Wallarah 2
COAL PROJECT

Wallarah 2 Coal Project

Response to Submissions

September 2013

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

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RESPONSE TO SUBMISSIONS

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September 2013

For:

Wyong Areas Coal Joint Venture
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RESPONSE TO SUBMISSIONS

for

Wyong Areas Coal Joint Venture

1 INTRODUCTION

This section outlines the status of the Project in the approvals process and explains the purpose of this Response to Submissions (RTS) document.

1.1 BACKGROUND

In 1995, the NSW Government invited competitive tenders for the Wyong Coal Development Areas comprising Exploration Licence 4911, Exploration Licence 4912 and Authorisation 405. These exploration areas contained substantial coal resources in the Central Coast region of NSW. Wyong Areas Coal Joint Venture (WACJV) was successful in this tender and was awarded the tenements. Exploration Licence 5903 was granted to WACJV in November 2001.

Following exploration and mine feasibility studies, WACJV is now seeking development consent for State Significant Development (SSD) under Division 4.1 of Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act) for the Wallarah 2 Coal Project (the Project). The conceptual layout of the Project is shown in **Figure 1**.

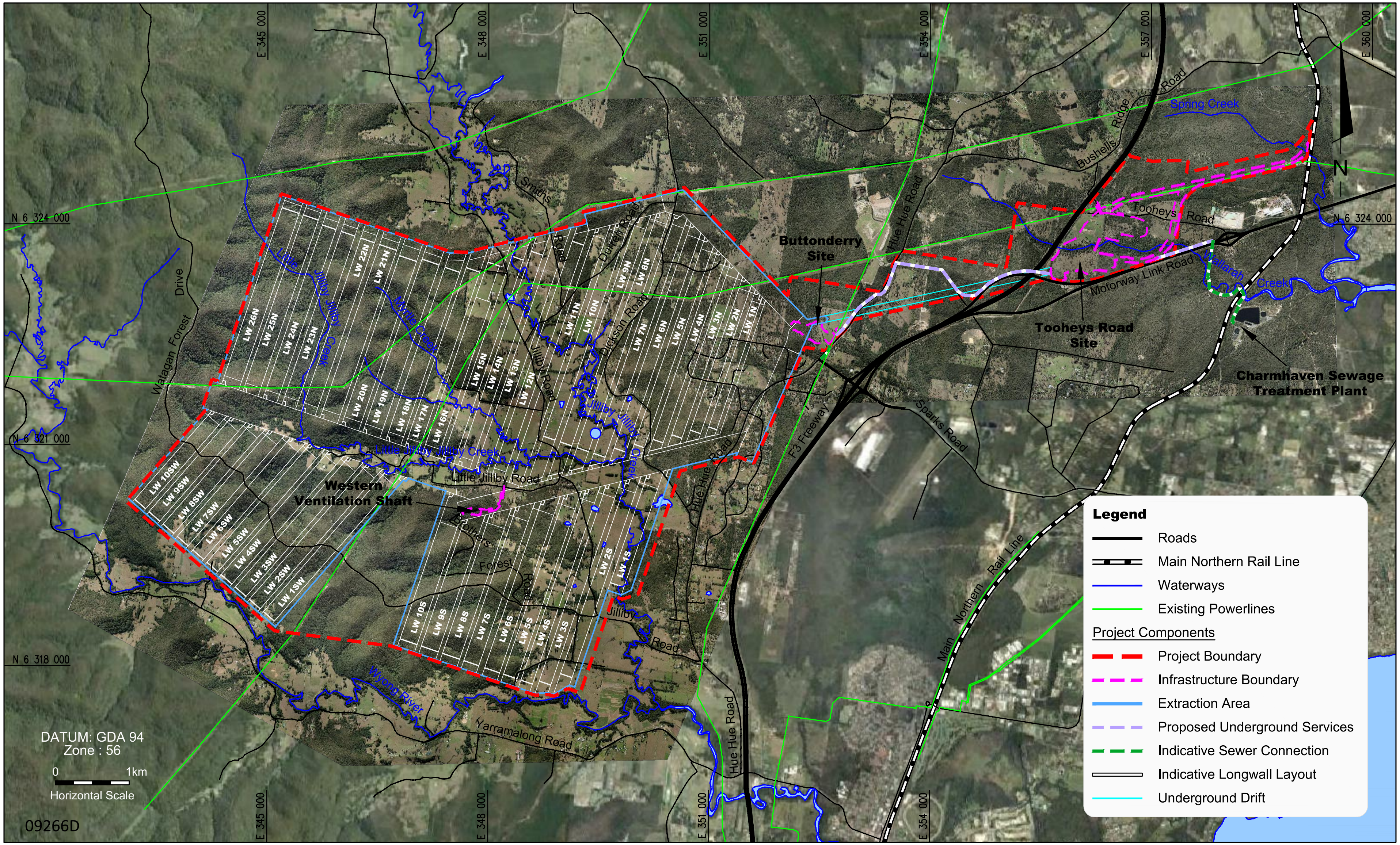
On 13 October 2011, WACJV made an application to the Department of Planning and Infrastructure (DP&I) for Director-General's Requirements (DGRs) under Part 2 of Schedule 2 of the *Environmental Planning & Assessment Regulation 2000* (EP&A Regulation). This request was supported by the 'Wallarah 2 Coal Project Background Document'. The DGRs were subsequently issued by DP&I on 12 January 2012.

Following the issuance of DGRs, the Wallarah 2 Coal Project Environmental Impact Statement (EIS) (Hansen Bailey, 2013) was prepared and ultimately placed on public exhibition from 26 April 2013 to 21 June 2013.

A total of 748 submissions were received by DP&I during the public exhibition of the EIS.

1.2 DOCUMENT PURPOSE

This RTS has been prepared by Hansen Bailey on behalf of WACJV to support SSD-4974 under section 78A(8A) of the EP&A Act. The document responds to the submissions raised by stakeholders during the public exhibition period.



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WALLARAH 2 COAL PROJECT

Conceptual Project Layout (Aerial)

FIGURE 1

1.3 DOCUMENT STRUCTURE

This RTS is structured as follows:

- **Section 2** outlines of the submissions received from stakeholders;
- **Section 3** provides comprehensive responses to the environmental and socio-economic issues raised in stakeholder submissions;
- **Section 4** provides the EIS Mitigation and Management Summary which has been updated to include additional commitments in this RTS document;
- **Section 5** lists the abbreviations used in this document; and
- **Section 6** outlines all materials referenced within the RTS.

Appendix A provides a summary of the stakeholders who made submissions in relation to the Project and assigns each stakeholder an identification reference (e.g. RA1, SIG1 or P1). The issues raised in each submission have been identified using a symbol under the relevant environmental or socio-economic aspect. A consolidated list of the submissions received is presented in **Appendix B** and categorised according to the environmental or socio-economic issues.

Responses to stakeholder submission issues (see **Section 3**) have been prepared and structured in accordance with **Appendix B**. Where a stakeholder has raised a specific issue, their stakeholder identification reference is noted prior to the response for that environmental or socio-economic issue.

Technical specialists involved in the preparation of the EIS have provided expert advice for this RTS. Where applicable and as referenced, this RTS should be read in conjunction with **Appendix A** to **Appendix I**, which provides additional detailed technical information.

2 STAKEHOLDERS AND SUBMISSIONS RECEIVED

This section provides a summary of the stakeholders that made submissions pertaining to the Project and the content in the EIS.

Following public exhibition of the EIS, DP&I provided to Hansen Bailey a total of 748 submissions from various stakeholders, including regulatory agencies, special interest groups and individual members of the public.

Submissions were received from 20 regulatory agencies, including:

- NSW Office of Water (NOW);
- NSW Environment Protection Authority (EPA);
- Office of Environment and Heritage (OEH) – Heritage Branch;
- OEH, NSW Department of Premier and Cabinet;
- Department of Primary Industries, Fisheries NSW (Fisheries NSW);
- Division of Resources and Energy (DRE), Trade and Investment NSW;
- Wyong Shire Council (WSC);
- Lake Macquarie City Council (LMCC);
- NSW Health;
- Department of Primary Industries – Office of Agricultural Sustainability & Food Security (DPI – Agriculture);
- Hunter Central Rivers Catchment Management Authority (HCRCMA);
- Central Coast Water Corporation;
- Transport for NSW (TfNSW);
- Australian Rail Track Corporation (ARTC);
- Roads and Maritime Services (RMS);
- Transgrid;
- NSW Mine Subsidence Board (MSB);
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC);
- Crown Lands NSW; and
- Forestry Corporation NSW (FCNSW).

Submissions were also received from 728 members of the public including seven special interest groups, namely:

- Australian Coal Alliance (ACA);
- Darkinjung Local Aboriginal Land Council (DLALC);
- Nature Conservation Council of NSW (NCC);
- Construction, Forestry, Mining and Energy Union (CFMEU);
- Economists at Large;
- Climate Future; and
- The Wilderness Society.

Of the 728 public submissions, 613 were objections, 108 were in support of the Project and seven were comments only.

The majority of the objections were 'form' letters listing a range of generic issues (i.e. identical pre-populated typed submissions made by multiple persons) whereby the sender was only required to place their name at the top and signature at the bottom of the letter. For example, one form letter was submitted by 321 members of the public.

Of the 108 supporting submissions, 32 were form letters.

Further information regarding the response to submissions and the broader approvals process for the Project can be found on the DP&I website: (http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4974).

3 ENVIRONMENTAL AND SOCIO-ECONOMIC ISSUES

This section responds to the submissions from stakeholders regarding a number of environmental and socio-economic issues. These issues are presented in ***Appendix B****.*

3.1 SUBSIDENCE

All references to the Subsidence Modelling Study (SMS) refer to Appendix G of the EIS. All references to the Subsidence Predictions and Impact Assessments (SPIA) refer to Appendix H of the EIS.

3.1.1 Subsidence Modelling

This section addresses the submissions from stakeholders regarding the reliability and accuracy of the numerical and empirical subsidence modelling.

Submission: RA6, SIG1, P6, P81, P94, P112

As explained in Section 1.1 of the SMS, the Incremental Profile Method (IPM) is an empirical method that is based on extensive measurements of mine subsidence undertaken at mine sites over a period of more than 50 years. The empirical data used in the IPM includes subsidence measurements for mines in the Newcastle and Southern Coalfields. The IPM is regarded as the best method for the empirical prediction of subsidence effects, provided that the geology at site being assessed is similar to the geology at the sites where the subsidence data was measured. It was recognised that subsidence predictions based solely on extrapolation of empirical data from the Newcastle and Southern Coalfields may not be appropriate, given that the Project differs from Newcastle and Southern Coalfield mines in the following ways:

- The Project involves the longwall extraction of coal at depths of cover of up to 700 m, which is significantly greater than the depths previously mined in the Newcastle Coalfield and is higher than the depths of mining in the Southern Coalfields where the depths of cover extend only up to 550 m;
- Mines in the Southern Coalfield usually mine at an extraction thickness of approximately 3.0 m, whereas the Project plans to operate at extraction thicknesses of between 3.0 m and 4.5 m;
- The Southern Coalfield seams are usually bounded above and below by reasonably strong strata, whereas the near-seam strata within the Extraction Area are relatively weak in comparison; and
- In the traditional mining areas of the Newcastle Coalfield, the overburden overlying the mined area often contains thick strong conglomerate units which tend to reduce surface subsidence. The overburden in the Extraction Area consists of finer grained sandstones and shales with minor conglomerates, suggesting that it would behave more like Southern Coalfield overburden.

Subsidence data from the Newcastle and Southern Coalfields is not rendered invalid or irrelevant by these differences in geology and mining geometry. These differences merely highlight the need for calibration of subsidence data from other coalfields. Accordingly, numerical modelling was undertaken to ensure that the empirical data used in the IPM was representative of the geological response to mining in the Extraction Area. The numerical model used is the Fast Lagrangian Analysis of Continua (FLAC) model, which was developed specifically for solving mining and geotechnical engineering problems.

WACJV conducted a review of the respective capabilities of the empirical and numerical models. As stated in Section 1.3 of the SMS, this review reached the following conclusions:

- Surface subsidence is heavily dependent on the geological and geotechnical characteristics of the Extraction Area, as well as the depth and geometry of the workings;
- It is the complex interaction of chain pillar and rock mass behaviour that dictates the surface response;
- It is the strength of the roof-pillar-floor system, rather than pillar width, that is the controlling factor in pillar stability;
- The IPM remains the most advanced empirical method for predicting the likely subsidence across a proposed layout provided that it is based on, or calibrated to, comparative data from that geological environment;
- The IPM utilises the surveyed response of the surface to mining, based only upon changes in seam thickness, panel and pillar widths and depths of cover;
- Caving mechanisms and rock mass behaviour can also contribute to subsidence behaviour. The numerical model has the capability to predict the chain pillar and rock mass behaviour;
- While numerical modelling is unsuited to the generation of subsidence predictions across an entire Extraction Area, it provides a basis for the development and calibration of empirical curves that can then be used in the IPM for broader scale predictions; and
- The development and use of an empirical model based on numerical modelling results would provide the most robust predictive approach for the Project.

Consequently, a mechanistically modified empirical model was developed. This is a hybrid subsidence prediction model which uses the results of the numerical modelling to calibrate the IPM model. The calibrated IPM model reflects the site-specific rock mass behaviour, allowing the model to satisfactorily predict the surface subsidence associated with the extraction of Southern Coalfield geometries within a Newcastle Coalfield geological environment.

To ensure that the FLAC model was appropriate for predicting subsidence effects induced by the Project, the model was subjected to a rigorous validation process by way of back analysis of field measurements from a range of sites in the Illawarra and Hunter regions including:

- Longwall extraction of Greta seam at 370 m depth;
- Partial extraction of Bulli seam at 470 m depth;
- Longwall extraction of the Bulli seam at 520 m depth; and
- Comparison of Hunter Valley Pikes Gully seam data to the Newcastle and Western Coalfield data sets.

The validation of the FLAC model was described in detail in Section 2.2 of the SMS. Based on this exhaustive process of validation and back-analysis, it was concluded that there was sufficient confidence in the capability of the FLAC model to satisfactorily simulate:

- Rock fracture distribution about the longwall panel;
- Overburden bridging and caving characteristics;
- Goaf loading characteristics;
- Chain pillar strength characteristics;
- Stress redistributions about the mining panels; and
- Overburden subsidence characteristics.

On these bases, the FLAC model was adopted by the Project as the most realistic method of assessing the ability of various mine layout options to control the associated surface subsidence to acceptable and manageable levels. Detailed analyses of the Project's geotechnical and geophysical databases were then undertaken to develop sonic-UCS and UCS – Modulus relationships to provide site specific characterisation of the rock mass for the modelling process.

The numerical modelling results were then applied across the Extraction Area using the IPM model to provide a complete suite of subsidence predictions and associated impact assessment. This innovative hybrid approach of combining state-of-the-art numerical modelling with state-of-the-art empirical modelling to produce subsidence predictions in a greenfield environment has been widely acclaimed as leading practice by industry observers. For example, '*The Strategic Review into Impacts of Potential Underground Coal Mining in the Wyong Local Government Area*' (DoP, 2008) recognised that:

> *"The Wallarah 2 site constitutes a greenfields mining site. The WACJV has noted in its submissions that there is a lack of existing subsidence data for the area, which is much deeper and has significantly different geology to neighbouring mining areas. The company has adopted a hybrid approach to subsidence prediction which, based on the information provided to the Panel, appears to be leading practice."*

The IPM modelling used in the SPIA was conducted by Mine Subsidence Engineering Consultants (MSEC), who are industry leaders in this field. Their extensive experience coupled with the research outcomes from such projects as ACARP Research Projects C8005 and C9067, undertaken by MSEC, and C10023 (undertaken by Strata Engineering (Australia) for the Australian Coal Association), provide a very sound basis for this work.

The IPM is the accepted method for assessing the subsidence induced by other underground mining proposals. The different geological conditions and greater mining depths for the Project had the potential to produce subsidence effects which might not be accurately represented by the IPM. The calibration of the IPM using the FLAC modelling results ensured that differences in geology and mining conditions were accounted for in the subsidence predictions. Section 3.7 of the SMS states that the subsidence values which would ordinarily be accepted for assessment (i.e. the IPM method predictions) were multiplied by a factor of 1.5 to account for these differences.

The SMS incorporates the findings of the '*Wallarah 2 Coal Project PAC Report*' (NSW Planning Assessment Commission, 2010), which states that:

> *"The hybrid prediction methodology for conventional subsidence is leading practice … There is a high degree of conservatism built into the prediction of conventional subsidence effects" …*
>
> *"The Commission accepts the EA predictions of conventional subsidence for the proposal as adequate for assessment."*

An independent peer review of the SMS was undertaken by Professor Bruce Hebblewhite, (Head of School of Mining, University of NSW). This peer review is presented in Appendix G of the SPIA. The peer review concluded that:

> "*I am of the opinion that "best-practice" subsidence prediction techniques have been adopted using innovative hybrid empirical and numerical techniques. These techniques have been rigorously evaluated, and validated as far as possible against available databases. … It will be absolutely essential that a comprehensive Wallarah site-based validation of the predictions and hence the prediction methodologies is carried out, once data is collected from subsidence associated with the initial longwall panels, to provide an even better level of confidence in the prediction techniques and the underlying assumptions and findings*".

WACJV accepts these comments and commits to a process of continual improvement and adaptive management in accordance with the underlying philosophy of the current Subsidence Management Plan (SMP) process. This SMP process stresses that subsidence predictions should not necessarily aim to generate subsidence values that precisely match the actual amount of subsidence that eventually occurs. Instead, the aim should be to predict subsidence with sufficient accuracy, so that the likely impacts can be determined and appropriate management plans developed to manage those impacts.

3.1.2 Chain Pillar Behaviour

This section addresses the submissions regarding the impact of chain pillar behaviour on surface subsidence.

Submission: RA6, P112

Section 2.3 of the SMS provides a detailed discussion on the geomechanical aspects of the numerical modelling. In particular, this discussion includes the role of geology, rock strength, goaf properties and chain pillar behaviour on the development of surface subsidence. Specifically, Section 2.3.3 of the SMS states that:

> *"A design approach was adopted whereby pillars were designed to yield when isolated in the goaf so as to minimise the risk of long term pillar failure. With this approach pillars are designed to fail and then become confined by goaf material so that any subsequent strength losses would result from variation in the residual pillar strength due to long-term claystone behaviour rather than large-scale intact pillar strength losses. The resultant change in subsidence would be largely controlled by the goaf and would be expected to be significantly less than impacts from long-term failure of intact pillars."*

Furthermore, Section 2.3.9 of the SMS states that:

> *"Validation studies by back analysis have provided confidence that this state-of-the-art prediction method is capable of providing a realistic overview of the anticipated ground behaviour for those conditions. The ground conditions modelled are likely to represent a conservative assessment in order to ensure a worst-case scenario. Whilst the conservative approach is appropriate for the current mine planning study, the monitoring and analysis of the actual subsidence measured during mining will enable further verification of the model and enhance its future predictive capability."*

The deformation and additional subsidence resulting from pillar compression is not restricted to areas of weak floor, because much of the deformation occurs above the pillars in the relatively weak Dooralong Shale material. This result is common and has been noted in micro-seismic investigations in a number of coal mines (ACARP, 1999). Therefore, since chain pillar behaviour is controlled by the performance of the overall roof-pillar-floor system, the presence of a weak floor will assist in pillar yield but is not a requirement for pillar yield.

Evidence of pillar yield will not emerge until the pillars are effectively isolated in the goaf (i.e. flanked on both sides by longwall extraction). This will not occur until the extraction of the second longwall. With the completion of second longwall and the subsequent extraction of third, the incremental subsidence will begin to reflect the combined impact of a sag subsidence component and pillar compression (as the total width of extraction becomes super-critical and the pillar becomes overloaded and yields).

If the pillars do not yield as the mine plan has been designed to do, the implication is that the resultant subsidence will be that of the sag subsidence component only. There would also be the chance that the pillars yield unexpectedly in the future and likely to result in greater subsidence effects. As explained in Section 2.3.3 of the SMS, the ultimate success of the pillar yield design is enhanced by the high cover depths which will generate overburden pressures that would make it difficult to design a non-yielding system.

3.1.3 Conservatism

This section addresses the submissions regarding the level of conservatism in the subsidence predictions.

Submission: RA6

As stated in Section 2.3.9 of the SMS, the ground conditions modelled are likely to represent a worst case scenario. If traditional empirical subsidence prediction techniques had been adopted for the Project, the predicted levels of subsidence would have been 50-75% of the values predicted by the calibrated IPM model. Although WACJV recognises that the modelling has taken a conservative approach to predicting the amount of subsidence that may result from mining, SMPs will be based on the maximum predicted impacts (i.e. 'worse case' predictions).

Consequently, the Executive Summary of the SMS explained that:

> *"The overall findings of the mine subsidence impact assessments, that have been undertaken by MSEC based on the conservative subsidence predictions that have resulted from the hybrid subsidence prediction approach, are that the levels of likely impact at all identified natural features and built infrastructure items within the Study Area are manageable, and these impacts can be controlled and managed by the preparation and implementation of the extraction or management plans".*

3.1.4 Specific Impacts

Rock Bars, Pools and Lower Order Streams

This section responds to the comments raised by stakeholders regarding the impact of mine subsidence on rock bars, pools and lower order streams.

Submission: RA3, P103, P106, P109, P125, P126, P138, P165, P170

Section 2.3.2 of the Surface Water Impact Assessment (SWIA) (Appendix J of the EIS) states that:

> *"The upland streams in the Wyong State Forest/Jilliby SCA are very steep and ephemeral and major pools are absent. There are no massive rock bars which retain permanent major pools and aquatic ecological systems. This is due to the steep terrain as well there being fewer outcroppings of massive sandstones because the units of the Terrigal Formation are thinner, weaker and less resistant than the Hawkesbury Sandstones found elsewhere and are not cliff-forming.*

The sandstones and siltstone/shales of the Terrigal Formation in the valleys are stress relieved and well jointed throughout.

In contrast, the Southern Coalfields are characterised by steep canyon-like narrow valleys with significant areas of resistant sandstone defining the creek beds including typical alternating rock bars and major pools. The streams in the Southern Coalfield are notably of lower gradient, extend over less topographic elevation and as rock-lined streams they generally comprise continuous rock bar and pool sequences along their entire lengths".

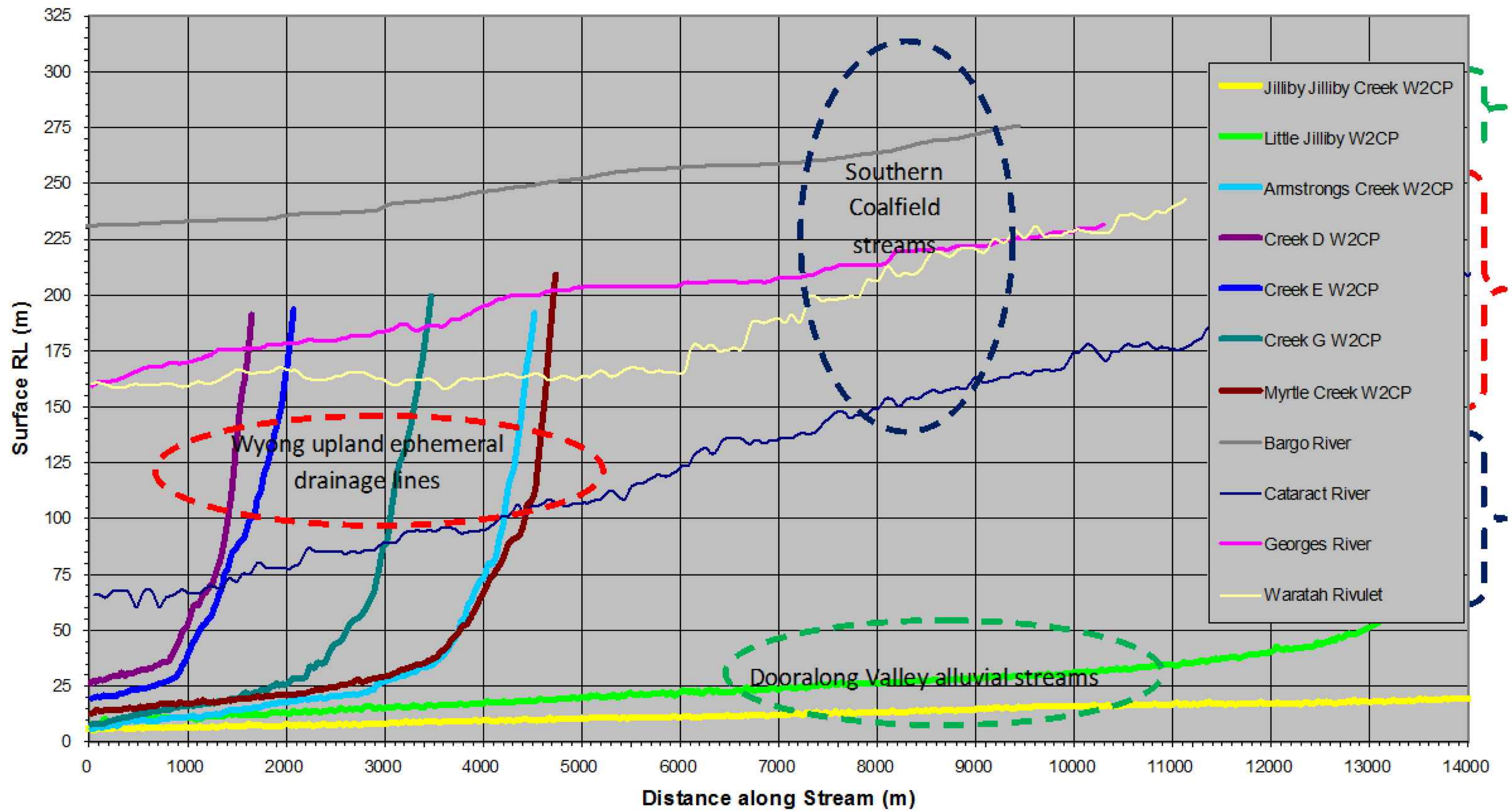
The character of the lower order streams within the Project Boundary is described further in **Section 3.3.4**. **Figure 2** illustrates the differences in gradients between the steep upland streams and very flat alluvial valleys within the Project Boundary, compared to the streams in the Southern Coalfields.

Furthermore, Section 5.3.2.4 of the SPIA states:

"The main concern of mine subsidence impacts on streams in the Southern Coalfield of NSW relates to mining induced surface flow diversions occurring into subterranean flows, where the surface water flows are small and occur between pools that are controlled by a series of rockbars. These rockbars are formed within the Hawkesbury Sandstones which commonly comprise thin bands of strong and brittle sandstone, occasional natural vertical joints and occasional cross bedding. There have been many cases where the natural erosion and weathering processes have led to natural surface water diversions through and beneath these rockbars and mine subsidence also results in these water flow diversions.

However this process is not expected to be significant over the W2CP because of the following:-

- *The major streams are wide valleys with deep alluvial deposits and, therefore, any fracturing of the bedrock is unlikely to be visible at the surface within the alluvials and any dilation of the bedrock level is likely to become water charged and not result in increased subterranean flows,*
- *There are few exposed rock platforms over the steeper sloped areas and along the smaller streams that are located up the sides of the valleys over the Project that retain permanent major pools and aquatic ecological systems,*
- *The upland streams in the Wyong State Forest; Jilliby SCA are very steep and ephemeral and major pools are absent.*
- *The strata layers that are located up the sides of the valleys over the Project are recognised to be stress relieved, and well jointed and generally less permeable,*
- *There are fewer outcroppings of massive sandstones because the units of the Terrigal Formation are thinner, weaker and less resistant than the Hawkesbury Sandstones found in the Southern Coalfields, and hence,*
- *There are no large exposed rockbars along these streams".*



HB 1163 F02 Wallarah RTS - Stream Gradients.dwg

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Comparison of Stream Gradients

FIGURE 2

The streams within the Project Boundary differ substantially in character from the streams in the Southern Coalfield. Therefore, it is considered that upsidence and closure thresholds relevant to gorges in Southern Coalfield are not relevant to the Project.

The findings in the SPIA are consistent with the '*Wallarah 2 Coal Project PAC Report*' (NSW Planning Assessment Commission, 2010) which states that:

> *"In its discussion of predictions of unconventional subsidence the EA points to the differences between the geomorphology of the Southern Coalfield and that associated with the Wallarah 2 Study Area, including:*
>
> - *The ridges in the forested areas of the Study Area are jointed and stress relieved.*
> - *The upland streams in the Study Area are contained within V-shaped gullies separated by unconfined ridges, in contrast to the Southern Coalfield streams which are contained in more U-shaped gorges cut into a plateau.*
> - *The valleys in the Study Area are not only much broader than the gorges of the Southern Coalfield but are filled with some 20-30 m of alluvium.*
> - *Rock bars and associated pools typical of the Southern Coalfield do not exist in the upland streams in the proposed Wallarah 2 mine area.*
> - *Streams in the alluvial filled wide valley floors above the proposed longwalls have water levels that are generally above the surrounding groundwater levels and the water levels in these streams are not controlled by a series of exposed rock bars."*

3.1.5 Far Field Effects

This section addresses the submissions regarding the potential impacts of far field effects and 'horizontal subsidence'.

Submission: SIG1

Sections 3.5 and 3.6 of the SPIA provide a detailed description of horizontal subsidence and far-field effects respectively.

Section 5.13 of the SPIA assessed the potential impacts of subsidence on water management infrastructure. The Wyong Weir and the Mardi Dam were not considered as they are located outside the Subsidence Impact Limit, and are therefore not predicted to experience conventional subsidence effects. The Extraction Area is located approximately 3 km from Wyong Weir and 3.5 km from the Mardi Dam.

At these distances, the impacts of far-field horizontal movements are not expected to be significant, as concluded in the 'Strategic Review into Impacts of Potential Underground Coal Mining in the Wyong Local Government Area' (2008) which stated:

> *"the … submission also expressed a concern that: "Mardi weir, the Mardi pump-pool and the proposed Porter's Creek weir project are all within the horizontal subsidence zone.*

> *"It appears that the … concerns relate to the impact of far-field horizontal movements on infrastructure that falls some considerable distance outside of the footprint of the proposed mine layout. The Panel is not aware of far-field horizontal movements having been of concern in the Newcastle Coalfield to date.*
>
> *The differential strains associated with this behaviour in the Southern Coalfield appear to be infinitesimal at distances of more than a few hundred metres away from the mine workings. Hence, based on the information available to the Panel, it appears that damage to water supply infrastructure is extremely unlikely to arise from far-field horizontal movements.*"

Furthermore the *Wallarah 2 Coal Project PAC Report* (2010) stated that:

> "*PSM, in a report prepared for Wyong Shire Council SC has concluded that:*
>
> *"Based on the conclusion that the estimates of subsidence reported by the W2CP can generally be accepted as a reasonable interpretation of the effects of the proposed mine layout, we conclude that man made infrastructure such as the major dams, transfer systems including the Mardi to Mangrove pipeline, water treatments plants (sic), weirs and pipelines are unlikely to be adversely affected.'*
>
> *"The Commission concurs with this conservative approach. It notes that mining in this area is not scheduled for some 15 to 20 years, by which time subsidence predictions will have been verified. Furthermore, subsidence movements should develop incrementally and the mine plan is amenable to modification (adaptive management). … The Commission concludes that: … It is extremely unlikely that the Wallarah 2 proposal will impact on infrastructure associated with the Gosford-Wyong Water Supply Scheme".*

3.1.6 Comparisons with Other Mines

This section addresses the submissions referencing environmental impacts at other mines and asserting that the same impacts will be caused by the Project.

Submission: RA3, P81, P112

MSEC and SCT are considered leading industry practitioners that are at the forefront of both practical industry experience and state-of-the-art research. Accordingly, these advisors are appropriately placed to consider and respond to any scientific information available for subsidence behaviour assessment.

This section distinguishes the Project from mines in the Newcastle and Southern Coalfields on account of its key parameters (e.g. geology, topography, mining depth, surface features, etc.).

Comparison with North Newcastle Coalfield Mines

This section addresses the submissions comparing the Project's extraction area with other mining areas.

Submission: RA3

The location of the Project makes it different to other mining areas, particularly in terms of geology, topography and landform, and depth of mining. **Section 3.1.8** references the *Strategic Inquiry into Coal Mining in the Wyong Area* (DoP, 2008) which distinguishes the Project from other Newcastle Coalfield mines where impacts to streams have occurred.

The following provides specific comparison of the Project with other underground mining areas further north in the Newcastle Coalfield, some of which are also operating in State Conservation Areas (SCA).

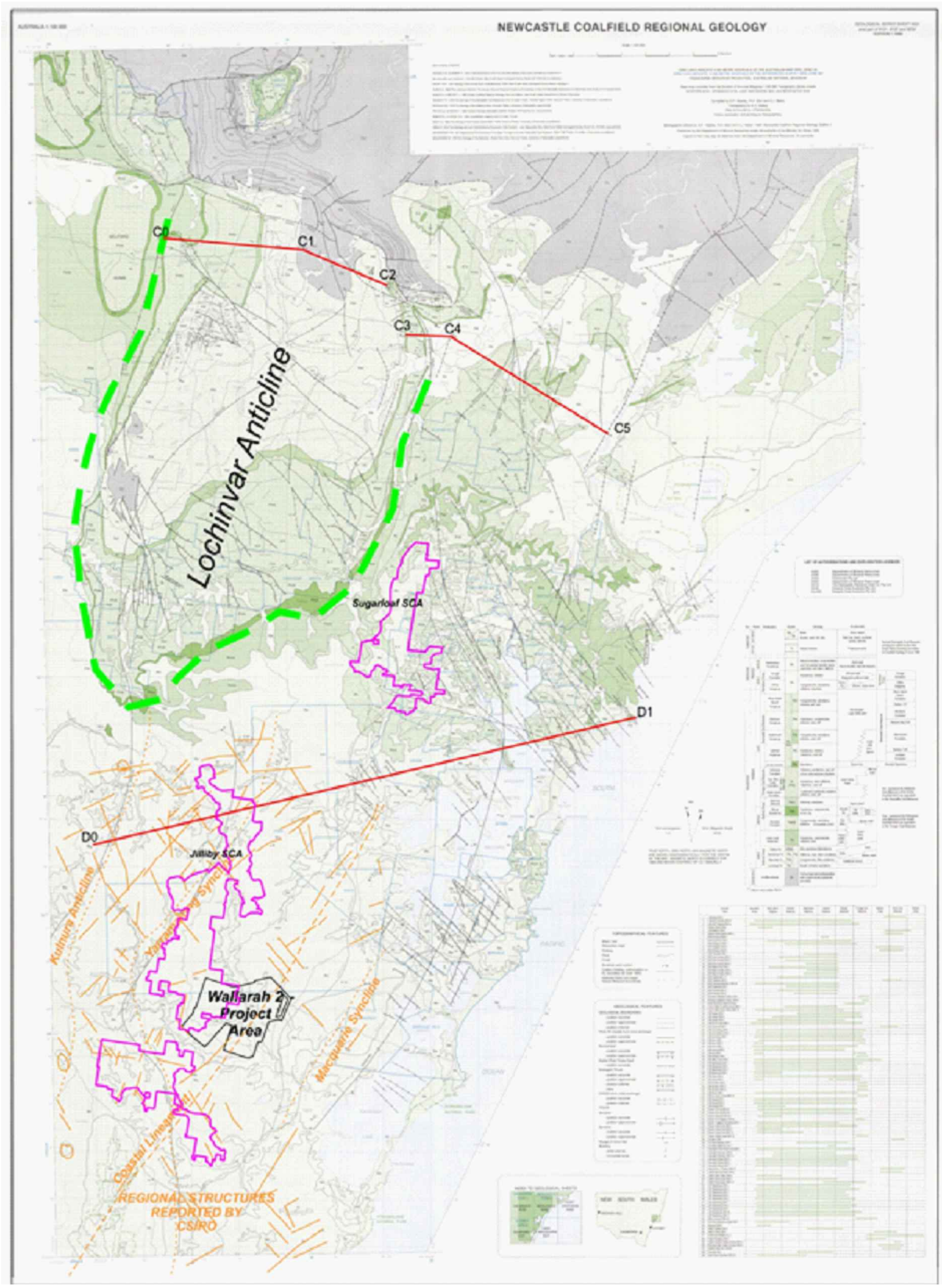
The structural geology of the North Newcastle Coalfield area is relatively complex. It is located close to the major regional structural feature known as the Lochinvar Anticline, and many faults and dykes are present. As a result, the area is affected by significant changes in dip of strata and regional structural features. **Figure 3** highlights the Lochinvar Anticline and shows the location of the Sugarloaf SCA, where mining is currently being undertaken.

This part of the North Newcastle Coalfield is typified by coarse rock types dominated by thick, massive sandstones and conglomerates. These rocks are strong and resistant to erosion, commonly resulting in steep topography such as high sandstone cliffs (over 20 m in height).

The main economic coal seams in the North Newcastle Coalfield have been mined for many decades and continue to be mined by both longwall and place-changing methods of extraction. Current operations are typically conducted at depths of around 160-200m, which represents a relatively shallow mining environment.

The Project and the Jilliby SCA

The Jilliby SCA and Wyong State Forest comprises the western forested area within the Extraction Area for the Project. The Jilliby SCA is remote from the influence of the Lochinvar Anticline and is known to be free of major geological structures. This has been confirmed by past surveys conducted by the CSIRO and extensive drilling, seismic, ground magnetic and aeromagnetic surveys undertaken in recent years by WACJV. These studies clearly establish the presence of very uniform dips across the SCA and the absence of complex or dramatic regional structural features. **Figure 3** and **Figure 4** show the relative structural simplicity in the Jilliby SCA compared to the Sugarloaf SCA to the north.



HB 1163 F03 Wallarah RTS - Structural Geology.dwg

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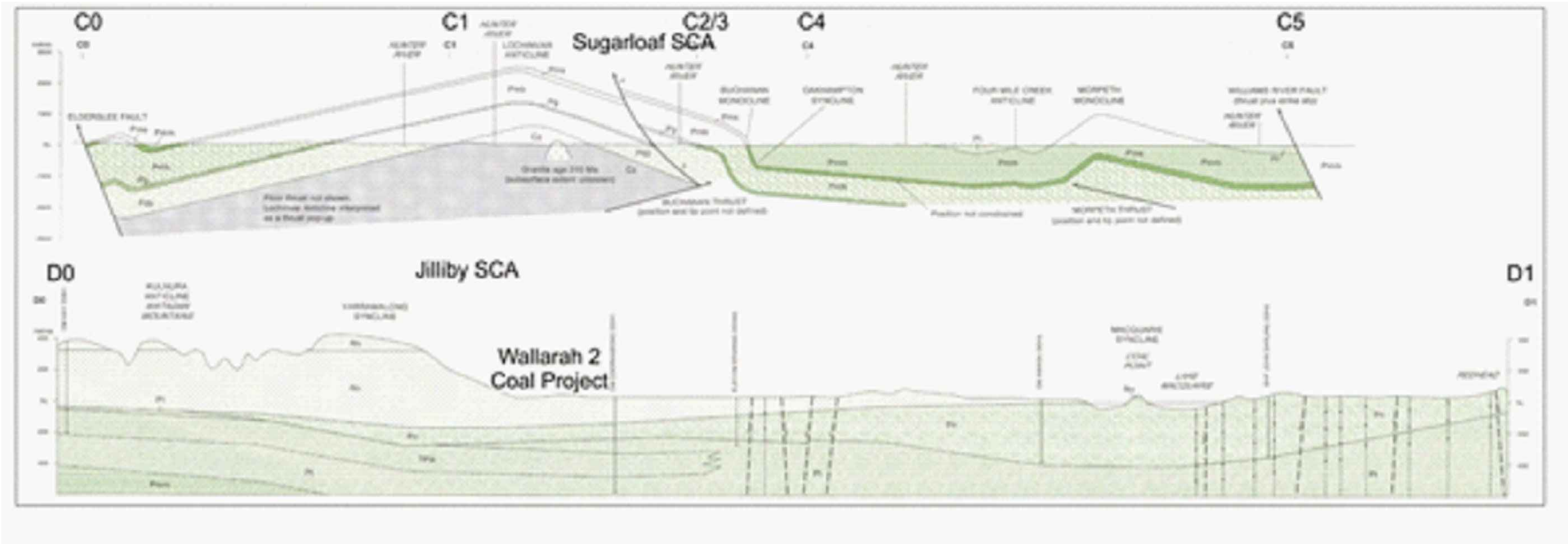
Structural Geology of the North Newcastle Coalfield

FIGURE 3



HB 1163 F04 Wallarah RTS - Comparison Cross Sections.dwg

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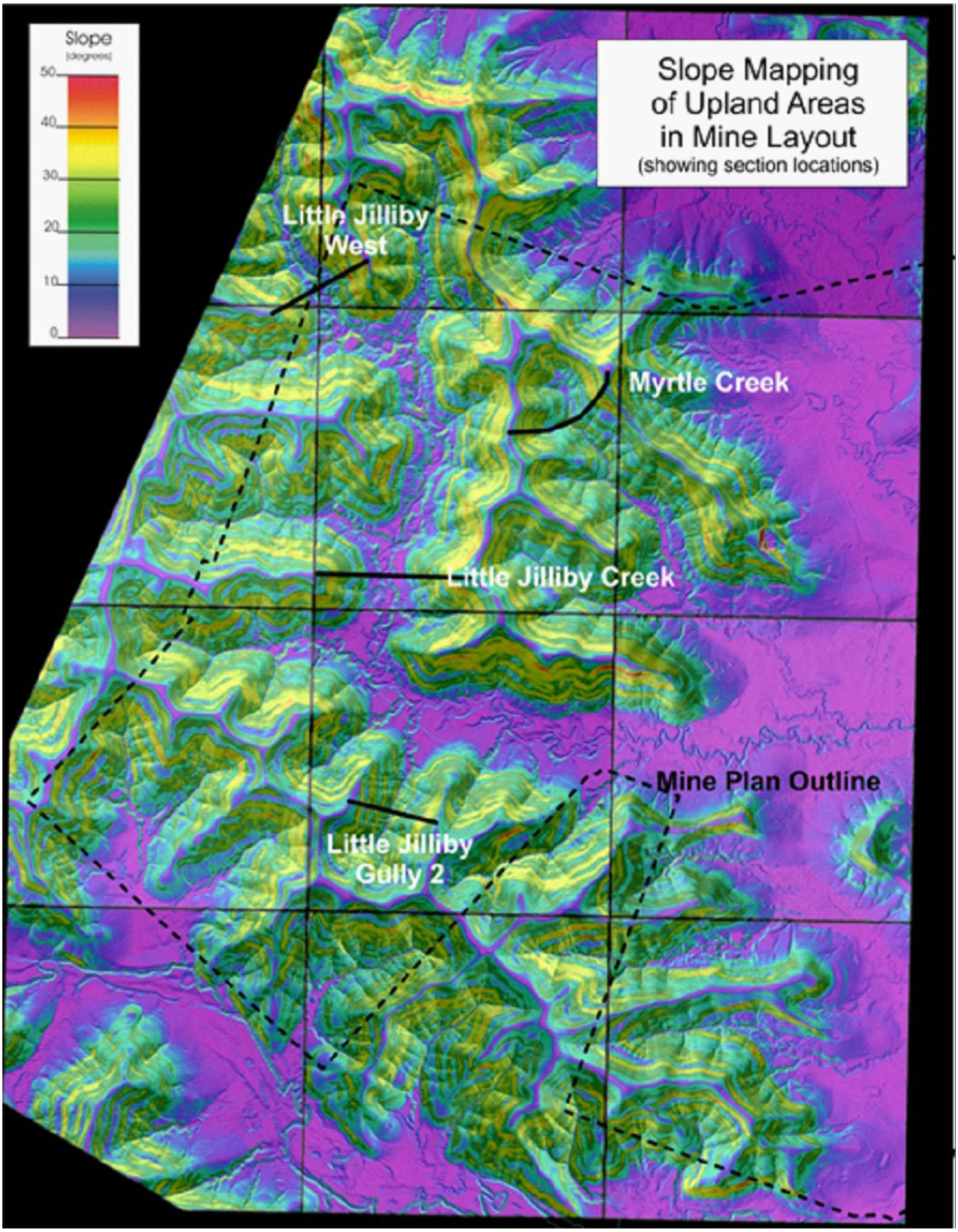
Comparison of Sugarloaf SCA and
Jilliby SCA Cross Sections

FIGURE 4

The lack of complex structure in the Extraction Area is related to both the remoteness from the influence of the Lochinvar Anticline, and the conditions prevailing during the deposition of the sedimentary strata. The geological stability at the time of deposition is reflected by the thickest known sequence of the coalesced Vales Point/Wallarah/Great Northern Seam known in the coalfield (up to 8.7m thick in this area).

The area is typified by finer rock types dominated by claystones and siltstones with interbedded sandstones and occasional occurrences of thin conglomerates. These rocks tend to be weaker and less resistant to erosion, resulting in the complete absence of natural cliffs in the Jilliby SCA. A detailed slope analysis for the Jilliby SCA is presented in **Figure 5** and **Figure 6**. This analysis identified that the slope angle is only greater than 45° in a small number of localised zones and rarely approaches 55°. There are no significant hardrock aquifers within the Extraction Area.

The economic coal seam beneath the Jilliby SCA (the Wallarah-Great Northern Seam) is at a depth of 395 m to 690 m, which will result in one of the deepest mining environments in Australia. The proposed longwall mining in the Jilliby SCA will be undertaken at depths of cover that are approximately three times greater than other underground mines in SCAs in the North Newcastle Coalfield. The specific design proposed for mining beneath the Jilliby SCA is that the unmined coal pillars yield as mining progresses. This innovative and industry leading approach will greatly moderate the differential subsidence effects across the mining area. This will further attenuate the surface effects of subsidence, which are already mitigated due to the much greater depth of the mining activity.



HB 1163 F05 Wallarah RTS - Slope Mapping.dwg

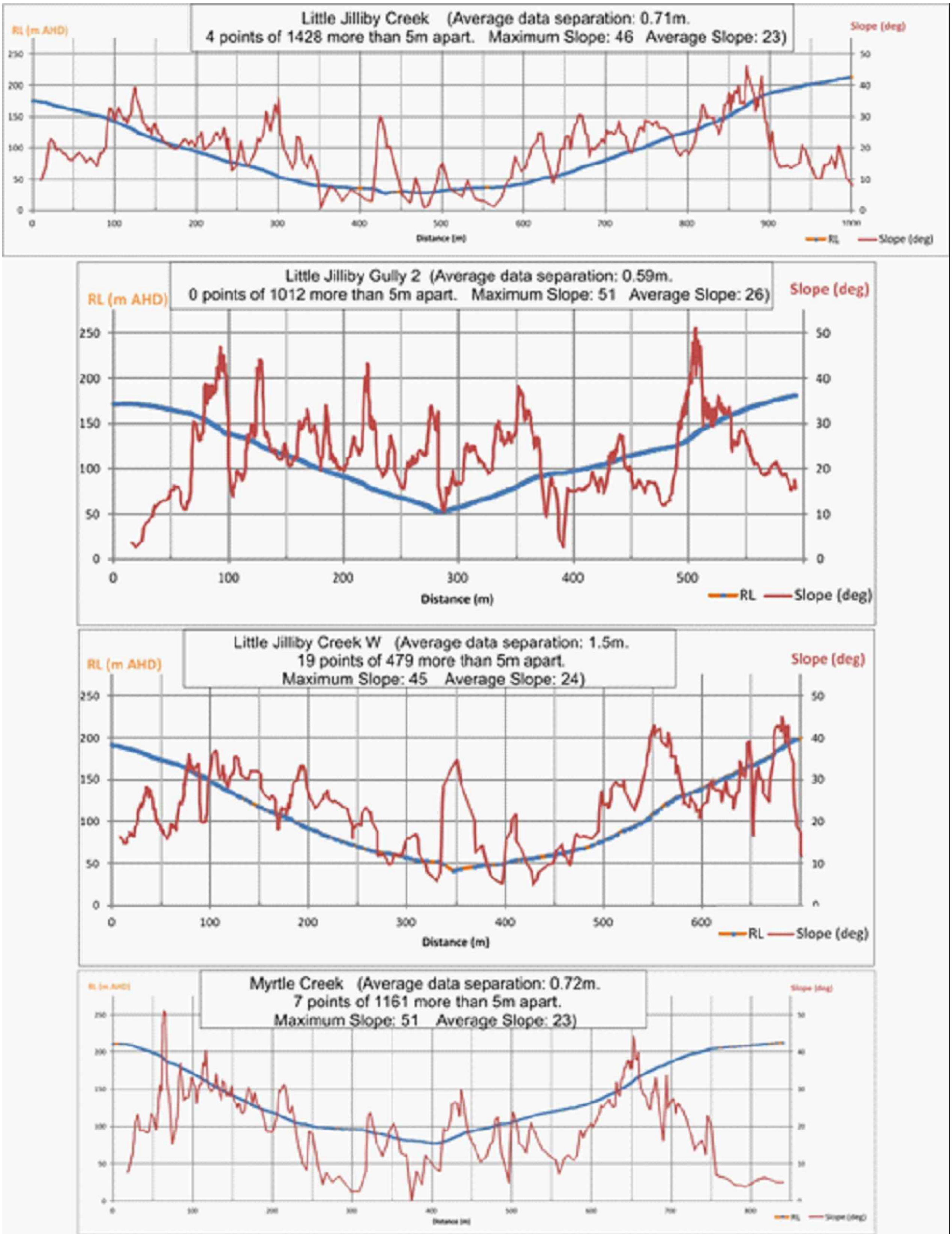
WALLARAH 2 COAL PROJECT

Wallarah 2 COAL PROJECT

Hansen Bailey ENVIRONMENTAL CONSULTANTS

Slope Mapping for Jilliby SCA

FIGURE 5



HB 1163 F06 Wallarah RTS - Cross Sections.dwg

WALLARAH 2 COAL PROJECT

Wallarah 2 COAL PROJECT

Hansen Bailey ENVIRONMENTAL CONSULTANTS

Valleys Cross Sections in Jilliby SCA

FIGURE 6

Conclusions

There are very major geological and topographic differences between the Jilliby SCA and the current mining environments in the North Newcastle Coalfield. There are also significant differences in the nature of the mining operations, such as much greater depths of cover and yielding coal pillars.

The greater depth of mining in the Jilliby SCA (compared to other mines), combined with the innovative pillar design, will significantly attenuate the surface subsidence effects.

In the more geologically and topographically complex locations in the North Newcastle Coalfield where mining is occurring at much shallower depths, there is a higher risk of more significant surface impacts that will require accompanying remediation measures. The absence of natural cliffs and lack of major faulting and geological structure will ensure that cliffline impacts observed in other mining areas will not occur in the Jilliby SCA.

Comparisons with the Southern Coalfield

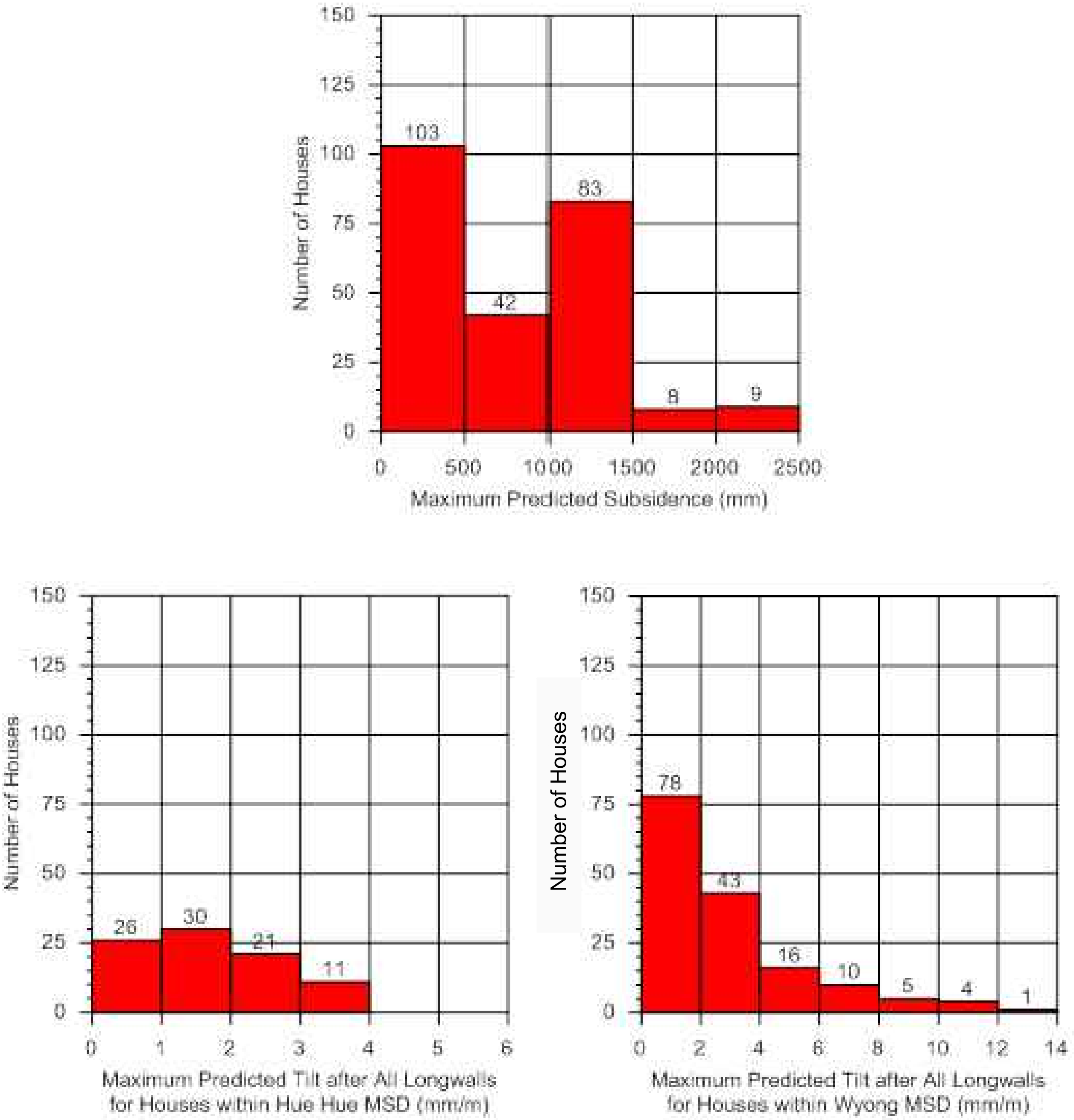
The location of the Project differs from mining areas in the Southern Coalfield, particularly in terms of geology, topography and landform. The specific differences with respect to rock bars, pools and 3rd order streams are discussed in **Section 3.1.4**.

3.1.7 Houses

This section addresses comments raised by stakeholders regarding the impact on houses.

Submission: SIG1, SIG7, P81, P86, P88, P91, P94, P96, P101, P102, P104, P106, P109, P110, P111, P112, P115, P117, P126, P135, P136, P138, P140, P141, P145, P170, P177, P178, P179, P180, P181

The potential impacts of subsidence on dwellings are discussed in detailed in Section 5.31 of the SPIA. Of the 245 houses that have been identified within the SIL, there are a total of 88 houses identified within the Hue Hue Mine Subsidence District. The Hue Hue Mine Subsidence District was proclaimed on 31 December 1985 and notified on 31 January 1986. A total of 157 houses identified are located within the Wyong Mine Subsidence District, which was proclaimed on 9 April 1997 and notified on 18 April 1997. The distribution of the predicted conventional subsidence parameters for the dwellings within the SIL are shown in **Figure 7**.



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Subsidence Effects for Dwellings

FIGURE 7

Figure 7 indicates that 42 houses have been predicted to subside between 500 mm and 1,000 mm, while 100 houses have been predicted to subside more than 1,000 mm.

The potential impacts on house structures are influenced by differential subsidence (which includes tilt, curvature and ground strain) rather than vertical subsidence. However, vertical subsidence can affect the heights of dwellings above the flood level. The potential impacts on dwellings due to changes in flood levels resulting from subsidence have been assessed in detail in the Flood Impact Assessment (Appendix K of the EIS).

It has been found from past longwall mining experience that tilts of less than 7 mm/m generally do not result in any significant impacts on houses. Some minor serviceability impacts can occur at these levels of tilt, including door swings and issues with roof gutter and wet area drainage. All of these serviceability impacts can be remediated using normal building maintenance techniques. Tilts of more than 7 mm/m can result in greater serviceability impacts that may require more substantial remediation measures, such as the re-levelling of wet areas or, in some cases, the re-levelling of the building structure.

The probabilities of impacts on dwellings due to ground curvature and strain have been assessed using the method developed as part of ACARP Research Project C12015. The overall distribution of the assessed impacts for the houses within the SIL is provided in **Table** 1.

As explained in Section 5.31 of the SPIA, dwellings within the SIL are expected to remain safe and repairable throughout the mining period, provided that they are in sound structural condition prior to mining. However, the assessments indicate that the potential impact on approximately one house within the SIL may be such that the cost of repair may exceed the cost of replacement.

It is not possible to identify the particular dwellings in each repair category at this stage. The numbers of dwellings in each repair category (as shown in **Table 1**) were predicted using a statistical approach.

Table 1
Assessed Impacts for Houses within the SIL

Group	Repair Category			
	No Claim or R0 – Adjustment	R1 – Very Minor Repair or R2 – Minor Repair	R3 – Substantial Repair or R4 – Extensive Repair	R5 – Repair
All houses (total of 245)	202 (82 %)	30 (12 %)	12 (5 %)	≈ 1 (< 0.5 %)

Source: Table 5.28, SPIA

The Wallarah 2 Coal Project PAC Report (2010) states that:

> *"Concerns were raised in public submissions regarding subsidence related damage to housing, the inconvenience of moving whilst repairs are carried out, and the lengthy process and financial and emotional stress on families associated with obtaining compensation for damage. ..The EA concludes that the overall levels of movement for the houses across the Study Area would not be predicted to change significantly. The Commission considers this conclusion to be reasonable provided that the longwall panel width and mining height do not change from that proposed in the EA."*

The Wallarah 2 Coal Project PAC report (2010) also stated:

> *"DII (2010) submitted that:*
>
> - *The proponent has designed the mine layout in an attempt to limit subsidence movements in the Hue Hue MSD to within the limits ascribed to this MSD. No such limits have been ascribed and applied to the Wyong MSD."*
> - *…the methods of predicting impacts to residential structures resulting from subsidence are still evolving. The Department's previous studies have identified significant inconsistencies between the predictions and actual observations of affected structures at other sites in NSW. The proponent's consultants have since adopted a new method for predicting subsidence on the residential structures within the application area. While I&I NSW MR supports in principle the general direction taken by this new method, it is yet to be tested.*
> - *Again, management of potential subsidence impacts on dwellings should require an approach involving adaptive management.*
>
> *Wyong Shire Council submitted through a report prepared by PSM that:*
>
> *Not withstanding the requirement for an SMP, the Repair Classification system proposed in the EA (Table 6.1) is considered to be an appropriate tool for the task of assessing repairs to houses. Use of this system, or a similar approach may also be appropriate for other rural/farm/commercial buildings.*
>
> *The Commission concludes that:*
>
> - *The impact prediction methodology for houses relied upon in the EA is yet to be validated*
> - *There is already in place a well established mechanism supported by legislation and administered by the Mine Subsidence Board for managing the impacts on mining on residential structures.*
> - *This mechanism is effective in not exposing residents to personal harm arising from mine subsidence and in maintaining and restoring structures to a condition equal to or better than their pre-mining state at no financial cost to owners.*
> - *Houses constructed prior to the declaration of the site being in a Mine Subsidence District may be exposed to greater impacts.*

- *The extent of impact to 23% of farm structures is yet to be quantified but is likely to be low if they are of flexible construction.*
- *These issues are of a nature and magnitude that should be able to be managed effectively through individual Property Plans as part of the Extraction Plan process."*

Impacts on dwellings (and associated structures including onsite waste management systems) will be managed through the development of Property Subsidence Management Plans (PSMPs). PSMPs will be developed in consultation with affected landowners in accordance with regulatory guidelines as generally described in Section 7.1.4 of the EIS.

Landowners that have suffered damage to property can make a claim for compensation under the *Mine Subsidence Compensation Act 1993* (MSC Act). Section 10 of the MSC Act establishes the Mine Subsidence Contribution Fund, which colliery proprietors are required to contribute to. The Mine Subsidence Contribution Fund is used to compensate affected landowners and pay for repairs to damage property. The Mine Subsidence Board administers the compensation scheme established by the MSC Act. Since the Mine Subsidence Contribution Fund is funded by colliery proprietors rather than taxpayers, the public will not bear the costs of repairs to infrastructure.

3.1.8 Connectivity

This section addresses the submissions regarding the potential for connectivity between the surface water regime and the mine workings.

Submission: RA3, SIG1, P81

Section 7.3 of the Geology Report (Appendix C of the EIS) discusses the faulting and its potential to provide connectivity. The report details the basis upon which the structure free location of the Extraction Area was selected.

The Geology Report responded to a report prepared by Northern Geosciences (2005) for the Australian Gas Alliance, which asserted that "*a major geological feature of the Jilliby Creek is that it follows a fault zone*" which "*provides a significant transient pathway to groundwater movement and discharge*". The Department of Primary Industries – Mineral Resources (Barry, 2005) reviewed the Northern Geosciences (2005) report and concluded that:

> *"There is unlikely to be any real potential for connection between near-surface aquifers and the deeper coal seam aquifers on the Dooralong and Yarramalong Valleys."*

Similarly, the Strategic Review into Impacts of Potential Underground Coal Mining in the Wyong Local Government Area (2008) recognised that:

> *"For a given excavation width, the severity of the impacts associated with conventional subsidence effects decreases with increasing depth of mining. Providing that the depth of mining is sufficient to support the development of a 'constrained zone' (see section 2.8.1 and Figure 12) then, in the absence of major geological features, surface water is unlikely to drain into the mining excavation (i.e. any drainage of surface water is likely to remain within the rocks of the 'surface zone'). There have been instances in the Southern, Newcastle and Lithgow Coalfields where water has drained into mine workings from the surface but by all accounts these have been confined to depths of less than 200 m. In the case of both the Newcastle and Western Coalfields, there have also been isolated instances of watercourses actually breaking through into mine workings at very shallow depth.*
>
> *The best known example of cracking of a stream bed in the southern Newcastle Coalfield is at Diega Creek, a small tributary of Cockle Creek within the Lake Macquarie catchment in Lake Macquarie LGA. Diega Creek was directly undermined by eight longwalls in West Wallsend Colliery between 1999 and 2004. The depth of cover was low (around 200 – 230 m) and the extraction height within the seam was high (4.8 m). However, panel width was low (150 – 175 m). Mine subsidence caused cracking of the stream bed, which in turn was implicated in a complete loss of surface flow in the stream. The mining company (Xstrata Coal) suggested that below-average rainfall during much of the period during which mining took place and following was a likely contributor to the low surface flows, since Diega Creek is recognised as being an ephemeral stream. When the Panel inspected Diega Creek in January 2008, pools contained water and the stream was flowing slowly. Xstrata Coal indicated that groundwater levels near the Creek had risen during 2007, probably due to the above average rainfall then prevailing."*
>
> *"Based on geological cross-sections (see Figure 10), the physical and chemical properties of alluvium and the aquitard claystone layers, the behaviour of these materials in other mining districts, and the adaptive approach proposed by the WACJV to mine planning and subsidence management, the Panel considers that the Wallarah 2 approach is consistent with industry best practice and that its conclusions in respect of potential impacts on the Wyong River are, on the basis of available evidence, reasonable. Typically, the target coal seam in the Wyong LGA varies from 350 m in the north to more than 600 m depth in the south. At these depths, the Panel is confident that the risk of connective cracking from the ground surface to the mined seam is extremely low. Hence, in the opinion of the Panel, there is no reason why the community and Government agencies should have concerns over potential loss of either creek or alluvial groundwater to mine workings."*

"Jilliby Jilliby Creek differs from the Wyong River in two significant aspects, namely:

- *it is located in a wider and flatter valley and*
- *Wallarah 2 is proposed to directly undermine it.*

The Panel has been advised that baseline drilling and permeability testing in the Jilliby Jilliby Creek catchment indicates that the valley-fill alluvial system is generally composed of stacked layers of sand, gravel, silt and clay and that the sequence is dominated by low permeability, fine grained sediments. Vertical hydraulic connection is inhibited by ubiquitous layered, fine-grained, less permeable sediments that result in confined or semi-confined hydrogeological conditions.

Assuming this to be the case, in the absence of major geological disturbances such as dykes and faults, hydraulic connectivity between surface and near surface groundwater and the mine workings is an unlikely outcome for the same reasons noted when discussing the Wyong River."

Furthermore, the Wallarah 2 Coal Project PAC Report (NSW Planning Assessment Commission, 2010) states that:

"As previously discussed (Section 4.4), based on review of NSW underground mines that have extracted longwall panels successfully beneath water bodies in the Sydney Basin, and in the Mandalong Mine, which operates in leases immediately north of the proposal, the Commission is of the view that, in the absence of major unforeseen geological features, connectivity between the alluvial valleys and their streams and underground mine workings and consequent loss of surface water is extremely unlikely."

Section 7.3 of the Geology Report also discusses the Boomerang Creek Tunnel example referred to by stakeholders. The Boomerang Creek Tunnel is a water supply structure located to the west of the Extraction Area. The intersection of significant faults during the drivage of the Boomerang Creek Tunnel is a well-documented case. As explained in Section 7.3 of the Geology Report, this case showed that while inflows of an estimated 2,000 L/min occurred when these faults were initially exposed, this rate dropped to only several litres per minute within a few hours. Such evidence supports the conclusion that even major structures (if they existed) are extremely unlikely to provide a *"significant transient pathway to groundwater movement and discharge*".

3.1.9 Transmission Lines

Transmission Line Towers

This section responds to the submissions regarding subsidence impacts on transmission line towers.

Submission: RA16, P106

The TransGrid operated 330 kV power lines 21 and 22 traverse the Extraction Area.

WACJV has consulted closely with both TransGrid (July and August 2013) and the Mine Subsidence Board (August 2013) to further develop appropriate strategies and discuss the impacts of longwall mining on the transmission line towers. The parties have agreed to the development of a three-person committee consisting of representatives from WACJV, TransGrid and the MSB. This committee will review the most appropriate methods and responsibilities for addressing issues related to transmission towers, particularly the two high deviation angle transmission towers (Towers 21-44T and 22-52T) considered to be most at risk. WACJV has also committed in writing (confirmed by Transgrid) to entering into a Commercial Arrangement and Feasibility Study / Analysis with TransGrid to provide a more detailed analysis and assist in determining the most appropriate methods for addressing issues relating to the high deviation angle towers and to allow appropriate time for the scoping of trigger based process stages linked to phases of mining.

The submission from Transgrid outlines a preference for sterilisation of coal or variation of the mine plan under the two high deviation angle transmission towers (21-44T and 22-52T). This option is merely a preference and in no way inhibits WACJV's options for addressing this issue without the need to sterilise coal or alter the current mine plan. This statement is supported by recent discussions and written correspondence from TransGrid confirming a willingness to work in co-operation with WACJV to consider options including transmission line relocation, structural modifications and modified transmission line designs. TransGrid further confirmed that the appropriate option will be determined via a Commercial Agreement and Feasibility Analysis, to which WACJV has agreed in writing, and that the associated costs of analysis, mitigation measures, adjustments, repairs, redesign, modification or relocation of the transmission lines will be borne by WACJV.

Impacts on Ground Clearance

This section addresses the submission from TransGrid regarding subsidence impacts on ground clearance.

Submission: RA16

Section 5.14.2 of the SPIA discusses the potential reduction in cable clearances due to subsidence caused by the Project. The management strategies identified include fencing off areas of the easement and earthworks to increase clearances to ground.

Given that predicted subsidence levels in some locations are in the order of 2.0-2.5 m, reductions in ground clearance are likely to be a significant electrical safety and reliability issue, especially for high voltage transmission lines.

As part of the committee established with TransGrid and the MSB, WACJV proposes to continue to evaluate appropriate options for addressing the issues associated with the lowering of transmissions lines. WACJV accept the responsibility and / or part thereof of costs associated with mitigation measures, adjustments, repairs, redesign or modifications to ensure the appropriate electrical safety and reliability issues are addressed.

Consultation

This section addresses the submission regarding consultation with TransGrid.

Submission: R16

As per Section 7.1.4 of the EIS, WACJV has initiated further consultation with TransGrid to investigate feasible options and develop management strategies for the continued safe operation of TransGrid's transmission lines. Consultation has included agreement to establish a committee consisting of WACJV, TransGrid and MSB representatives as a mechanism for reviewing the most appropriate methods and responsibilities for addressing issues. WACJV agrees to remunerate TransGrid appropriately in the development and operation of the committee and other activities associated with the management of impacts associated with TransGrid infrastructure.

3.1.10 State Conservation Area

This section addresses the issue of remediation for surface cracking in the Jilliby SCA as a result of subsidence.

The extent of observed surface cracking and the observed widths of surface fractures tend to be smaller over mined longwall panels with greater depths of cover than over panels with shallower depths of cover. The proposed mining beneath the Jilliby SCA (proposed to be mined after Year 20 of the Project) will occur at depths of cover ranging from 395 m to 690 m. This is considerably greater than the depths of cover at other mines within the Newcastle Coalfield.

Mining induced surface cracks at the Project are expected to be limited to:

- The opening of existing natural joints; or
- An occasional tension crack located on steeply sloping terrain; or
- Cracking within exposed bedrock in valley floors.

Few mining induced surface cracks are expected to occur in areas in the base of the valleys where deep or alluvial soils overlie the bedrock.

Remediation activities for mining induced surface cracking is generally required if the cracks presents a hazard or an increased risk of erosion. With regard to increased risk of erosion, detailed assessments of the streams within the Jilliby SCA have indicated that the streams occur mainly in alluvial and boulder filled gullies and that bedrock outcrops are uncommon. Due to the plasticity of the alluvial and colluvial deposits, it is unlikely that subsidence will cause cracking that exacerbates erosion.

Due to the presence of dense vegetation and steep topography in the Jilliby SCA, access is generally only available via sparse, unsealed tracks. Cracking along these unsealed access tracks may warrant remediation, as this may pose a safety hazard to users of these tracks. Due to the limited accessibility and use of areas within the Jilliby SCA (beyond the existing access tracks), and the level of surface cracking expected to occur, the need for remediation beyond the access tracks is not anticipated to be required.

Given that the access tracks within the Jilliby SCA boundary are excluded from the conservation area, there is not expected to be any remediation for surface cracking within the Jilliby SCA.

3.1.11 Disused Quarry

This section address the submission regarding the impacts on a disused quarry near the Jilliby SCA.

Submission: P106

The quarry site is currently not operational. The subsidence consequences for this site have been assessed in Section 5.23.1 of the SPIA. The subsidence effects induced by the Project may cause marginally stable rocks or loose boulders to become dislodged. As a safety precaution, it is recommended that access to the quarry is restricted whilst the longwalls beneath the quarry (LW14N and LW15N) are being mined.

If the quarry becomes operational again prior to mining beneath the site, management strategies will be developed in consultation with the proprietors of the quarry.

3.1.12 Optical Fibre Cables

This section addresses the submission contending that impacts on optical fibre cables have not been considered.

Submission: P112

The predicted subsidence consequences for optical fibre cables are discussed in Section 5.19.1 of the SPIA and summarised in Section 7.1.3 of the EIS. Since optical fibre cables are direct buried, ground strain is the relevant aspect of subsidence. The predicted ground strains are similar to strain values at other locations in NSW where impacts to optical fibre cables have not occurred.

3.1.13 Water Supply Infrastructure

This section addresses the submission regarding impacts on water supply infrastructure (both public and private).

Submission: P183

Potential impacts on public water infrastructure (such as reservoirs and pipelines) have been assessed in Section 5.13 of the SPIA. Potential impacts on farm dams have been assessed in Section 5.26 of the SPIA.

3.1.14 Subsidence Associated with Development Headings

The section addresses the submission questioning why the development headings do not result in any subsidence.

Submission: P112

The development headings shown on Figure 18 of the EIS trend in a NW and SSW direction from the bottom of the drift. The development headings are a series of 4 to 5 parallel roadways separated by unmined coal pillars. Whilst the collective width of these roadways and pillars may be similar to the width of the longwalls, the presence of the coal pillars prevents the development headings from subsiding. This explains why there is area overlying the development headings that is not subject to subsidence.

3.1.15 Longwall Panel Widths

The section addresses the submission questioning how the width of a longwall panel can be varied along its length.

Submission: P112

The width of a panel can be varied by driving another gate road generally at the tailgate side of the face and dropping off the required number of longwall shields to line up with the new tailgate roadway. This technique will be adopted where required. This technique is also used under other circumstances to navigate around tailgate roadway falls and blockages.

3.1.16 Ground Strains

This section addresses the submission regarding the method used to calculate ground strains based on predicted curvature values.

Submission: P112

As explained in Section 4.3 of the SPIA, the maximum conventional strains were predicted by applying a conservatively selected factor of 15 to the maximum predicted curvatures. This is the empirical relationship between conventional strain and conventional curvature that was adopted based on observations in the Southern Coalfield.

The submission questions the validity of applying this factor when the geology of the Extraction Area differs from the geology of the Southern Coalfield. As explained in

Section 4.3 of the SPIA, the subsidence profiles predicted using the numerical modeling were identified to be most similar in shape to the subsidence profiles observed in the Southern Coalfield. The empirical relationship between strain and curvature is governed by the shape of the subsidence profile, rather than the geological environment. Therefore, it is valid to predict conventional strain using the empirical relationship between strain and curvature observed in the Southern Coalfield.

3.1.17 Director-General's Requirements

This section addresses the submission questioning where the Director-General's Requirements relating to subsidence have been addressed.

Submission: P112

Table 1.2 of the SPIA identifies the sections of the SPIA and SMS that address the Director-General's Requirements (DGRs) concerning subsidence. The "Subsidence Prediction Report" referenced in this table is the SMS. The 'Subsidence Impact Report' referenced in this table is the SPIA.

3.1.18 Identification of Surface Infrastructure

This section addresses the submission contending that surface infrastructure within the SIL has been incorrectly described or omitted from figures.

Submission: P112, P141

Further surveys and inspections of all infrastructure items within the SIL will be undertaken during the development of the SMP. All potentially affected infrastructure will be identified and management and mitigation measures will be developed.

3.1.19 Peer Review

This section addresses the submission asserting that the peer review of the SPIA was not conducted on the latest version of the SPIA.

Submission: P112

The peer review of the SPIA by Professor Bruce Hebblewhite (dated 10 July 2012) consider Revision 3 of the SPIA (dated 24 June 2012). The SPIA was updated to address Professor Hebblewhite's comments and Revision 4 was issued on 22 July 2012. The addendum contains a typographical error and incorrectly states that the additional review was conducted on Revision 3 of the SPIA. The addendum to the peer review (dated 5 October 2012) considered Revision 4 of the SPIA.

3.1.20 Earthquakes

This section addresses the submissions contending that underground mining will exacerbate the impacts of earthquakes.

Submissions: P103, P126, P182, P184

Earthquakes are generally caused by deep seated crustal activity. Earthquakes do not generally affect underground mines and have little or no effect on the subsided areas. Reviews and mine subsidence ground monitoring over and near areas that have experienced recent earthquakes have revealed little to no evidence that the presence of subsided ground led to additional earthquake movements.

3.2 GROUNDWATER

All references to the Groundwater Impact Assessment (GIA) refer to Appendix I of the EIS.

3.2.1 Subsidence Impacts on Vulnerable Bores

This section addresses the submissions from stakeholders regarding the potential for damage to groundwater bores within the SIL.

Submission: RA8, RA9, P67, P112

Section 6.4 of the GIA identifies 12 existing private bore locations within the Subsidence Impact Limit (SIL). Groundwater levels within this zone may fall by up to 1.4 m due to subsidence. However, 55% to 75% recovery is expected to occur within 6 months under low rainfall conditions. Recovery will occur much more rapidly under high rainfall conditions. Although subsidence induced displacement is unlikely to affect borehole yield in a measurable way, the boreholes could be susceptible to mechanical damage and may need to be repaired or re-drilled if damaged.

WACJV has committed to ongoing consultation with bore owners and repairing and if necessary, replacing any bore water supply affected by the Project.

3.2.2 Estimation of Impacts

This section addresses the submissions from stakeholders regarding the input parameters used in the numerical modelling. In particular, WSC asserts that 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.

Submissions: RA6, RA9, RA12

The conclusions in relation to groundwater impacts are the result of input parameters to the groundwater flow model. The primary input parameters governing groundwater flow are the horizontal and vertical hydraulic conductivities. Vertical conductivity is especially important given that it governs the potential leakage from the alluvial aquifer system to deeper strata (via the Patonga Claystone and Tuggerah Formation) once mining commences.

Hydraulic conductivities for the groundwater flow model were generated using the methodology outlined in Section E4.1 in Appendix E of the GIA, where matrix properties were assigned to a 'look up' table based on the results of core tests and packer tests. The process included consideration of jointing insofar as inspections of individual joints in core samples using a hand loupe magnifier. These inspections indicated either calcite in-filled joints or joint apertures of less than 0.04 mm (approximate limit of resolution). Non in-filled joint faces were commonly observed to be clean and free of alteration. These observations, together with preliminary calculations prior to development of the regional model, supported a conceptual model where in situ joints were unlikely to significantly enhance conductivities at a regional scale.

Additional information is provided in the Issue Paper (**Appendix D**) describing further assessments of the hydraulic conductivity governing vertical leakage in the constrained zone.

3.2.3 Average Climate Data

This section responds to submissions from WSC regarding the use of average climatic conditions for assessing the recharge of the groundwater system.

Submissions: RA6

Rainfall recharge to the alluvial lands was assessed as part of the groundwater model calibration process, which used locally measured rainfall (Honeysuckle rain gauge) and measured water table responses. The model calibration process is described in Section E6 in Appendix E of the GIA. Subsequent to calibration, a recharge rate of 150 mm/year (0.41 mm/day) was adopted for the assessment of mining related impacts. This rate of recharge is the average calculated rate to the alluvial lands during the relatively dry spell between 2002 and mid 2007 (see Figure E7 in the GIA) and is therefore considered to be conservative. It is much lower than the assessed long term average recharge rate of approximately 400 mm/year (1.1 mm/day).

3.2.4 Equilibrium of Groundwater System

This section addresses the submission from WSC asserting that groundwater inflows to the mine (up to 2.5 ML/day) will reduce streamflows by the same magnitude.

Submission: RA6, P112, P173

The existing groundwater flow system within the region is considered to be in quasi-equilibrium. Mining associated with the Project will upset this equilibrium and will induce depressurisation of the strata as described in Section 6.1 of the GIA.

The rate and extent of depressurisation above the coal seam will be impeded by the Tuggerah Formation and the Patonga Claystone. Ultimately, long term downwards leakage from the alluvial lands will be established. The rate of leakage is predicted to be very low (about 2 millilitres/day per square metre at the end of mining) and will be sustained beyond 500 years. This rate of leakage would not impact water levels in the alluvium or baseflows to the surface drainages since the rate of rainfall recharge to the alluvium is calculated to be at least 410 millilitres/day/m^2 (0.41 mm/day), which is the average rate of recharge during the dry period from 2002 to 2007.

The predicted groundwater inflows of up to 2.5 ML/day are sourced almost entirely from porous storage in the deep strata. As a result, the rate of groundwater inflow is not sensitive to rainfall intensity. A very small volume of 0.02 ML/day (7.3 ML/annum) is attributed to leakage from the alluvial lands associated with Jilliby Jilliby Creek. This rate is established within approximately 1 to 2 years of longwall panel extraction.

The rate of vertical leakage from the Wyong River alluvium is negligible.

3.2.5 Groundwater Quality Monitoring

This section addresses the submissions from stakeholders regarding the adequacy of baseline groundwater quality monitoring data. This section also addresses submissions regarding mitigation measures for impacts to groundwater quality (if these occur).

Submission: RA6, RA12, P94, P177

It is acknowledged that baseline groundwater monitoring was fragmented, with water level, salinity and pH being monitored from 1999 to 2001 at many of the piezometers installed in the alluvial lands. Subsequently, access to these piezometers was not possible. However, it is important to note that the available data supports a quasi-steady state system for the important alluvial lands aquifer where the water table fluctuates over a predictable range in response to rainfall. Ionic speciation was also conducted on water samples collected on at least five occasions during 1998-1999. This speciation data was reduced to a representative sampling and plotted as the tri-linear speciation in Figure C3 in Appendix C of the GIA.

The water quality baseline data, including the more recent continuous monitoring at the Honeysuckle Park property (owned by WACJV), provides sufficient data to reasonably characterise the water quality of the alluvial aquifer system. As explained in Section 6.5 of the GIA, groundwater quality is not predicted to change as a result of the Project. However, should future (rigorous) monitoring of the aquifer system identify a deterioration in water quality that can be attributed to the Project, mitigation measures may include localised re-routing of rainfall runoff to enhance aquifer recharge or changes to the mine plan. Measures to mitigate impacts on groundwater quality will be detailed in the Water Management Plan.

3.2.6 Connectivity of Defects in the Patonga Claystone Aquitard

This section addresses the submissions from stakeholders regarding the extent and connectivity of the defect system within the Patonga Claystone aquitard.

Submission: RA6, P164, P173

This issue has been addressed in the Issue Paper entitled '*Review of the constrained zone hydraulic conductivity*' (see **Appendix D**).

3.2.7 Brine Disposal

This section addresses the submissions from stakeholders regarding the environmental impacts resulting from the underground disposal of brine. In particular, it has not been identified whether the coal seam aquifer ultimately discharges into the ocean or whether it has the potential to be intersected by the streams and lakes of the Central Coast floodplain.

Submissions: RA2, RA4, P112

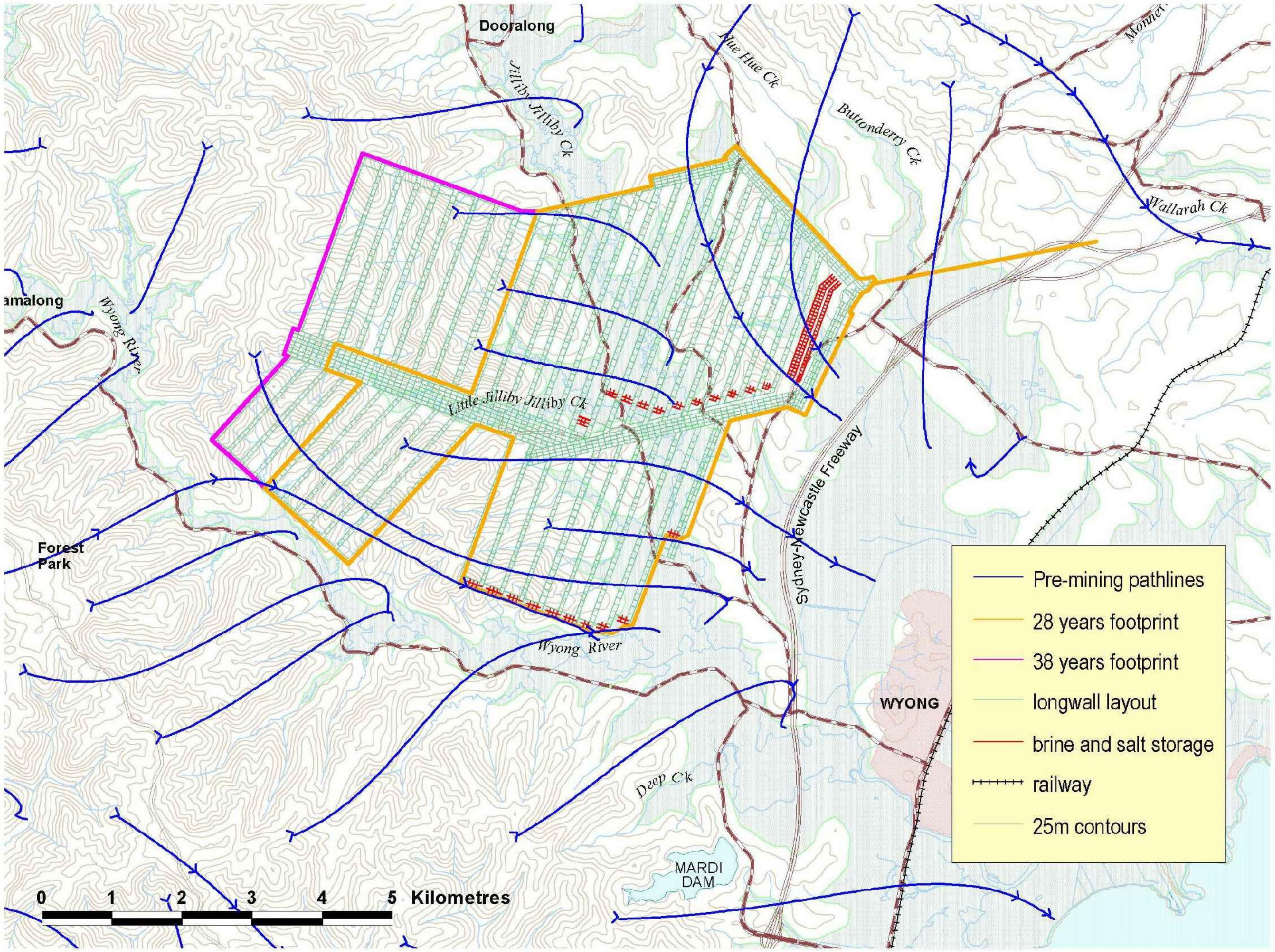
WACJV proposes to store brine and salt mixture in the underground workings. During the first 14 years of the Project, a partly dried salt mixture will be generated as a by-product of the water treatment process. The salt mixture will be sealed in dedicated development headings located to the east of longwall LW1, as shown in **Figure 8**. The underground mine water storage (shown in Figure 18 of the EIS) consists of five development headings, of which two headings will be used for disposal of the salt mixture.

From Year 15 onwards, the water treatment process will generate brine as a byproduct. The brine will be pumped into underground workings at the start lines of panels to the west and south-west of the sealed storages (see **Figure 8**).

The potential impacts of salt and brine disposal were assessed in Section 6.5.1 of the GIA. Since the exhibition of the EIS, additional calculations have been undertaken and groundwater flow paths have been generated from groundwater modelling to understand the potential migration of the brine in the long term.

Flow paths for a recovered (or repressurised) flow system have been assessed by developing a steady state model and reviewing the resulting pathways. **Figure 8** shows the pathways prior to disturbance by underground mining. These pathways all originate within the Wallarah-Great Northern coal seam and track in the direction of the arrows. Flow lines originating to the southwest of the Project trend to the east-northeast before rising through the strata and terminating beneath the Wyong River. The upwards trajectory beneath the river is not evident in the two-dimensional plan form (**Figure 8**). The three dimensional projection in **Figure 9** illustrates the upward trajectory and shows the surface topography and the bottom surface of the flow model (8 times vertical exaggeration).

Flow lines originating in the western part of the Extraction Area adopt an easterly and south-easterly flow direction before rising through the strata and terminating beneath Jilliby Jilliby Creek. These upward flows from the hardrock system are reflected in the expected naturally occurring higher salinities observed near the base of the alluvial aquifer system associated with Jilliby Jilliby Creek. Flow lines originating to the north-east of the Extraction Area adopt a southerly then south-easterly flow direction before terminating in low lying coastal areas to the east of the Project.



09389B

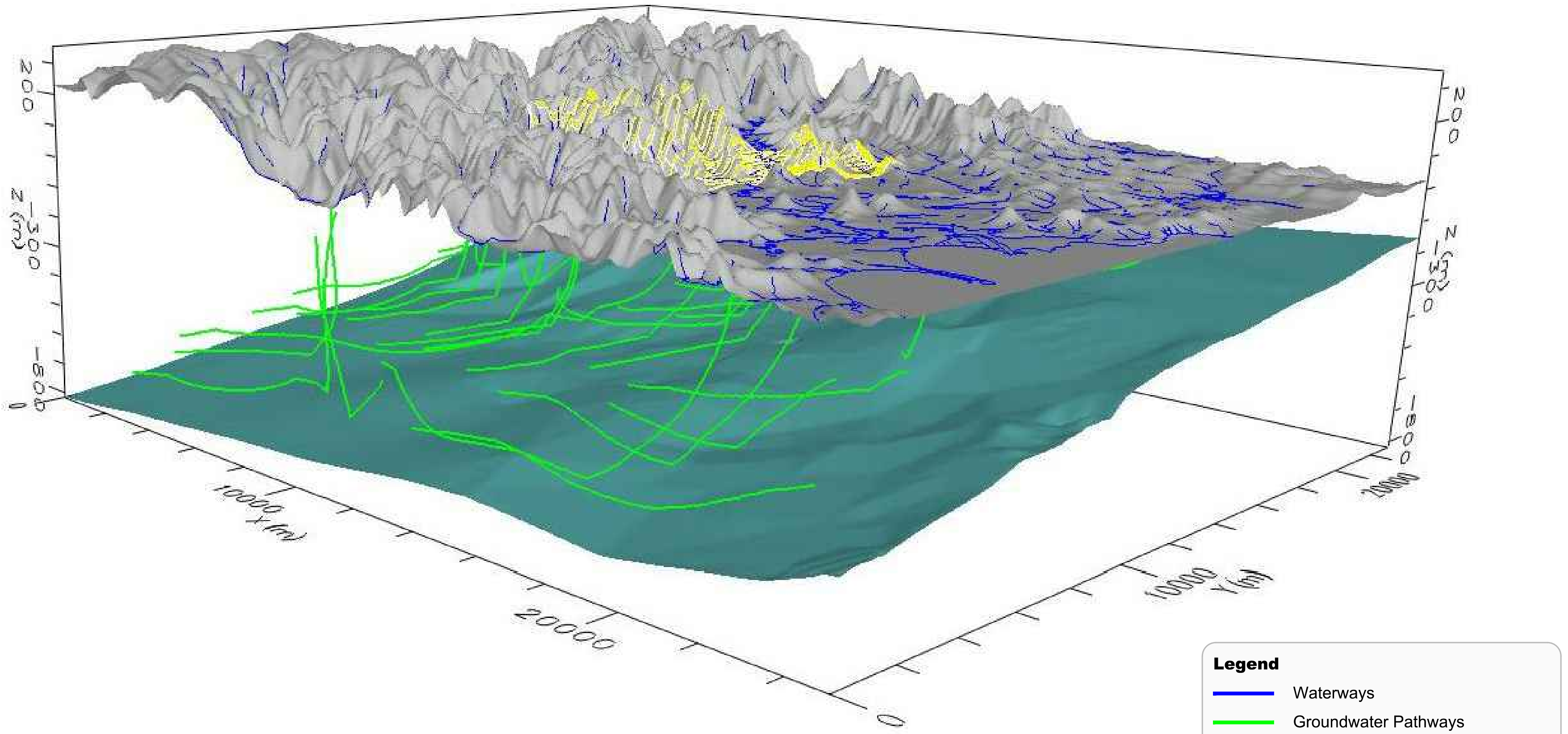
WALLARAH 2 COAL PROJECT

Predicted Pre-mining Groundwater Flow Paths - 2D

FIGURE 8

Wallarah 2 COAL PROJECT

Hansen Bailey ENVIRONMENTAL CONSULTANTS



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WALLARAH 2 COAL PROJECT

Predicted Pre-mining Groundwater Flow Paths - 3D

FIGURE 9

Wallarah 2 COAL PROJECT | Hansen Bailey ENVIRONMENTAL CONSULTANTS

Figure 10 shows the post-mining steady state flow paths using starting locations identical to those used in **Figure 8** for pre-mining flows. **Figure 10** illustrates that pathways will be deflected within the mine workings and will intercept the brine and sealed salt storage areas. These pathways will then adopt an easterly flow direction before rising to the surface in low lying coastal areas approximately 2 km to 3 km to the east of the Project Boundary.

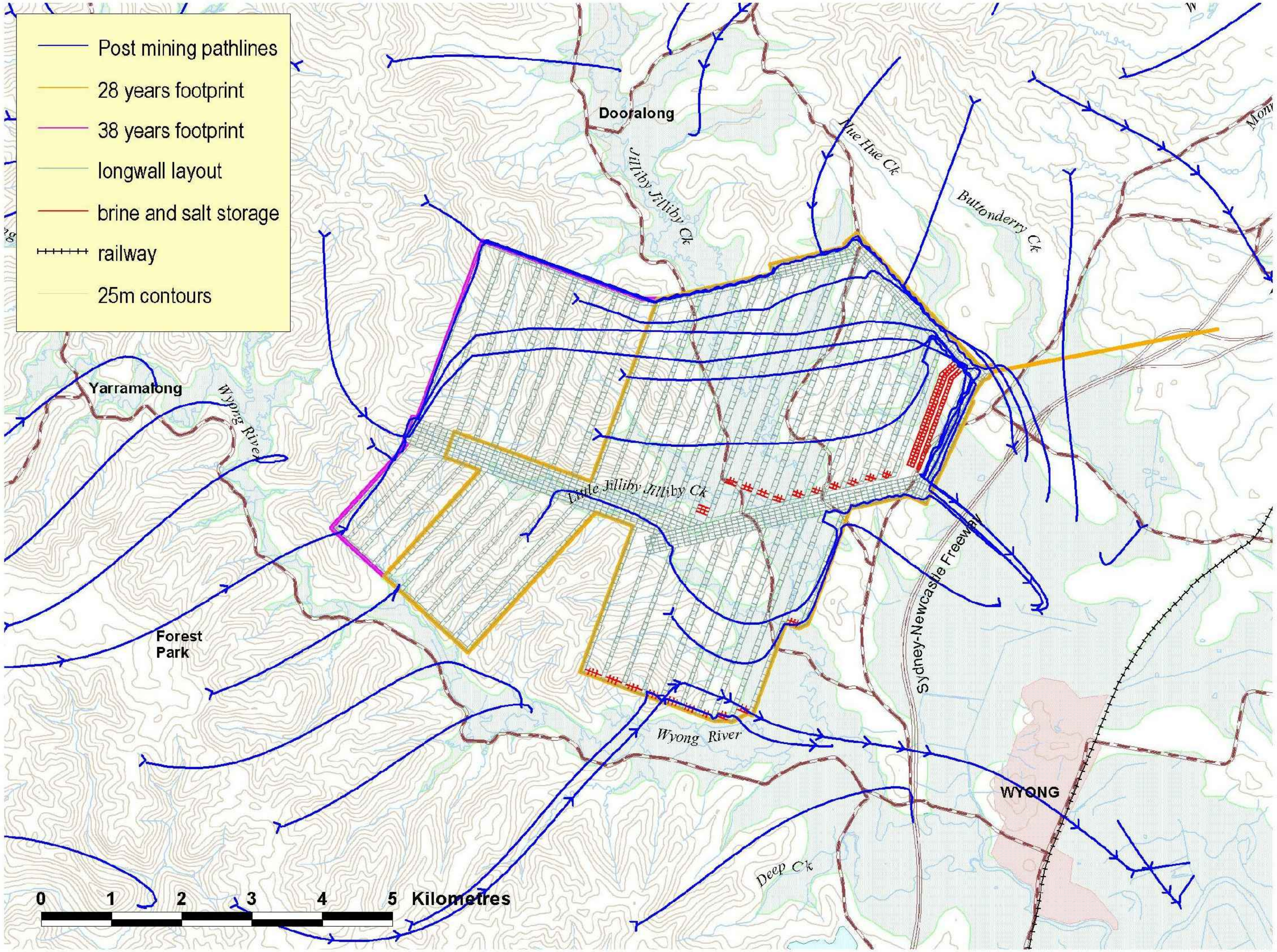
Within the abandoned workings, the salt mixture produced in the first 14 years is expected to remain relatively immobile as re-saturation of the workings and surrounding strata occurs. Immobility is attributed to the sealed storage and to the high density of the salt compared to the naturally occurring strata groundwater.

The brine retained in the underground workings has the potential to disperse and mix with inflowing groundwater during recovery of water levels. A worst case scenario would involve complete mixing of strata groundwater with brine. Calculations based on the inflowing groundwater filling the void spaces (roadways, goaves, etc.) and completely mixing with the brine indicate that the diluted product will exhibit a salinity of approximately 8,600 mg/L.

In comparison, the naturally occurring formation water exhibits a salinity of approximately 7,500 mg/L. In the unlikely event that the sealed salt mixture fully disperses with the groundwater inflows to the abandoned workings, the diluted product will exhibit a fully mixed salinity of approximately 9,500 mg/L.

A mixed / diluted groundwater would be expected to migrate eastwards at depth along the pathlines indicated in **Figure 10** exiting the hardrock system beneath coastal unconsolidated low lands. The velocity of migration is predicted to be less than 1E-03 m/day beyond the area disturbed by underground mining. This velocity results in a travel time of more than 8,000 years before any increase in salinity might be observed near surface.

However, at this low velocity, it is improbable that any increase in salinity would be observed near the surface given that the shallow unconsolidated deposits are subjected to high rates of rainfall recharge when compared to possible future seepage rates.



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WALLARAH 2 COAL PROJECT

Predicted Post-mining Groundwater Flow Paths

FIGURE 10

Wallarah 2 COAL PROJECT

Hansen Bailey ENVIRONMENTAL CONSULTANTS

3.2.8 Impacts on Stream Flows

This section addresses the submissions from stakeholders regarding the description of groundwater discharge areas and quantification of groundwater contributions to stream flows. It also discusses the effect that lowering of groundwater aquifer levels will have on these discharge areas and stream flows.

Submission: RA4, SIG1, P81, P87, P106, P125

Figure E20 in Appendix E of the GIA summarises the assessment completed for groundwater contributions to stream baseflows for defined stream areas. These contributions have been determined by interrogation of mixed boundary conditions which have been used to represent the surface drainage system in the regional groundwater flow model. The results indicate that there will be no discernible change to these baseflows over the Project life.

3.2.9 Reference to Other Longwall Mining Operations

This section addresses submissions from stakeholders regarding the limited reference to vertical leakage and pressure losses measured at other longwall operations in NSW (e.g. Mandalong Mine, Dendrobium Mine).

Submissions: RA4, SIG1

Information regarding the Mandalong Mine was obtained from the original EIS (prepared in 1997) and the Mandalong Mine 2011 Annual Environmental Management Report (AEMR). The Mandalong Mine is situated approximately 8 km to the north of the Project. Longwall panels at Mandalong Mine have been extracted at shallower depths of approximately 160 m to 200 m beneath the alluvial lands of the Mandalong Valley, increasing to a depth of 350 m elsewhere. The overburden strata present in the Mandalong area are similar to the strata within the Project Boundary. However, the Munmorah Conglomerate appears to be a more massive unit in the Mandalong area.

Information obtained from the Mandalong Mine 2011 AEMR indicates that no mining related impacts have been recorded in the alluvium or shallow overburden above the longwalls. A fault was intersected when the first longwall was mined, but no impacts were recorded in the alluvium. Dykes and faults that were intersected by the workings '*usually produced moderate groundwater flows which reduced over time to minor seepage flows of nuisance value only*'.

Dendrobium Mine is situated in the Southern Coalfield within a very different topographic and geological setting. Historical mining operations at Dendrobium Mine have occurred at shallower depths than those proposed for the Project. For these reasons, it is not appropriate to assume that hydrogeological impacts assessed at Dendrobium Mine would apply to the Project. However, longwall mining impacts in the southern, western, Upper Hunter and Newcastle coalfields have generally informed the conceptual subsidence model developed for the Project.

As a result, groundwater flow modelling for the Project demonstrates that vertical depressurisation will occur, but the associated leakage losses from surface systems will be small. Pressure head losses (drawdowns) of 5 to 10 m are predicted to occur in the Patonga Claystone and losses of greater than 200 m are predicted to occur in the underlying Tuggerah Formation. The predicted depressurisation of the strata is illustrated in Figures E12 to E16 in Appendix E of the GIA. These are consistent with (or greater than) pressure head losses reported in the Southern Coalfield.

In respect of material properties adopted for claystone aquitards in the southern coalfield, which tend to govern vertical leakage, the groundwater model for Metropolitan Mine adopted vertical hydraulic conductivity (Kz) values of 3.8E-06 m/day and 7.3E-06 m/day for the Bald Hill Claystone and Wombarra Claystone respectively. The BHP Billiton owned Bulli Seam Operations covers an area of approximately 240 km^2. The Environmental Assessment for Bulli Seam Operations adopted vertical conductivities of 3.0E-06 and 3.1E-06 m/day for the Stanwell Park Claystone and the Bald Hill Claystone respectively. A more recent example is provided by groundwater modelling undertaken for the proposed NRE 1 development where the vertical conductivity values assigned to the Bald Hill Claystone, Stanwell Park Claystone, Coalcliff Sandstone and the Loddin Sandstone were 3.1E-06 m/day, 3.7E-07 m/day, 3.5E-07 m/day and 2.0E-06 m/day respectively. These vertical conductivity values are consistent with the values used in the groundwater model for the Project.

3.2.10 Groundwater Drainage Above Longwall Operations

This section addresses the submissions from stakeholders regarding the assumptions used to determine the height of complete groundwater drainage above mined longwall panels and the differences with recent data published by Tammetta (2012).

Submissions: RA4

The cracking regime above longwall panels has been assessed and reported in the Subsidence Modelling Study (Appendix G of the EIS). The methodology adopted is based on FLAC modelling for '*site specific*' conditions and is considered to be superior to simplified empirical relationships like Tammetta (2012).

The submission from OEH contends that the zone of complete groundwater drainage will extend to 20-30 m below ground level in the western forested areas. It is acknowledged that there will be an increased height of connective cracking for wider longwalls in the western elevated terrain. The zone of complete drainage is predicted to extend to 270 m above the longwall panels in the western area, compared to approximately 200 m for the panels underlying the floodplains. However, the depth of cover in the western forested area approaches 690 m. Therefore, the zone of complete groundwater drainage does not extend as close to the surface as suggested by OEH.

In order to be able to predict the behaviour of the groundwater flow system which might be affected by the cracking regime in the western area, WACJV proposes to install a comprehensive network of pore pressure (vertical array) monitoring boreholes across the region with a focus on the initial longwalls in the eastern area. The evolving pressure loss regime will be continually assessed in conjunction with subsidence monitoring. If it is determined that adverse impacts may occur in either the alluvial lands or the elevated western areas, WACJV proposes to adjust the mine plan to reduce subsidence effects to an acceptable level. This may include changing the height of seam extraction or reducing panel widths.

3.2.11 Groundwater Flow and Permeability

This section addresses the submission from the ACA contending that groundwater flow (to depths of at least 500 m) is governed by fracture permeability rather than core permeability. The ACA also challenges the existence of a constrained zone in light of data from the Southern Coalfield and the Ulan Mine.

Submissions: SIG1

Fracture / joint permeability has not been universally demonstrated to govern groundwater flow down to 500 m depth. While fractures and joints can enhance groundwater flow, they can only do so if a connected network prevails. If fractures are not connected, then flow is governed by the hydraulic conductivity of the rock matrix. Similarly, if the conductivity of a fracture is lower than the matrix conductivity, then the matrix conductivity will govern flow.

Joints / fractures are present in the groundwater flow system and have been considered in the GIA. However, they are considered to form a modestly connected network above the Dooralong valley floor and a disconnected network below the valley floor. Cook (2009) focuses on the Terrigal Formation and considers fracture related storage which is apparently associated with major faulting. No major faulting has been identified within the Project Boundary. In addition, Cook (2009) specifically states that the Patonga Claystone was assessed as having low potential for useful groundwater supplies.

Neither the Southern Coalfield nor the Ulan Mine exhibit geological settings that are similar to the geology encountered within the Project Boundary. In addition, the longwall constraints (panel widths and heights) adopted by Ulan Mine and Southern Coalfield mines are different to the constraints proposed for the Project. For these reasons, it is not appropriate to assume that a constrained zone will not exist on the basis of experiences in the Southern Coalfield and at Ulan Mine.

The numerical subsidence model used in the Subsidence Modelling Study (Appendix G of the EIS) predicted no significant enhancement to the pre-mining vertical conductivity within the constrained zone. However, enhancement in horizontal conductivity through bed separation is predicted. Accordingly, vertical conductivity in the regional groundwater flow model has not been enhanced in the constrained zone.

3.2.12 Hydraulic Conductivity

This section addresses submissions from the ACA contending that the hydraulic conductivity values adopted in the groundwater model are "substantially on the low side of reality", resulting in unrealistically low values for groundwater inflows and the rate at which depressurisation progresses through the strata.

Submission: SIG1

The hydraulic conductivity values adopted in the groundwater model reflect the presence of claystones, siltstones and laminites. The Issue Paper (see **Appendix D**) demonstrates that a weakly connected joint network can exhibit low vertical conductivities (consistent with the conductivities adopted in the regional groundwater models) through upscaling to an Equivalent Porous Medium (EPM).

The rate of depressurisation through the strata overlying subsided longwalls can be assessed by examination of predicted impacts for models W3 and W4 in the GIA. In these models, pressure losses are observed to migrate to a height of between 200 m and 250 m above the Wallarah-Great Northern coal seam within approximately one year of caving. Depressurisation then slows within the upper parts of the Tuggerah Formation and the Patonga Claystone as leakage is initiated from shallower alluvial strata. This is consistent with expectations and is not considered to be '*on the low side of reality*'.

3.2.13 Leakage Losses from Alluvial Lands

This section addresses the submissions from the public asserting that the magnitude of leakage losses from the alluvial lands equates to 3,000 ML/year.

Submission: SIG7, P5, P127, P131, P170

As explained in Section 6.2 of the GIA, the rate of downward leakage of 2 millilitres/day per square metre of land applies to an alluvial lands area (within the Project Boundary) of approximately about 9.3 km^2. This results in a total leakage loss from alluvial lands of approximately 0.02 ML/day or approximately 7.3 ML/year.

The total leakage loss from non-alluvial land within the Project Boundary was calculated to be approximately 0.08 ML/day (or 29.2 ML/annum) from the hardrock groundwater system. The sum of contributions from alluvial and hardrock groundwater systems provides a total leakage loss of 36.5 ML/annum.

The misinterpretation of leakage losses may be due to typographical errors in the GIA. In the final paragraph in Section 8 of the GIA, the leakage losses from the alluvial aquifer should read "0.02 ML/day (7.3 ML/year)" instead of "0.02 ML/day (7.3 ML/day)". Similarly, the leakage losses from the hardrock groundwater system should read "0.08 ML/day (29.2 ML/year)" instead of "0.08 ML/day (29.2 ML/day)".

3.2.14 Aquifer Interference Policy

This section addresses the submission from NOW regarding the specific requirements of the Aquifer Interference Policy (AIP).

Submission: RA1, P1

The submission from NOW identified some requirements under the AIP that required further assessment.

- **AIP Requirement 1:** *Describe the water source(s) the activity will take water from.*

  The groundwater sources comprising the alluvial lands hosted within the Dooralong Valley and the deeper hardrock strata (aquitards) are comprehensively described in Section 3 of the GIA.

- **AIP Requirement 3**: *Predicted the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity?*

  The longer term groundwater influx that will enter the abandoned workings post-mining is estimated to be 0.22 ML/day when mining is completed. The cumulative volume of groundwater influx after 500 years is estimated to be in excess of 64,000 ML.

- **AIP Requirement 4**: *Made these predictions in accordance with Section 3.2.3 of the AIP?*

  NOW questioned whether the modelling was subject to peer review. With the exception of the recent additional modelling undertaken to respond to submissions from stakeholders, all modelling was discussed and the findings made available for peer review.

- **AIP Requirement 14**: *Considered any potential for causing or enhancing hydraulic connections, and quantified the risk?*

  The potential for leakage from the alluvial lands to the mine workings via the cave zone has been further assessed with the aid of a number of additional models. Findings (including uncertainty) are provided in the Issue Paper (**Appendix D**).

- **AIP Requirement 15**: *Quantified any other uncertainties in the groundwater or surface water impact modelling conducted for the activity?*

  The potential for leakage from the alluvial lands to the mine workings via the cave zone has been further assessed with the aid of a number of additional models. Findings (including uncertainty) are provided in the Issue Paper (**Appendix D**).

3.2.15 Minimal Impacts Criteria

This section addresses the submission from NOW requesting an assessment against the minimal impacts criteria under the AIP for the water sources underlying the alluvial system.

Submissions: RA1

The hard rock groundwater system underlying the alluvial lands is regarded as a non-productive system due to the very low hydraulic conductivities of the rock strata. The hard rock groundwater system would not support a useful water supply. The AIP does not provide minimal impact criteria for non-productive aquifer systems. Accordingly, an assessment could not be conducted. However, the Terrigal Formation above the valley floor and adjacent to the alluvial aquifer system could in some areas, be regarded as a fractured rock, less productive system. An assessment in respect of minimal harm criteria prescribed in Table 1 of the AIP is as follows:

- ***Water table (1)*** *– Impacts to be less than or equal to 10% cumulative variation in the water table and 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site.*

  There are no high priority groundwater dependent ecosystems or high priority culturally significant sites identified in the Jilliby Jilliby Creek WSP or the Central Coast Unregulated WSP.

- ***Water table (1)*** *– A maximum of 2 m decline at any water supply work is allowed unless make good provisions apply.*

  Maximum subsidence in some areas is predicted to be 2.5 m which is above the maximum 2 m prescribed range. However there are no identified water supply works in the areas where subsidence may exceed 2m

- ***Water pressure (1)*** *– A cumulative pressure head decline of not more than 40% (maximum 2 m) of the post water sharing plan pressure head above the base of the water source is allowed.*

The maximum pressure head decline in parts of the Terrigal Formation will exceed 2 m.

- ***Water quality (1a)*** - *Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity*.

Due to the existence of a substantial constrained zone, there is not predicted to be any significant mixing of groundwaters from the coal seam and the fractured rock aquifer. Therefore, no long term change in water quality is predicted to occur in the Terrigal Formation fractured rock aquifer.

- ***Water quality (1b)*** - *Increase in salinity to be less than 1% of the long term average salinity.*

Due to the existence of a substantial constrained zone above the longwall panels proposed to be mined, there is not predicted to be any significant mixing of groundwaters from the coal seam and the fractured rock aquifer. Therefore, no long term change in salinity is predicted to occur in the Terrigal Formation fractured rock aquifer.

- ***Water quality (1c)*** - *Mining activity should not be undertaken within 200 m laterally or 100 m vertically of the water source.*

  While there is no direct mining activity within these prescribed limits, consequential subsidence has direct impact on the fractured hardrock groundwater systems. Licensing in respect of groundwater leakage from the hard rock water bearing strata into mining operations is currently required under Part 5 of the *Water Act 1912*. Should this strata be legislated under a future WSP under the *Water Management Act 2000* (WM Act) then the relevant Water Access Licence (WAL) will need to be sought under the WM Act.

3.2.16 Baseline Monitoring Data

This section addresses the submissions regarding efforts to obtain access to private bores to obtain further monitoring data.

Submission: P112

WACJV has recently obtained access to five bores on a private property within the Dooralong Valley, at which monitoring has recommenced.

WACJV is also in the process of installing three deep Vibrating Wire Piezometers (VWP) and a deep monitoring bore to monitor the coal seam aquifer. These bores will provide at least two years of monitoring data prior to the commencement of coal extraction.

3.3 SURFACE WATER

All references to the Surface Water Impact Assessment (SWIA) refer to Appendix J of the EIS.

3.3.1 Water Management System Design

This section addresses the submissions from stakeholders regarding the design of the mine water management system and the containment of mine water.

Submission: RA2, RA4, RA6, SIG1, P112, P118

As described in Section 5.3.1 of the SWIA, the mine water management system has been designed to ensure that there are no uncontrolled discharges (overflows) from the mine water storages (Portal Dam, Stockpile Dam and Mine Operations Dam) to the receiving environment under all historical climatic conditions. For the historical period of available climate data from 1889 to 2011, there were no simulated uncontrolled discharges from the mine water storages. Locations of the mine water dams are shown in Figure 19 of the EIS.

The storm event which occurred over the June 2007 long weekend, as well as the storm events which caused flooding within the local region in 1974, 1981, 1989, 1991 and 1996, have all been modelled in the water balance model and did not result in uncontrolled discharges from any of the mine water storages.

It is possible that an event greater than the design capacity of the mine water storage dams could occur and potentially cause uncontrolled discharges to Wallarah Creek. During such an extreme weather event, it is likely that Wallarah Creek would be in flood and any uncontrolled discharges from the mine water storages would be significantly diluted by flood flows in the receiving water.

The discharge of untreated mine water is not part of the water management system design for the Project. As mentioned above, the mine water management system has been designed to avoid uncontrolled discharges to the receiving environment from mine water storages for all historical climatic conditions.

Section 5.7 of the SWIA shows that the maximum gross groundwater inflow to the underground is conservatively estimated at 900 ML/year. However, from Year 5 onwards, large volumes of mine void space will become available for water storage as mining proceeds. A portion of the groundwater inflows will be naturally diverted to the underground mine void and will not be dewatered and pumped to the surface operations. The net groundwater inflows to the underground sump for dewatering are predicted to peak at approximately 600 ML/year. As shown in Table 5.12 of the SWIA, the maximum dewatering pump capacity from the underground sump to the Mine Operations Dam (MOD) will be 3.5 ML/day.

Mine water storage dams will be constructed with a clay-lined base (or similar) to maintain integrity and prevent seepage / leakage of water to Wallarah Creek. Detailed design of mine water dams will be undertaken in the detailed design stage of the Project, following the granting of the relevant approvals.

3.3.2 Treated Water Discharges

Wallarah Creek Water Quality

This section addresses the submissions raised by stakeholders regarding the reported water quality of Wallarah Creek.

Submission: RA2, P20, P73, P112

Table 4.3 of the SWIA provides a comparison of the existing water quality of Wallarah Creek and the expected quality of treated water to be discharged to Wallarah Creek. The water quality parameters for Wallarah Creek presented in Table 4.3 of the SWIA represent the 95% Upper Confidence Limit of Average concentrations at W6 (Wallarah Creek Midstream), with samples taken monthly between May 2006 and December 2011.

The monitoring data presented in Table 2.11 provides an indication of the variability in the background water quality in Wallarah Creek. Table 2.11 of the SWIA contains a typographical error: values identified as 10th percentile and 90th percentile values are actually 20th percentile and 80th percentile values (for all parameters at all monitoring sites).

End-of-Pipe Environment Protection Licence (EPL) Discharge Limits

This section addresses the submissions from stakeholders regarding the applicable water quality limits for treated water discharges from the water treatment plant.

Submission: RA2, P20

Table 4.3 of the SWIA provides anticipated water quality parameters for treated water produced by the Water Treatment Plant (WTP).

WACJV has proposed discharge limits for environmental protection based on baseline water quality monitoring that was undertaken in Wallarah Creek from 2006 to 2012. The water quality parameters for Wallarah Creek presented in Table 4.3 of the SWIA represent the 95% upper confidence limit of average concentration of the analytes.

Preliminary end-of-pipe discharge limits for physical and chemical stressors and toxicants were determined using the principles detailed in the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality' (ANZECC guidelines) (ANZECC, 2000). The ANZECC guidelines indicate that the preferred approaches to deriving trigger values are (in order of most to least preferred):

- Use of biological effects data;
- Use of local reference data; and
- The tables of default values provided in the ANZECC guidelines.

The Wallarah Creek catchment is considered to be a slight to moderately disturbed ecosystem, for which the ANZECC guidelines recommend that the 80th percentile of the reference distribution is taken as the low-risk trigger value. In the absence of biological effects data, the background water quality monitoring undertaken from 2006 to 2012 has been used as preferred local reference data.

Table 2 shows the Wallarah Creek 80th percentile values, the default trigger values under the ANZECC guidelines and the proposed end-of-pipe discharge limit for treated water. These values will be reviewed in consultation with EPA over the Project life in consideration of ongoing background data monitoring and any regulatory requirements.

Table 2
Preliminary EPL Limits for Discharges to Wallarah Creek

Parameter	Unit	Wallarah Creek (W6) 80th Percentile Value[1]	ANZECC Guidelines Default Trigger Value[2]	Proposed End-of-Pipe Discharge Limit[3]
Electrical Conductivity	µS/cm	516	300	500
pH	pH units	5.9 – 6.8	6.5 – 8.5	6.0 – 8.5
TSS	Mg/L	24	-	25
Dissolved Oxygen	% saturation	67.8	85	70
Calcium	mg/L	13.6	1,000	40
Sodium	mg/L	81.4	115	80
Magnesium	mg/L	9.8	2,000	70
Potassium	mg/L	3	-	3
Sulphate	mg/L	19.9	400	20
Chloride	mg/L	141.8	175	140
Arsenic	mg/L	0.0005	0.013	0.0005
Barium	mg/L	0.15	1	0.15
Cadmium	mg/L	0.0001	0.0002	0.0002
Chromium	mg/L	0.001	0.001	0.001
Copper	mg/L	0.003	0.0014	0.003
Lead	mg/L	0.0008	0.0034	0.001
Manganese	mg/L	0.105	0.1	0.1
Nickel	mg/L	0.002	0.1	0.002
Zinc	mg/L	0.097	0.008	0.097
Iron	mg/L	1.764	0.2	1.5
Mercury	mg/L	0.00005	0.0006	0.0006
Ammonia	mg/L	0.06	0.02	0.06
Nitrate and Nitrite	mg/L	0.052	0.7	0.05
Total Phosphorus	mg/L	0.1	0.025	0.1
Oil/grease	mg/L	2.5	300	2.5

Notes: *1. Monthly monitoring data from May 2006 to March 2012. Analytes analysed in a concentration below the detection limit were replaced for the calculation of the 80th percentile with half of the detection limit.*

2. 95% of species protected. Lowest of irrigation, livestock, ecosystem and recreational trigger values.

3. 100 percentile limit.

Treated Water Discharge Volumes

This section addresses the submissions regarding the volumes of treated water discharges from the WTP and the impacts of the treated water discharges on the flow regimes of Wallarah Creek.

Submission: RA4, SIG1

Sections 3.2 and 3.3 of the SWIA describe the proposed water management strategy. The WTP will have a capacity of up to 3 ML/day (including backwash) or a net capacity of 2.7 ML/day (excluding backwash volumes). As stated in Table 5.12 of the SWIA, the net volumetric efficiency of the WTP is 97% (treated water volume / net feed volume), which results in a maximum treated water discharge to Wallarah Creek of 2.6 ML/day (or 950 ML/year).

The WTP does not necessarily operate all year-round, due to the variability of rainfall. In periods of less intense rainfall, it is possible that there will not be a need to treat mine water to reduce the volume of water within the mine water system. The WTP specifications and the capacity of the MOD have been conceptually designed as an integrated system to treat the expected volumes of groundwater inflows plus the stormwater runoff volumes accumulated onsite. The MOD is the 'buffer' storage which stores the rainfall runoff, whilst the WTP operates to reduce the MOD stored inventory to below 5 ML. Once the MOD volume has been reduced to below 5 ML, the WTP operates only to supply treated water to meet onsite water demands.

Section 5.9.1 of the SWIA shows a sample of the WTP behaviour during a storm event which causes a sudden increase in stored water in the MOD. During dry periods, the volume of water stored in the MOD is maintained at less than 5 ML. Details of the WTP utilisation and treated water outflows are provided in Section 5.11.6 of the SWIA. The range of results reflects the variability in rainfall runoff at the Tooheys Road site. The 99^{th} percentile results represent extremely wet conditions. As mentioned above, the mine water management system has been designed to achieve no uncontrolled discharges (overflows) from mine water dams to the receiving environment for all conditions in the period of recorded historical climate data (123 years).

Section 4.5.3 of the SWIA assesses the impacts of the treated water discharges on the Wallarah Creek flow regime. The results indicate the following:

- There are negligible impacts on the frequency of flows greater than 10 ML/day in Wallarah Creek; and
- The frequencies of low flows up to 10 ML/day are increased. For example, for the pre-mining case, a flow of 1 ML/day occurred approximately 17% of the time, whereas during mining it is predicted to occur approximately 30% of the time.

Although the treated water discharge will alter the flow-duration relationship of Wallarah Creek, the creek will remain ephemeral and will still experience a similar frequency of zero to very low flow events.

Treated Water Reuse

This section responds to the submissions regarding the reuse of treated water from the WTP.

Submission: RA4

The design of the site water management system is based on the principle of minimising fresh water usage by recycling mine water. The first priority for treated water from the WTP is to meet onsite water demands. Section 5.6 of the SWIA details the estimated site water demand volumes, including demands for:

- Tooheys Road Site activities;
- Buttonderry Site activities;
- Underground mine operations; and
- Water losses in product coal moisture leaving the site.

The water demands of the Buttonderry Site are not able to be met using treated water due to the separate locations of the two sites. However, the Buttonderry Site demands constitute only 7% (30 ML/a) of total site demands. The total demand to be met by treated water as a first priority is estimated to reach a maximum of 420 ML/year from Year 8 onwards. As shown in **Figure 11** (Figure 5.7 in the SWIA), the net inflow to the underground sump exceeds the site demands from Year 3 onwards.

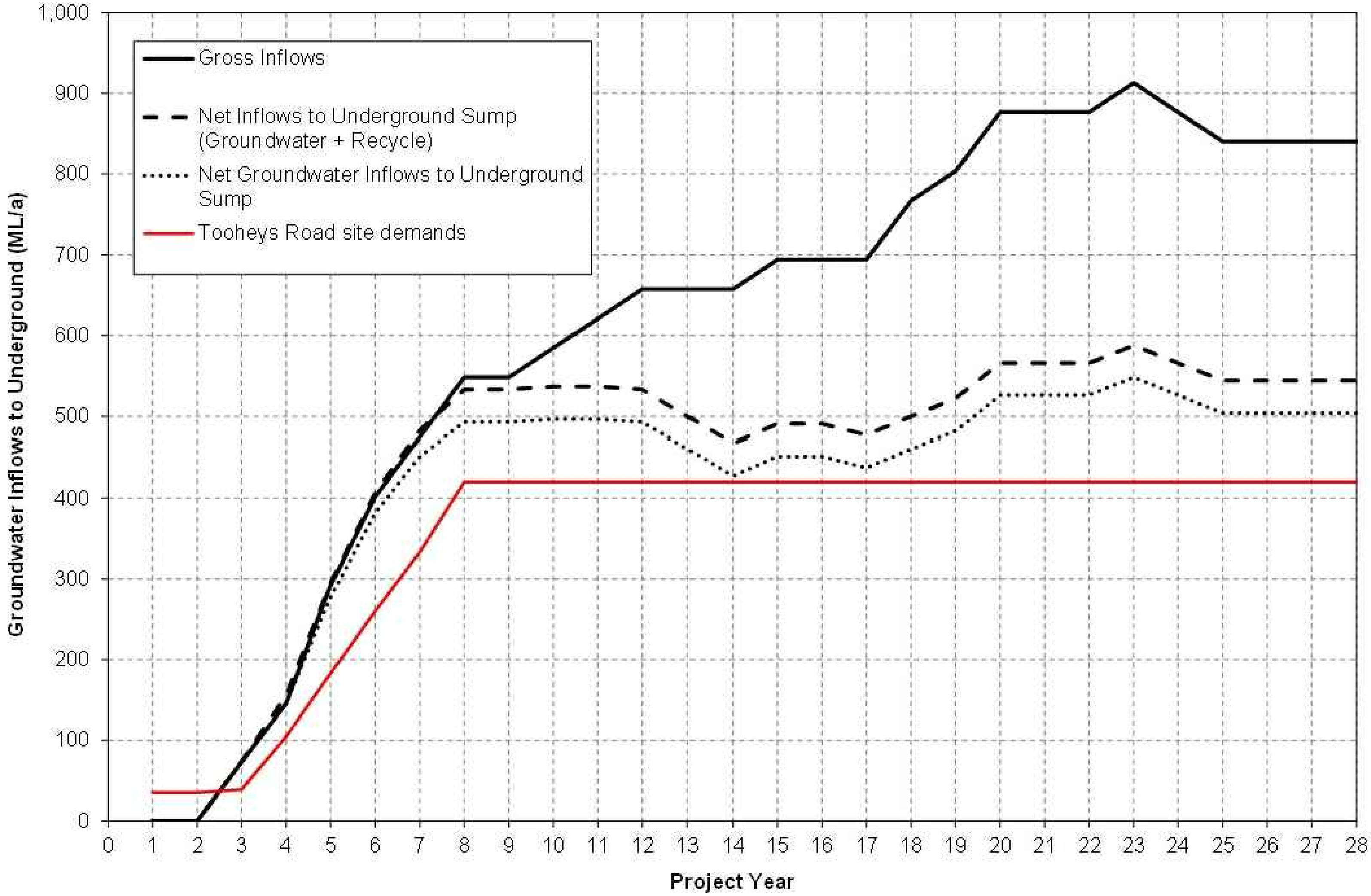
The difference between the net inflows and the site demands, plus any treated rainfall runoff, is released as treated water to Wallarah Creek. Figure 5.9 of the SWIA shows the makeup water requirements from an external source (including Buttonderry demands). The model accounts for evaporation from storages and the efficiency of the WTP. As explained in Section 3.9.1 of the EIS, WACJV can potentially provide treated water for beneficial industrial and non-potable purposes to local authorities and businesses. The final water management strategy would be dependent on agreements and further approvals by external parties.

Environmental Impact of Waste Products

This section addresses the submissions from stakeholders regarding the environmental impacts of the WTP waste products.

Submission: RA4, P112

Sections 3.2 and 3.4 of the SWIA describe how the brine and salt solution produced by the WTP will be disposed of within the underground mining void. During the first 14 years of the Project, the WTP will produce a partly dried salt mixture that will be disposed of and sealed in a dedicated permanent storage area. Due to the coal barriers and the high density of the partly dried salt mixture, it is expected to remain relatively immobile.



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Predicted Groundwater Inflows Compared to Site Water Demands

FIGURE 11

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For the remainder of the Project life, the WTP will produce a brine by-product, which will be disposed of in the underground voids of the extracted longwalls. The impacts of the disposal of the brine are further assessed in **Section 3.2.7**.

Brine is produced as a by-product of the Reverse Osmosis (RO) process, which is utilised to reduce the salinity of mine water. In the first 14 years of the Project, a Brine Treatment Plant will be operated to substantially dewater the brine, producing a partly dried salt mixture. The Brine Treatment Plant is needed in the first 14 years to reduce the volumes of salty by-products that require disposal. Post year 14, there is sufficient underground void space for the disposal of the brine, which is less concentrated relative to the salt mixture. Nevertheless, WACJV will retain the option of continuing the brine treatment process beyond Year 14 of the Project.

3.3.3 Surface Water Quality Monitoring

This section addresses the submissions from stakeholders regarding the location of surface water monitoring points.

Submission: RA2, RA6

Section 6.4 of the SWIA details the existing and proposed surface water monitoring program for the Project. Table 6.3 in the SWIA shows that the WTP monitoring point will be located at the release point from the WTP. The existing Wallarah Creek surface water monitoring locations W6 and W12 are located on Wallarah Creek downstream and upstream of the discharge location respectively and will continue to be utilised during operations.

As indicated in Table 6.1 of the SWIA, the surface water storages will be subject to water quality monitoring on a monthly basis for pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS). Additional observations will be taken when onsite daily rainfall exceeds 25 mm. Comprehensive water quality analyses will be undertaken for each surface water storage on an annual basis. As part of the surface water monitoring program, all sources of contaminants will be identified and monitored for changes associated with the Project.

Monitoring of upstream, onsite and downstream water quality will assist in demonstrating that the site water management system is effective in meeting its objective of avoiding adverse impacts on receiving water quality. Monitoring will allow for impacts to be detected and for appropriate corrective action to be taken at an early stage, should they be required.

WACJV will adhere to the Environmental Protection Licence (EPL) conditions for surface water quality monitoring and will report on the performance of the surface water monitoring program against the relevant conditions in the Annual Review for the Project.

3.3.4 Hydrology and Geomorphology

Stream Classification

This section addresses the submission from OEH regarding the classification of streams, in particular the use of the term 'ephemeral' to describe Wallarah Creek and Jilliby Jilliby Creek.

Submission: RA4

The use of the term 'ephemeral' in the SWIA is consistent with Water Sharing Plans (WSP), which define 'ephemeral' as "*Temporary or intermittent; for instance, a creek or wetland which dries up periodically".* For example, NOW describes the Mooki River water source as an ephemeral system, even though the Mooki River is higher than a 3rd order stream. In the SWIA, the term 'ephemeral' has been used interchangeably with the term 'intermittent'. The terminology used does not intend to misrepresent the nature of the flow regime of the streams potentially impacted by the Project and is based on the flow duration curves for Wallarah Creek and Jilliby Jilliby Creek (see Section 2.7 of the SWIA). The terminology used does not impact on the findings of the SWIA.

Flow Gauging Data

This section addresses the submission from OEH regarding the flow gauging data for third order and higher streams used for the SWIA.

Submission: RA4

NOW operates stream gauging stations in the vicinity of the Project. Streamflow data from these stations have been used to determine potential impacts on flow regimes in Wallarah Creek, the Wyong River and Jilliby Jilliby Creek. Section 2.7 of the SWIA provides a review of the flow gauging data obtained from the NOW stream gauging stations. The Wyong River and Jilliby Jilliby Creek stream gauging stations have approximately 40 years of flow gauging data each, whereas the Wallarah Creek stream gauging station has approximately 11 years of data. The Wyong River and Jilliby Jilliby Creek stream gauging stations are still operational and are therefore considered to be the best available measure of flows for these watercourses.

Installation of additional flow gauging stations on, for example, Little Jilliby Jilliby Creek would assist in characterising the existing hydrologic regime, but would provide no extra information for assessing the impacts of the Project prior to approval. Additional flow monitoring would potentially provide some additional information to confirm the predicted negligible impact of the Project. However, due to natural climate variability, it is very difficult to detect small impacts on flow.

Wallarah Creek Geomorphology

This section addresses the submissions from stakeholders regarding the geomorphological impacts of the Project on Wallarah Creek.

Submission: RA2, RA6

The potential impacts of controlled treated water releases on the stream condition of Wallarah Creek have been assessed in Section 4.5.4 of the SWIA. Based on the relatively low flow rate of treated water discharge and the good condition of bank vegetation, it is unlikely that these flows would result in adverse hydraulic impacts, such as increased bed and bank erosion. Due to the negligible impact on erosion, the discharges of treated water will not alter the geomorphology of Wallarah Creek.

In order to minimise any material environmental harm to the environment, WACJV will meet the EPL conditions for treated water discharge including any requirements for geomorphological assessment of Wallarah Creek.

Stream Characterisation

This section addresses the submission regarding the extent of stream characterisation survey work undertaken for the EIS.

Submission: RA4

Section 2.3 of the SWIA described the character of Wallarah Creek and the upland streams in the western forested area. The western forested area refers to the parts of Wyong State Forest (WSF) and Jilliby State Conservation Area (Jilliby SCA) within the Project Boundary. Extensive surveys of the drainage lines in the western forest areas were undertaken by WACJV geologists, geomorphologists and subsidence experts as part of the background studies for the EIS. In response to the submissions raised over level of stream characterisation, additional surveys were undertaken in August 2013 to obtain further information on the stream character of the drainage lines in the western forested area that were identified by stakeholders to be of significance.

Sections 2.3.1 to 2.3.5 of the SWIA evaluated the environmentally relevant aspects of the stream character that may be potentially affected by the subsidence effects resulting from the Project. The evaluation completed within the SWIA considered the presence and character of sandstone occurrences in the upland stream channels, as these may play a role in controlling local hydraulic flow conditions.

Sandstone outcrops were identified to provide potential aquatic habitat (where rock bars are present to store water in pools) and may contain Aboriginal archaeological sites such as grinding grooves. Each of these environmental features and values, if present, may be potentially affected by subsidence.

The assessment demonstrated that four main types of sandstone occurrences existed in the upland stream channels, including:

- Type A – Sandstone unit does not form bench or outcrop in drainage line itself
- Type B – Sandstone present in drainage line forms localised bench outcrop
- Type C – Sandstone outcrop forms extended benchtop or floor of creek bed; and
- Type D – Sandstone present as boulders only.

The submission contends that the presence of sandstone outcrops may result in subsidence related cracking, as observed in the Southern Coalfield.

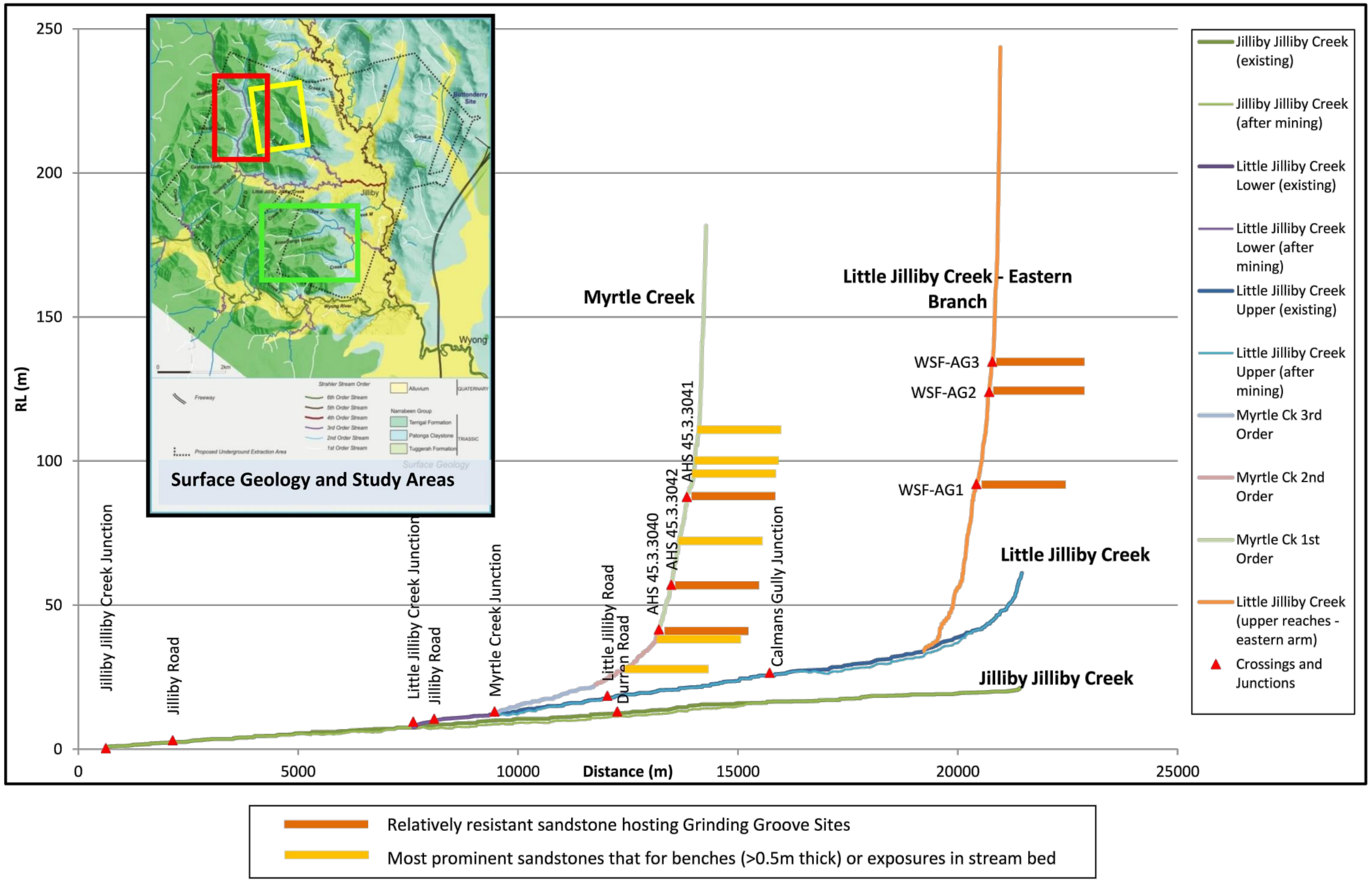
The potential for subsidence impacts is limited within the Extraction Area due to specific conditions in the streams that differ markedly in slope, geology, morphology and physical resilience compared to other locations such as the Southern Coalfields. For instance, the forested hills are stress relieved landscapes that feature strongly jointed, relatively weak sandstones interbedded with finer textured strata. Sandstones are not a significant controlling element in the surface environment of stream channels within the Project Boundary. The nature of the Narrabeen Group sandstones differs markedly from the sandstones of the Southern Highlands and even the Hawkesbury Sandstones present in the plateau areas of the southern part of the Central Coast hinterland.

Most of the upland streams in the western forested area of the Extraction Area are typically first and second order ephemeral streams under the Strahler stream classification system. Little Jilliby Jilliby Creek is the only third order stream in the western forested area. Myrtle Creek and Armstrong Creek are both second order streams in the western forested area. These creeks are classified as third order streams where they exist on the private lands within the alluvial floodplain zones of the Extraction Area.

The lower sections of Little Jilliby Jilliby Creek, Myrtle Creek and Armstrong Creek in the Jilliby SCA and WSF are of low elevation and low gradient. As such, the main stream sections in western forested area mostly occur within alluvial materials of varying depths and textures. Thus, the "*upland streams*" in the western forested areas are not truly "*upland*" in the topographic sense.

Accordingly, the presence of *in situ* sandstone outcrops within the uplands streams does not extend to all second order streams, much less the third order streams. Sandstone outcrops are uncommon to rare in stream sections that are topographically low, as these sections are underlain by the Patonga Claystone. However, sandstone boulders can be found in varying proportions in all stream channels throughout the western forested areas. As these main drainage lines continue into the Jilliby Jilliby Creek and Little Jilliby Jilliby Creek floodplains, sandstone outcrops are absent and sandstone boulders occur infrequently.

Figure 12 shows the slope analysis of the western forested area. **Figure 13** shows the location of the stream characterisation study areas as well as stream gradient profiles for different stream order sections of Little Jilliby Jilliby Creek and Myrtle Creek.



Upland Streams Characterisation – Stream Order and Gradients

HB 1163 F12 Wallarah RTS - Uplands Stream.dwg

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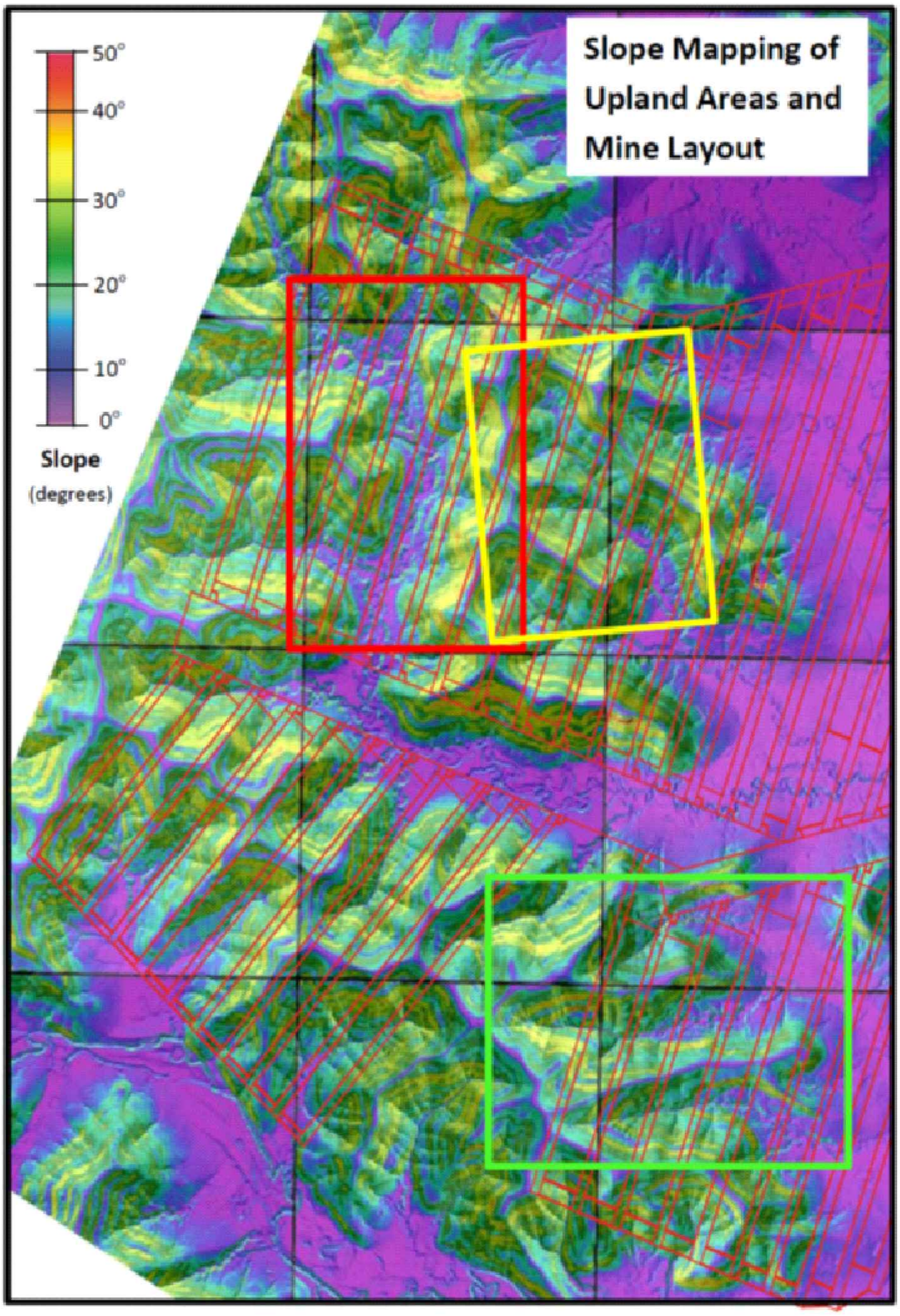
Uplands Stream Characterisation : Slope Conditions

FIGURE 12

Upland Streams Characterisation: Slope Conditions



Upper Little Jilliby Jilliby Creek Upland Stream Study Area

Upper Myrtle Creek Upland Stream Study Area

Middle and South Armstrong Creeks Upland Stream Study Area

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Upland Streams Characterisation : Stream Order and Gradients

FIGURE 13

Key sandstone occurrences in Myrtle Creek are also depicted in the figure and are compared to the main sandstone occurrences hosting grinding groove sites in the upstream sections of Little Jilliby Jilliby Creek overlying the longwall panels. Stream characterisation information was gathered throughout sections of Little Jilliby Jilliby Creek, Myrtle Creek and Armstrong Creek within the Extraction Area. Topographic imaging has also been derived from detailed aerial laser survey information for use in characterising the streams within the Extraction Area.

Little Jilliby Jilliby Creek

Little Jilliby Jilliby Creek extends from the headwaters and highest points of the Jilliby SCA, down through the alluvial valleys of Little Jillliby Jilliby Creek and the Dooralong Valley, to its confluence with Jilliby Jilliby Creek. As evident in **Figure 14**, the sections of Little Jilliby Jilliby Creek within the Project Boundary are largely within the initial alluvial zone at the base of the forested hills. It continues to be fed by very steep first and second order tributaries as it continues through to the deeper alluvial areas on private property. The lower sideslopes of the hills adjacent to Little Jilliby Jilliby Creek within Project Boundary, and the rock strata beneath its alluvial base, are comprised of Patonga Claystone. **Figure 14** includes depictions of the area without vegetative cover to provide a better understanding of the relevant morphological conditions, and numerous photographs to show typical instream conditions.

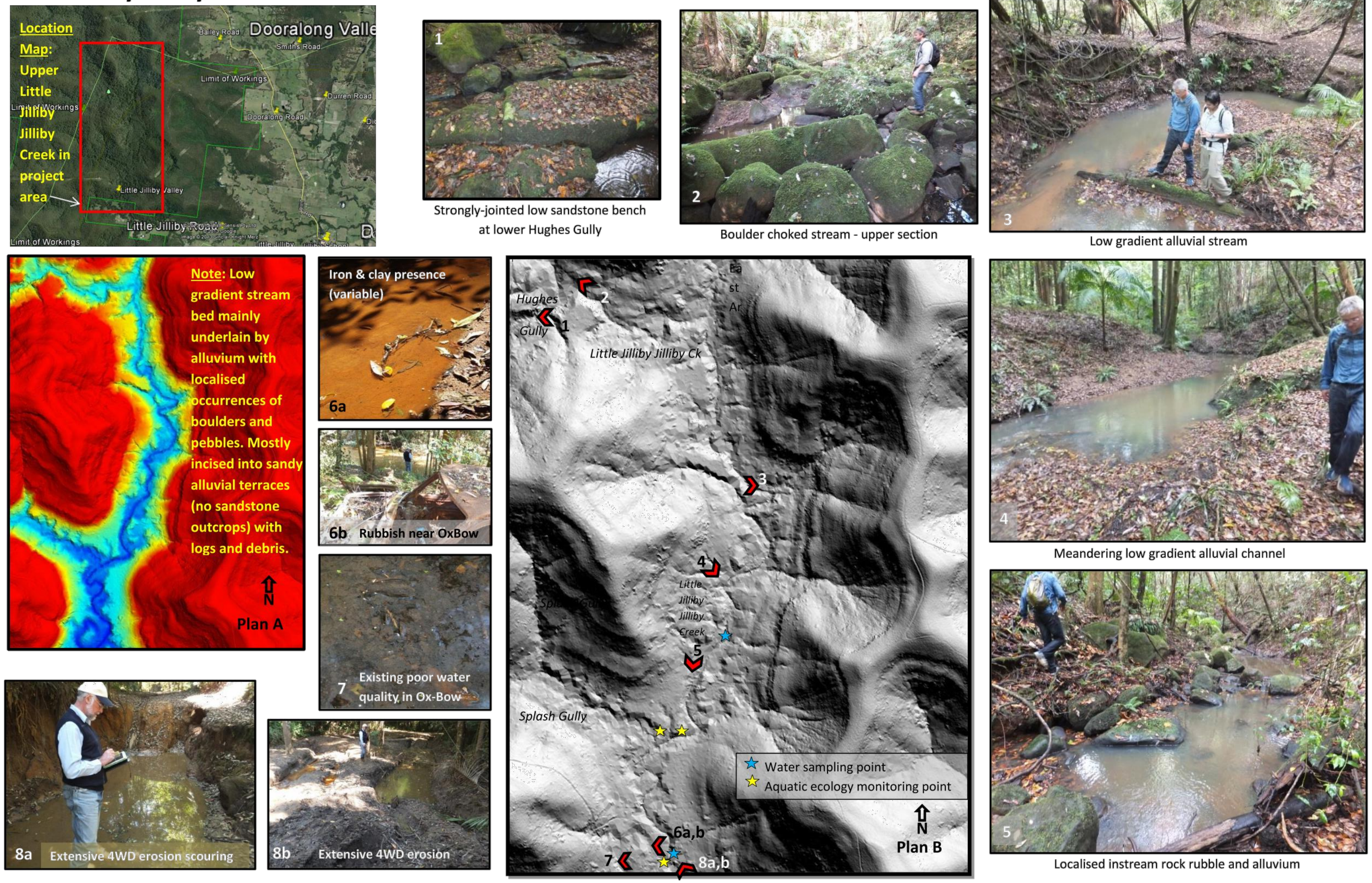
Little Jilliby Jilliby Creek continues for several km upstream of the area that will be mined during the 28 year Project life. Contingent upon a separate approval in the future, it is scheduled that mining in this upland section of Little Jilliby Jilliby Creek may not occur until approximately 2048 to 2052 (Year 32 to 36).

Plan A in **Figure 14** indicates the stream incision into remnant alluvial materials, which demonstrates that Little Jilliby Jilliby Creek has meandered across the valley floor over time leaving ox-bow features. This is highlighted within the lower reaches below Splash Gully within Plan A in **Figure 14**. There have been no substantive *in situ* sandstone outcrops identified within the stream channel in this area, although the uppermost zone and the steep side tributaries do contain generally well jointed, stress-relieved benches (see Photograph 1 in **Figure 14**).

There are no substantive pools associated with intact rock bars across the alignment of Little Jilliby Jilliby Creek. Instead, the outcrops tend to form benches in the steep slopes that do not have capability for pondage. The vast majority of sandstone present exists as dislodged boulders from outcropping and boulder fields of small to large size boulders affected by water or water-transported erosion.

NOTE: Schedule for mining beneath channel alignment of upper Little Jilliby Jilliby Creek: Project Years 32 to 36 (approximately 2048 to 2052 which is outside the project application period).

Little Jilliby Jilliby Creek Characterisation



HB 1163 F14 Wallarah RTS - Upper Jilliby Jilliby Ck.dwg

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Upper Jilliby Jilliby Creek

FIGURE 14

Some isolated pools may occur and have been identified where depositional material (fine sand to boulders) has formed a dam. In these instances, it is evident that these pools are temporary in nature and disappear once the dams are eroded during rainfall and associated flow events.

The lower section of the Little Jilliby Jilliby Creek's study area was observed to be affected by rubbish dumping and extensive erosion of the areas adjacent to the channel (and possibly within its flood zone) due to 4WD and trail bike activity.

Several points along Little Jilliby Jilliby Creek are subject to ongoing aquatic ecology monitoring and periodic water quality sampling by WACJV.

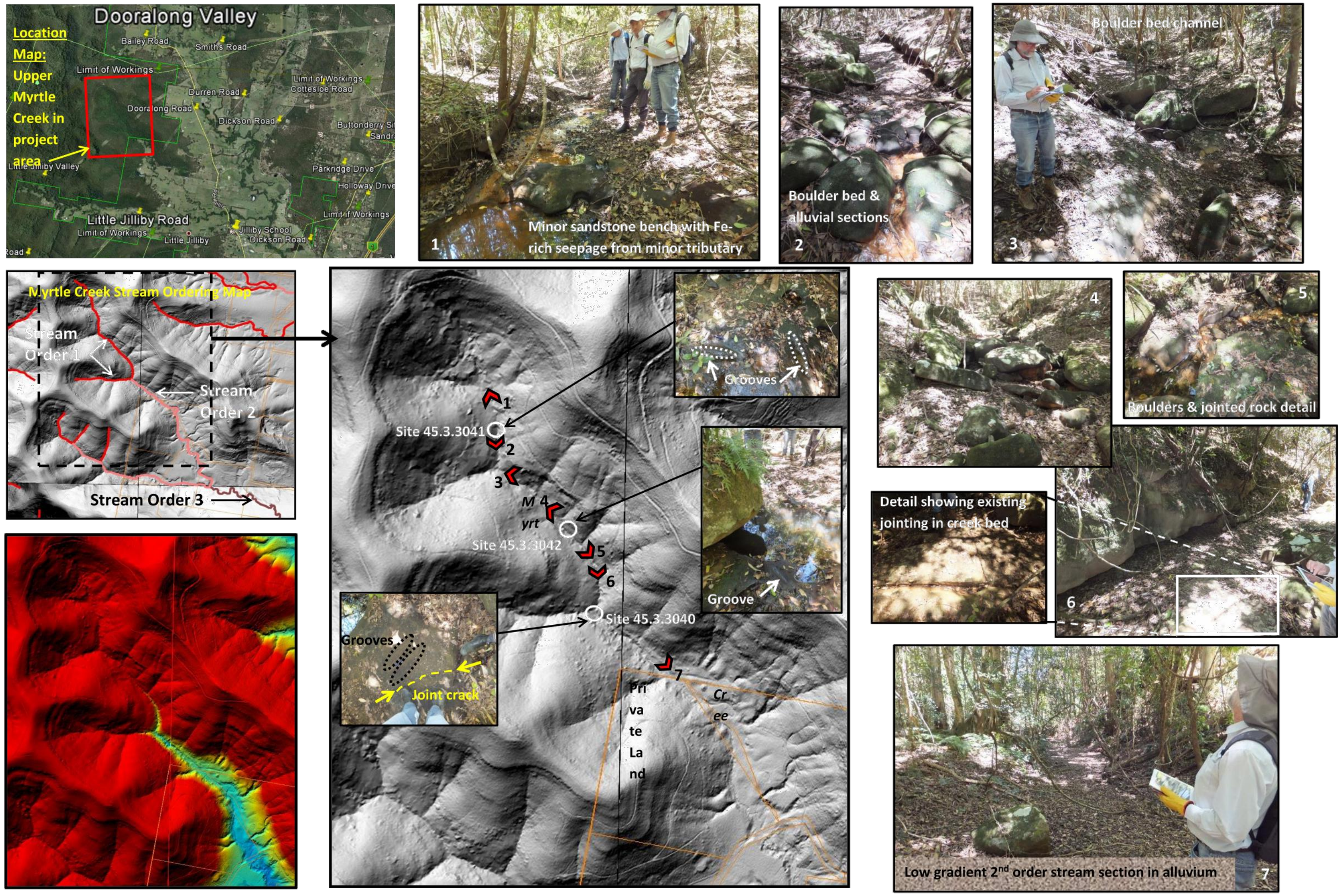
Myrtle Creek

Figure 15 illustrates the stream characterisation for upper Myrtle Creek. The aerial plan showing the topographic colour indicates that at the lowest section of the study area, the stream encounters deepening alluvial base material and very low stream gradients.

The upland sections of Myrtle Creek (first and second order streams) exhibit a greater occurrence of *in situ* sandstone outcroppings in the channel. However, these channel outcroppings (as benches or as discrete stream bed floor sections for a total of approximately 45 m) are shown to be commonly well jointed and therefore less vulnerable to damage from rock movement effects associated with subsidence (see photographs in **Figure 15**). This is also the case for the archaeological sites, some of which feature joint or stress cracking immediately in or surrounding grinding grooves sites.

Upper Myrtle Creek Characterisation

NOTE: Longwall mining beneath channel alignment of 3rd order Myrtle Creek is scheduled to first occur for one year in Project Year 14 (2028) and later from Project Years 24 to 34 (~2038 to 2048).



HB 1163 F15 Wallarah RTS - Upper Myrtle Ck.dwg

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Upper Myrtle Creek

FIGURE 15

Armstrong Creek System

The Armstrong Creek system includes the "*middle*" and "*south*" arms of Armstrong Creek within the Extraction Area. The stream characterisations of both the middle and south arms are depicted in **Figure 16**.

The middle and south arms feature more prominent, resistant sandstones that form steep slopes, often boulder-choked (see photographs 7 and 11 of **Figure 16**), separated by low gradient stream zones in alluvial sediments and/or alluvial/colluvial materials over finer textured strata (see Photographs 5, 6, 8 and 13 of **Figure 16**). The yellow colour in the topographic imaging indicates channel incision in the low gradient, alluvial fill material.

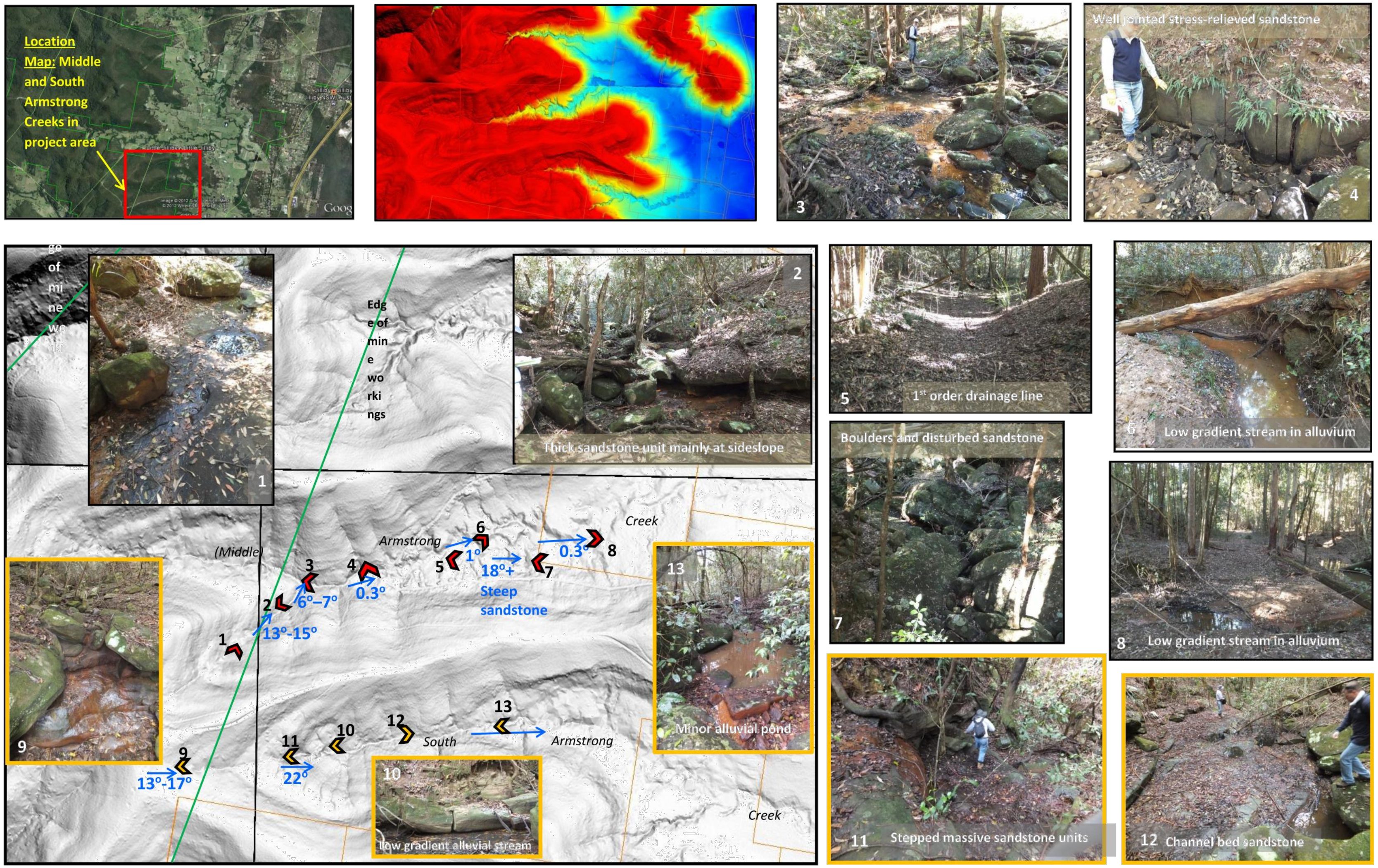
Below these characterised stream sections, Armstrong Creek reduces to a typically minor to nearly indistinguishable flow path across the Dooralong Valley alluvial floodplain despite being a third order stream.

As for Little Jilliby Jilliby Creek and Myrtle Creek, the Patonga Claystone underlies Armstrong Creek in the lower topographic sections where alluvial fill is encountered. The basal slopes of the surrounding hillsides display the trademark enhanced fluted erosion pattern and lower slope profile. These features are most evident in the coloured topographic imaging and grey aerial topographic base maps in **Figure 14**, **Figure 15** and **Figure 16**.

As is the case in the other stream systems, the sandstone outcropping in Armstrong Creek typically continues to show strong jointing and also weathering along bed partings of thin interbedded layers. Often these conditions are better displayed in the side slopes adjacent to the channel, as there may be no evidence of intact remnant *in situ* sandstone forms in the stream channel itself (see photographs 4 and 10 of **Figure 16**). This occurs where the erosion action of the watercourse has removed the readily dislodged sandstone joint blocks from the outcrop.

Shallow temporary ponds are evident, especially in the alluvial stream sections. These result from sediment and debris deposited during falling flow stages which form localised dams (see photograph 13 of **Figure 16**). The deposited material would otherwise result in riffle sections of streamflow that later result in damming effects that form chains of ponds as the flow diminishes. The duration of ponding before a localised stream dries out varies. However, it appears that there is often sufficient fine material in the alluvium for ponding periods to extend for weeks before fully drying out.

Middle and South Armstrong Creek Characterisation



HB 1163 F16 Wallarah RTS - Middle And Sth Armstrong Ck.dwg

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Middle and South Armstrong Creek

FIGURE 16

3.3.5 Subsidence Impacts

Accelerated Erosion

This section addresses the submissions from stakeholders regarding the potential erosion impacts on Jilliby Jilliby Creek due to subsidence caused by mining.

Submission: RA1, RA7, RA10, RA11, P126

As documented in Section 2.3.7 of the SWIA, Jilliby Jilliby Creek and Little Jilliby Jilliby Creek currently experience significant bank erosion at isolated locations. The presence of riparian vegetation has been observed to play a key role in bank stability along these watercourses under existing conditions.

The submission from HCRCMA asserts that the Project will increase the bed gradient along Jilliby Jilliby Creek by 7.6 times, from 0.13% to 1.0%. The maximum tilt that is predicted to occur along Jilliby Jilliby Creek due to subsidence is 10 mm/m (see Section 5.3.1 of the Subsidence Predictions and Impact Assessments), which is equivalent to the 1% change in gradient referred to by HCRCMA. However, this 1% change in gradient is the maximum tilt that is predicted to occur at a specific point along Jilliby Jilliby Creek, as opposed to the change in the average gradient along the entire length of the creek. As shown in Figure 4.12 of the SWIA, the average bed gradient along Jilliby Jilliby Creek will be increased from 0.13% to approximately 0.2%.

The potential impacts of the Project on in-stream erosion are considered in Section 4.9.2 of the SWIA. The quantitative assessment of impacts on flow velocity and stream power indicated isolated locations where erosion potential is increased. However, the increased velocities and stream powers are generally within the range of values currently experienced at other locations along these creeks and hence will be manageable through ongoing monitoring and remediation of identified problem areas, with a focus on maintaining or enhancing riparian vegetation.

Management plans to be developed following the grant of Development Consent will document the progression of subsidence associated with individual longwall panels and will present detailed hydraulic and geomorphic assessments to identify erosion risk areas.

An assessment of low-flow behaviour along Jilliby Jilliby Creek and Little Jilliby Jilliby Creek has been undertaken to identify the locations where flow is likely to break out of the main channel. The results of the assessment show that subsidence is unlikely to significantly affect breakout locations or overbank inundation during low flow conditions and is unlikely to result in channel avulsions.

Impacts on Yarramalong Valley

This section addresses the submissions regarding measures to ensure that subsidence impacts on the Wyong River are minimised.

Submission: RA6, RA11, P112, P165

As explained in Section 3.13.4 of the EIS, the Project has avoided longwall mining beneath the Wyong River. As a result, only a small portion of the Yarramalong Valley is located within the SIL. As assessed in Section 7 of the GIA, the Wyong River alluvial aquifer is predicted to experience an increase in alluvial storage of 30 ML/year due to subsidence. The worst case reduction in surface runoff of 30 ML/year is predicted to have only a negligible impact on the flow regime of the Wyong River.

Impacts of Subsidence on Water Quality

This section addresses the submissions from the public regarding the interception of polluted coal seam waters due to subsidence in the Yarramalong and Dooralong Valleys.

Submission: P1, P94, P102, P107, P138, P140, P165, P169, P170, P173

Mine subsidence will result in fracturing of the bedrock above the goaf. However, there is predicted to be a constrained zone of at least 100 m thickness, which is free of connective cracking. Due to the lack of connectivity between the surface and the coal seam, there is not expected to be any interception of coal seam waters. As a result, water quality is not predicted to be altered as a result of subsidence.

Mitigation of Subsidence Impacts

This section responds to the submissions raised by stakeholders regarding proposed mitigation measures for impacts of subsidence on streams.

Submission: RA4, RA7, RA11, P81, P126

Quantitative analysis of the hydraulic characteristics of Jilliby Jilliby Creek and Little Jilliby Jilliby Creek (Section 4.9.2 of the SWIA) indicates that subsidence is not expected to result in significant adverse impacts on erosion potential. The proposed management strategy is based on ongoing monitoring of bed and bank stability to enable any unexpected impacts to be identified and remediation measures implemented (where practicable). A key component of remediation measures (if required) would be the maintenance and enhancement of riparian vegetation, as well as the use of large woody debris in bed control structures.

3.3.6 Water Quality Impacts

Impacts on Water Quality in Water Supply Catchment

This section addresses the submissions from stakeholders regarding the impacts of the Project on water quality in the water supply catchment.

Submission: RA12, SIG1, P4, P6, P73, P79, P82, P87, P91, P95, P96, P102, P107, P113, P118, P126, P138, P165, P169

Wallarah Creek and Buttonderry Creek are located outside of the Gosford-Wyong Water Supply Scheme catchment and are part of the Tuggerah Lakes Water Source. Therefore there are no potential impacts to the water quality of the Gosford-Wyong Water Supply Scheme due to possible overflows from the mine water management system or the proposed discharges of treated water to Wallarah Creek.

Impacts on the water quality of the Tuggerah Lakes Water Source due to possible overflows from the mine water management system or the proposed discharges of treated water to Wallarah Creek have been assessed in Sections 4.4 and 4.5.5 of the SWIA.

A detailed assessment of the potential impacts of subsidence on stream geomorphology, including water quality in Jilliby Jilliby Creek has been undertaken by International Environmental Consultants Pty Ltd (IEC, 2009). A quantitative assessment of the impacts of subsidence on the hydraulic characteristics of Jilliby Jilliby Creek and Little Jilliby Jilliby Creek has been provided in Section 4.9 of the SWIA.

Impacts on Water Quality during the Construction Phase

This section addresses the submissions regarding the impacts on surface water quality during the construction phase of the Project.

Submission: RA6

As outlined in Section 5.2 of the SWIA, the water balance model is configured to represent the changing characteristics of the water management system over the 28 year Project life, including the construction period. The construction period represents the first three years of the Project life, which has been simulated in the water balance model.

As described in Section 4.4 of the Surface Water Impact Assessment, there are not predicted to be any uncontrolled overflows from the mine water management system to Wallarah Creek in any year of the Project, including the construction period (Year 1 to Year 3). There are predicted to be overflows from the Entrance Dam at the Buttonderry Site during the construction period ranging from 0 ML/year (during an extremely dry year) to approximately 65 ML/year (during an extremely wet year). Since there is no coal handling at the Buttonderry Site, the primary potential pollutant will be suspended sediment. The runoff will be suitable for release after treatment of sediment within the Entrance Dam.

Section 5.3.1 of the SWIA describes the staging of the Project. During the construction period, the appropriate sediment and erosion control works will be installed to treat sediment from rainfall runoff at the Tooheys Road Site.

The proposed erosion and sediment controls are described in Section 6.3 of the SWIA. There is no coal handling at the Tooheys Road Site during Year 1. Groundwater inflows to the underground commence in Year 2 of the Project, corresponding with the construction of the required drift. The volumes of groundwater inflows are shown in Section 5.7 of the SWIA. The WTP will be operating from the end of Year 1 of the Project to treat any groundwater inflows and any rainfall runoff, with excess treated water to be discharged to Wallarah Creek in accordance with the water management strategy and the conditions of an EPL.

Impacts on Water Quality during Mine Closure

This section addresses the submissions from stakeholders regarding the impacts on surface water quality following mine closure.

Submission: RA6

Section 4.3.2 of the SWIA describes the preliminary proposed final landform of the Tooheys Road Site and Buttonderry Site with regards to the water management infrastructure. It is proposed that on completion of mining, the Tooheys Road Site will be rehabilitated to a condition that is suitable for ongoing use as an industrial site. Pollution control structures such as drains and sediment dams will be retained for the future industrial use of the site.

Post-mining, it is proposed that the Buttonderry Site will be rehabilitated and revegetated to provide additional conservation areas to further enhance the ecological offsets for the Project. Water quality impacts during closure of the Buttonderry Site will be managed as per the Sediment and Erosion Control Plan described in Section 6.3 of the SWIA.

3.3.7 Legislative Requirements

This section addresses submissions regarding water related legislation.

Submission: RA6, SIG1

The SWIA has considered all current legislation relevant to the Project as outlined in Section 4 and Section 6. This includes consideration of impacts from the Project on the taking of water from the catchment in accordance with the *Water Management Act 2000* and *Water Act 1912*.

The *EPBC Act Water Trigger Amendment 2013* was passed by parliament on 19 June 2013. 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. In its submission, SEWPaC indicated that a decision on whether the water trigger applies to the Project was still pending.

3.3.8 Water Supply

External Water Supply Requirements

This section responds to the submissions regarding the Project's requirement for external water supplies.

Submission: RA9, P170

Section 4.2 of the SWIA assesses the mine site water requirements. As explained in **Section 3.3.2**, the requirement to obtain water from external water sources is minimised by the recycling of mine site water and prioritising the use of water treated onsite, rather than from an external source.

The results of the water balance modelling show that the maximum external water requirement is 52 ML/year in Year 1. It is proposed to obtain this water, as well as all potable water required for the site (approximately 10 to 20 ML/year) from the Gosford-Wyong Councils Water Authority (GWCWA) town water system. It is noted that after Year 4 of the Project, the mine is expected to have excess water and will rely on the town water system only for potable water for the Buttonderry Site.

The maximum external water requirement (52 ML/year) represents a very small fraction (0.14%) of the current licensed town water supply volume under the Central Coast Unregulated Water Source WSP (approximately 36,750 ML/year) and will have a negligible impact on water availability in the GWCWA town water system. As stated in Clause 28 of the WSP, the long term average annual extraction limit of 36,750 ML/year is based on 2013 drought demand. Therefore, the impact of the Project on town water supplies is negligible even in drought conditions.

The potable water sourced from the town water supply will be used for operational activities. Potable water will not be used for diluting mine water. Mine water will be treated via the processes utilised by the Water Treatment Plant, not by diluting the mine water with potable water.

Loss of Surface Water from Water Supply Catchment

This section responds to the submissions raised by stakeholders regarding potential loss of surface water from the water supply catchment.

Submission: RA1, RA4, SIG1, SIG3, P3, P4, P7, P9, P10, P87, P88, P91, P112, P113, P117, P118, P125, P134, P136, P140, P146, P169, P170

Section 4.6 of the SWIA assesses the potential loss of surface water in the water supply catchment. This assessment demonstrates that the Project is unlikely to result in any substantial impact on the water supply catchment. The increase in alluvial storage capacity due to subsidence will cause a greater volume of surface runoff to infiltrate into the groundwater system. The reductions in runoff volumes are predicted to be 270 ML/year in the Jilliby Jilliby Creek catchment and 30 ML/year in the Wyong River catchment.

As shown in Section 4.6 of the SWIA, the reduction in surface runoff will have only a negligible impact on the flow regime of Jilliby Jilliby Creek. The impact on the Wyong River will be even less given the lower magnitude of the impact and the greater flows in the river compared to Jilliby Jilliby Creek.

Water Access Licences

This section responds to the submissions raised by stakeholders regarding the licensing of clean water take.

Submission: RA1

Section 4.7.3 of the SWIA has assessed the maximum clean water take. It was found that the maximum clean water take at both the Buttonderry Site and Tooheys Road Site are less than the harvestable rights. Therefore, WALs are not required for the water taken from the catchment by these sites.

WALs will be required to authorise take of surface water from the Jilliby Jilliby Creek Water Source and the Wyong River Water Source resulting from subsidence effects, as described in Section 4.6 of the SWIA.

The proponent holds a WAL with a share component of 185 units in the Jilliby Jilliby Water Source.

Cease to Pump Events

This section responds to the submissions raised by stakeholders regarding the potential for increases in cease to pump events in the Tuggerah Lakes Water Source.

Submission: RA4

The water source that is most likely to be impacted by the Project is the Jilliby Jilliby Creek Water Source, since most of the proposed underground mining is located beneath the Jilliby Jilliby Creek catchment. The area of underground mining beneath the Wyong River water source is much smaller. There is no underground mining beneath the area of the Tuggerah Lakes Water Source; however the Wyong River and Jilliby Jilliby Creek catchments are both part of the Tuggerah Lake catchment.

Section 4.6 and Figure 4.8 of the SWIA indicate that impacts of the WACJV on the flow frequency relationship in Jilliby Jilliby Creek are negligible. The relative impacts in the Wyong River and Tuggerah Lake catchments will be even less than the impacts on Jilliby Jilliby Creek. Therefore, the increase in cease to pump events in the Tuggerah Lakes Water Source is expected to be negligible.

Jilliby Jilliby Creek Flow Regime

This section responds to the submissions raised by stakeholders regarding the potential change to the flow regime of Jilliby Jilliby Creek.

Submission: RA6

Section 4.6 and Figure 4.8 of the SWIA indicate that the impacts of the Project on the flow frequency relationship in Jilliby Jilliby Creek are negligible. The assessment includes an extended consideration of the variation in stream flow over extended periods of time (1889 to 2012). The historical data includes all climatic conditions in this period (1889 to 2012) including severe droughts.

3.4 FLOODING

All references to the Flood Impact Assessment (FIA) refer to Appendix K of the EIS.

3.4.1 Model Suitability

This section addresses the submission from OEH regarding the modelling methodology used in the FIA.

Submissions: RA4

The modelling completed for the FIA adopted the '*rainfall-on-the-grid*' method of modelling. This method of modelling possesses a number of advantages that have provided an overall benefit to the FIA, including greater accuracy of flood estimates near the numerous minor tributaries along the floodplain. It is acknowledged that some instabilities can occur when using the "*rainfall-on-the-grid model*" method. However, these instabilities were able to be overcome by using a very fine grid and double precision processing.

The cumulative mass error for model runs was within the accepted "*healthy*" range of ±1% and the hydrographs created by the model were very similar to previous hydrological models for design storms and calibration storms within the region. These model outcomes provide confidence that the method of modelling was appropriate for the catchment within the Project Boundary.

3.4.2 Model Calibration

This section addresses the submission from OEH regarding the calibration of the model used in the study.

Submissions: RA4, P112

As shown in Table 5.1 of the FIA, satisfactory correlation was achieved between modelled flows and recorded flows at Wyong, Gracemere, Jilliby and Yarramalong gauging stations for specific historic flood events. As explained in Section 5.5 of the FIA, the model was determined to be accurate for small and moderate floods. Due to the lack of recorded data for large storms (50 year Average Recurrence Interval (ARI) or larger), the model was unable to be specifically calibrated for large floods.

The calibration of the model was considered adequate given that the purpose of the FIA was to assess the impacts of subsidence on flood levels and flows, rather than to determine the absolute flood levels and flows for large or extreme floods.

The 2007 flood mentioned in the submission from OEH was used for calibration of the model. Whilst this storm was significant for the wider region, the 2007 storm was approximately equivalent to a 3 to 5 year ARI storm in the area of Jilliby Jilliby Creek within the SIL. Consequently, the data recorded within the Jilliby Jilliby Creek catchment for the 2007 flood provided little value in calibrating the model for larger storms. The storms used in the calibration of the model are listed in Table 5.1 of the FIA. Only recorded floods with sufficient hydrological and streamflow data were used for model calibration.

Conservative values were used for model parameters to ensure a conservative estimate of the absolute values of flood levels and flows. The same model parameters were used for both pre and post subsidence model scenarios to achieve the primary purpose of the FIA, which is to compare flood conditions before and after subsidence resulting from the Project. The parameters and inputs used in the TUFLOW model are presented in Annex A to Annex I of the FIA.

3.4.3 Impacts due to Climate Change

This section addresses the submission from OEH acknowledging the impacts resulting from climate change.

Submissions: RA4

The FIA made an allowance for climate change to both the pre and post subsidence models by increasing rainfall by 20% and tailwater levels by 1.1 m. As expected, the increase in rainfall resulted in increases to flooding flows and levels. However, there was no substantial difference in the changes to flood depths as a result of subsidence predictions for the Project. Therefore, the consideration of climate change effects does not significantly alter the impact of the Project.

Given that the purpose of the FIA is to determine the change in flood levels due to subsidence, the relevant comparison is between pre-subsidence flood levels with climate change effects and post-subsidence flood levels with climate change effects. It is not appropriate to compare pre-subsidence flood levels without climate change changes to post-subsidence flood levels with climate change effects. Such a comparison would be assessing the impact of change impacts, independent of the Project.

3.4.4 Probable Maximum Flood

This section addresses the submission from OEH requesting the assessment of impacts on the extent of the Probable Maximum Flood.

Submissions: RA4

The six hour duration Probable Maximum Flood (PMF) was modelled to provide an indication of flood behaviour in extreme rainfall events. As explained in Section 5.6 of the FIA, peak flood levels during the six hour duration PMF event were found to be approximately 4 m higher than the flood levels for a 100 year ARI event, under both pre and post subsidence conditions. The PMF extent for pre-subsidence conditions was shown in Figure I0 in Annex I of the FIA. If required, a larger scale drawing showing the extent of the PMF can be provided to OEH.

The PMF represents an estimate of the largest possible flood that can occur within a catchment. A flood of this magnitude would typically result in extreme flood levels and velocities causing extensive inundation of properties and major infrastructure damage. Hence, assessments of the PMF are typically used for flood emergency planning, rather than impact assessment.

The 100 year ARI flood event is typically used for assessment of development impacts because most jurisdictions in Australia require protection of infrastructure against floods of this magnitude.

Further, the PMF was not used as the Flood Planning Level (FPL), as this would be contrary to '*normal practice*' and the policy outlined in the NSW Floodplain Development Manual, which provides for "*a merit based approach to selection of appropriate flood planning levels (FPLs). This recognises the need to consider the full range of flood sizes up to and including the PMF and the corresponding risks associated with each flood, whilst noting that with few exceptions, it is neither feasible nor socially or economically justifiable to adopt the PMF as the basis for FPLs. FPLs for typical residential development would generally be based around the 1% AEP flood event plus an appropriate freeboard (typically 0.5m)*" (Ref p.2).

3.4.5 Changes in Flood Behaviour

This section addresses the submissions from stakeholders regarding the predicted changes in flood conditions.

Submissions: RA6, SIG1, P126

The FIA modelling predicted no substantial change in the overall volume of flood flow as a result of subsidence. As explained in Section 8.1 of the FIA, there will be a slight decrease in the peak flood flow, corresponding with a slight increase in the duration of the 100 year ARI flood event. The reduction in peak flows of approximately 2% and increase in duration of approximately 6% are generally due to detention effects within the SIL.

The FIA model predicts that during a 100 year ARI flood event, subsidence induced by the Project will cause an additional 40.3 ha of land to become flood prone and 6.4 ha of land to become flood free. There will be virtually no impacts in the Yarramalong Valley except to two small backwater areas.

The FIA model used for the Project confirmed that local streams within the SIL flood rapidly. The TUFLOW model in this assessment used topographic data at 10 m grid intervals, as well as detailed geometry data for the individual streams. As a result, the accuracy of flood estimates for all of the smaller tributaries was greatly improved compared to previous flood models. This has been reflected in the identification of properties potentially impacted by flooding. The accuracy was also improved for the main floodplains of Jilliby Jilliby Creek and the Wyong River; especially in predicting secondary flow effects across the floodplains. The model also confirms that both the Yarramalong and the Dooralong Valleys are currently extremely flood prone with both waterways typically overtopping their banks during the 3 to 5 year ARI storm events with 10 year ARI floods extending over most of the width of the floodplains.

3.4.6 Predicted Impacts on Dwellings

This section addresses the submissions from stakeholders regarding the potential impacts on dwellings and the development of mitigation strategies for adversely impacted dwellings.

Submissions: RA4, RA6, SIG1, P4, P126, P141, P158

Flood impacts were assessed using the TUFLOW computer model to determine flood conditions (levels, depths, flows, velocity, duration and risk levels) before and after subsidence induced by the Project. The results of the flood modelling are presented in Section 6 of the FIA.

The model predicts that six dwellings may experience major adverse impacts, 11 may experience moderate adverse impacts and 10 may experience minor adverse impacts. There will also be 14 dwellings that will be unaffected by changes to flood behaviour and 49 dwellings that will be beneficially impacted. The degree of positive impacts are expected to be very small and will apply to properties downstream due to detention effects within the SIL.

The objective of the FIA was to accurately identify every property that may be adversely affected as a result of changes to flood behaviour for floods up to the 100 year ARI flood event. Appropriate mitigation measures will be developed and implemented through PSMPs. WACJV will develop PSMPs for the 27 dwellings that are predicted to experience major, moderate or minor adverse flooding impacts as a result of the Project. The 14 dwellings in the negligible impact category are not expected to require mitigation measures as these dwellings will continue to satisfy planning requirements for freeboard and flood risk.

In all instances, mitigation measures must ensure that the new, modified or relocated house will be flood free (i.e. >0.5 m freeboard above maximum flood level in a 100 year ARI event). This requirement ensures that no property owners will be adversely affected by the mitigation process. Given that many of these buildings are already flood prone, it can be expected that most property owners will derive a general benefit from these proposed mitigation measures.

In some circumstances, mitigation measures may be impractical or unacceptable to property owners. As a result, voluntary purchase of properties by WACJV is also an available option. Arrangements for voluntary purchase will be developed by WACJV with property owners and will be included in PSMPs.

The description of mitigation options in Section 7 of the FIA was not intended to be an exhaustive list of options that may be considered for the PSMPs, nor was it intended to suggest a particular option for any specific property. Each individual PSMP will be developed in consultation with each property owner and in accordance with WSC's planning requirements to determine the best mitigation for that property and with due consideration of costs and appropriateness to individual circumstances. Any secondary impacts that might result from mitigation works will also be addressed as part of the PSMPs.

During the development of PSMPs, WACJV will work closely with WSC to confirm that the impacted properties identified in the FIA are properly considered and that controls in impacted areas are appropriately updated.

WACJV will be obligated under the *Mining Act 1992* and its Development Consent to address and mitigate adverse impacts caused by changes to flood behaviour as a result of the Project. WACJV will commit to complying with all legal and planning requirements and to work closely with the community to meet expectations as far as practicable.

3.4.7 Potential Impacts to Access Roads

This section addresses the submissions from stakeholders regarding the inundation of access points and the mitigation measures to restore access to property.

Submissions: RA6, RA4, SIG1, P81, P106, P109, P141, P158, P170, P176

The issue of emergency access during floods has been extensively considered in the FIA. All of the key access points that may suffer greater and longer periods of inundation were identified in Sections 6.7 and 6.8 of the FIA. Adverse impacts are predicted at three key road access points in the Dooralong Valley (D50, D70 and D80/D81), and 1 minor road access point in the Yarramalong Valley (Y80/Y90). The low points identified as Y80 and Y90 are in close proximity and provide access to the same residences. This pair of low points is considered a single access point.

While it might not be possible to flood-proof all public roads in the region, mitigation options will aim to ensure that no property will suffer longer interruptions to access than under current conditions. Where possible, mitigation measures will also aim to improve emergency access relative to existing conditions.

The issue of road modifications and associated long term maintenance liability was not dealt with in detail in the FIA. The option of raising road levels was discussed in the context of ensuring that emergency services could obtain access to all areas of the river valleys, and that such access was not adversely affected or slowed by changes in flood behaviour and levels. Other options to mitigate the impacts of the Project, such as road deviations and the provision of alternate emergency access routes, may also be feasible and will need to be discussed with WSC to determine the most effective mitigation measure. When preferred options for each location are developed and agreed in consultation with WSC and landholders, it is understood that WSC will be the approving authority and will be provided with detailed design documentation of all proposed mitigation/remedial works (including drainage and ancillary works) and comprehensive assessments of any long term maintenance requirements as part of the relevant Subsidence Management Plans for Road Infrastructure.

It is understood that any road modifications will require detailed designs to be submitted to WSC for approval as part of the relevant Subsidence Management Plans for Access Routes. This would include consideration of drainage, usage, constructability, long term maintenance requirements and ancillary works. Overall access requirements and acceptable levels of flooding will be considered holistically as well as at specific locations.

The mitigation options described in the FIA report were not intended to be definitive or exhaustive but are initial suggestions of options that may be viable and appropriate. It is acknowledged that mitigation options such as levees and road raising have the potential to alter flood behaviour. As such, mitigation options will be thoroughly analysed using the TUFLOW model to confirm they will not exacerbate local flooding. It is intended that every mitigation option will be developed in consultation with WSC and will satisfy their Development Control Plan (DCP) conditions as well as other relevant statutory requirements.

Detailed assessment of potential flood mitigation measures will be undertaken after the grant of Development Consent. This assessment will satisfy any mitigation criteria and objectives established in the course of consultation with WSC and the community during the development of Subsidence Management Plans.

3.4.8 Changes to the Floodplain

This section addresses the submission from the ACA regarding the potential for subsidence to alter surface drainage patterns, particularly the creation of depressions that retain water.

Submissions: SIG1

The FIA was primarily focused on large flood events, but also included modelling of small floods (5 year ARI event). In all cases, the overall duration of flooding was found to increase only slightly in certain areas due to subsidence.

Subsidence may cause some local drainage patterns to change within the floodplain region in the SIL, but main streams will continue to behave as they currently do in draining water from the valleys. With the exception of some very minor variations, subsidence will generally be uniform across the floodplain. As a result, new depressions that may trap floodwater are not anticipated.

It is not anticipated that any water will be retained or impeded on the floodplains within the SIL. However, there will be some adjustment of the Jilliby Jilliby Creek stream bed near the downstream boundary of the SIL, including potential accretion of up to 0.5 m immediately upstream of the boundary and up to 0.5 m scour immediately downstream of the boundary. This is within the typical range of natural changes to streams and is likely to occur over several years during minor floods as subsidence progresses. Given that the main channel of Jilliby Jilliby Creek is approximately 3 m deep at this location and typical debris within the channel includes logs of up to 1 m diameter, it is unlikely that these changes will be noticeable. However, the progress of these changes will be monitored and remedial action will be undertaken if necessary.

3.4.9 Impacts on Farm Dams

This section addresses the submission from the ACA regarding the potential for cracking of farm dams and other impoundments.

Submissions: SIG1, P170, P183

Farm dams and other impoundments were not found to be a significant flood related issue; but were still included in the topographic input to the model. Issues relating to direct settlement impacts on farm dams and impoundments are addressed in Section 5.26 of the Subsidence Predictions and Impact Assessments (Appendix H of the EIS). There will be changes to topography where farm dams are located. Although cracks and fissures are unlikely to occur due to subsidence, WACJV will be responsible for any repairs and / or remediation in the unlikely event that such damage does occur. Mitigation measures for impacts to farm dams will be included in PSMPs.

3.4.10 Impacts on Aquifers

This section addresses the submission from the ACA regarding potential impacts on aquifers due to "forced feeding" by volumetric water displacement and pressure gradients during flood conditions.

Submissions: SIG1

Being typically short in duration, large floods only have a minor impact on aquifers, which is usually a function of the long term hydrograph recession curve and the period between rainfall events. Cracking, fracturing and faulting are not expected to occur at the surface of the floodplains. The natural groundwater level is typically only 1 or 2 metres below the surface and would not be significantly affected by changes to flood levels due to subsidence from the Project.

The main channel of Jilliby Jilliby Creek is typically incised 2 m to 3 m below floodplain level and will continue to operate as the sink for groundwater across the floodplain, whereas the groundwater system will continue to be fed by direct rainfall and flows from the surrounding hillsides.

3.4.11 Exacerbation of Geological Faulting

This section addresses the submission from the ACA asserting that geological faulting will be exacerbated by flooding.

Submission: SIG1

The submission from the ACA asserts that geological faulting will be exacerbated by "*flood water pressure penetration*" through "*vertical drainage surface cracking*". As explained in **Section 3.23**, the extensive exploration program undertaken for the Project has determined that there is no evidence of faulting within the Extraction Area.

3.4.12 Changes to Subsidence Predictions

This section addresses the submission from WSC stating that flooding impacts will be altered if subsidence effects differ from the predicted values.

Submissions: RA6

The flood model will be revisited if there are changes to the mine plan or if there are differences between predicted subsidence levels and actual subsidence measurements. The model will be re-run if there are changes or variations that could alter predicted flood levels. Revisions of the flood model (if required) will be undertaken in close consultation with WSC.

3.4.13 Comparisons with Other Studies

Previous Flooding Assessments

This section addresses the submission from OEH regarding variations between the flood levels predicted in the FIA and the predictions of earlier flooding assessments.

Submissions: RA4

The variations between flood levels predicted in the FIA and the levels predicted in the previous flood assessments by ERM can be observed by direct comparison of the tables in these reports presenting the impacts on every dwelling. The dwelling identification numbers used in the FIA are consistent with the identification numbers used in the previous ERM studies.

Wyong River Catchment Flood Study

This section addresses the submission from OEH requesting the comparison of the predictions in the FIA and the Wyong River Catchment Flood Study.

Submissions: RA4

As soon as the results of the Wyong River Catchment Flood Study (WRCFS) become available they will be compared to the results of the FIA for consistency of results. WACJV will submit a supplementary report that compares the results of the FIA and WRCFS. It is anticipated that the WRCFS will predict slightly lower flood levels than the FIA due to the use of conservative model parameters and rainfall values in the current model.

3.4.14 Topographic Data

This section addresses the submission regarding the accuracy of the topographic data used in the FIA.

Submission: P112

The Digital Terrain Models used in the FIA were developed using Aerial Laser Survey data, which produced topographic data to an accuracy of ± 0.1 m laterally and ± 0.2 m vertically. The topographic data for the post-mining case was obtained by applying the predicted subsidence effects to the pre-mining topography.

3.5 AIR QUALITY

All references to the Air Quality and Greenhouse Gas Assessment (AQGGA) refer to Appendix L of the EIS.

3.5.1 Construction Phase Impacts

This section addresses the submissions from stakeholders regarding the assessment of air quality impacts during the construction phase.

Submissions: RA6, SIG1, P112

Section 7.1 of the AQGGA provided detailed dust emission estimates for a construction phase scenario. The estimated dust emissions during construction were found to be significantly lower (approximately 50% lower) than the estimated dust emissions during the operational phase. Therefore, dust levels at private receivers will be lower during the construction phase than during the operational phase.

Section 8 of the AQGGA demonstrated that the Project will comply with the air quality impact assessment criteria at all locations during the operational phase. Due to the lower emissions during the construction phase, it can be concluded that the construction phase of the Project would also comply with the air quality criteria under all modelled climatic conditions. Construction dust management measures are outlined in Section 11 of the AQGGA.

3.5.2 Air Quality Assessment Methodology and Adequacy

This section addresses the submissions from Wyong Shire Council and Lake Macquarie Council suggesting that the air quality assessment was not undertaken in accordance with applicable legislation.

Submission: RA6, RA7

The AQGGA was completed in accordance with the 'Approved Methods for Modelling and Assessment of Air Pollutants in NSW' (DECC, 2005) (the Approved Methods). The submission from EPA confirmed that the air quality assessment was conducted in accordance with the Approved Methods.

The Approved Methods is not legislation but rather a guideline for the completion of air quality assessments in NSW.

3.5.3 Assessment of Project Only Impacts

This section addresses the submission from WSC regarding the assessment of Project only emissions (rather than Project emissions with baseline conditions).

Submissions: RA6

The AQGGA has assessed both incremental impacts (Project only) and cumulative impacts. Incremental impacts are presented in Sections 8.1 to 8.7 and cumulative impacts are presented in Section 8.8 of the AQGGA. The assessment is in accordance with the Approved Methods.

Cumulative impacts have been assessed based on the baseline conditions described in Section 5.2 of the AQGGA, which included site specific monitoring for Total Suspended Particulates (TSP) and PM_{10}.

3.5.4 Adopted Background Levels

This section addresses the submission from LMCC requesting the validation of background $PM_{2.5}$ levels using data from the EPA operated air quality monitoring station at Wyong.

Submissions: RA7

At the time of assessment, there was no available $PM_{2.5}$ monitoring data in the immediate vicinity of the Project. Consequently, background $PM_{2.5}$ levels were estimated based on representative PM_{10} / $PM_{2.5}$ ratios from monitoring conducted elsewhere.

Since October 2012, data has been collected from an EPA operated monitoring site at Wyong (approximately 8 km from the Project Boundary). The average concentrations recorded at Wyong for the first half of 2013 were 15 µg/m^3 for PM_{10} and 6 µg/m^3 for $PM_{2.5}$. The AQGGA adopted a slightly higher background levels for PM_{10} (18 µg/m^3) and a marginally lower background level for $PM_{2.5}$ (5 µg/m^3). These minor differences would not alter the conclusions of the assessment. Therefore, the background levels adopted in the AQGGA are considered appropriate.

3.5.5 Implementation of Best Practice Dust Management Measures

This section addresses the submissions regarding the implementation of best practice dust controls and the requirements for an air quality management plan.

Submissions: RA6, RA7, RA2, RA8, SIG1, P2, P112

WACJV has committed to the implementation of all best practice dust management measures outlined in the AQGGA. Full details of dust management measures will be provided in an Air Quality Management Plan (AQMP), which the proponent will prepare in accordance with the conditions of the development consent for the Project. The AQMP will describe all best practice dust control and monitoring measures to be implemented, including the measures required by the EPA. All measures will be quantifiable, auditable, measurable and enforceable. The AQMP will include Key Performance Indicators (KPIs) for determining compliance with the plan and conditions of development consent. Although considered an unlikely occurrence due to the anticipated high moisture content of the Project's resource, should spontaneous combustion be determined to be a risk in the future, it shall be considered in the AQMP with relevant management and mitigation measures incorporated to the approval of relevant regulators.

Submissions from the public assert that it is not possible to prevent dust emissions from the site. The implementation of best practice dust management measures does not guarantee the avoidance of dust emissions. Instead, these measures are implemented to ensure that dust concentrations at private receivers are maintained below levels that are considered acceptable by regulatory authorities.

3.5.6 Impacts from Coal Transportation

This section addresses the submissions regarding the potential impacts of coal transportation by rail.

Submissions: RA7, SIG1, P4, P5, P112, P175

WACJV is committed to implementing best practice emissions controls on coal transportation. WACJV will be guided by current best practice and legislative requirements at the time.

Further to this, to ensure that fugitive dust emissions from coal transportation are minimised, WACJV will implement best practice load profiling and will water spray the surface of loaded coal wagons.. A study of dust emissions from rail transportation at Duralie Coal Mine was completed for the approval of the Duralie Extension Project. The study found that the water spray system in place at the train loading facility was very effective in controlling dust emissions from rail transport, achieving 99% control of emissions (Katestone Environmental, 2012*)*.

The air quality monitoring requirements for the Project will be outlined in the AQMP. Continuous monitoring stations are not intended to be established along the rail corridor as suggested in some submissions. Such monitoring is not considered necessary since recent studies have determined that fugitive emissions are not a significant concern. In any event, dust levels within the rail corridor are the result of all train movements. Should it be required, it would therefore be more appropriate for monitoring to be undertaken by the appropriate rail authority or government agencies, rather than an individual rail transport customer.

3.5.7 Stack Emissions

This section addresses the submission regarding the potential for significant stack emissions.

Submissions: SIG1, P20, P106

With regard to stack emissions, the Project will operate a ventilation stack and a flare. The AQGGA included the emissions from the ventilation stack and flare in the assessment of impacts on ambient air quality. All predictions in the AQGGA were below the impact assessment criteria, indicating that stack emissions will result in acceptable air quality impacts.

The ventilation stack will emit mine ventilation air, which must have low pollutant levels to ensure the health and safety of underground mine employees. When mine ventilation air is emitted from a ventilation stack, pollutant concentrations are further dispersed and diluted, resulting in ambient air quality concentrations that are significantly lower than the already safe levels that existing underground miners work in.

The purpose of the flare is to convert the methane to CO_2, which has a lower global warming potential. The burning of natural gas (methane) will result in emissions of other products of combustion (mainly oxides of nitrogen), which have been assessed in Section 8.6 of the AQGGA.

3.5.8 Methane Releases

This section addresses submissions regarding the potential for release of methane gas.

Submissions: SIG1, P112

The proposed gas capture and management system will involve pre-drainage (to reduce the methane content of the coal seam prior to mining) and post drainage (to extract gas left behind in the goaf after mining). Gas drainage will occur via in-seam and surface to in-seam drainage holes (pending access to private land). A proportion of the methane will be released via the mine ventilation shaft (in low concentrations).

Most of the gas will be flared in an enclosed structure, however there may be free venting of methane under emergency conditions that prevent the operation of the flare. Venting of methane does not present a risk to health as a pollutant in ambient air, and would be controlled and managed from the perspectives of explosive and occupational health and safety.

3.5.9 Amenity Impacts associated with Coal Dust

This section addresses the submissions from stakeholders regarding potential amenity impacts due to coal dust, including dust on laundry and cars.

Submissions: SIG1, P2, P118, P175, P178

Amenity impacts are assessed using the impact assessment criteria for dust deposition. A deposition rate of 4 g/m^2/month is considered the level below which visible dust on laundry and surface does not result in annoyance to the community.

All dust deposition predictions in the AQGGA are significantly below this level (maximum of 0.1 g/m^2/month). Annoyance and amenity impacts due to dust emissions are therefore not expected.

The predicted dust deposition levels at the local schools (Blue Haven Public, Lake Haven, Warnervale and Woongarrah) are considerably below the impact assessment criteria of 4 g/m^2/month. As a result, amenity impacts are not expected to occur at these schools

3.5.10 Proposed Monitoring

This section addresses the submissions regarding monitoring measures to ensure that dust levels are safe.

Submission: SIG1, P81

As outlined in Section 11.3 of the AQGGA, the existing monitoring network will be updated or augmented with a number of continuous PM_{10} / $PM_{2.5}$ monitoring instruments. These will provide near real-time data on dust levels in the local community. Full details and locations of monitors will be outlined in the AQMP.

3.5.11 Health Impacts associated with Coal Dust

This section addresses the submissions from stakeholders regarding the potential for health impacts from coal dust.

Submission: SIG1, SIG3, P2, P4, P3, P15, P20, P67, P76, P79, P81, P82, P85, P88, P91, P96, P101, P102, P107, P109, P110, P113, P115, P125, P136, P138, P140, P144, P147, P150, P164, P169, P178

All modelling predictions presented in the AQGGA indicate that the predicted incremental PM_{10} and $PM_{2.5}$ concentrations at the closest residential receivers are all below the impact assessment criteria for PM_{10} and advisory reporting standards for $PM_{2.5}$.

A cumulative assessment, incorporating existing background levels indicated that the Project is unlikely to result in any additional exceedances of the relevant criteria and standards at the neighbouring receivers. The health based criteria set by the NSW EPA are based on studies undertaken in urban areas with large populations where there is higher exposure to air pollutants from combustion sources (i.e. emissions from traffic fumes and industrial sources).

Combustion sources release air pollutants which are composed of fine particulates containing acidic and carcinogenic substances that can be detrimental to a person's health.

Particulate releases from underground mining activities contain a smaller fraction of fine particulate and a higher proportion of relatively inert (crustal) material compared to diesel particulate.

Additional responses to submissions concerning health impacts are provided in **Section 3.7**.

3.5.12 Fine Dust Emissions and Dispersion of Coal Dust

This section addresses the submissions regarding the potential for fine dust particles to disperse across urban growth areas at various distances from the Project.

Submission: SIG1, SIG7, P2, P3, P4, P131, P134, P136, P140, P146, P147, P150, P169, P175, P178

The impacts from fine dust particles ($PM_{2.5}$) and coarse particles (PM_{10}) have been assessed in the AQGGA. The results are presented as contour plots, showing dispersion across a wide area, and also as tabulated results at individual sensitive receptors. All predictions are below the impact assessment criteria for PM_{10} and less than the advisory reporting standards for $PM_{2.5}$ at all sensitive receivers.

Contour plots presented in the AQGGA provide an indication of the distance that fine particles travel at certain concentration and deposition levels (shown by each contour line). A wide range of meteorological conditions were modelled based on a full year of hourly meteorological data for the period from July 2010 to June 2011.

What is clear from the contours is that as dust plumes travel, the concentration decreases due to dilution with ambient air. Within approximately 2 km of the Project, the predicted annual average PM_{10} and $PM_{2.5}$ will be largely indistinguishable from background. It is also noted that the majority of the dust generated by the Project will consist of coarse particulates.

The potential impact of dust emissions from the coal loader and other aspects of the Project have been assessed in the AQGGA. That is, all emission sources have been considered in the modelling. The EPA stated in their submission that the AQGGA has adequately assessed the potential impacts of the Project on air quality.

3.5.13 Composition of Coal Dust

This section addresses the submission regarding the potential for health impacts from chemical components of coal dust.

Submission: SIG1, P20

Both the size and composition of particulate matter are important in determining potential health impacts due to exposure. The assessment of impacts from exposure to PM was completed in accordance with the Approved Methods, which requires an assessment of all particles (regardless of composition) against impact assessment criteria for particle sizes PM_{10} and $PM_{2.5}$).

It is also noted that in terms of health impacts from particles, the focus is shifting towards greater scrutiny of fine particles ($PM_{2.5}$), which are derived primarily from combustion processes (such as vehicle emissions). In contrast, mechanically generated coal dust is composed of predominantly coarse particulates (i.e. greater than PM_{10}). Fine particles or $PM_{2.5}$ are derived primarily from combustion processes, such as vehicle emissions.

3.5.14 Long Terms Trends in TSP Levels

This section responds to the submission regarding the doubling of TSP levels between 1994 and 2008.

Submission: SIG1

TSP monitoring data collected for the Project since 1999 indicates that annual average TSP has actually decreased between 1999 and 2012 at one site and increased by 33% at the other sites. Despite this increase, the TSP levels in 2012 were only 30% of the impact assessment criteria.

3.5.15 Impact on Drinking Water Tanks

This section addresses the submissions from the public regarding impacts of coal dust on drinking water tanks.

Submission: P2, P15, P20, P96, P101, P104, P110, P136, P138, P145

A recent study (Lucas et al, 2009) conducted near the Dalrymple Bay Coal Terminal (in Queensland) investigated the potential health risks of elements in coal dust entering rainwater tanks systems used for potable supply. Leaching tests were conducted on samples of different coal types to identify the potential for trace element release into rainwater tanks. In addition, water samples were collected from the rainwater tanks and taps of three homes within the dust deposition zone of Dalrymple Bay area. The leaching tests indicated that only negligible amounts of trace elements were released into the rainwater tanks after the dust deposited on rooftops.

Furthermore, concentrations of those trace elements were within the thresholds prescribed by the Australian Drinking Water Guidelines (ADWG) as being safe for human consumption. The research concluded that “tank and tap samples were all below ADWG and indicated a minimal likelihood of coal dust being an issue with respect to human health” (Lucas et al, 2009).

The deposition rates predicted in the AQGGA (maximum of 0.1 g/m^2/month) are significantly lower than the annual deposition levels surrounding the Dalrymple Bay Coal Terminal (maximum of 5 g/m^2/month), as reported by Katestone Environmental (2009).

However, it is noted that all rainwater tanks should be maintained in accordance with the advice outlined in ‘NSW Health’s Rainwater Tanks Brochure’ to ensure water is safe for drinking. It is also good practice for any rainwater system to have a simple first flush system installed to prevent particulate matter (or any other undesirable materials) accumulating on the roof from being washed into the tank during rain events.

3.5.16 Impact of Dust on Solar Panels

This section addresses submissions from the public regarding the impacts of coal dust on solar panels by reducing available sunlight.

Submission: P2, P101

The deposition rates predicted in the AQGGA are low and unlikely to be more noticeable than background dust levels in neighbouring residential areas. As such, there will be no change in the sunlight available for the operation of solar panels.

3.5.17 Impact of Dust on Vegetation

This section addresses the submissions from the public regarding impacts of coal dust on vegetation and insects and larger fauna.

Submission: P2, P3, P161

The deposition rates predicted in the AQGGA are low and unlikely to be more noticeable than background dust levels. The predicted deposition rates are orders of magnitude lower than the levels that are known to result in impacts on vegetation. Similarly, there is no evidence to suggest that the levels predicted in the AQGGA would adversely impact fauna and biota in nearby rivers.

3.5.18 Respirable Crystalline Silica

This section responds to the submissions from the public regarding the impacts of respirable crystalline silica.

Submission: P4, P106

Silica (SiO_2) is a naturally occurring mineral composed of silicon and oxygen. It exists in crystalline and amorphous forms depending on the structural arrangement of the oxygen and silicon atoms. Fibrogenic dust refers to dust that causes increase of fibrotic (scar) tissue after deposition in the gas exchange region of the lung. Only the crystalline forms are known to be fibrogenic and only the respirable particles (those which are capable of reaching the gas exchange region of the lungs) are considered in determining the health impacts of crystalline silica. The three most common types of crystalline silica are quartz, tridymite and cristobalite. Human exposure to crystalline silica occurs most often during occupational activities that involve the working of materials containing crystalline silica products (e.g. masonry, concrete and sandstone). Activities that involve cutting, grinding or breaking of these materials can result in the liberation of fine respirable particles.

Crystalline silica is not a key emission source for this Project and there are no activities that are likely to create significant amounts of respirable particles (e.g. cutting or grinding). The DGRs from DP&I and EPA did not require a quantitative assessment of respirable crystalline silica.

3.5.19 Omission of Maps

This section addresses to the submissions from the public regarding the omission of maps showing dust 'fall out'.

Submission: P4

Contour maps for all pollutants assessed are included in the AQGGA (Figures 8.1 to 8.11).

3.5.20 Dust on the F3

This section addresses the submissions from the public regarding impacts from dust on motorists using the F3.

Submission: P4

The F3 is not considered as a sensitive receiver in the context of an air quality assessment. The EPA defines "sensitive receiver" in the Approved Method as:

> "*A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area. An air quality impact assessment should also consider the location of known or likely future sensitive receptors. For hydrogen fluoride, a sensitive receptor includes land-use areas with vegetation sensitive to hydrogen fluoride such as grapevines and stone fruit*."

3.6 GREENHOUSE GAS

3.6.1 Greenhouse Gas Emissions and Climate Change

This section addresses the submissions from stakeholders regarding the quantity of greenhouse gas emissions generated by the Project and the implications for climate change.

Submission: RA6, SIG1, SIG6, SIG7, P4, P64, P73, P82, P91, P98, P109, P113, P118, P126, P144, P147

The AQGGA included estimates of Scope 1, 2 and 3 emissions and provided an overview of the potential impacts on the environment. It is impossible to isolate the Project's impacts on climate change at a local level, and the contribution of the Project to global changes in sea levels, acidification, etc. However, as an example, the average annual Scope 1 emissions generated by the Project would represent approximately 0.04% of Australia's annual average commitment under the Kyoto Protocol. The Scope 1 emissions would account for a very small portion of Global Greenhouse Gas (GHG) emissions, given that Australia in total contributes approximately 1.5% of global GHG emissions (ABS, 2010).

GHG emissions in Australia are currently collectively managed at a national level, through initiatives implemented by the current Australian Government (i.e. carbon tax and emissions trading scheme). As such, Australia's GHG emissions, inclusive of emissions associated with the Project, would be capped at a level specified by the Australian Government.

Under the emissions trading scheme, there will be no limit on the level of GHG emissions from individual facilities, with the incentive for facilities to reduce their GHG emissions provided by the carbon pricing mechanism.

The Project would contribute to the revenue generated by the emissions trading scheme. This revenue is to be used to fund initiatives designed to reduce Australia's GHG emissions.

While coal is expected to continue to be a significant part of the overall energy supply in the medium term, an emissions trading scheme will encourage the take up and competitiveness of low carbon alternatives to coal fired electricity. Market based mechanisms are generally considered an effective way of implementing GHG emission reductions and providing compliance with reduction targets while reducing costs and promoting technological innovation.

3.6.2 LMCC Greenhouse Gas Emission Reduction Target Policy

This section responds to the submission stating that the Project does not meet LMCC's Greenhouse Gas Emission Reduction Target Policy (2008).

Submission: RA7

The policy states *"The objective of this policy is to achieve rigorous emission reduction targets for greenhouse gases at a Citywide and Council-operations level. This policy supersedes the greenhouse gas reduction targets documented in the Lake Macquarie Greenhouse Action Plan (2004)."*

The Project is located entirely within the Wyong LGA and as such, will not contribute to GHG emissions from the Lake Macquarie LGA. WACJV will develop an Energy and Greenhouse Strategy which will implement energy efficiency initiates to reduce GHG emissions.

3.6.3 Water Treatment Plant

This section addresses the submission on the amount of energy required for the WTP.

Submission: SIG1

WACJV will investigate the feasibility of beneficial re-use of the captured methane for on-site power generation (see Section 7.6.4 of the EIS). This would assist in reducing the energy requirements for operating the water treatment plant.

3.6.4 Mitigation Measures

This section addresses the submission regarding the brevity of proposed greenhouse gas mitigation measures.

Submission: RA6, P112

Greenhouse gas mitigation measures are outlined in Section 10.6 of the AQGGA. Additional detail on GHG mitigation measures will be provided in the AQMP, which would be required as a condition of development consent. As stated in Section 7.6.4 of the EIS, WACJV will also develop an Energy and Greenhouse Strategy within 2 years of the commencement of longwall mining.

Although the submission notes that the list of mitigation measures is brief, the proposed mitigation measures are significant in terms of GHG savings. For example, the proposed methane capture and utilisation has the potential to achieve a GHG reduction of more than 50% through flaring; with additional reductions achieved through the beneficial re-use of methane for on-site power generation (if feasible).

3.6.5 Intergenerational Equity and Climate Change

This section addresses the submission regarding the issue of intergenerational equity and climate change.

Submission: SIG1, P73, P103, P150, P151, P153, P155, P169, P171

The principle of inter-generational equity is that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. By participating in carbon pricing mechanisms, the Project will directly contribute to investment in energy efficiency and clean energy initiatives designed to reduce Australia's greenhouse gas emissions.

These initiatives include:

- $1.2 billion Clean Technology Program to improve energy efficiency in manufacturing industries and support research and development in low-pollution technologies;
- $10 billion Clean Energy Finance Corporation to invest in renewable energy, low-pollution and energy efficiency technologies; and
- $946 million Biodiversity Fund (over the first six years) to protect biodiverse carbon stores and secure environmental outcomes from carbon farming.

3.7 HEALTH

All references to the Health Risk Assessment (HRA) refer to Appendix M of the EIS. References to the AQGGA refer to Appendix L of the EIS.

3.7.1 Health Effects Associated with Particulate Matter

This section addresses the submissions regarding the health effects of crystalline silica, coal dust and particulate matter on sensitive populations in the local area.

Submissions: RA7, SIG1, SIG3, SIG5, P2, P3, P4, P5, P7, P9, P10, P15, P81, P82, P113, P118, P136, P144, P147, P150, P164, P169, P174, P175, P178

The potential health effects associated with particulate matter (due to coal dust and other sources of dust such as road dust) have been outlined in Section 3.2 of the HRA. The background information in Section 3.2 of the HRA indicates that potential health effects include a number of well-defined health outcomes (e.g. hospital admissions, exacerbation of asthma etc.). The young, elderly and those with underlying respiratory disease are most at risk due to exposure to particulate matter, as the cardiovascular and respiratory systems are the target for the effects of particulates.

In the case of crystalline silica, Section 3.2.6 of the HRA outlines the potential health effects associated with exposure. The health effect of most concern is silicosis, which is characterised by shortness of breath, cough, fever and cyanosis (bluish skin).

Silicosis may often be misdiagnosed as pulmonary oedema (fluid in the lungs), pneumonia, or tuberculosis. Lung cancer is another health outcome associated with exposure to respirable crystalline silica.

Although particulate matter is associated with particular health outcomes, **Section 3.7.2** demonstrates that the Project is unlikely to cause any mortalities or hospitalisations.

3.7.2 Mortality and Morbidity

This section addresses the submissions raised regarding the increase in risk of mortality of 1 in 100,000 and other morbidity risks as a result of particulate pollution.

Submissions: SIG1, P4, P78, P81, P88, P108, P109, P112, P115, P118, P146

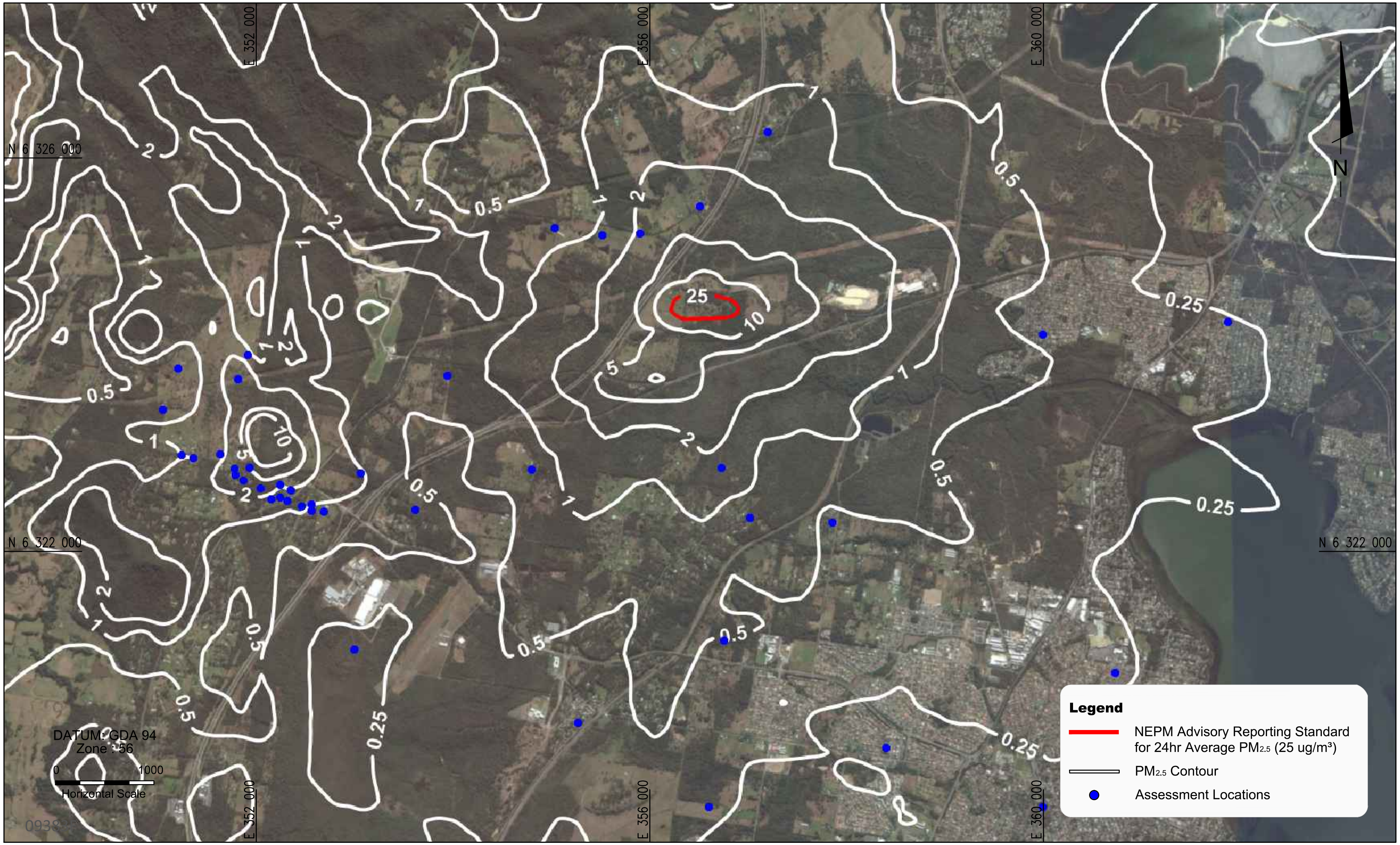
The HRA noted an increased risk of mortality due to exposure to $PM_{2.5}$ of 1 in 100,000. This result was based on selecting the worst case exposure, which occurs only at the nearest receiver, and extrapolating this value to a theoretical population of 100,000. This approach represents a theoretical scenario where 100,000 people are all subject to the worst case exposure. The worst case exposure occurs at the receiver identified as P11 in Figure 3.2 of the HRA.

The approach adopted in the HRA did not take into account the population of the surrounding areas, where exposure is much lower. This is an overly conservative approach, as the most densely populated areas (e.g. Wyong, Warnervale and Woongarrah) are predicted to be exposed to $PM_{2.5}$ levels that are significantly lower than the worst case scenario (as shown in **Figure 17**). The contribution of the Project to $PM_{2.5}$ levels decreases with distance from the mining operations.

When the calculations are undertaken using a wider range of health outcomes and including the actual and predicted populations in the surrounding area (including the predicted population for the new Warnervale Town Centre), the risks to the population of the Central Coast are significantly lower than the risk predicted using the approach in the HRA. This is because these new calculations consider the exposure of the different areas (as it relates to the overall population) instead of assuming that the worst case exposure applies to each individual in the Central Coast (which does not occur).

Table 3 shows the number of cases within the ‘Whole Study Population’ that are attributable to $PM_{2.5}$, including the number of background occurrences and the cases that are predicted to be attributable to the Project. The ‘Whole Study Population’ includes the population of the surrounding areas including Blue Haven, Gorokan, Warnervale (including the predicted population of the new town centre), Wyong, Woongarrah, Lake Haven, Hamlyn Terrace, Watanobbi and Jilliby. The predicted dust and noise levels at all of these suburbs are below the relevant impact assessment criteria.

As shown in **Table 3**, the number of cases attributable to the Project is significantly less than one for all health outcomes. This means that the Project is unlikely to cause any mortalities or admissions during its 28 year duration.



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Wallarah 2 COAL PROJECT

Hansen Bailey ENVIRONMENTAL CONSULTANTS

$PM_{2.5}$ Concentrations from the Project

FIGURE 17

Table 3
No. of Attributable Cases for the Whole Study Population due to $PM_{2.5}$

Adverse Health Outcome	Background Occurrence (Cases per Year)	Annual Contribution from Project (Cases per Year)	Total Contribution over 28 year Project duration
All-cause mortality, 30+years (long-term)	3.1	0.002	0.06
Cardiopulmonary mortality, 30+years (long-term)	2.8	0.001	0.03
Ischemic Heart Disease, 30+ years (long-term)	2.0	0.001	0.03
Lung cancer mortality, 30+ years (long-term)	0.4	0.002	0.06
Daily mortality, all causes, all ages	2.0	0.004	0.1
Daily mortality, cardiovascular disease, all ages	0.4	0.0003	0.008
Hospital admissions for respiratory disease, 65+ years	0.4	0.0003	0.008
Hospital admissions for cardiac disease, 65+ years	0.8	0.0005	0.01
Hospital admissions for pneumonia and bronchitis, 65+ years	0.2	0.0004	0.01
Hospital admissions for cardiovascular disease, 65+ years	0.7	0.0008	0.02
Hospital admissions for Chronic Obstructive Pulmonary Disease,65+ years	0.1	0.00009	0.003
Hospital admissions for respiratory disease, 15-64 years	0.8	0.004	0.1
Emergency Department visits for asthma, 1-14 years	0.09	0.00009	0.003

3.7.3 Impact on Health Services

This section responds to submissions raised by stakeholders regarding the possible increase in demand for health services.

Submissions: RA7, SIG1, P2

In examining the potential health outcomes for the purely theoretical worst case situation assessed in the HRA, the impact of the Project on the health of the community is considered to be low.

In the case of $PM_{2.5}$ exposure, there is clear epidemiological evidence for health effects even at low concentrations. When risk calculations for $PM_{2.5}$ are extended to cover the surrounding communities, the risk remains low even for more sensitive outcomes. Having assessed the risk for more sensitive outcomes and age groups, the highest risk is found for hospital admissions for respiratory disease in the 15 to 64 year age group and daily all-cause mortality (all ages).

As shown in **Table 3**, the exposure of the population to the $PM_{2.5}$ levels generated by the Project is predicted to result in less than one additional admission for all health outcomes. Therefore, the Project is unlikely to result in a greater demand on health services in the area.

3.7.4 Study Population and Particulate Matter

Construction, Mining, Stockpiling, Loading and Transport Emissions

This section addresses the submissions regarding concerns about emissions from coal stockpiling resulting in dust nuisance and particulate pollution in the surrounding suburbs.

Submissions: RA8, SIG1, P2,, P5, P7, P15, P82, P108, P125, P131

The potential impact of dust emissions from coal stockpiling and all other aspects of the Project have been assessed in the AQGGA. All potential dust generating activities have been included in the modelling assessment (shown in Table 7.2 of the AQGGA). Most surface activities are associated with the handling and stockpiling of coal. The HRA used the results of the AQGGA to evaluate the risk posed by dust generated by the Project, including emissions from coal stockpiling.

The HRA refers to the results of a Queensland Rail Study which concluded the impact of dust from rail movements did not significantly impact surrounding communities.

3.7.5 Data

Inconsistent Concentration Response Functions

This section addresses the submission from NSW Health regarding concerns about the use of different study populations for the all-cause mortality and hospital admissions Concentration Response Functions (CRFs).

Submissions: RA8

There are subgroups of the population that are more sensitive to the effects of air pollution than the general population. The epidemiological studies that investigate the effects of air pollution within the population conduct analyses for the more susceptible groups. The study populations that have been used are those that have been identified as being more vulnerable for the outcomes assessed. The age groups have been matched to the age groups to which the CRFs apply.

NSW Relevant Statistics

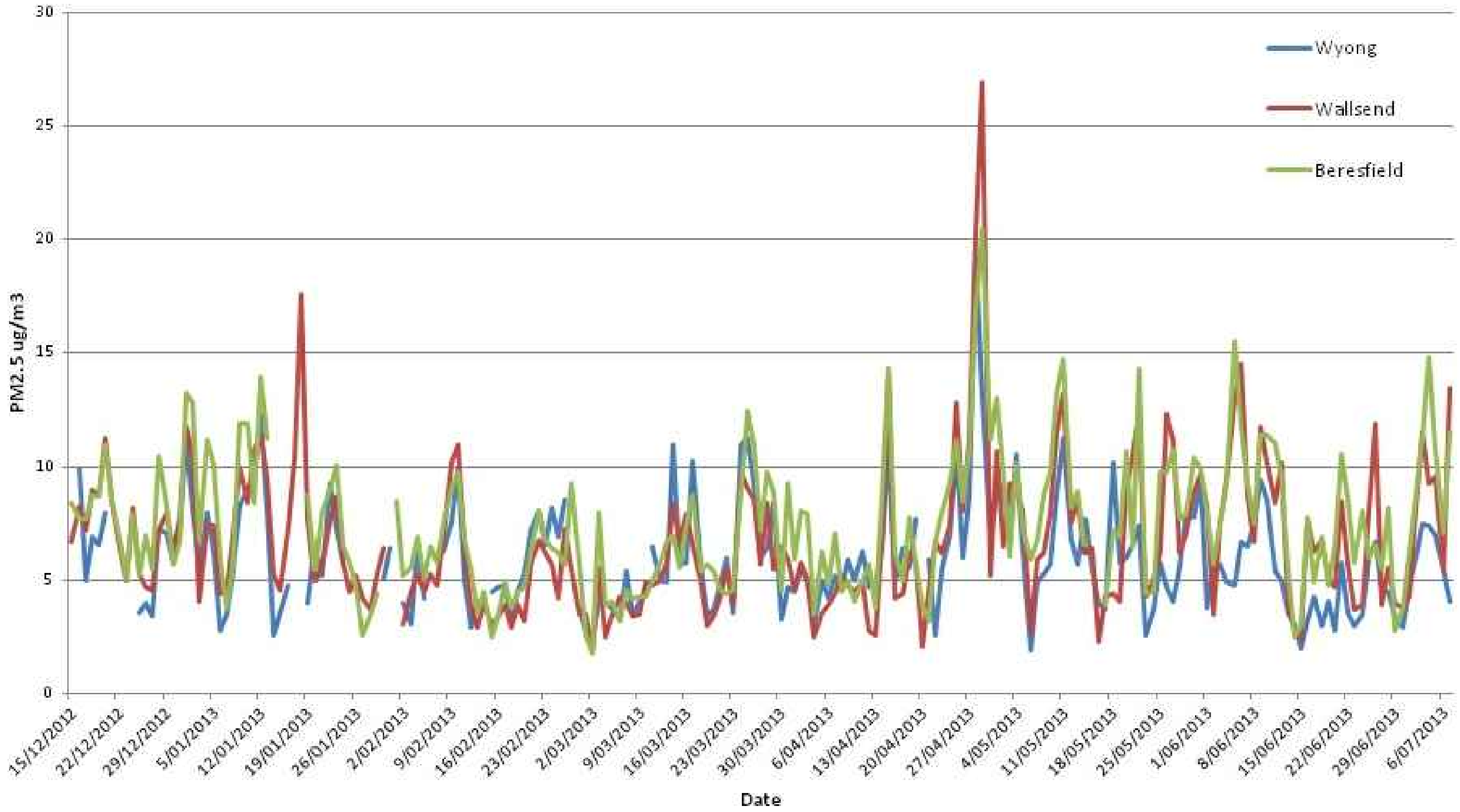
This section addresses the submission from NSW Health questioning why health statistics from NSW Health's Health Statistics website in regards to daily hospitalisation rates for cardiovascular disease were not used. It also addresses the submission made by the Australian Coal Alliance questioning why localised data was not used to calculate risk.

Submission: RA8; SIG1

Health statistics for each of the outcomes included in the HRA were obtained from either the Health Statistics website (NSW Health) or from ABS. Where data was available for the identified health outcomes and age groups, the Central Coast statistics were used. For many of the outcomes, including all-cause mortality, the rates per 100,000 population were slightly higher than those observed for Sydney. Not all the data available on the Health Statistics website were consistent with the age groups that the concentration-response functions applied to.

For some of the outcomes being considered, data for NSW as a whole was available from the NSW Health Statistics website. In cases where data specifically for the Central Coast was not available for the age groups for which CRFs have been obtained, ABS data for the Lower Hunter region has been used. A comparison of available statistics in the NSW Health Statistics database for the Lower Hunter region and the Central Coast region shows that the incidence rates for the Lower Hunter are slightly higher than the Central Coast. Using this data in the HRA is a conservative approach and may lead to a slight overestimate of the cases attributable to $PM_{2.5}$ exposure.

Calculations performed using the local health and population data show that the risk is actually lower than the values shown in the HRA as demonstrated in **Figure 18** and **Table 3**. These calculations included the population data for Blue Haven, Gorokan, Warnervale (including the predicted population of the new Town Centre), Wyong, Woongarrah, Lake Haven, Hamlyn Terrace, Watanobbi and Jilliby.



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Comparison of Wyong, Wallsend and Beresfield $PM_{2.5}$ Levels

FIGURE 18

There was not sufficient background $PM_{2.5}$ data available for Wyong to use in the assessment. A comparison of the data from Beresfield and Wallsend with the Wyong data over the same period showed that the $PM_{2.5}$ levels followed similar trends and that the data from Beresfield was very similar to the Wyong data (as shown in **Table 3**). As a result, the Beresfield data has been used in the HRA as background data.

Uncertainties and Knowledge Gaps

This section addresses a submission questioning how the uncertainties and knowledge gaps in the air and water impacts had been accounted for.

Submission: RA6

Uncertainty is inherent in any risk assessment and it is important to understand the implications of all assumptions made within the risk assessment. With respect to potential exposure, the average 24-hour and annual concentrations were used to determine health outcomes, which represent most likely exposure estimates. In the case of health statistics, where data was not specifically available for the Central Coast, data from the Lower Hunter was used. Since the background rates for the Lower Hunter were slightly higher than the rates for the Central Coast, the likelihood of some outcomes are conservative.

The predicted $PM_{2.5}$ concentrations are based on the maximum daily and annual production rates. This represents the worst case scenario and is likely to over predict the $PM_{2.5}$ concentrations which will in turn overestimate the risk posed by the Project.

In the absence of local $PM_{2.5}$ background data for the local area, Newcastle (Beresfield) data has been used. This is likely to over predict the risk due to background $PM_{2.5}$.

3.7.6 Health Impacts Due to Noise

This section addresses the submissions from stakeholders regarding concerns about the noise impacts from rail transportation, stockpiling and mining on the health of residences at established suburbs and new suburbs along the rail corridor.

Submissions: RA8, SIG3, P5, P7, P9, P109, P110, P112, P113, P125, P169

The document 'Burden of disease from environment noise' (WHO, 2012) indicates that the health impact of noise (such as sleep disturbance) is related to the noise level. The Noise and Vibration Impact Assessment (Appendix N of the EIS) for the proposed development predicts that there will be no change in the L_{Amax} noise level and only a marginal change in the $L_{Aeq,\ 24Hr}$ noise level in the vicinity of the rail line. Using the guidance provided in the 'WHO Methodological Guidance for estimating the burden of disease from environmental noise' (WHO, 2012) this marginal change will result in less than a 1% increase in sleep disturbance of the population in the immediate vicinity of the rail line.

Factors affecting the probability of sleep disturbance are the noise level and its magnitude relative to the ambient noise level. Section 8.3 of the Noise and Vibration Impact Assessment has assessed the sleep disturbance anticipated from short term noise events. The assessment concluded that sleep disturbance is unlikely to occur when the appropriate noise controls have been implemented.

3.7.7 Potable Water Supplies

This section addresses the submission regarding the quality of the potable water to be used during construction.

Submissions: RA8

WACJV will ensure that the potable water supplies sourced from carts during construction meet the 'Australian Drinking Water Guidelines' (NHMRC, 2011) and the 'Private Water Supply Guidelines' (NSW Health, 2008).

3.8 NOISE

3.8.1 Project Noise Impacts

This section responds to the submissions regarding the noise impacts of the Project.

Submission: RA6, P2, P125, P131, P147, P150, P169

As described in Section 7.8.3 of the EIS, the Project Specific Noise Criteria (PSNC) are not predicted to be exceeded at any privately owned residences during construction and operations. Mitigation measures are outlined in Section 7.8.4 of the EIS.

3.8.2 Noise Control Measures

This section responds to submissions received regarding the proposed noise control measures for the Project.

Submission: RA2, RA6, RA8, P112

As described in Section 7.8.4 of the EIS, the following best practice noise controls have been included in the modelling for the Project:

- The rail spur will include relevant control measures (curve radii of at least 200 m to minimise wheel / rail interface noise, concrete bridges or vibration isolation material between the rails and steel bridges and continuously welded rails);
- Double skin insulated cladding of crushing plant;
- Low noise rated conveyors and motor drives;
- Conveyor structures with side and roof screens to provide effective directional noise amelioration;
- Concrete (or sand-lined or similar technology) coal loading bin;
- Acoustically isolated vibrating screens / transfers;
- Acoustically insulated conveyor head / transfer plates;

- Design of the Product Stockpile coal reclaim system to minimise dozer reliance for train loading;
- Selection of mobile plant with secondary noise control kits;
- Removal of surface rail crossing and requirement for trains to sound warning horns whilst on site;
- Replacement of mobile plant reversing alarms with low level alarms;
- Low noise rated gas flares and the use of enclosures; and
- Proactively engage with predicted noise impacted property owners (where impacts predicted on over 25% of vacant land).

In addition to the meteorological monitoring system, WACJV will develop a leading practice noise monitoring network surrounding the Tooheys Road and Buttonderry sites which is representative of the closest sensitive receivers, including:

- Quarterly attended noise monitoring (during construction and operation);
- Regular correlation of real time noise monitoring results with the meteorological station to proactively manage operations during noise enhancing conditions when surface facility activities are approaching the intrusive criterion (particularly during construction of Buttonderry Site in the vicinity of Amberwood Close); and
- A network of real time noise monitors.

Similar to the air quality monitoring system, trigger levels will be developed to generate visual alarms to notify the site supervisors of noisy operations that may require attention.

WACJV will develop a Noise Management Plan (NMP) for the construction and operation of the Project. The NMP will incorporate the feasible and reasonable mitigation and noise monitoring network described above as well as additional practical noise minimisation management including (but not limited to):

- Mobile and coal handling equipment will be maintained in good condition to minimise unnecessary noise;
- Noise suppression will be constructed and maintained on the conveyor system and transfer points;
- Selection of quiet plant for use in construction activities. When using contractors for construction, preference will be given to contractors able to use low noise emission equipment;
- All construction and operational personnel will receive training in best practice work methods to minimise noise; and
- Dozer operations will be managed or curtailed to avoid the risk of excessive noise from multi-dozer activity.

3.8.3 Rail Noise Impact at Blue Haven

This section responds to the submissions raised regarding potential increased noise impacts associated with the rail loop junction with the Main Northern Rail Line (MNRL).

Submission: P2, P118, P147, P150

As discussed in Section 7.8.2 of the EIS, licences issued by the OEH regulate rail traffic noise in NSW. The noise levels recommended by the OEH for the assessment of rail noise exposure is that the cumulative noise levels should not exceed $LA_{eq,\ 24\ hr}$ 60 dBA and $LA_{max\ (95th\ percentile)}$ 85 dBA assessed at residential building facades.

Section 7.8.3 of the EIS identifies that noise modelling for a peak annual production output of 5 Mtpa shows that the additional rail traffic noise will marginally increase (1-2 dBA) the existing $LA_{eq,\ 24\ hour}$ rail traffic noise levels on the Main Northern Rail Line. With respect to the LA_{max} noise levels, the Project is not expected to increase the existing levels.

The OEH $LA_{eq,\ 24\ hour}$ 60 dBA criteria is shown to be satisfied at approximately 70 m from the rail line. As Blue Haven is greater than 500 m from the rail loop / rail line junction, the OEH criteria is met.

3.8.4 Sleep Disturbance

This section responds to the submissions raised regarding potential sleep disturbance resulting from the Project.

Submission: SIG1

As described in Section 7.8.3 of the EIS, the noise impact assessment addressed sleep disturbance by considering plant and activities identified as likely to generate short term noise impacts. Key sources assessed included train horns, coal wagon bunching, train loading bin and coal transfer chutes. Without secondary noise mitigation, modelling (see Appendix N of the EIS) identified that sources could give rise to noise levels that exceed the recommended sleep disturbance criteria at up to five representative receiver locations under worst-case meteorological conditions.

However with the application of effective noise controls described and committed to in Section 7.8.4 of the EIS, modelling has shown (see Appendix N of the EIS) noise levels from the Project are predicted to remain below the recommended sleep disturbance criteria.

3.8.5 Rail Noise

This section addresses the submission regarding the assessment of cumulative rail noise in accordance with the Rail Infrastructure Noise Guideline (EPA, 2013).

Submission: RA17

ARTC requested an additional assessment of rail noise impacts in accordance with the 'Rail Infrastructure Noise Guideline' (RING) (EPA, 2013).

When there is likely to be an increase in rail noise, the RING requires an assessment of the increase in day $L_{Aeq, 15h}$, night $L_{Aeq, 9h}$ and L_{AMax} noise levels. In order to predict the change in rail noise levels, ARTC provided the train timetable and Sound Exposure Levels for different types of trains using the section of the rail network between Islington Junction and Kooragang Island.

For the section of the rail line considered, the Project will generate a maximum of six train cycles per day (six trips in each direction). For one of the six train paths, there are two available timeslots. One timeslot is in the day period (7 am to 10 pm) and the other is in the night period (10 pm to 7 am). Depending on which timeslot is chosen for this train path, there will either be seven day trips and five night trips (Scenario 1) or six day trips and six night trips (Scenario 2). The impacts for both scenarios were assessed.

Table 4 shows the increase in average noise levels due to the rail movements generated by the Project. The additional train movements are not expected to increase the existing L_{AMax} noise levels.

Table 4
Increase in Average Rail Noise Levels for Day and Night Periods

Day	Scenario 1		Scenario 2	
	Day Period Noise Level ($L_{Aeq, 15h}$)	Night Period Noise Level ($L_{Aeq, 9h}$)	Day Period Noise Level ($L_{Aeq, 15h}$)	Night Period Noise Level ($L_{Aeq, 9h}$)
Monday	0.77	0.84	0.67	0.99
Tuesday	0.64	0.84	0.56	0.99
Wednesday	0.81	0.84	0.73	0.99
Thursday	0.67	0.88	0.58	1.03
Friday	0.69	0.84	0.60	0.99
Saturday	0.84	1.24	0.73	1.49
Sunday	0.85	1.49	0.73	1.74

The RING states that if a development results in an increase in the L_{Aeq} noise level of more than 2 dBA, there needs to be strong justification as to why it is not reasonable or feasible to reduce the increase. However, as shown in **Table 4**, the Project is predicted to increase L_{Aeq} noise levels by up to 1.74 dBA. Having regards to RING and the predicted levels in **Table 1,** no further justification is required.

3.9 ECOLOGY

All references to the Ecological Impact Assessment (EIA) in this section refer to Appendix O of the EIS.

3.9.1 Management Plans

This section addresses the submissions from stakeholders regarding the preparation of management plans.

Submissions: RA4, RA6, RA9, SIG1, P177

All management plans, including a Biodiversity Management Plan (BMP) and Rehabilitation Management Plan (including weed and pest controls) will be prepared in accordance with any development consent granted. The relevant government authorities will be consulted during the preparation of these management plans. The measures that will be considered in the biodiversity management plans are outlined in Section 8.3 and 8.4 of the EIA.

3.9.2 Flora Survey Effort

Age of Survey Data within the Surface Infrastructure and Offset Areas

This section responds to submissions from stakeholders regarding flora surveys that were undertaken more than five years ago.

Submissions: RA4

As the majority of the quadrat data provided in the EIS was collected outside of the five year timeframe prescribed by regulatory bodies, additional flora surveys were conducted in July 2013. These surveys were conducted within the infrastructure boundary at the Tooheys Road and Buttonderry Sites, as well as in the proposed Hue Hue and Tooheys Road offset areas. The July 2013 surveys provided a total of 30 additional quadrats. The locations of these quadrats relative to the 2005 – 2007 quadrats are shown in **Figure 19**. These new quadrats not only adequately replace the 23 quadrats collected from 2005 – 2007, but also increase the level of survey effort to meet the minimum number of quadrats required by regulatory agencies.

Data from the 2012 – 2013 quadrats was very similar to data from the 2006 – 2007 data, indicating that there have been no significant changes in vegetation community composition within the infrastructure and offset areas.

Given that the infrastructure boundary for the Western Ventilation Shaft was surveyed in 2012, no further quadrat surveys were considered necessary for this area.

Survey Effort within the Subsidence Impact Limit

This section responds to the submissions from stakeholders regarding the survey effort within the SIL.

Submissions: RA4, RA6

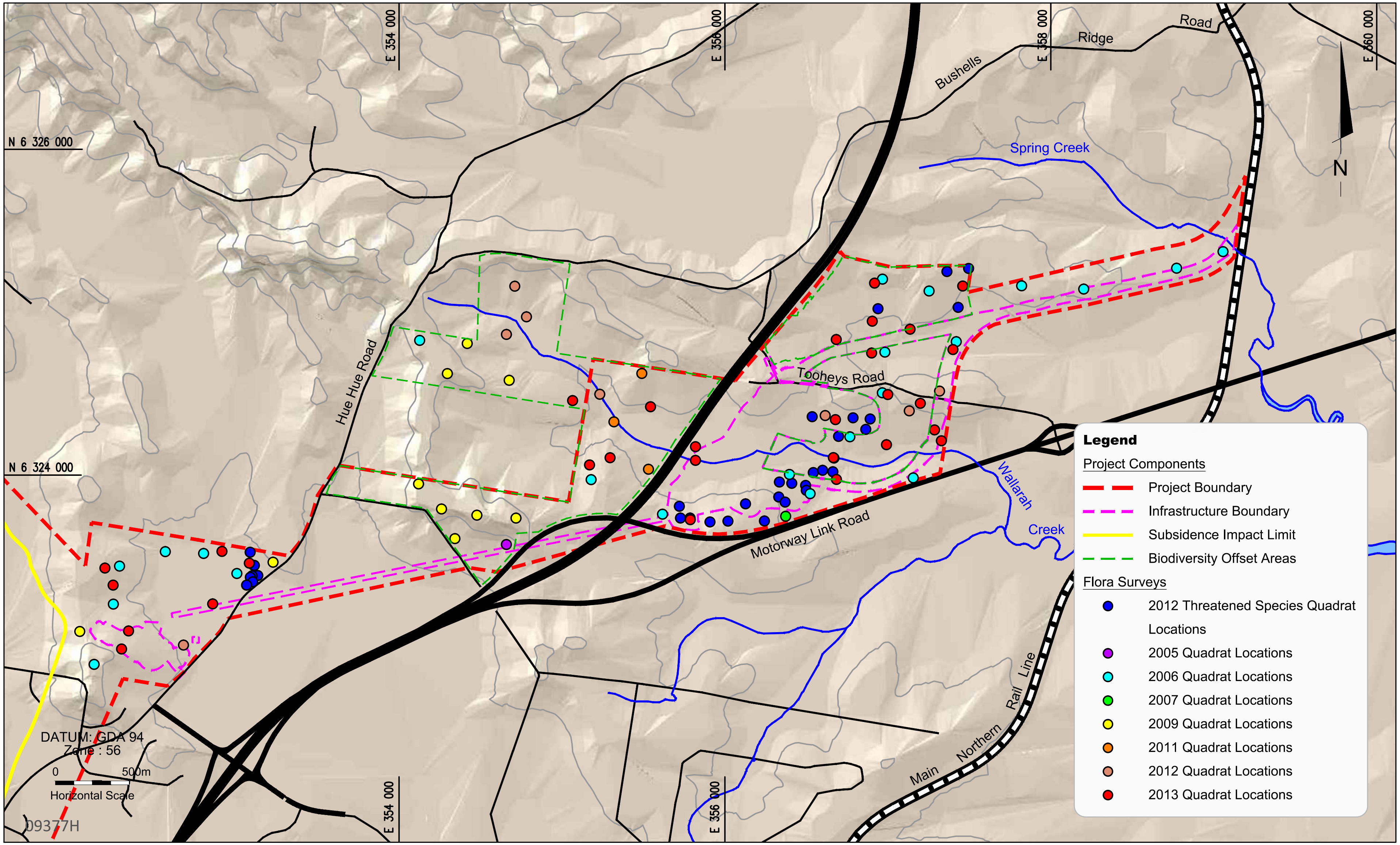
A large portion of land within the SIL is dominated by agricultural land. As stated in Section 4.3.1 of the EIA, the majority of this land is private freehold, which was not accessible for flora surveys. Section 4.3.1 of the EIA also states that the surveys conducted within the Honeysuckle Park property (owned by WACJV) provided an accurate representation of the ecological values of the majority of the unsurveyed agricultural land within the SIL. Further detailed surveys of agricultural lands were not considered necessary given that these areas provided very limited habitat value for native flora and fauna.

The northern to north-eastern extents of the SIL consisted of residential areas which were not accessible for surveys. The following vegetation communities have been mapped in these residential areas:

- Smooth-barked Apple – Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin;
- Spotted Gum – Broad-leaved Ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin (EEC);
- Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin; and
- Woollybutt – Paperbark sedge forest on alluvial plains of the Central Coast, Sydney Basin (EEC).

As outlined in Sections 5.2.10 to 5.2.12 of the EIA, vegetation in these residential areas is largely characterised by canopy species with either a cleared / grazed understorey or a highly modified understorey comprised primarily of garden species. The modified nature of the vegetation communities in these residential areas provides limited habitat value for native flora and fauna. As such, detailed surveys of these areas were not considered necessary.

The western portion of the SIL consists of the Wyong State Forest (SF) and the Jilliby State Conservation Area (SCA). With the exception of a small area (<3 ha) to be disturbed for the development of the Western Ventilation Shaft, no vegetation will be cleared from these areas. The vegetation communities to be disturbed have been described in detail in Sections 5.2.7 and 5.2.12 of the EIA. These communities have been ground-truthed at the proposed location of the Western Ventilation Shaft. Detailed subsidence modelling indicates that there will be no significant impacts on vegetation communities within the SIL. Given the limited disturbance that will occur within the SIL, the survey effort within the SIL is considered to be sufficient.



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Flora Survey Effort

FIGURE 19

Adequacy of Threatened Flora Surveys

This section addresses the submissions from stakeholders regarding the survey effort for threatened flora species.

Submissions: RA4

Threatened species searches and density estimates were conducted for the threatened flora species *Angophora inopina* and *Melaleuca biconvexa* during the 2012 surveys. The 2012 surveys did not target *Tetratheca juncea* because targeted searches for this species conducted in the offset properties determined that the species was adequately offset. Further searches for *Grevillea parviflora ssp parviflora* were not conducted in 2012 because previous targeted searches located this species only within the Hue Hue Road offset area.

Detailed targeted searches for threatened orchid species, including *Cryptostylis hunteriana*, were conducted in the impact and offset areas from 2011 to early 2012. Therefore, further searches for threatened orchid species were not necessary. Although targeted searches for *Acacia bynoeana* were not conducted, searches for this species were incorporated into the general flora surveys in the impact and offset areas.

Targeted searches for the aforementioned threatened flora species within the SIL were not considered necessary due to the limited extent of disturbance. Nevertheless, the assessment has adopted a conservative approach by assuming that these threatened flora species have the potential to occur within areas of suitable habitat within the SIL. The areas of potential habitat for threatened fauna that will be cleared, subsided and offsets have been presented in Table 6.2 of the EIA. The potential impacts of subsidence on these species have been considered in the Assessments of Significance (7-part tests) conducted for those species (refer to Appendix H of the EIA). The Assessments of Significance indicated that significant impacts on these species are not predicted to occur as a result of the Project.

3.9.3 Fauna Survey Effort

Amphibian Surveys

This section addresses the submissions from stakeholders regarding surveys for threatened amphibian species.

Submissions: RA4

In general, the fauna survey effort is considered to have been appropriate for adequately assessing the impacts of the Project. However, it is acknowledged that there was limited survey effort for amphibians within the SIL. It was conservatively assumed that threatened frog species occur within the Project Boundary due to the availability of suitable habitat and historical recordings. The threatened frog species assessed are listed in Section 6.8.1 of the EIA. Assessments of Significance for these species are provided in Appendix H of the EIA. Furthermore, detailed assessments for recorded and potentially occurring threatened frog species listed under the EPBC Act are provided in Sections 7.1.4 to 7.1.8 of the EIA.

Further surveys for threatened frog species will be conducted once survey conditions are appropriate to determine areas where threatened frogs are more likely to occur and to fulfil survey effort requirements specified by regulatory agencies.

Fauna Survey Methods

This section addresses the submissions from stakeholders regarding the survey methods utilised for fauna surveys.

Submissions: RA4

As stated in Section 4.5.6 of the EIA, bird call recordings were used to supplement dedicated diurnal surveys and recordings were specifically reduced not to catch the 'dawn chorus' as the majority of these species were already detected during the diurnal surveys.

It is acknowledged that surveys utilising particular fauna survey methods (such as Elliot traps, Cage traps, etc.) were limited. However, the Project Boundary is within an area that has been historically well surveyed and the fauna species that could potentially occur are considered to be well known and understood.

Records of historical surveys conducted within the Project Boundary were utilised to supplement results of current fauna surveys. Any threatened species that have been historically recorded within the Project Boundary and surrounding areas were considered as likely to occur. Impacts on potentially occurring species have been assessed as if they were recorded. Potential impacts on recorded and potentially occurring threatened species have been assessed in Section 6.8 of the EIA. A complete list of fauna species recorded within the Project Boundary is provided in Table G.1 of Appendix G of the EIA.

Targeted Baiting for Spotted-tailed Quoll

This section addresses the submission from OEH regarding the baiting of camera trap surveys for the Spotted-tailed Quoll.

Submissions: RA4

OEH suggested that the baiting associated with camera trap surveys did not specifically target the Spotted-tailed Quoll (*Dasyurus maculatus*). This species occupies very large home ranges, ranging from 620 ha to 2,560 ha, and it is unlikely that further targeted camera surveys would increase the likelihood of successfully recording this species. Nevertheless, the Spotted-tailed Quoll is considered a potentially occurring species based on historic sightings in the surrounding locality. The potential impacts of the Project on the Spotted-tailed Quoll have been assessed in the EIA (Section 6.8.14, Section 7.24 and Appendix H).

3.9.4 Community and Species Descriptions

This section addresses the submission regarding the level of detail for threatened species population distribution and abundance estimates.

Submissions: RA6

Details on the distribution of all threatened species recorded during surveys within the Project Boundary are provided in Section 5.5 (Flora) and Section 5.7 (Fauna) of the Ecological Impact Assessment. These sections also provide numbers of historic records for the wider locality.

Density estimates for the threatened flora species *Angophora inopina* (Charmhaven Apple) and *Melaleuca biconvexa* (Biconvex Paperbark) are provided in Sections 5.5ii and 5.5v of the EIA, respectively. Total numbers of recorded individuals of all threatened flora species within the impact and offset areas has been provided in Table E2 of Appendix E in the EIA. Abundance values could not be calculated for fauna species as the majority of records are based on vocalisations which do not provide an accurate estimate of numbers. Furthermore, the majority of the recorded threatened fauna species consisted of highly mobile avifauna and bats which travel across large areas. No threatened populations were recorded within the Project Boundary, accounting for the lack of information on the abundance or distribution of threatened populations.

The detail provided in the EIA with regard to distribution and abundance of threatened species and populations is considered adequate.

3.9.5 Clearing of Vegetation and Removal of Habitat for Native Species

The section addresses the submissions from stakeholders regarding the impacts caused by vegetation clearing, including the removal of habitat for native fauna and flora.

Submissions: RA4, RA10, SIG1, SIG3, P1, P3, P9, P10

The Project will clear areas of native vegetation, including state listed EECs, and remove areas of habitat for a number of threatened species. The EIA provides a robust assessment of these potential impacts. The EIA has considered the habitat requirements of all species which occur or have the potential to occur, the extent of direct habitat clearance and the potential to avoid, mitigate and / or compensate for the predicted impacts. The direct and indirect impacts of vegetation clearing were assessed in Section 6.1 of the EIA. The impacts of vegetation clearance on EECs, Groundwater Dependent Ecosystems (GDEs) and threatened species were assessed in Sections 6.5 to 6.8 of the EIA.

The EIA concluded that the impacts of the Project could be ameliorated for all recorded and potentially occurring species through a combination of avoidance, mitigation and compensatory measures. Avoidance measures have been progressively incorporated in the design of the surface infrastructure areas to reduce the area of vegetation to be cleared.

Mitigation measures such as active fauna management and monitoring will be detailed in the BMP. Compensatory measures include the provision of a comprehensive Biodiversity Offset Package (BOP), which will conserve habitat for EECs and threatened species in perpetuity.

It is acknowledged that some native vegetation communities either lack or have insufficient like-for-like offsets. The Office of Environment and Heritage (OEH) was consulted to discuss options for the adequate offsetting of these communities as well as appropriate protection mechanisms for the BOP. The outcomes of these discussions are addressed in more detail in **Section 3.9.9** and **Section 3.9.10**.

Overall, the offset areas proposed in the BOP will result in the protection of a larger area (208 ha) of like-for-like or structurally similar native forest / woodland and Derived Native Grassland (DNG) than what is proposed to be cleared (60.5 ha). Furthermore, areas of DNG present within offset areas already show indications of natural regeneration and will be allowed to regenerate back to native woodland. Areas of exotic grassland will be progressively revegetated, thus further increasing available habitat for native flora and fauna. The BOP provides an overall offset to disturbance ratio of 3.4:1 for native forest / woodland and DNG. Specifically, the BOP offers offsets for each EEC at a ratio close to or substantially higher than 4:1, with an overall offset ratio of 6.3:1 for EECs, which compares favourably with the precedents for similar projects.

The proposed BMP will include measures for rehabilitating degraded areas and revegetating grassland areas back to native vegetation. The offset areas will be conserved in perpetuity and the quality of the native vegetation will be improved through active management. As a result, there will no net loss of biodiversity, which is consistent with the required ‘Maintain and Improve’ principles of the *Native Vegetation Act 2003*.

3.9.6 Assessment of Impacts – Subsidence Impacts

Native Species and Communities

The section addresses the submissions from stakeholders regarding the impacts of subsidence on native species and communities.

Submissions: RA4, SIG1, SIG3, P1 P3, P9, P10, P81, P114, P144, P166, P170, P178

The potential impacts of subsidence on ecological values were described in Section 6.2 and Sections 6.5 to 6.8 of the EIA, with further assessments of potential impacts on MNES detailed in Section 7 of the EIA. The Key Threatening Processes associated with subsidence were discussed in Section 6.9 of the EIA.

Areas of Vegetation within the SIL

This section responds to the submission from OEH regarding the extents of vegetation communities within the SIL.

Submission: RA4

The areas of the various vegetation communities (including EECs and GDEs) within the SIL were not specifically included in the EIA. **Table 5** shows the areas of each vegetation community within the SIL.

Table 5
Vegetation Communities Present Within the SIL

Vegetation Community	Total area of vegetation within SIL	EEC (TSC Act)	Potential GDE
Blackbutt - Turpentine open forest of the foothills of the North Coast	0	Yes*	Yes
Coachwood - Crabapple warm temperate rainforest of the North Coast and northern Sydney Basin #	582.3	Yes*	Yes
Mountain Blue Gum - Turpentine moist shrubby open forest of the coastal ranges of the Central Coast, Sydney Basin	1,040.7	No	No
Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin	0	Yes	Yes
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin	1.2	Yes	Yes
Rough-barked Apple - red gum grassy woodland of the MacDonald River Valley on the Central Coast, Sydney Basin	25.5	Yes	No
Scribbly Gum - Red Bloodwood heathy woodland on the coastal plains of the Central Coast, Sydney Basin	0	No	No
Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	98.1	No	No
Spotted Gum - Broad-leaved Ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin	174.7	Yes	No
Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	927.4	No	No
Swamp Mahogany swamp forest on coastal lowlands of the North Coast and northern Sydney Basin (EEC)	0.7	Yes	Yes

Vegetation Community	Total area of vegetation within SIL	EEC (TSC Act)	Potential GDE
Woollybutt - Paperbark sedge forest on alluvial plains of the Central Coast, Sydney Basin (EEC)	26.0	Yes	Yes
Derived Native Grassland	2.5	No	No
Exotic/Agricultural/Low Diversity Grassland	1,106.9	No	No
Total Vegetation	*3,985.9*		
Total Native Vegetation	*2,879.1*		
EECs – Total area	*810.4*		
GDEs – Total area	*610.2*		

**: The Biometric communities Blackbutt-Turpentine and Coachwood-Crabapple do not have an EEC equivalent. However due to the limited distribution and regional significance of the local community equivalents, a conservative approach has been taken and these communities have been considered as EECs for the purposes of this Project.*

Impacts on the Giant Barred Frog

This section addresses the submission from OEH regarding the impacts of subsidence on the Giant Barred Frog (Mixophyes iteratus).

Submission: RA4

Giant Barred Frogs forage and live amongst deep and damp leaf litter in rainforests, moist eucalypt forests and nearby dry eucalypt forests and breed around shallow, flowing rocky streams from late spring to summer (OEH, 2013). While it is acknowledged that there may be temporary localised changes to water tables due to subsidence, no significant impacts are predicted to occur to the waterways, wetlands or riparian habitats which provide habitat for the Giant Barred Frog.

The potential impacts of subsidence on the Giant Barred Frog are considered to be minor. SEWPaC has not raised any concerns regarding the impacts of subsidence on the Giant Barred Frog. An assessment in accordance with SEWPaC's Offsets Assessment Guide (2012) was undertaken. The proposed biodiversity offset strategy satisfies the requirement for direct offsetting measures to meet at least 90% of the offsetting requirement. The remaining offset requirements will include other compensatory measures such as funding for research or education programs identified in the Commonwealth approved recovery plan.

To address this requirement, Cumberland Ecology utilised the 'Offsets Assessment Guide' (SEWPaC, 2012) to calculate required further indirect offsets which determined a monetary contribution in the sum of $59,878.42 for the indirect offset for the Giant Barred Frog.

WACJV will contribute $60,000 for relevant research in relation to the Giant Barred Frog, the details of which will be included in the Biodiversity Management Plan which shall be developed in consultation with relevant regulators.

Pristine habitat for this species is still available in the locality and the species is well represented in nearby conservation reserves such as the Watagans National Park and Olney State Forest.

Additional surveys to further determine the extent of the distribution of the Giant Barred Frog within the SIL are proposed to be undertaken once survey conditions are appropriate. In addition, the BMP will include monitoring and adaptive management to check ongoing potential impacts from subsidence.

Impacts of Subsidence on Wetland Communities

This section addresses the submission from OEH regarding the impacts of subsidence on wetland EECs.

Submissions: RA4

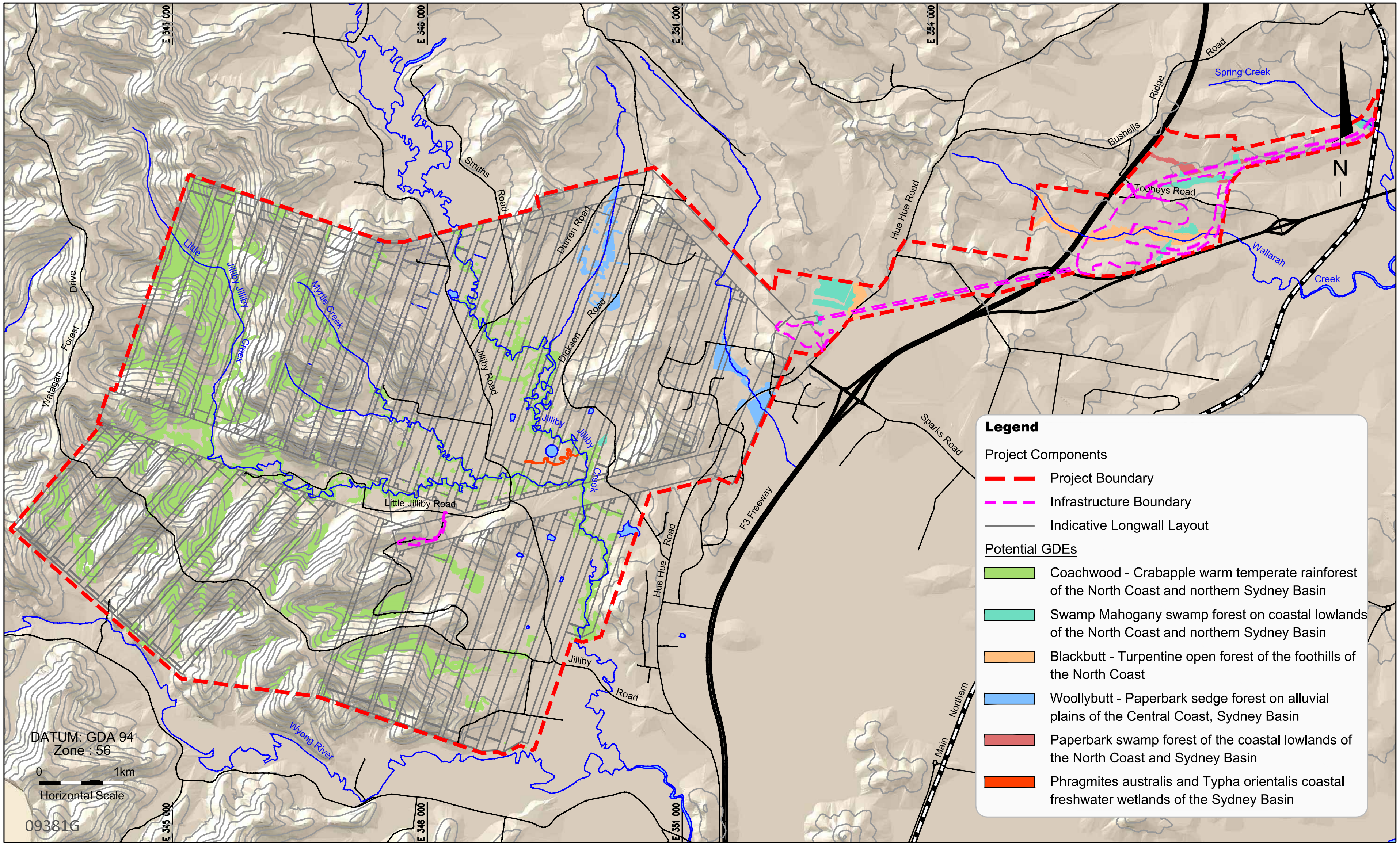
Concerns have been raised that subsidence from longwall mining will have an impact on the following wetland communities within the SIL:

- Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin (EEC); and
- *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin (EEC).

Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin is only present within the Tooheys Road Site and is absent from the SIL. Therefore, subsidence will not result in any impacts on this community.

Less than 1.5 ha of Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin is present in the SIL, located within the Honeysuckle Park property. Groundwater monitoring wells, set to intercept the underlying rock aquifer and the alluvial aquifer, are present at several locations within Honeysuckle Park. An assessment of the impacts of subsidence on Phragmites australis and Typha orientalis coastal freshwater wetlands, as well as other potential wetland and GDE communities within the SIL is provided in Section 6.6.2 of the EIA.

The location of these communities relative to the longwall layout is shown in **Figure 20**.



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Potential Groundwater Dependent Ecosystems

FIGURE 20

Wallarah 2 COAL PROJECT

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3.9.7 Key Threatening Processes

This section addresses the submissions from stakeholders regarding the exacerbation of Key Threatening Processes.

Submissions: RA4, SIG1, P9

Submissions have stated that the Proposal will exacerbate Key Threatening Processes (KTPs), including:

- Clearing of native vegetation;
- Loss of hollow-bearing trees;
- Removal of dead wood and dead trees; and
- Anthropogenic climate change.

Furthermore, it is has been stated that subsidence induced by the Project will exacerbate the following KTPs:

- Alteration to habitat following subsidence due to longwall mining; and
- Alteration of natural flow regimes or rivers and streams and their floodplains and wetlands.

The impacts of these KTPs were assessed in Sections 6.1, 6.2, 6.6 and 6.9 of the EIA. The strategies to offset the predicted impacts from KTPs are discussed in Section 8.4 of the EIA.

3.9.8 Impacts on Migratory Birds

This section addresses the submissions from stakeholders regarding the impacts of the Project on migratory bird species.

Submissions: RA4, SIG1, SIG3, SIG7, P1, P3, P5, P67, P80, P81, P82, P94, P95, P107, P109, P136, P146, P147, P150

Concerns have been raised regarding the impacts of the Project on migratory species listed under international agreements. While some terrestrial species have been listed, the vast majority of migratory species listed within the provided submissions are wetland/marine species which generally move along the coastlines and rarely fly inland. When they do fly inland, they are usually dependent on wetlands and inundated areas.

The Commonwealth Government's Protected Matters Search Tool (PMST) was used to conduct a search for any migratory species recorded within a 10 km radius of the site. The likelihood of occurrence for these species was assessed in Appendix B of the EIA. The potential impacts of vegetation clearing and subsidence on migratory species known or with the potential to occur within the Project Boundary were assessed in Sections 6.8.5, 6.8.6, 7.20, 7.21, 7.22 and 7.27 of the EIA. No impacts resulting from clearing or subsidence are predicted to occur to any migratory species known or with the potential to occur within the Project Boundary.

It is acknowledged that other EPBC Act listed migratory wetland / marine species, which were not considered within the Likelihood of Occurrence assessments, may pass through the Project Boundary. However, these species are unlikely to settle due to the lack of appropriate breeding / feeding habitat. As a result, these species would tend to concentrate around Tuggerah Lake (approximately 8 km to the south-east of the Project).

The potential impacts of subsidence on ecological values were described in Section 6.2 and Sections 6.5 to 6.8 of the EIA. The potential impacts from subsidence on water quality are also detailed in the reports on Surface water and Groundwater. Detailed modelling has indicated that subsidence will not have any significant impacts on water supply and quality. Furthermore, an appropriate Water Management Plan will be implemented, and the proposed Water Treatment Plant will treat mine water to a quality that is comparable to the receiving surface water quality.

Therefore, no significant impacts to the water quality downstream of the Project are predicted. The current water quality of the streams within the water supply catchment and Tuggerah Lake will not be degraded as a result of the Project. Therefore, there are not predicted to be any impacts to migratory wetland and marine bird species settling around Tuggerah Lake.

3.9.9 Biodiversity Offset Strategy

Assessment of Offsets using the new EPBC Act Offsets Policy

This section addresses the submissions from stakeholders regarding the assessment of proposed offsets using the Offsets Assessment Guide under the new EPBC Act Offsets Policy.

Submissions: RA6, SIG1

Since the exhibition of the EIS, further fieldwork has been conducted to assess the proposed Biodiversity Offset Package (BOP) under the new EPBC Act Offsets Policy's *Offsets Assessment Guide*. In particular, assessments were conducted for the species listed as 'controlled action' species: namely Charmhaven Apple (*Angophora inopina*) and Black-eyed Susan (*Tetratheca juncea*), listed as Vulnerable under the EPBC Act; and Spotted-tail Quoll (*Dasyurus maculatus*) and Giant Barred Frog (*Mixophyes iteratus*), listed as Endangered under the EPBC Act.

The results of the assessment under the *Offsets Assessment Guide* were provided to SEWPaC in June 2013. SEWPaC has reviewed this assessment and is satisfied with the adequacy of the proposed BOP for offsetting impacts to Matters of National Environmental Significance (MNES).

As stated in **Section 3.9.6**, indirect offsetting measures will be required for the Giant Barred Frog. WACJV will provide indirect offsets in the form of funds for research or education programs to meet the 100% offset requirements under the EPBC Act Offsets Policy.

Adequacy of the Biodiversity Offset Package under the OEH Interim Offset Policy 2011

This section addresses the submissions from stakeholders regarding the assessment of proposed offsets under the OEH Interim Offset Policy 2011.

Submissions: RA4, RA6, RA10.

The submission from OEH stated that the total offset areas for the vegetation communities that will be directly impacted are generally of a quantum which would be acceptable under the 'OEH Interim Offset Policy 2011', with the exception of four communities:

- Scribbly Gum - Red Bloodwood heathy woodland on the coastal plains of the Central Coast, Sydney Basin;
- DNG;
- Mountain Blue Gum - Turpentine moist shrubby forest of the coastal ranges of the Central Coast, Sydney Basin; and
- Spotted Gum - Grey Ironbark Open Forest on the foothills of the Central Coast, Sydney Basin.

A meeting with OEH was held on 13 August 2013 to discuss offset strategies and protection and delivery of the BOP. In particular, the adequacy of the proposed BOP under the OEH Interim Offset Policy 2011 was discussed in terms of compliance with Principle 3 of the NSW offset principles for major projects (including SSD). This principle states that "*where offset sites that are exactly like-for-like are not reasonably available, offsets may include vegetation communities of a similar type or a type of a higher conservation priority, or threatened species of a higher conservation priority*".

During the meeting, OEH personnel provided the following advice for the purposes of re-assessing the proposed BOP under Principle 3:

- Vegetation communities included in the proposed BOP could be grouped by Vegetation Formation;
- DNG can be included in the respective vegetation formations as a low condition version of the parent vegetation community; and
- The vegetation formation groupings should meet a minimum ratio of 2:1 to be considered adequate under the 'OEH Interim Offset Policy 2011'.

The proposed BOP was re-assessed in accordance with the advice provided from OEH. The vegetation communities present in the proposed BOP were grouped into three main vegetation formations, namely:

- Wet Sclerophyll Forests;
- Dry Sclerophyll Forests; and
- Forested Wetlands.

The offset ratios for these vegetation formation groups are provided in **Table 6**.

Table 6
Offset Ratios for Formation Groupings of Vegetation Communities

Formation	Vegetation Communities	Impact Area (ha)	Offset Area (ha)	Ratio
Wet Sclerophyll Forests	• **Blackbutt - Turpentine open forest of the foothills of the North Coast*** • *Mountain Blue Gum - Turpentine moist shrubby open forest of the coastal ranges of the Central Coast, Sydney Basin*	7.5	16.9	2.2
Dry Sclerophyll Forests	• *Derived Native Grassland* • *Scribbly Gum - Red Bloodwood heathy woodland on the coastal plains of the Central Coast, Sydney Basin* • Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin • **Spotted Gum - Broad-leaved Ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin** • Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	50.1	180.4	3.6
Forested Wetlands	• **Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin** • **Rough-barked Apple - Red gum grassy woodland of the MacDonald River Valley on the Central Coast, Sydney Basin** • **Swamp Mahogany swamp forest on coastal lowlands of the North Coast and northern Sydney Basin**	2.9	10.8	3.8

Italics – less than 2:1 offset ratio on a like-for-like basis.

Bold – EEC

* The Biometric community Blackbutt-Turpentine does not have an EEC equivalent. However due to the limited distribution and regional significance of the local community equivalent, a conservative approach has been taken and this community has been considered as an EEC for the purposes of this Project.

The offset ratios for all vegetation formation groupings are greater than the minimum 2:1 ratio requirement stipulated by OEH personnel as being acceptable under the 'OEH Interim Offset Policy 2011'.

Offsets for River-flat Eucalyptus Forest

This section addresses the submission from OEH regarding offsets for River-flat Eucalyptus Forest on Coastal Floodplains of the NSW North Coast and Sydney Basin Bioregion EEC.

Submissions: RA4

The submission from OEH states that the BOP does not provide for an offset for the threatened ecological community River Flat Eucalypt Forest on Coastal floodplains of the NSW North Coast and Sydney Basin Bioregion (RFEF).

As stated in Section 6.5 ii) of the EIA, the RFEF EEC is represented in the Study Area by two communities:

- Rough-barked Apple – Red Gum grassy woodland of the MacDonald River Valley on the Central Coast, Sydney Basin; and
- Blackbutt – Turpentine open forest of the foothills of the North Coast.

The Rough-barked Apple – Red Gum grassy woodland community is present only in the Hue Hue road offset and as remnant fragments within the SIL. Although this community will not be cleared by the Project, an area will be conserved within the BOP.

As stated in Section 5.2.5 of the EIA areas of the local alluvial riparian forest support vegetation that can only be accommodated within Blackbutt – Turpentine open forest community of the Biometric classification. The Biometric community Blackbutt - Turpentine open forest is not equivalent to RFEF EEC. However, the local riparian community has a very limited distribution and given the regional significance of this local vegetation community, a conservative approach has been taken and this community has been included within the RFEF EEC. This community is present within the infrastructure boundary for the Tooheys Road Site. Impacts on this community will be adequately offset through the conservation of 16.9 ha of the community within the BOP.

3.9.10 Protection and Delivery of Biodiversity Offset Package

This section addresses the submission from OEH regarding the offsetting mechanism for the Project.

Submissions: RA4

During the meeting with OEH on 13 August 2013, the suitability of the protection mechanisms listed in Section 8.4.3 iii) of the EIA for the Project was discussed.

Of the mechanisms listed in the EIA, the following mechanisms were determined to be suitable options for the Project:

- Entering into of a trust agreement under the *Nature Conservation Trust Act 2001;*
- Entering into of a biobanking agreement under Part 7A of the *TSC Act;*
- Acquisition or retirement of biodiversity credits under Part 7A of the *TSC Act;*

- Entering into of a planning agreement under the EP&A Act that makes provision for development contributions to be used or applied towards the conservation or enhancement of the natural environment.

Of these mechanisms, the anticipated preferred option is to enter into a trust agreement under the *Nature Conservation Trust Act 2001*. However, the protection mechanism and the timeframe for the submission of the final BOP will be finalised following further consultation with relevant government agencies.

3.10 AQUATIC ECOLOGY

All references to the Aquatic Ecology Impact Assessment (AEIA) refer to Appendix P of the EIS.

3.10.1 Additional Survey Effort for 3rd Order Streams

This section addresses the submissions regarding the survey effort and description of surveys for the 3rd order section of Little Jilliby Jilliby Creek and other 3rd order stream sections.

Submissions: RA4

The AEIA specified that there would be continuing baseline aquatic ecology surveys conducted for the Project to fulfil the commitment to: '*provide an Environmental Management Plan (EMP) which will incorporate both the existing EIS aquatic ecology study data, and additional data from on-going biannual (Autumn and Spring) studies, in order to provide a suitable database against which changes that may be attributable to construction or operation of the mine can be measured, assessed and where necessary remediated.'*

As explained in the AEIA, access to some of the aquatic ecology monitoring sites during the Spring and Autumn seasonal surveys was difficult due to challenging terrain, extremely wet weather conditions and lack of access to private property. Consequently, future aquatic ecology surveys are proposed, which will include additional aquatic habitat evaluation field excursions. These surveys will be conducted in the summer and winter non-AusRivAS sampling periods and will be used to select suitable sites for seasonal baseline survey. The first out-of-season site evaluation procedure was outlined in the Section 4.4 of the AEIA and included the results of the August 2012 characterisation of the western-forested upper catchment aquatic habitats.

Two additional seasonal aquatic ecology surveys have since been undertaken. The surveys undertaken during Spring 2012 and Autumn 2013 are detailed in **Appendix E**. These surveys incorporated aquatic ecology baseline sampling of five new sites including a number of the western-forested upper catchment aquatic habitats that were previously identified in the August 2012 site survey (namely the lower portion of Splash Gully, Little Jilliby Jilliby Creek upstream of the Splash Gully confluence and the billabong / lagoon next to Little Jilliby Jilliby Creek downstream of the Splash Gully confluence).

These baseline surveys also included new sites established in farm dams or lagoons on the Jilliby Jilliby Creek flood plain to enable characterisation of these aquatic habitat types.

Since those two seasonal surveys, a further aquatic habitat gap analysis evaluation survey was conducted in August 2013 for the upper portion of Little Jilliby Jilliby Creek (see **Appendix E**). From this survey, two additional western-forested upper catchment aquatic habitats (one in the upper 3rd order reaches of Little Jilliby Jilliby Creek and one in the 2nd order reach of Myrtle Creek) are scheduled for full seasonal aquatic ecology baseline sampling in Spring 2013.

The August 2013 site habitat evaluation survey also included additional aquatic habitat assessment in the Wallarah Creek sub-catchments. The upcoming Spring 2013 baseline survey will incorporate a new monitoring site downstream of the proposed treated water discharge point.

The assessment approach adopted for the Project is that of initial broad-brush aquatic habitat assessment and baseline evaluation as part of the EIS, followed by ongoing targeted aquatic habitat assessments to confirm EIS predictions and provide a more robust baseline database. This a well-established procedure for evaluating and managing aquatic ecology impact for projects that have a long lead time, such as coal mining projects.

3.10.2 Fish Survey Effort and Methods

This section addresses the submission regarding the survey effort for fish in 3rd order streams.

Submissions: RA4

The majority of the baseline aquatic ecology surveys for the EIS were undertaken during or immediately following flood events. The assessment of potential fish utilisation of aquatic habitats was made on the basis of listing expected fish species from existing and relatively recent fish surveys in the Wyong River catchment and then evaluating potential fish access to identified aquatic habitats (see Section 4.6 of the AEIA). This is considered a well-accepted procedure in aquatic ecology habitat evaluation. Since that time, the focus of the aquatic ecology survey effort has been on increasing the knowledge base for the western-forested upper catchment aquatic habitats (1st to 3rd order stream sections) that are in small boulder or detritus constrained pools (in 1st and 2nd order streams) or shallow clear sandy detritus constrained pools (at least in Little Jilliby Jilliby Creek).

The surveys to date have captured and identified seven of the 10 species recorded in the Wyong River by Cummings et al (2008), and an additional species (Coxs gudgeon) listed by TEL (2008). The majority of the species (five of the six expected species) caught to date are gudgeons, while native fish have been recorded at 12 of the 16 sites sampled to date, including two sites in the Wyong River, three sites in Jilliby Jilliby Creek, four sites in Little Jilliby Jilliby Creek, one dam site in Jilliby Jilliby Creek, one lagoon site in Little Jilliby Jilliby Creek, and one site at the lower end of Splash Gully (a 2nd order stream draining to Little Jilliby Jilliby Creek).

No native fish have been caught in Hue Hue Creek, or the creeks associated with the Project's infrastructure areas (Buttonderry Creek, Spring Creek and Wallarah Creek). To date, the only pest species identified date is the plague minnow, which has been recorded at 11 of the 16 sites.

The distribution data obtained to data has confirmed that there is suitable and occupied native fish habitat in:

- Jilliby Jilliby Creek within the mine footprint;
- Little Jilliby Jilliby Creek to the upper 3rd order reach (at least to a point east of Spotted Gum Point); and
- Dams and lagoons within the alluvial floodplains of Jilliby Jilliby Creek and Little Jilliby Jilliby Creek.

The extended additional baseline surveys have also confirmed that there is suitable native fish habitat along the complete section of Little Jilliby Jilliby Creek within the Extraction Area, and in the Little Jilliby Jilliby Lagoon below Splash Gully.

3.10.3 Threatened Aquatic Invertebrate Species and Semi-aquatic Species

This section addresses the submissions regarding the distribution of threatened species populations.

Submissions: RA4, RA6, SIG1, P178

The submission refers to the report card for the Wyong River water source (OWE, 2009). The report card states that there is one threatened aquatic invertebrate species present in the catchment, but it does not identify the particular species. It is assumed that the report card is referring to the *Adams emerald dragonfly* as this is the only threatened aquatic invertebrate species listed under the *Fisheries Management Act 1994* (FM Act) that could occur in the locality.

Section 2.3 of the AEIA states that "*the mountain creek habitats of the Jilliby Creek SCA are unlikely to support Adams emerald dragonfly by virtue of insufficient permanent and running water habitats to support this species over its extended (seven year) aquatic life stage*".

Notwithstanding, Section 2.2.1 the AEIA commits to on-going targeted surveys for the Adams emerald dragonfly habitat. It also recommended that; "*notwithstanding this conclusion, the on-going aquatic ecology baseline surveys will continue to include targeted surveys for Adams emerald dragonfly habitat*".

In order to locate likely habitat for *Adams emerald dragonfly,* the Spring 2012 and Autumn 2013 surveys included new sites in Little Jilliby Jilliby Creek within the SCA, including Splash Gully, Little Jilliby Jilliby Creek above Splash Gully, and in an offstream lagoon downstream of Splash Gully. These surveys did not yield any specimens of *Adams emerald dragonfly.* This was not unexpected based on the combination of adverse water quality and habitat characteristics (Splash Gully and the lagoon site) and unstable sediment substratum with no gravel riffle sections (in the Little Jilliby Jilliby Creek site).

The aquatic habitat evaluation survey conducted on 2 August 2013 for the upper portion of Little Jilliby Jilliby Creek indicated the presence of gravel riffle sections and the existence of suitable native gudgeon habitat in pools. These habitat observations, stream-reach physical characteristics and water quality results (showing elevated conductivity) were discussed with EPA to determine whether the upper reaches of Little Jilliby Jilliby Creek were capable of supporting *Adams emerald dragonfly*. It was concluded that there may be suitable *Adams emerald dragonfly* habitat available in the upper-most 3rd order section of Little Jilliby Jilliby Creek, located within the Extraction Area above the Hughes Gully confluence (see **Appendix E**). This reach of Little Jilliby Jilliby Creek will be subject to full seasonal aquatic ecology baseline sampling in Spring 2013. The Spring 2013 survey will also include extensive riffle surveys for *Adams emerald dragonfly* larvae, as this will be the optimum time for conducting the searches. In addition, if suitable *Adams emerald dragonfly* habitat is located in the 2nd order reach of Myrtle Creek during the seasonal aquatic ecology baseline sampling scheduled for Spring 2013, targeted surveys for *Adams emerald dragonfly* will be subsequently conducted in those areas of suitable habitat.

To account for the possibility of other threatened aquatic species (not listed under the FM Act) being present, the stream health surveys will include the location and description of aquatic and semi-aquatic edge plants. These surveys will also include specific searches for *Mundia triglochinoides* (a rhizomatous plant listed as vulnerable under the TSC Act). While *Mundia triglochinoides* is known to occur in at least five sites north and south of the Wyong River, generally east of the F3 Freeway, there is one site in the Wyong River floodplain just upstream of the Jilliby Jilliby Creek confluence (outside the Extraction Area). The species is reported from swamps or shallow fresh water on heavy clay (NSW Scientific Committee Determination, updated 28 February 2011). To date, this species has not occurred at any of the aquatic ecology survey sites. If plants that are potentially threatened species are located, specimen plant material will be submitted to the NSW Botanical Gardens, in line with our present procedures for confirming aquatic plant specimen taxonomy.

The overall taxonomy of crayfishes for the mid coast region is currently not stable and as a precaution, any crayfish found during surveys that cannot be positively identified are photographed. The photographs are submitted to Mr Robert McCormack of Australian Aquatic Biological for identification. Mr McCormack is an acknowledged expert on crayfish and was responsible for the Gosford LGA Crayfish survey. Mr McCormack is currently extending the surveys for the remaining mid-north Coast LGAs.

As stated in Section 4.6 of the AEIA, there is suitable and known platypus and native water rat habitat in the Wyong River, Jilliby Jilliby Creek and Little Jilliby Jilliby Creek. The baseline stream health surveys include evaluation of aquatic habitat for platypus and native water rat. To date, water rat feeding stations and animal tracks have been found in the Wyong River. However, no water rat feeding stations, platypus burrows or animal sightings have been made elsewhere. Notwithstanding, the surveys have confirmed that suitable habitat for these species is present in most areas in the 3rd order sections of these streams as well as in floodplain lagoons and larger dams.

3.10.4 Impacts of Subsidence

This section addresses the submissions regarding the impacts of subsidence on aquatic ecology and the measures to manage and remediate these impacts.

Submission: RA4, RA11, SIG1

The potential impacts on aquatic ecology have been assessed based on the predicted subsidence impacts. The assessment of subsidence impacts has been justified in **Section 3.1**.

Section 5.1.2 of the AEIA describes the possible impacts on aquatic ecosystems including impacts of subsidence related erosion, loss of water from alluvium ecosystems, and fracturing in slope streams due to subsidence. Section 5.3 of the AEIA provides a summary of the adopted avoidance, minimisation, mitigation and offsetting measures to manage impacts on aquatic ecology.

Section 6 of the AEIA outlines the mechanisms by which both unpredicted and residual risks will be monitored, managed and mitigated or remediated. As stated in **Section 3.3.5**, WACJV will conduct stream health monitoring to determine the impacts of subsidence on the geomorphology of streams within the Extraction Area, which are expected to be negligible. If remediation is required, soft engineering techniques will be utilised wherever possible. In their submission, Fisheries NSW supported the use of soft engineering techniques. Measures for the monitoring and remediation of streams will be addressed in the WMP.

There will be an integrated approach to monitoring and adaptive management, which aligns subsidence monitoring with surface water, terrestrial ecology and aquatic ecology monitoring. The adaptive management approach involves the collection of subsidence, ecology and water quality data to test predictions, refine models and modify the mine plan (if required to mitigate impacts). Adaptive management also allows remediation techniques to be evaluated and refined as mining progresses.

The mine plan provides opportunities for early data acquisition, allowing model predictions to be validated and refined prior to mining under key streams. Early mining under Hue Hue Creek and the Alison Trig station hill to the west of Hue Hue Creek provide valuable opportunities for model validation and refinement prior to mining under Jilliby Jilliby Creek. Mining under Jilliby Jilliby Creek initially involves mining under small creek sections at right angles to the longwalls. This provides further monitoring data for model refinement.

The monitoring commitments will be detailed in the BMP, which will be developed in consultation with the relevant regulators. Monitoring measures will ensure that adaptive management, in the form of developing decisions about longwall panel dimensions and soft remediation measures, can result in an overall low risk of impact on aquatic ecological values.

3.10.5 Ephemeral Nature of Streams

This section addresses the submissions from stakeholders regarding use of the term 'ephemeral' to describe third order streams (including Little Jilliby Jilliby Creek).

Submission: RA4

The AEIA uses the term 'ephemeral' to refer to streams where the surface flow is intermittent. During dry periods, the flow in these streams either ceases altogether or becomes reduced to a series of isolated ponds such that fish passage is prevented. Therefore, the terminology used to describe the streams does not affect the conclusions regarding the aquatic habitat provided by the streams.

3.10.6 Risk of Underground Injected Brines Returning as Surface Waters

This section addresses the submission regarding the potential impacts to the aquatic environment arising from the underground disposal of brine.

Submission: RA4

The potential impact of underground brine disposal on surface water sources has been discussed in **Section 3.2.7**. Although the brine is extremely saline, the brine will mix with inflowing water from the surrounding coal seam and adjacent strata to result in a diluted product with a salinity of approximately 8,600 mg/L (compared to 7,500 mg/L for the formation groundwater). The diluted product will be further diluted due to rainfall recharge of the shallow alluvial soils. As a result, the residual risk to aquatic ecology is predicted to be low.

3.10.7 Impacts on Wyong River and Tuggerah Lake

This section addresses the submissions regarding impacts on the water quality of the Wyong River and Tuggerah Lake, and the flow-on impacts on aquatic ecology.

Submission: SIG1, P2, P109

The submissions assert that interception of coal seam waters will occur due to subsidence, which will impact the water quality of the Wyong River and ultimately Tuggerah Lake. As explained in **Section 3.3.5**, there is predicted to be a constrained zone with a thickness of at least 100 m. In the absence of connective cracking, interception of coal seam groundwater will not occur as a result of subsidence. Therefore, the water quality of the Wyong River and Tuggerah Lake will not be impacted by subsidence resulting from the Project.

3.10.8 Macroinvertebrate Diversity in Wallarah Creek

This section addresses the submission regarding the differences in the macroinvertebrate diversity results presented in the AEIA and the results obtained by OEH in Wallarah Creek.

Submissions: RA2, RA4

The submissions identified a discrepancy in the macroinvertebrate diversity results obtained by OEH from a Wallarah Creek south sub-catchment reference site and the results obtained from the Wallarah Creek north sub-catchment reference site used in the AEIA. However, the submission acknowledged that the discrepancy could be due to differences between the actual sites (such as source water quality). This is a reasonable conclusion as the OEH reference site is located in an arm of the south Wallarah Creek in an almost undisturbed 42 ha forested coastal plain sub-catchment. This sub-catchment is located between the rail line easement and the motorway easement, and discharges directly into the Wallarah Creek estuary. In contrast, the Tooheys Road Wallarah Creek monitoring sites used in the AEIA receives runoff waters from Hue Hue Road and agricultural lands upstream, resulting in poorer water quality at this site. The discrepancy in the macroinvertebrate diversity results is likely to be due to differences in the sub-catchments in which the OEH and AEIA sampling sites are located.

3.10.9 Monitoring of Ecotoxicology

This section addresses the submission recommending that water quality monitoring should include an assessment of the ecotoxicology of treated water discharges and overflows from the mine water dams.

Submissions: RA2, RA4

Section 3.3.1 discusses the impacts of overflows from the mine water management system. The water balance model predicts that the mine water dams will not overflow under any historical rainfall conditions (1889 to 2011). It is possible that mine water dams will overflow during an extreme rainfall event.

However, during such an event, Wallarah Creek would be in flood and any uncontrolled discharges from the mine water storages would be significantly diluted by flood flows in the receiving water.

The proposed water quality parameters for the treated water to be discharged to Wallarah Creek are presented in **Section 3.3.2**.

The water quality monitoring program for the Project will include testing to ensure that the treated water is free of ecotoxic effects. This process will be documented in the Water Management Plan. Discharge limits for treated water will also be detailed in the EPL.

Appropriate monitoring of treated water discharges will be included in the WMP and BMP, which will be developed in consultation with the relevant regulators.

3.10.10 Aquatic Ecology Monitoring Program

This section addresses the submissions regarding the measures to monitor and mitigate impacts of subsidence on aquatic habitat.

Submissions: RA4, RA11

Section 6 of the AEIA provides the framework for aquatic ecology monitoring and management using a Trigger Action Response Plan (TARP) approach. The BMP will include details on the integrated monitoring and mine model refinement program throughout the Project life to inform later mining and ensure a continued negligible and manageable risk to aquatic ecology ecosystems.

For aquatic ecology and surface water monitoring there will be a set of permanently established upstream and downstream mining sites in larger streams for monitoring of overall stream function and condition. There will also be sites established in reference (not to be mined) smaller sub-catchments for providing reference data for mining impacts in smaller sub-catchments. Site specific aquatic ecology subsidence monitoring sites will be established upstream and downstream of sub-catchment or stream segments to be undermined.

Monitoring sites will be sampled at least two years prior to mining (to provide a minimum of four seasonal surveys prior to mining), during mining and for at least two years post-mining. For the larger order streams, these sites will be established up- and down-stream of longwall segments (where the segments cross the stream at right angles) or will be the sites set for longer-term monitoring of whole stream segments (for larger order streams). This detail will be included in the BMP, which will be developed in consultation with the relevant regulators. Monitoring will be used to compare pre- and post-mining aquatic ecology condition, make recommendations for remediation and evaluate the success of remediation measures. Detailed completion criteria for the monitoring results would be developed for the TARP included in the BMP.

3.10.11 Autumn 2011 Survey

This section addresses the submission regarding the timing of the Autumn 2011 aquatic ecology survey.

Submission: P112

The Autumn sampling season is defined in the AusRivAS guidelines as the period from 15 March to 15 June. The Autumn 2011 baseline aquatic ecology survey was undertaken between 27 June 2011 and 1 July 2011. The surveys were delayed slightly due to flooding of the catchments in which sampling sites are located.

3.11 TRAFFIC AND TRANSPORT

All references in this section to the Traffic and Transport Impact Assessment (TTIA) refer to Appendix Q of the EIS.

3.11.1 Intersection Traffic Modelling

This section addresses the submission requesting full results of the intersection traffic modelling.

Submissions: RA13

Full intersection summary results of the SIDRA modelling are presented in **Appendix F**. The tables in **Appendix F** detail the performance of the intersection for all movements, including the worst performing leg.

3.11.2 Proposed Intersection Upgrades

This section addresses the submission regarding the proposed intersection layout for F3 / Sparks Road and other proposed intersection treatments.

Submissions: RA13

An indicative layout for the F3/Sparks Road intersection was presented in the TTIA to satisfy the DGRs. There is expected to be a major increase in future traffic demands within the local area, particularly at the F3/Sparks Road intersection. This increase in traffic demand is due to the projected population growth in the region and occurs even in the absence of the Project. The F3/Sparks Road intersection will need to be upgraded to accommodate the expected increase in traffic demands. The indicative layout proposed in Appendix E of the TTIA was intended as a guide only.

Since the exhibition of the EIS, Parsons Brinckerhoff (PB) has undertaken further consultation with RMS regarding proposed future intersection layouts. PB understands that RMS is currently assessing the design characteristics and requirements of the F3/Sparks Road intersection to accommodate future traffic demand. An upgrade of the F3/Sparks Road intersection will be required irrespective of the traffic generated by the Project. That is, the upgrade will be required to accommodate increases in background traffic and traffic generated by other developments.

Future consultation/discussion regarding development contributions will be undertaken at a later stage between WACJV and RMS's Development Assessment Team and F3 Widening Project Team.

The design for the F3/Sparks Road intersection that is ultimately progressed by RMS will in all likelihood supersede the design proposed in the EIS.

Appendix E of the TTIA also presents conceptual layouts for the other intersections. These are also intended only as a guide.

WACJV will consult with RMS and Wyong Shire Council during the planning and design of these intersection treatments.

3.11.3 Tooheys Road Site Access

This section addresses the submission regarding the Safe Sight Intersection Distances to and from the Tooheys Road site access, the height clearances for both the balloon loop bridge and F3 Underpass, and the use of high vehicles during Project operation.

Submissions: RA13

The Tooheys Road Site access will be designed and located, in consultation with relevant regulators, to best achieve the necessary safe sight distances. Clear driver sightlines on Tooheys Road will be considered in the rail bridge abutment design. Consideration will be given to reducing the posted speed limit on Tooheys Road to further improve safety.

No high or heavy vehicles will utilise the Tooheys Road F3 underpass to access the site. All high or heavy vehicles will utilise the Motorway Link Road and Tooheys Road.

The proposed concrete arch bridge (balloon loop bridge) to the east of the proposed Tooheys Road Site access will be built to accommodate high vehicles and as such, will have suitable vertical clearances.

3.11.4 Impacts of Subsidence on Road Infrastructure

This section addresses the submission from stakeholders regarding the impacts of subsidence on bridges and the F3 Freeway.

Submissions: RA13, P67, P138, P170

The only bridges located within the SIL are local road bridges. The potential impacts of subsidence on these bridges were assessed in Section 5.10.2 of the SPIA.

The maximum predicted tilts for the various local road bridges vary from 0.2 mm/m (0.02%) to 2 mm/m (0.2%). These changes in grade are small in magnitude are not predicted to affect the serviceability or drainage of these bridges.

The maximum predicted ground curvatures for the local road bridges are 0.05 km^{-1} hogging and 0.04 km^{-1} sagging. These values represent radii of curvature of 20 km and 25 km respectively. These curvatures are not predicted to adversely impact these structures.

Bridges will also be subject to valley related upsidence and closure movements. The maximum predicted upsidence for the bridges ranges from 25 mm to 100 mm. The maximum predicted closures also range from 25 mm to 100 mm. The bridges on Durren Road are concrete box culvert bridges and the bridge on Jilliby Road is a single span concrete bridge. The valley movements will only be transferred into the bridges if the movement joints in these structures do not have sufficient capacity to accommodate the closure movements. The other bridges within the SIL are timber and steel structures. Due to their flexibility, these structures are expected to be able to accommodate the valley related movements.

Structural inspections of local road bridges will be undertaken to determine their movement tolerances, and mitigation strategies will be developed if required.

The SIL occurs at least 1 km from the F3 Freeway therefore no impacts to the F3 from subsidence are predicted.

3.11.5 Proposed Airport in Wyong

This section addresses the submission regarding WSC's proposal for an airport.

Submissions: RA13

The *Draft Wyong Local Environment Plan 2012* (draft Wyong LEP) identifies an area of land as the potential site for a Type 3 Airport (limited service airport with a single runaway of up to 2,600 m in length).

WACJV has undertaken and will continue to undertake consultation with WSC regarding the potential interaction between the Project and the proposed airport. No conventional subsidence effects will occur in the vicinity of the proposed airport.

3.11.6 Consultation with WSC on Road Safety

This section responds to the submission requesting that WACJV consult with WSC to address road safety deficiencies and ensure that adequate levels of safety are maintained during construction.

Submissions: RA14

As outlined in Section 7.12.4 of the EIS, WACJV will undertake consultation with WSC to develop an agreement for addressing road safety issues. The agreement will identify mitigation priorities and / or responsibilities, and provide an appropriate contribution towards addressing the relevant road safety deficiencies and ensuring that adequate levels of safety are maintained during construction.

If necessary, WACJV will obtain appropriate directions from RMS prior to consulting with WSC.

3.11.7 Development of Construction Traffic Management Plan

This section responds to the submission raised by stakeholders recommending that WACJV prepare a Construction Traffic Management Plan.

Submissions: RA14, P112

As stated in Section 7.12.4 of the EIS, WACJV will develop a Traffic and Transport Management Plan (TTMP) to manage impacts of the Project on the traffic network. This plan will include site-specific traffic management measures for each stage of construction. Traffic associated with construction will be managed in accordance with 'Traffic Control at Work Sites*'* (Roads and Traffic Authority, 2010) and the relevant Australian Standards.

The TTMP will include procedures for auditing the implementation of the plan to ensure that road safety aspects are observed. In relation to the future construction of the Western Ventilation Shaft in Year 13, the TTMP will be revised at an appropriate time to include measures for managing the movement of heavy vehicles in order to minimise the disruption of traffic during the before and after school periods on Jilliby Road in the vicinity of Jilliby Public School. Consultation with the school will occur when revising the TTMP.

3.11.8 Traffic Impacts During Construction

This section addresses the submission asserting that impacts during the construction phase have not been adequately assessed.

Submission: RA6

The TTIA assesses the traffic impacts during six scenarios. The performance of the local traffic network during the construction of the Tooheys Road Site and Buttonderry Site in 2015 is assessed in Scenario 2. Scenario 1 assesses the performance of the local traffic network in the absence of the Project. The difference in the results of Scenario 1 and Scenario 2 reflects the impact of the Project during the construction of the Tooheys Road Site and Buttonderry Site. Scenario 6 assesses the performance of the road network during the construction of the Western Ventilation Shaft in 2026. Scenario 5 assesses the performance of the road network in the same year, except without the contribution of the Project. The difference in the results of Scenario 5 and Scenario 6 reflects the impact of the construction of the Western Ventilation Shaft.

3.11.9 Transportation of Coal

This section addresses the submission regarding the transportation of coal to Newcastle via the road network.

Submission: RA7

The Project will not involve any transportation of coal by road. In the event that rail transportation becomes temporarily unavailable, coal will be stockpiled at the Tooheys Road Site until rail access is restored.

3.11.10 Background Traffic Volumes

This section addresses the submission regarding the average annual daily traffic data used in the TTIA.

Submission: P112

Average annual daily traffic (AADT) data for the key roads in the vicinity of the Project was sourced from the RMS traffic count stations. AADT data was only available for the period from 1995 to 2004.

An annual traffic growth rate was applied to the 2004 traffic volumes to estimate the background traffic volumes during the Project life. The annual traffic growth rates used to calculate future background traffic growth were specified in Section 2.2 of the TTIA.

3.12 RAIL

3.12.1 Rail Loop and Coal Handling Infrastructure

This section addresses submissions regarding the arrangement of the rail loop and coal handling infrastructure.

Submission: RA13, P112

The proposed rail loop was conceptually shown in Figure 19 of the EIS. This is shown in greater detail in **Figure 21**. From the junction with the Main Northern Rail Line, a single track spur will be constructed to the actual loop. The loop turnout is located approximately 1.7 km from the main line. The loop has a length of approximately 4.2 km, with a length of 2.5 km from the loop turnout to the loader and 1.4 km from the loader back to the loop turnout. The 1.7 km spur between the main line turnout and the loop turnout will allow a train to leave the main line at the turnout speed which is planned to be a minimum of 40 km/h.

As outlined in Appendix R of the EIS, the Project is anticipated to be serviced by trains with a length of approximately 720 m (38 wagons) or 860 m (46 wagons). Therefore, the rail loop has sufficient capacity to hold up to three trains on the coal loop at any given time. There is capacity to hold two empty trains before the loader and one laden train after the loader. One of these trains can also stand on the single track spur between the main line turnout and the loop turnout.

That is, a laden train can stand on the single track spur and wait for its departure path, allowing loading of another train to commence. If loading of the first train is delayed, two empty trains can still be received with one train standing in the loop and one train on the single track spur. The capability to receive two empty trains whilst one train is being loaded provides flexibility for operations and gives train controllers the certainty that the Project can receive a train departing from the port.

The signalling layout will be developed at a later stage in consultation with relevant regulators. Given the length of the spur and the loop, sufficient space is available to accommodate signals.

HB 1163 F21 Wallarah RTS - Rail Infrastructure Layout.dwg

WALLARAH 2 COAL PROJECT

Wallarah 2 COAL PROJECT

Hansen Bailey ENVIRONMENTAL CONSULTANTS

Rail Infrastructure Layout

FIGURE 21

3.12.2 Demand Year and Availability of Freight Paths

This section addresses a submission regarding the demand year used for the Rail System Capacity Assessment and the impact of passenger network strategic objectives on the availability of freight paths. This section also addresses submissions regarding the additional freight capacity created by the Northern Sydney Freight Corridor.

Submission: RA13, RA7, RA17, SIG1

The Rail System Capacity Assessment has used the current 2011 passenger timetable in conjunction with the Northern Sydney Freight Corridor (NSFC) 2016 paths, as established and agreed with the network owner (TfNSW).

The NSFC includes existing coal paths but does not include any new coal path allowances. Infrastructure upgrades planned under the NSFC program should cover existing freight paths and additional container path requirements through to 2028. The passenger timetable will change within this timeframe. However, information on future timetables is not available at this stage and therefore was not considered in the assessment.

The additional freight capacity created by the NSFC does not include any additional paths for coal transportation. The Rail System Capacity Assessment determined that the construction of the passing loops at Awaba will ensure that there is sufficient capacity for the Project's train movements. That is, the Project is not reliant on the additional paths created by the NSFC.

LMCC promotes greater use of rail based freight. Given that the additional paths created by the NSFC will not be used for coal transportation, the Project will not impact the availability of paths for freight transportation.

3.12.3 Measures to Maintain and Improve the Rail Network.

This section addresses submissions regarding the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail network.

Submission: RA13, RA7

Capacity upgrade requirements and the Project's contribution to securing these paths will be achieved through investment in infrastructure upgrades. The potential contribution of the Project has been discussed and will be agreed in consultation with TfNSW.

To address any Rail Safety requirements, the Project will engage an approved and accredited construction contractor to build the balloon loop and an accredited operator to operate the trains in accordance with the requirements of the National Rail Safety Regulator.

The Project will not transport any coal to port via the road network. Therefore, upgrades to the road network to facilitate coal transportation are not necessary.

3.12.4 Interactions with Proposed Rail Infrastructure

This section addresses submissions regarding the potential impact on the proposed New Warnervale Station North, Warnervale new town and possibly Warnervale Stabling as well as any future quadruplication of the Short North. An emerging interface may also exist with Bushells Ridge Aboriginal Lands claim.

Submission: RA13

The Rail System Capacity Assessment considered all advice provided by TfNSW. This advice did not include the Warnervale elements raised in this submission.

As discussed in **Section 3.12.2**, the existing 2011 timetable was used for the Warnervale plans. TfNSW has advised that both the proposed North Warnervale Station and Warnervale stabling are likely to be located to the south of the Project. Additional passenger traffic generated by these developments is likely to be heading to Sydney and therefore away from the Project. Based on recent discussions with TfNSW, it is understood that it is unlikely that these plans will impact on the Project or vice versa.

TfNSW advised that there are no plans to quadruple the Short North in the near future.

3.12.5 Lack of Assessment on Rail Systems Impact

This section addresses the submission from Transport for NSW regarding the lack of assessment on rail systems impact.

Submission: RA13

The DGRs relating to impacts of the rail network have been reproduced in the submission from TfNSW. These issues have been addressed in **Section 3.12.2** and **Section 3.12.3**.

3.12.6 Coal Preparation

This section responds to submissions regarding coal handling and preparation.

Submission: RA13

The Introduction in the Rail Study (Appendix R of the EIS) states that the Project includes a coal handling plant, which is incorrect. WACJV is not seeking approval for the construction or operation of a coal handling and preparation plant.

3.12.7 Coal Supply

This section responds to the submissions raised by Transport for NSW and LMCC regarding the supply of coal to domestic power stations.

Submission: RA7, RA13

The Project does not include plans to supply coal to domestic power stations. The current rail path capacity limits the supply of coal to the Lake Macquarie and Central Coast power stations.

If domestic supply is to be undertaken in the future, the Project will obtain the necessary approvals and develop the appropriate infrastructure for transporting coal to local power stations.

3.12.8 Rail Capacity on ARTC Network

This section addresses the submission regarding the availability of train paths on the ARTC Network for the additional rail traffic generated by the Project.

Submission: RA17

WACJV has consulted with ARTC to determine the availability of paths on the ARTC Network as identified for the Project through the rail systems description and operations analysis conducted by the Network Access Division of RailCorp for the EIS.

Based on current expected growth, ARTC indicate that it is unlikely that the additional train volume proposed for the Project will have difficulty accessing paths on the ARTC network between Islington Junction and either Port Waratah or Kooragang Island.

WACJV and ARTC will continue to consult throughout the approvals process and development phase toward the establishment of a mutually acceptable commercial agreement.

3.12.9 Maximum Daily Train Movements

This section addresses the submission from Lake Macquarie City Council regarding the impact of train movements exceeding the daily average.

Submission: RA7

The Rail Study (Appendix R of the EIS) states that the Project will require an average of 4.33 train cycles per day. The Rail Study also states that a maximum of 6 train cycles per day are required to assemble a large Cape Size vessel. The Rail System Capacity Assessment has determined that there is sufficient capacity for the additional six cycles per day generated by the Project, providing that passing loops are constructed at Awaba.

3.12.10 Awaba Passing Loops

This section addresses the submission regarding the construction of passing loops at Awaba.

Submission: RA7

The Rail System Capacity Assessment determined that the construction of passing loops at Awaba would ensure sufficient capacity for the train cycles generated by the Project.

The design and construction of the passing loops will be undertaken by the rail authority. The necessary planning approval for this work will also be sought by the rail authority. The Project's contribution to the funding of these upgrades will be determined through ongoing consultation with TfNSW.

3.13 ABORIGINAL ARCHAEOLOGY AND CULTURAL HERITAGE

All references to the Aboriginal Cultural Heritage Assessment refer to Appendix S of the EIS.

3.13.1 Assessment Adequacy

This section addresses the submissions regarding the adequacy of the Aboriginal Cultural Heritage Assessment.

Submission: RA6 and SIG2

WSC acknowledged in their submission that a comprehensive survey and report of the cultural heritage of the areas surveyed within the Project Boundary had been undertaken. Furthermore, DLALC acknowledges adequate consultation and consideration of the group's comments during field work and preparation of the Aboriginal Cultural Heritage Assessment.

WACJV will continue to consult with the Aboriginal community during the construction and operation of the Project.

3.13.2 Impacts on Aboriginal Archaeology and Cultural Heritage

This section addresses submissions regarding the impacts of the Project on Aboriginal archaeology and cultural heritage

Submission: RA4, SIG2, SIG3, P73

An Aboriginal Cultural Heritage Assessment was undertaken for the Project in accordance with the 'Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010' (DECCW, 2010a) and the 'Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales' (DECCW, 2010b). The current heritage assessment, including previous recordings, identified 11 sites within the Project Boundary, including seven axe grinding groove sites, two artefact scatters, one isolated find and one culturally modified tree. It is acknowledged that these sites are of cultural significance given that they attest to the previous occupation and use of land by Aboriginal people.

As a result of the Project, one artefact scatter (WC-OS2) will be directly impacted by surface infrastructure development at the Tooheys Road Site. A further five axe grinding groove sites may be indirectly impacted by subsidence (WSF-AG3, WSF-AG4, #45-3-3040, #45-3-3041 and #45-3-3041). The extent of impacts due to subsidence cannot be predicted with certainty. However, a risk based assessment determined that the impacts of the Project present a very low risk of damaging the integrity of the axe grinding groove sites.

3.13.3 Aboriginal Heritage Information Management System Listings

This section addresses to the submission from OEH regarding the registration of five Aboriginal archaeological sites on the Aboriginal Heritage Information Management System (AHIMS) database.

Submission: RA4

OEH stated that five Aboriginal archaeological sites (WC-OS2, WSF-AG1, WSF-AG2, WSF-AG3 and WSF-AG4) identified by the Aboriginal Cultural Heritage Assessment were not registered on the AHIMS database.

However, an Aboriginal Site Recording Form for each of the aforementioned sites was submitted to the AHIMS Registrar. The sites have been allocated the following registration numbers:

- WC-OS2: Wallarah Creek Open Site 2 (AHIMS #45-3-3584);
- WSF-AG1: Wyong State Forest Axe Grooves 1 (AHIMS #45-3-3613);
- WSF-AG2: Wyong State Forest Axe Grooves 2 (AHIMS #45-3-3614);
- WSF-AG3: Wyong State Forest Axe Grooves 3 (AHIMS #45-3-3615); and
- WSF-AG4: Wyong State Forest Axe Grooves 4 (AHIMS #45-3-3616).

3.13.4 Management and Mitigation

This section addresses submissions regarding the measures proposed to manage impacts on Aboriginal archaeology and cultural heritage.

Submission: RA4 and SIG2

To manage potential impacts on Aboriginal archaeology and cultural heritage, WACJV has committed to preparing an Aboriginal Cultural Heritage Management Plan (ACHMP) upon receiving development consent. The ACHMP will be developed in consultation with OEH and registered Aboriginal stakeholders, and will be completed and approved by DP&I prior to the commencement of construction. OEH acknowledges and supports WACJV's proposed mitigation and management approach.

The ACHMP will include the following provisions:

- Protection of sites (WC-OS1, WC-ST1, WC-IF1) that are not impacted by the Project (e.g. fencing);
- Monitoring of indirectly impacted sites (i.e. sites affected by subsidence) before, during and after mining to ensure that the sites' condition is monitored and maintained. These are the seven grinding groove sites (WSF-AG1 to WSF-AG4 and sites 45-3-3040 to 45-3-3042). This monitoring would be undertaken in consultation with the registered Aboriginal stakeholders;

- Further assessment in the Wyong State Forest/Jilliby SCA, in conjunction with the registered Aboriginal stakeholders, will take place on a panel by panel basis prior to that panel being mined to ensure that no further sites requiring recording and monitoring are within that area;
- Artefact scatter WC-OS2 was extensively tested during an archaeological test excavation program and the site is known to be a diffuse artefact scatter containing a very low density of artefacts. No further archaeological investigation is required;
- Induction procedures for construction personnel and the implementation of an unanticipated finds protocol to recognise and avoid Aboriginal cultural heritage items during the construction phase;
- Protocols for the involvement of registered Aboriginal stakeholders in the event that Aboriginal archaeology is encountered during the construction phase;
- Protocols for the escalation of archaeological investigation should the unanticipated finds protocol warrant such action; and
- Protocols regarding a Care and Control agreement for any Aboriginal cultural heritage items, such as artefacts, recovered during the course of the Project.

As the authorising agency, OEH has found that the Project and its interactions with Aboriginal cultural heritage have been adequately addressed by the Aboriginal Cultural Heritage Assessment and has recommended development consent conditions with respect to cultural heritage.

3.14 HISTORIC HERITAGE

All references to the Historic Heritage Assessment refer to Appendix T of the EIS.

3.14.1 Adequacy of Assessment

This section addresses a submission regarding the adequacy of the Historic Heritage Assessment.

Submission: RA6

WSC acknowledged in their submission that a comprehensive survey and report of the historic heritage of the areas surveyed within the Project Boundary had been undertaken.

3.14.2 Statement of Heritage Impact

This section addresses the submission regarding the provision of a Statement of Heritage Impact for each State or locally significant historic heritage item impacted by the Project.

Submission: RA3

A Statement of Heritage Impact (SoHI) assesses the impact of a development on the heritage value of a place or site and provides measures for the conservation, maintenance and/or enhancement of that place or site.

Three sites of local heritage significance were identified by the Historic Heritage Assessment as being potentially impacted by subsidence. The potentially impacted sites are the Brick and Iron Silo, the dwelling 'Bangalow' and the Little Jilliby Road Bridge, as shown on Figure 46 of the EIS. A SoHI has been prepared for each of the locally significant heritage sites in accordance with *Statements of Heritage Impact* (NSW Heritage, 2002) and the *NSW Heritage Manual* (HO/DUAP, 1996). These SoHIs are presented in **Appendix G**.

Wyong State Forest Historic Site 1 (WSF-HS1) is a disused forestry road near Little Jilliby Jilliby Creek. Although this site could be of interest to locals or visitors, it does not satisfy any of the criteria for heritage significance, as prescribed in 'A Guide to the Heritage System' (NSW Heritage Office, 2005). As a result, WSF-HS1 has been assessed as having no historic heritage significance (see Section 4.3.3 of the Historic Heritage Assessment). Section 7.15.3 erroneously identifies WSF-HS1 as a site of local heritage significance.

A SoHI is not required for WSF-HS1 or any of the other sites within the Project Boundary that were assessed as having no heritage significance.

3.14.3 Heritage Listings

This section addresses the submission regarding the new heritage listings in the Draft Wyong Local Environment Plan 2012.

Submission: RA3

The Historic Heritage Assessment consulted the *Wyong Local Environment Plan 1991* (Wyong LEP)) which identified 97 heritage sites within the Wyong LGA. The draft Wyong LEP identifies 159 heritage sites.

A review of the Draft Wyong LEP has determined that none of the new heritage listings are located within or in the immediate vicinity of the Project Boundary or the SIL. Therefore, no additional assessment is required.

3.14.4 Subsidence Impacts on Historic Heritage

This section addresses a submission from the public regarding potential impacts on historic heritage sites in the local vicinity.

Submission: P3

A member of the public asserted that two historic heritage sites at Wyong Creek will be impacted by "horizontal subsidence", namely the dwelling 'Bangalow' on Lot 103/DP 1133862 (formerly Lot 129/DP 755271) and the Wyong Creek Community Hall on Lot 1/DP 945671.

Both 'Bangalow' and the Wyong Creek Community Hall are listed in the Draft Wyong LEP 2012 as items of local heritage significance. The dwelling 'Bangalow' is located within the SIL. The impacts of the Project on this site have been assessed in Section 4.4.3 of the Historic Heritage Assessment.

The Wyong Creek Community Hall is located outside of the SIL and as such, will not be subject to any vertical subsidence, tilts or curvatures. The structure may be subject to far-field horizontal movements. These minor horizontal movements are bodily movements associated with no measurable strain. As a result, the structural integrity of the item is not predicted to be impacted by the Project. Proposed measures for the management of subsidence at historic heritage sites are outlined below in **Section 3.14.5** to ensure that heritage values are not impacted or diminished.

3.14.5 Potential Archaeological Sites

This section addresses a submission which highlights the potential for subsurface archaeological sites.

Submission: RA3

The survey undertaken as part of the Historic Heritage Impact Assessment considered the possibility of potential archaeological sites, including subsurface deposits that may not be manifest on the surface. The items recorded during the survey where either farm ephemera (such as sheds, enclosures and fences) or the remains of the logging industry in the form of tracks and culverts. None of these items are likely to be associated with significant subsurface deposits and no potential archaeological sites were assessed as being present within the Project Boundary.

3.14.6 Management and Mitigation

This section addresses the submission regarding the preparation of a Historic Heritage Management Plan.

Submission: RA3

To manage the impact of the Project on historic heritage sites, WACJV will prepare a Historic Heritage Management Plan (HHMP) upon receiving development consent. The HHMP will be prepared to the satisfaction of DP&I prior to the commencement of mining. The management plan will include:

- A list and map indicating the location of historic heritage sites identified within the Project Boundary and/or SIL;
- A review of the significance assessment and statement of significance during the operations phase for each identified historic heritage site impacted by the Project;
- Ongoing risk-based dilapidation studies to assess and monitor the structural integrity of identified and impacted historic heritage sites; and
- Building maintenance and/or remediation work if it is deemed that the Project is causing damage to historic heritage sites and its aesthetics.

WACJV will consult with relevant regulatory agencies during the preparation of the HHMP.

3.15 VISUAL

This section addresses the submission suggesting that the findings of the Visual Impact Assessment cannot be verified due to lack of information on the heights of structures.

Submission: P112

Appendix E of the EIS provides plan and elevation drawings for the relevant infrastructure items. The Visual Impact Assessment considered these drawings in its assessment.

3.16 SOCIAL

All references to the Social Impact Assessment (SIA) refer to Appendix V of the EIS.

3.16.1 Range of Social Impacts Associated with the Project

This section addresses a submission asserting that the SIA did not consider the full range of social issues.

Submission: RA7

The SIA was prepared in accordance with the DGRs, as well as in consideration of WSC's letter to DP&I (dated 7 November 2011) which informed the drafting of the DGRs.

The issues the submission identified as requiring further assessment are social issues that are typical of areas which are experiencing a significant change in both economic and social structure as a result of mining. These impacts are well documented and associated with cumulative impacts resulting from a number of mining projects being developed simultaneously (Franks et al, 2010). In these cases, such as in the Upper Hunter Valley in NSW and the Bowen Basin in Queensland, there has been a significant shift in structure from predominantly agricultural communities to predominantly mining communities with the associated social costs and benefits.

It has also been well documented that one of the most significant variables affecting socio-economic impact on local communities is the magnitude of the incoming workforce relative to the size of the receiving community. There is extensive evidence provided in the EIS which shows that the overall social impact of the Project will not significantly change the basic economic and social structure of the communities affected. There were a number of variables that were discussed in the EIS which showed this to be the case. For example, the Project would be the first major new mining development in the Wyong LGA.

As of 2011, only 0.68% of the workforce in the Wyong LGA was employed in the mining industry. During the operational phase of the Project, the impact of 242 employees migrating into the Secondary Study Area, including indirect and induced workers (i.e. multiplier jobs), would represent an increase of 0.42% to the workforce in Wyong (as of 2011) and an increase of 0.11% to the workforce in the Secondary Study Area.

The Secondary Study Area is comprised of the Wyong, Gosford and Lake Macquarie LGAs. Furthermore, the estimated increase in the demand for housing will be 0.44% of the total housing stock in Wyong LGA. This small increase in demand is not anticipated to have a significant impact on rental prices or the cost of permanent housing.

The other important distinction is that the Project is entirely underground, whereas the majority of mining developments in the Hunter Valley and Bowen Basin are open cut mines. Underground mines present a much lower risk of the issues raised in the submission in relation to public health.

3.16.2 Sense of Belonging

This section addresses the submissions regarding emotional distress associated with changes to the place where people live, and the loss of their attachment or sense of belonging to places and people.

Submission: RA7, P106

While significant to individuals, impacts to people's sense of belonging need to be assessed in terms of the degree of impact to a community as a whole. There is well documented evidence that a sense of belonging is lost by any individual when they do not feel in control of change that may be occurring in their communities (Franks et al, 2010). As explained in Section 7.17.4 of the EIS, the degree of change in the social and economic structure within the Secondary Study Area is predicted to be very minor.

3.16.3 Impacts of Shift Work

This section responds to the submissions raised by stakeholders regarding changes to shift workers the employment structure resulting from the Project impacting on aspects of community life.

Submission: RA7

The Project will not significantly change the dependence on shift work in the Secondary Study Area. As discussed in Section 2.5 of the SIA, the current sectors of the economy with the highest percentage of employees are job types where shift work has been and will continue to be a normal practice. There are many workers, particularly women with children, working in these sectors that may prefer shift work due to the flexible hours. The Project will not significantly change this situation.

In Lake Macquarie LGA, the three highest sectors of employment in the 2011 Census were Health and Social Assistance (14.6%), Retail Trade (11.8%) and Manufacturing (10.3%) which may be adding significantly more stress on families and individuals than the very marginal increase resulting from the Project.

3.16.4 Level of Pride

This section addresses the submissions from stakeholders regarding impacts on the level of pride in the area.

Submission: RA7

Discussion of this issue is heavily value loaded as there are many individuals in mining communities that feel pride in their community. As discussed in **Section 3.16.2**, social impacts such as loss of pride have occurred in communities where the pace of change overwhelms the individuals that make up the traditional component of the community.

However, there is significant evidence in the social development work conducted by WSC which demonstrates a high level of pride in their communities. Specifically, the WSC 'Community Strategic Plan' (2012) states that there was *"No significant change in the mean wellbeing scores for Central Coast residents over the period 2007 to 2012. The mean wellbeing score of 4.1 reflects a high level of wellbeing in the community".* The small degree of change to the socioeconomic structure of the Secondary Study Area resulting from the Project is not expected to change the high level of wellbeing in the community.

3.16.5 Increase in Domestic Violence

This section addresses to the submissions raised by stakeholders regarding the potential for increases in domestic violence resulting from the Project.

Submission: RA7

Public Safety is well documented in the social planning documents from both WSC 'Community Strategic Plan 2030' and LMCC 'LMCC Social Plan 2009-2014'. These documents indicate that domestic violence is associated with families with low esteem and particularly those which have unemployed members. These documents also demonstrate that the Central Coast and Lake Macquarie areas are perceived by their residents as safe areas. The addition of 242 working persons to the total workforce of 211,000 in the Secondary Study Area is not anticipated to lead to an increase in domestic violence.

3.16.6 Changes in Living Costs and Increased Wealth Divide

This section addresses the submissions regarding the potential for changes in living costs including housing affordability and an increased wealth divide.

Submission: RA7, P138

Increases in the cost of living are a well-documented impact of a situation where there is a large number of incoming workers relative to the local workforce resulting in increased demand for housing and expenses, particularly during the construction phase of a development (Franks et al, 2010). As discussed in Sections 2.6 and 6.1 of the SIA, the large number of construction workers (over 7,000 in 2006) living in the Secondary Study Area demonstrates that the demand for accommodation generated by the Project will be low compared to the accommodation available.

The large majority of construction workers will commute to the site either on a daily basis (local workers) or a work week basis. The estimated number of non-local workers commuting to the site is 225. The latest statistics available from the NSW Office of Housing (Rent Report 102 – December Quarter 2012) indicate that in the Wyong LGA during the December quarter of 2012, rental prices for one bedroom apartments decreased and rental prices for two bedroom apartments did not change. Annual figures were below averages for the greater Metropolitan region and NSW.

In addition, Section 4.1 of the SIA shows that there were over 2,500 hotel, motel and serviced apartment rooms in the Secondary Study Area with a vacancy rate of 52% in December 2011.

Section 2.2.2 of the SIA shows that there is already a clear wealth divide between the residents of the Primary Study Area and the other residents of the Wyong LGA based on income and employment. The Primary Study Area stands out in the Wyong LGA as a localised pocket of wealth within a LGA that has one of the highest rates of metropolitan unemployment in NSW. As of December 2012, Wyong LGA had an unemployment rate of 8.1%, compared to 5.1% for the state (DEEWR, 2010). The Project has the potential to reduce this gap by providing an additional 322 employment opportunities within the Wyong LGA (see Section 6.2.2 of the Social Impact Assessment).

3.16.7 Increased Demand for Health and Support Services

This section addresses the submissions regarding the potential increase in demand for health and support services due to increases in population and health impacts associated with the Project.

Submissions: RA7

Section 3.1 of the SIA discusses the existing demand for health services whilst Section 6.2.5 discusses the impacts resulting from the Project.

The increase in demand for health services is anticipated to be proportionate to the relative increase in the population. The increase in population due to the Project was estimated to range from 403 to 734 which represent an increase to the population of the Secondary Study Area of 0.22% to 0.44%. This increase is considered to be well within the normal planning assumptions of health care providers.

As discussed in Section 3.7.3, the $PM_{2.5}$ emissions generated by the Project are unlikely to result in any additional hospitalisations. Therefore, the air quality and health impacts of the Project will not increase demand on health services.

3.16.8 Impacts on Wyee

This section addresses the submissions asserting that the Social Impact Assessment does not consider the impacts of the Project on the community of Wyee.

Submission: RA7

Wyee is located in the LMCC designated Morisset Planning District in the southern part of the Lake Macquarie LGA. As such, Wyee falls within the Secondary Study Area, as shown in Figure 4 of the SIA. Wyee is described as a “small village centre” in a “dispersed location” (LMCC Lifestyles, 2020). Social impacts on Wyee have been considered through the assessment of impacts on the Secondary Study Area.

Wyee is considered to be within reasonable commuting time of the Project. As a result, it is possible that a share of the in-migrating population will relocate to Wyee. However, the number of persons relocating to Wyee as a result of the Project will be very low compared to the current population of Lake Macquarie LGA. The SIA estimated a population increase within the Lake Macquarie LGA of 246 to 411 persons.

This increase is very minor when compared to the LGA’s existing population of 189,006 (as of 2011). The 2011 population of Wyee was 2,588 which represented 1.4% of the population of Lake Macquarie LGA. On a proportional basis, the relative share of the incoming population that will relocate to Wyee would range from 3 to 6 persons. Given that Wyee is closer to the Project than other towns in the Lake Macquarie LGA, it is possible that a larger share of the incoming population would relocate to Wyee. Tripling the share would result in an anticipated population increase of 9 to 18 persons. An increase of 18 persons to the population of Wyee is not considered significant.

3.16.9 Impact of Additional Train Movements on Road Traffic Delays

This section addresses the submissions regarding the impact of additional train movements on delays for road traffic at level crossings.

Submission: RA7

As assessed in the Rail Study (Appendix R of the EIS), the additional train movements associated with the Project will increase closure times at the Adamstown and Islington level crossings by 56 minutes per day. Under current conditions, the Adamstown Crossing is closed for 432 minutes each day (30% of the time). The Project will increase closure time to 488 minutes each day (34% of the time). Similarly, the Islington Crossing is currently closed for 463 minutes per day (32% of the time). The Project is predicted to increase closure time at this crossing to 519 minutes (36% of each day). Therefore, the rail movements associated with the Project will increase closure times at level crossings by 4%.

Furthermore, the majority of train movements will occur outside of peak morning and afternoon traffic periods. The increase in delay times of 4%, with additional delays mostly occurring outside of peak hours, is not expected to lead to significant social impacts associated with traffic delays.

3.16.10 Mitigation Measures for Adverse Social Impacts

This section addresses the submissions asserting that the Social Impact Assessment fails to recommend measures to mitigate any negative social impacts or enhance any social benefits.

Submission: RA7

Section 7 of SIA and Section 7.17.5 of the EIS outline the management and mitigation measures are recommended, having regard to the results of the assessment.

3.16.11 Typographical Error

This section addresses the submissions from stakeholders regarding typographical errors in Figure 10 and Figure 11 of the SIA.

Submission: RA9

There are typographical errors in the x-axes of Figure 10 and Figure 11 in the SIA. The data shown in these figures are from October 2011 to October 2012. This does not affect the conclusions of the assessment.

3.16.12 Land and Housing Value in the Directly Affected Area

This section addresses the submissions regarding the potential for the Project to negatively affect land and housing prices in the Directly Affected Area.

Submission: RA9, SIG1, P113, P117, P160

Section 6.2.7 of Appendix V discusses recent trends in property prices on both the eastern and western side of the F3 Freeway and notes that "*At this stage of development there has been no evidence reviewed which suggested a loss in housing values as a direct result of the Project.*"

3.16.13 Incompatibility Between the Project and the Wyong Employment Zone

This section addresses the submissions regarding the potential for the Project to discourage clean industry and development in the area resulting in a loss of future employment opportunities in the Central Coast area.

Submission: SIG1, P81, P118

As discussed in Section 2.4.1 of the EIS, the land within the Wyong Employment Zone (WEZ) was rezoned for General Industrial, Environmental Conservation and Infrastructure land uses in November 2008. It is predicted that this development will generate employment for approximately 6,000 people. Development of the WEZ is currently well behind earlier planning schedules.

Section 2.5 of the SIA discusses employment policy and trends within the Central Coast region. The employment challenges were described in the Central Coast Regional Strategy (CCRS) (DoP, 2011) as follows:

- "*ensuring that sufficient employment lands and commercial office space is provided in appropriate locations to accommodate growth in existing and emerging industries and*
- *businesses increasing and diversifying job opportunities and increasing the level of employment self containment promoting innovation and skills development within the Region supporting and strengthening the existing employment base to help key industries achieve critical mass encouraging*
- *and investigating opportunities to diversify the Region's economy* "

Wyong Shire Council (WSC) has endorsed the CCRS but states in a recent State of the Shire Report (2011) that "it remains uncertain whether Wyong Shire can fulfil…" the growth targets in the CCRS.

The operations phase of the Project is expected to generate a total of approximately 800 jobs, comprised on 300 direct jobs and 500 flow-on jobs. The Project will therefore assist in addressing the employment challenges described in the CCRS.

There are not predicted to by any exceedances of the noise and air quality impact assessment criteria at the site of the WEZ. Therefore, the Project should not discourage development within the WEZ.

3.17 ECONOMICS

All references to the Economic Impact Assessment refer to Appendix W of the EIS.

3.17.1 Impact on Farmland Values and Proposed Residential Areas

This section addresses the submissions regarding the impact of the Project on farmland values and the values of residential property.

Submission: RA9, SIG1, P2, P135, P136, P140

The value of a property represents the present value of the expected stream of benefits that can be obtained from that land (and its associated infrastructure), including the expected future stream of net income from any agricultural production, amenity, etc. Any unmitigated impacts on the productivity of agricultural land or the amenity of current or future residential land will reflect on the value of a property.

The only impact on agricultural land identified in the EIS was in relation to the proposed offset areas and the potential for minor subsidence impacts on a turf farming operation, which may, but are very unlikely to result in a temporary loss of production while subsidence effects are remedied. These agricultural impacts were considered minor in the EIS.

For the purposes of understanding a highly unlikely but worst case scenario for impact assessment purposes, the cost of offset land (which reflects its agricultural productivity), the cost of remediation for the turf farm and a worst case assumed loss of production for 2-years was included in the Benefit Cost Analysis (BCA) for the Project.

The Extraction Area is located entirely within two Mine Subsidence Districts (MSDs). The Project has been designed to manage subsidence implications and to satisfy the subsidence criteria for these MSDs. Since the proclamation of the MSDs, all new residential development in these areas is required to meet certain structural standards. Any impact on existing or new houses due to mine subsidence is remedied by the Mine Subsidence Board (MSB) using funds obtained from a Mine Subsidence Levy on the coal mining industry. Given that impacts on houses will be remedied or compensated for, the impacts of the Project on property values are considered to be negligible.

Air quality modelling predicts that no properties will be significantly impacted by dust (refer to Section 7.5.3 of the EIS). Noise modelling for the existing private residential dwellings exposed to the Tooheys Road Site shows that the PSNC are satisfied at all dwellings. However, predicted noise modelling under a worst case modelling scenario suggests that the PSNC criteria may be exceeded over more than 25% of the contiguous land ownership at two private properties near the Tooheys Road Site (see Section 7.8.3 of the EIS). Even though there is no impact on the associated residences, there is the theoretical potential for these individual properties to experience some property devaluation. However, these landowners would be entitled to compensation via the acquisition of these affected properties at unencumbered property values.

Land in the vicinity of the Project that is not physically impacted will experience some increase in land value as a result of increased economic stimulus in the region and thus increased demand for property.

3.17.2 Risk Assessment and Benefit Cost Analysis

This section addresses a submission stating that the risks, benefits and costs associated with the Project need to be re-rated based on the claimed knowledge gaps and uncertainties that remain and the findings of further recommended studies.

Submission: RA6

The BCA of the Project was based on the best available information about the Project, including information from a range of specialist assessments predicting the likely environmental, social and cultural impacts. The Economic Impact Assessment considered reasonable worst case assumptions for the purposes of the impact assessment including the BCA. The incorporation of risk assessment in BCA requires knowledge of the probabilities of different outcomes occurring. In the absence if this level of information, the accepted approach in BCA is to undertake sensitivity testing.

This involves changing the values of critical variables in the analysis, to determine how the results might be affected. Sensitivity testing was undertaken in Section 2.6 of the Economic Impact Assessment, with the BCA result tested for changes to the following variables:

- Opportunity cost of land;
- Capital costs;
- Operating costs;
- Coal value;
- Forestry impacts;
- Agricultural impacts;
- Greenhouse gas impacts; and
- Social value of employment.

This analysis indicated that the results of the BCA were not sensitive to reasonable changes in the assumptions for any of these variables. In particular, significant increases in the values used for impacts of greenhouse gas emissions, agricultural impacts and forestry impacts had little impact on the overall economic desirability of the Project.

The results were most sensitive to decreases in the value of the product coal. However, substantial and sustained reductions in assumed coal prices would be required to make the Project undesirable from an economic efficiency perspective.

3.17.3 Rail Network Costs

This section addresses a submission stating that the BCA does not incorporate costs on the broader rail network such as an apportionment of both capital and recurrent costs for the Awaba North loops project, upgrade to 30t axle load, increase in maintenance and asset renewal costs.

Submission: RA13

The BCA of the Project includes payments for railing coal to Newcastle. Rail costs paid by coal producers include a component to cover the costs of rail access and use. There is also a component that is transferred by rail access providers to rail infrastructure managers to fund current and future infrastructure. The inclusion of an allowance for the apportionment of network capital and recurrent infrastructure costs associated with the Project would result in double counting.

3.17.4 Impacts of Climate Change

This section addresses the submissions stating that the Project is unacceptable for climate change and that BCA does not include the costs of climate change from transportation outside Australia and the burning of coal.

Submission: SIG1, SIG6, P64

Determining the desirability of a Project based on a single indicator (such as greenhouse gas) is nonsensical and contravenes the objects of the EP&A Act. If impact on climate change was the only indicator considered, all existing and proposed developments or activities would be undesirable. Current climate change policy in Australia aims to meet specified targets through the setting of a price on carbon. When an appropriate price (tax) is set on carbon (that reflects the desired quantity target) or when a quantity target is established through a tradeable permit scheme, it is not necessary for governments to intervene further. The market will re-allocate resources so as to achieve the desired level of greenhouse gas.

Rather than focusing on a single impact, BCA is concerned with weighing up all the economic efficiency costs and benefits of a project and determining whether the aggregate benefits to society exceed the costs.

The BCA for the Project accounted for all GHG emissions associated with the mining of coal and delivery of product coal to port. This exceeds the level of GHG generation that the 'National Greenhouse and Energy Reporting (Measurement) Technical Guidelines' (Commonwealth Department of Climate Change and Energy Efficiency, 2011) would attribute to the Project.

The BCA used an estimate of the global social damage cost of carbon of $23/t CO2-e, reflected by the Federal Government's current carbon tax. The global social damage cost of CO_2-e is the present value of the additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions.

GHG emissions from the burning of coal are not relevant to a BCA of the Project. The downstream use of the coal constitutes a different activity, which will be subject to a separate BCA. If coal is proposed to be used for coal-fired electricity generation, the costs associated with the BCA for an electricity generating development would include the cost of coal, labour, land and capital inputs, electricity distribution and environmental impacts, such as greenhouse gas generation. The benefits associated with an electricity generation development BCA would include the community's willingness to pay for electricity. There may also be externality benefits of electricity for economic development, education and medical care. All of these costs and benefits are relevant considerations at this next stage of the production process.

3.17.5 Royalties

This section addresses the submissions regarding the royalty rate applied in the BCA.

Submission: SIG5

The royalty rates applicable for coal mining in NSW are:

- 6.2% for deep underground mines (coal extracted below 400 m);
- 7.2% for other underground mines; and
- 8.2% for open cut mines.

As indicated in the Economic Impact Assessment, the Project will involve underground coal mining at depths of between 350 m and 690 m. Royalties were estimated by applying the 6.2% rate to coal mined at depths greater than 400 m and the 7.2% rate for coal mined at depths less than 400 m.

3.17.6 Commonwealth Taxes

This section addresses submissions regarding the calculation of revenue to the Commonwealth derived from company tax.

Submission: SIG5

The amount of company tax payable on the Project was estimated by applying the corporate tax rate of 30% to the estimated gross profit of the Project.

The submission suggests that the effective company tax rate is likely to be 10% to 17% of gross profit, instead of the 30% required by the Australian Tax Office. Two studies are quoted as the source of this claim. One of these studies calculates the effective tax rate for the entire mining sector (not only the coal mining sector) according to Gross Operating Surplus (GOS) instead of gross profit. GOS does not account for production costs such as consumption of fixed capital, interest, royalties, land rent payments and direct taxes payable on inputs. GOS is the incorrect denominator for estimation of the effective tax rate.
The other study also refers to the Australian “mining sector” (rather than the coal mining sector) and it is not clear if any coal mining companies were included in the data used in the analysis.

Although the level of the effective tax rate on the mining sector in general and on this specific Project can be debated, the Economic Impact Assessment will still support the conclusion that the Project will have net social benefits to Australia and NSW.

3.17.7 Production

This section responds to the submission regarding the production schedule for the Project.

Submission: SIG5

The Economic Impact Assessment and the EIS both state that production will be up to 5.0 Mtpa of product coal over a Project life of 28 years (3 years of which is construction).

3.17.8 Price and Quality of the Coal

This section addresses a submission regarding the assumed price of coal and specifications of the coal produced by the Project.

Submission: SIG5

The coal produced by the Project will be largely export quality thermal coal. The price of coal assumed in the BCA ($99/tonne) is considered applicable to this specification of coal. Nevertheless, there is considerable uncertainty around the future price of coal from the Project (and the USD/AUD exchange rate). Consequently, variations in the assumed price of coal from the Project have been considered in the sensitivity analysis (see Section 2.6 of the Economic Impact Assessment).

3.17.9 Costs of Production

This section addresses the submissions from stakeholders stating that there is limited information on operating costs and that the estimate given for operating costs is unrealistically low.

Submission: SIG5

Detailed information on operating costs for the Project is commercial-in-confidence and was therefore not reported in the Economic Impact Assessment.

One of the reasons that the production costs are relatively low is that the Project, unlike other coal mining operations, does not require complex processing of the run-of-mine (ROM) coal mined to produce coal of saleable quality. The in-situ quality of coal is high, allowing the Project to operate without a Coal Preparation Plant. In addition, the operating costs reported in the Economic Impact Assessment are net of royalties, unlike the cash costs for other mines referenced in the submission.

3.17.10 Social Value of Employment

This section addresses the submission regarding the social value of employment in the BCA.

Submission: SIG5

The submission asserts that the inclusion in the BCA of a social value for the employment created by the Project is inappropriate. The submission references a number of people who purportedly oppose its inclusion in the BCA.

There are two problems with the arguments in this submission. Firstly, it misunderstands the fundamental concepts of neoclassical welfare economics on which this value is based and secondly, the submission misrepresents the views of other economists.

Neoclassical welfare economics and BCA are based on the concept that individuals are the best judge of what makes them better or worse off. It is then the addition of individual benefits and costs that gives an indication of community wellbeing, and hence costs and benefits in BCA. Therefore, it is not appropriate for the author of this submission to determine (without any empirical evidence) whether the community holds values for the employment of others. The values of the community are dependent on the preferences of individuals within the community.

Portney (1994) (a member of the Blue Ribbon Panel that considered the merits of non-market valuation methods in assessing environmental damage claims in the USA) recognised that the broader community may hold non-market values for social outcomes such as employment. Portney (1994) identified that the concept of existence values (which has been applied extensively in an environmental context) should be interpreted more broadly and includes non-market, non-environmental goods:

> *If I derive some utility from the mere existence of certain natural environments I never intend to see (which I do), might I not also derive some satisfaction from knowing that refineries provide well-paying jobs for hard-working people, even though neither I nor anyone I know will ever have such a job?. I believe I do. Thus, any policy change that "destroys" those jobs imposes a cost on me – a cost that, in principle, could be estimated using the contingent valuation method.... Since regulatory programs will always impose costs on someone – taking the form of higher prices, job losses, or reduced shareholder earnings – lost existence values may figure every bit as prominently on the cost side of the ledger as the benefit side* (Portney 1994, p. 13).

There is considerable empirical evidence to support Portney's assertion. Employment effects have been included in a number of choice modelling studies, including in relation to:

- Employment effects of energy programs (Johnson and Desvouges, 1997);
- Direct and indirect forest industry employment changes due to protection of threatened populations of Woodland Caribou in Alberta (Adamowicz et al., 1998);
- Direct forest industry impacts due to changes in forest management in Saskatchewan, Canada (Moon 2004);
- Irrigation related employment losses as a result of wetland protection (Morrison et al. 1999);
- Loss of direct jobs and regional income from a reduction in broad scale tree clearing in the Desert Uplands of Queensland (Blamey et al. 2000); and
- Local employment losses from different conservation management strategies for the Matang Mangrove Wetlands in Perak State, Malaysia (Othman et al. 2004).

In all cases except Adamowicz (1998), the social attribute of employment was highly significant in the respective econometric models. In a coal mining context, Gillespie Economics (2008, 2009a and 2009b) found that the NSW community had a positive and statistically significant willingness to pay for additional years that mines would provide direct jobs.

There are therefore very strong theoretical and empirical arguments for inclusion of a social value for employment provided by the Project.

The first concern raised by Professor Bennett regarding the inclusion of a social value for employment in the 'Maules Creek Coal Project Economic Impact Assessment (Gillespie, 2011) relates to the limitations of benefit transfer (i.e. the transfer of a value from a study in a different location and context). Limitations with benefit transfer are acknowledged and are dealt with in the Economic Impact Assessment by conservatively reporting the BCA results both with and without the inclusion of the social benefits of employment.

The second concern raised by Professor Bennett relates to situations where the economy may be at full-employment. Under these circumstances, proposed developments do not add to employment in society. The latter issue is not considered relevant in the context of this Project because it is difficult to argue that the Australian economy would be at full employment over the life of the Project. The Wyong LGA has an unemployment rate of 8%, which is significantly higher than the rate of 5.2% for the whole of NSW (DEEWR, 2011).

As identified by the submission, Professor Bennett is one of Australia's most senior academic economists. In particular, his field of expertise is non-market valuation. He has included the social value of employment in a number of his research studies including the following peer reviewed and published studies:

- Morrison, M., Bennett, J. and Blamey, R. (1999). 'Valuing improved wetland quality using choice modelling', *Water Resources Research*, Vol. 35, No. 9, pp. 2805-14;
- Bennett, J., Van Bueren, M. and Whitten, S. (2004). 'Estimating society's willingness to pay to maintain viable rural communities', *Australian Journal of Agricultural and Resource Economics*, Vol. 48, Iss. 3, pp. 487–512;
- R.K. Blamey, J.W. Bennett, J.J. Louviere, M.D. Morrison and J.C. Rolfe (2002), 'Attribute Causality in Environmental Choice Modelling', *Environmental and Resource Economics*' Vol. 23, pp. 167–186;
- Blamey, R., Rolfe, J., Bennett, J., and Morrison, M., (2000), 'Valuing remnant vegetation in Central Queensland using choice modelling', *The Australian Journal of Agricultural and Resource Economics*, Vol. 44, No. 3, pp. 439-56; and
- Gillespie, R. and Bennett, J. (2012), 'Valuing the Environmental, Cultural and Social Impacts of Open Cut Coal Mining in the Hunter Valley of NSW, Australia', *Journal of Environmental Economics and Planning*.

Professor Quiggin and Dr Denniss are also quoted by the author of the submission as criticising the inclusion of the social value of employment in the BCA. However, examination of the references provided does not support such a claim.

Professor Quiggin's main issue relating to employment effects at Warkworth was whether the number of additional jobs gained would be as great as suggested, from a general equilibrium perspective. He made no comment on the veracity of a social value of employment from choice modelling studies.

Similarly, the affidavit of Dr Denniss was concerned with the use of input-output analysis and the extent to which employment generated by the Warkworth Extension Project would crowd out other employment in the region. Dr Denniss made no comment on the veracity of the social value of employment included in the BCA.

Deloitte Access Economics (2012) does not analyse this issue at all but simply reproduces the claims in the submission by Economists at Large.

3.17.11 Externality Costs

This section addresses a submission asserting that the impacts of the Project on water supplies, air quality, amenity and local traffic have not been included in the BCA.

Submission: SIG5

A submission states that the BCA ignores debates over the potential impacts of the Project by assuming there will be no impacts. The submission asserts that by ignoring these external costs, the value of the Project is overstated. This claim is incorrect. The potential externality impacts of the Project were considered in the EIS in a number of ways.

At its simplest level, the BCA identified net production benefits of the Project to Australia of $346 M and identified that any environmental, social and cultural impacts to Australia, after mitigation, would need to be valued at greater than this amount for the Project to be questionable from an economic efficiency perspective. The EIS provides detailed (non-monetary) consideration of the environmental, social and cultural impacts of the Project and the proposed means of mitigating these impacts. This threshold value approach to BCA leaves the ultimate considerable of the physical level of externality impacts and their value to the decision-maker. This approach clearly does not ignore the potential externality impacts of the Project and leaves it open to the decision-maker to resolve any debates about the potential level of the externality impacts of the Project.

At the next level of the BCA, detailed consideration was given to the value of potential externalities based on the expert assessments in the EIS. The BCA considered the NSW Government (2012) Guideline for the use of cost benefit analysis in mining and coal seam gas proposals. This guideline provides that the practical principle of materiality applies when attempting to value the impacts of a project on the well-being of people. This principle provides that only those impacts that are likely to have a material bearing on the decision need to be considered in the BCA.

Based on the expert assessments in the EIS, the impact on water supplies, air quality, and local traffic were considered negligible, so there was no material externality cost to include in the BCA. Some negligible to moderate potential visual amenity impacts were identified. The cost of mitigating these visual impacts was included in the BCA. Potential subsidence impacts were acknowledged and incorporated into the BCA through the mine subsidence levy which aims to pay for remedying or compensating landowners for damage to property. For properties where noise impacts were predicted, the full cost of acquisition of the affected properties was included as a cost in the BCA, as opposed to incorporating only the partial property value impact. The BCA also acknowledged that there would be some loss of ecological values but that these would be mitigated through the provision of ecological offsets. The economic cost of providing these offsets was included in the BCA. Greenhouse gas costs were also valued and included in the BCA. Therefore, externality impacts were clearly not ignored in the BCA.

Overall, the Project was estimated to have net social benefits to Australia of between $346 M and $531 M (in discounted terms as a net present value) and hence is desirable and justifiable from an economic efficiency perspective. These figures again provide a threshold value that any other impacts (e.g. identified in resolving disputes between experts) would need to exceed to make the Project questionable from an economic efficiency perspective.

3.17.12 BCA Overstates Economic Benefits and Lacks Transparency

This section addresses a submission which asserts that the BCA overstates the economic case for the Project, fails to clearly demonstrate the economic benefits of the Project to Australia and NSW and lacks transparency around key calculations.

Submission: SIG5

The view that the BCA overstates the economic case for the Project reflects the issues raised in the submission with respect to the estimation of royalties, company tax, production schedule, quality of coal, costs of production, and social value of employment externalities. However, as identified above the issues raised are of questionable validity. The estimated net benefits to Australia of between $346 M and $531 M are clearly demonstrated. Although BCA is not recommended to be undertaken at the sub-national level, through consideration of the distribution of Australian costs and benefits, the BCA also clearly demonstrates that the Project would have net benefits to NSW.

The BCA recognises the uncertainty around its core assumptions and undertakes sensitivity testing of key variables. The sensitivity analysis indicates that the BCA results are not sensitive to reasonable changes in assumptions regarding any of these variables.

The Economic Impact Assessment very clearly identifies and documents the steps in the BCA and the major assumptions embodied in it. Some elements of the BCA, and indeed BCA of all private investment projects, are based on commercial-in-confidence financial data and there is a limit to which this can be disclosed in the publicly available report.

3.17.13 Use of Input-Output Analysis

This section responds to the submission objecting to the use of input output analysis in the Economic Impact Assessment.

Submission: SIG5

This submission incorrectly suggests that input-output modelling has fallen from favour with economists and provides a number of quotes purportedly supporting this claim and referring to the assumptions of input-output analysis.

The application of input-output analysis is a suitable methodology for predicting changes in the structure of regional economies and is consistent with the NSW DP&I (formerly DoP) 'draft Guidelines on Economic Effects and Evaluation in EIA' (2002, p. 18):

> *If a proposal is predicted to have significant economic impacts at the regional or State scale, it is appropriate to assess these economy-wide effects. ... These impacts can be assessed by means of a multi-sectoral or input-output model which identify regional impacts in terms of changes in the value of output for separate sectors of the regional economy, as well as changes in value-added, income and employment.*

The assumptions underlying input-output analysis are well documented, including in the Economic Analysis of the Project (see Attachment 3 of the Economic Impact Assessment in the EIS Appendix W). One of the key simplifying assumptions of input-output analysis is that there is unlimited labour and capital available to the region at fixed prices and therefore regional economic activity does not face capacity constraints that would result in increases in prices and crowding-out of other economic activity.

Crowding out would be most prevalent if the regional economy was at full employment and it was a closed economy with no potential to use labour and other resources that currently reside outside the region. In this situation, a mining project requiring labour and other resources would compete for them with existing activities. However, the Central Coast Region is not at full employment and is not a closed economy. It has potential access to employed and unemployed labour and capital resources from across the country and overseas.

Even where a mining development utilises already employed labour resources from inside the region, there is a filter effect where these jobs are filled by other employed or unemployed labour resources, which creates vacancies that are then filled by other employed or unemployed labour resource etc. This filter effect is driven by the continual addition to the labour force from school leavers, TAFE and University graduates and potentially persons not currently seeking employment. The potential labour force to meet demand in the region is considerably greater than just the labour force in the region and hence from a regional perspective is virtually unlimited.

Consequently, for small open economies, price increases and crowding out of other economic activity is likely to be negligible. In this respect, a study by Deloitte Access Economics (2011) found no statistical evidence of higher rental, housing or grocery prices in Singleton as a result of mining.

While more complex models such as Computable General Equilibrium (CGE) modelling can conceptually deal with the positive economic activity impacts of a project and any partially offsetting negative economic activity impacts, for small regional economies, it is unlikely that these more complex models will surpass the simpler input-output model. Firstly, the small open economy condition minimises the need to address offsetting impacts.

Secondly, given the considerable difficulties associated with estimating a large number of coefficients and parameters required for CGE models when there is virtually no local data available, many exogenous assumptions are required to be made by the modeller, so the increased uncertainty is likely to more than offset the increase in model sophistication. Consequently, CGE models are mostly used at the State and National level for large scale policy issues.

The submission provides two examples to illustrate that input-output modelling has fallen out of favour. On closer examination, neither example demonstrates this point. The first quote from NSW Treasury (2009) states that:

> *Model based economic impact assessment [such as IO analysis] is* ***not a substitute for*** *a thorough economic analysis of a policy. The appropriate method for analysing policy alternatives is benefit cost analysis (BCA).*

This is not in dispute. The main method used to analyse the economic efficiency of the Project was BCA. Input-output (IO) analysis is identified in Section 1 of the Economic Impact Assessment as a method for providing information on the economic activity provided by the Project, as an adjunct to the BCA, not as a substitute for it.

The submission also refers to the following statement from the Warkworth decision in the NSW Land and Environment Court:

> *There is another, more fundamental issue with the IO analysis. The IO analysis only looks to economic impacts, not environmental or social impacts, and then only to economic impacts measured by reference to goods and services with a market value, not those without a market value. It provides, therefore, some information but only on one set of matters relevant to be considered by the approval authority in determining the project application. The IO analysis is not a substitute for the decision-making process that the approval authority must undertake in determining the project application, and the conclusions the IO analysis reaches cannot be substituted for the fact finding, weighting and balancing of all of the relevant environmental, social and economic matters required to be considered by the approval authority.*

> *The conclusions the IO analysis reaches on the economic benefits of approving the Project, evaluated for their reliability and given appropriate weight, need to be balanced against all other environmental, social and economic benefits and costs.* (Preston J, at par 463).

However, the statement is erroneous in its criticism of IO in that IO does not purport to look at environmental and social impacts. It is solely concerned with examining the market based economic activity associated with a project. Similar to all the individual environmental, social and cultural assessments undertaken as part of the EIS, IO provides one piece of information on the economic consequences of the Project for consideration by the decision-maker.

IO is often used to inform government policy. Recently, it has been used by the NSW Government in relation to National Parks and the Commonwealth Government in relation to the draft Murray Darling Basin Plan, along with other forms of economic and environmental analysis. The Reserve Bank of Australia (2013) used input-output analysis in its research paper on the Industry Dimensions of the Resource Boom.

3.17.14 Other Employment Impacts

This section responds to the submission that suggests negative employment consequences of the Project.

Submission: P4

This submission suggests that the NSW taxpayer will bear the costs of additional health jobs created due to dust emissions and construction jobs to address the impacts of subsidence, flooding, and road and rail traffic. However, this statement ignores the findings of the specialist assessments of impacts that identify negligible dust, subsidence, flooding, road and rail impacts.

3.17.15 Financial Benefits to South Korea

This section addresses the submissions from the public regarding the return obtained by South Korea from the mine compared to NSW taxpayers.

Submission: P4, P67, P91, P125

This submission asserts that the NSW taxpayers obtain a benefit of $7 a tonne or slightly more while the citizens of South Korea acquire coal worth around $170 a tonne minus the cost of mining and transport.

NSW obtains direct benefits from royalties and also benefits indirectly from the company and other taxes payable on the Project. The South Korean investment in the Project also provides economic stimulus to the regional, state and Australian economy.

The Project requires significant capital investment from South Korea with the investors facing considerable investment risk (e.g. whether they will obtain approval, future prices, future costs, changes in technology of energy alternatives, etc.).

As identified in the BCA, the return to South Korea in the form of net profit from the investment is of a similar magnitude as the royalties and company tax that will accrue to Australia. The return to Australia is obtained without any investment risk.

3.17.16 Tourism Jobs

This section addresses the public submission regarding the development of Tuggerah Lakes into a fishing mecca that could generate as many long term jobs as the Project.

Submission: P4

Whilst the investment proposed by the author of the submission may provide jobs, whether the proposal is desirable from an economic perspective would depend on whether the benefits exceed the costs. The Project would not have any impacts on this proposed investment to develop Tuggerah Lakes as a fishing mecca and these two proposals are certainly not mutually exclusive.

3.17.17 Local Economic Benefits

This section addresses the submission contending that the significant economic benefits of the Project will be to a foreign company, rather than the local economy.

Submission: P125

As discussed in Section 3.3.2 of the Economic Impact Assessment, the operation of the Project is predicted to make the following contributions to the regional economy:

- $625M in annual direct and indirect regional output or business turnover;
- $391M in annual direct and indirect regional value-add;
- $79M in annual direct and indirect household income; and
- 805 direct and indirect jobs.

Although the Project will produce coal for export, there will be significant benefits to the local economy as demonstrated above.

3.18 SOIL & LAND CAPABILITY

All references to the Soils and Land Capability Impact Assessment (SLCIA) refer to Appendix X of the EIS.

3.18.1 Insufficient Assessment of Soil and Land Resources

This section addresses the submission from stakeholders contending that the soil and land survey does not satisfy the DGRs.

Submission: SIG1, P176

The DGRs stated that the EIS must address the issue of “Land Resources — including a detailed assessment on the potential impacts on:

- Soil and land capability (including land contamination;”.

The SLCIA was undertaken using baseline data and limited ground-truthing across the site. The assessment utilised published soil maps of the area to a scale of 1:100,000, which is consistent with a semi-detailed investigation and at a level justifiable to adequately to address the DGRs.

The 'Guidelines for Surveying Soil and Land Resources' (McKenzie et al 2008) provide minimum and maximum intensities for any modal scale representative of survey intensity. In accordance with the sampling locations mentioned, this survey would fit broadly within a 'Reconnaissance' scale category, which is not deemed to be a detailed assessment of soils and land capability. Further site sampling of key soils in critical areas would have brought the survey intensity to approaching the 'Detailed' level defined by McKenzie et al (2008). However, the SLCIA was augmented with a published 1:100,000 soil landscape map (Murphy and Tille, 1993). The EIS has undergone the regulatory review process and DP&I has deemed that the SLCIA was sufficient for satisfying the DGRs. It is therefore considered that a relevant level of assessment was conducted for the Project.

3.18.2 Survey Scale of Soil and Agricultural Resources

This section responds to the submissions from stakeholders regarding the reporting of the survey scale for the soil and agricultural resources across the Project Boundary.

Submission: SIG1, P176

The scale of survey and field assessment was not clearly presented in the methodology. The DGRs did not prescribe a specific scale of survey other than requiring a detailed assessment. It was implied that the survey scale should be commensurate with the previous soil landscapes mapping and to complement them. Prior mapping was presented at 1:100,000 scale (Murphy and Tille, 1993). .

While the scale was omitted from the maps within the SLCIA, the soil and land evaluation maps are presented at close to 1:50,000 scale.

3.18.3 Baseline Data

This section addresses the submission regarding the adequacy of the baseline data collected for the SLCIA.

Submission: SIG1, P176

The DGRs and the 'Draft Agricultural Assessment Guidelines 2011' do not provide a definition of "Detailed assessed soil and land resources assessment. Due to the Project's small direct disturbance area, it is considered sufficient to use the data already presented in the prior soil mapping of the area (Murphy and Tille, 1993) and the Soils and Land Information System (SALIS) database before undertaking limited site assessment for ground-truthing the baseline information.

The site assessment undertaken for the SLCIA included:

- A site walkover focused predominantly on the surface infrastructures sites and public access roads. The surface infrastructure sites have been targeted due to the higher potential for soil and landscape disturbance at these locations compared to other areas within the Project Boundary;
- Landscapes within the Project Boundary were evaluated using the baseline information, including assessment of landform variability, geomorphologic units and landscape connectivity;
- Site features were noted, including erosion features, indications of soil movement (e.g. slumping) and salinity indicators across the study area (e.g. dead vegetation, salinity resistant vegetation, scalding, salt crusts, etc.); and
- During the site walkover, four open cut profiles situated along roadways and along erosional features were logged by a CPSS qualified soil scientist in order to gain an understanding of sub-surface soil conditions within the Project Boundary.

Due to the limited number of soil types identified within the Project Boundary, inaccessible terrain (with limited agricultural potential) within the Extraction Area, and the proposed directly disturbed areas for the Project, the baseline assessment undertaken is considered to be adequate for the purposes of the DGRs and the Draft Agricultural Assessment Guidelines.

3.18.4 Reliability of Soil and Land Information System

This section addresses the submissions from stakeholders regarding the reliability of information obtained from the SALIS database.

Submission: SIG1, P176

Although the SALIS database does not provide a detailed assessment of the reliability of entries, the source of the data can be identified and evaluated. In most cases, the data is from NSW government sources, which is generally reliable. The 20 sites of soil data referenced (see **Appendix I**) have been commonly referred to in the SLCIA and this information is available for public reference online.

The soil information collected from the SALIS database (DIPNR, 2011) was collected in the field prior to the SALIS database becoming available to the general public. The names presented on the logs sheets were Murphy and Tille, who were NSW government personnel at the time. Murphy and Tille were authors of the Gosford 1:100,000 soil landscape map. Soil profiles were logged in accordance with Stace et al (1968) and Northcote (1979), which suggests that the work was undertaken by trained soil scientists.

3.18.5 Presentation of Supporting Information from Field Surveys

This section addresses the submission regarding the provision of supporting information from the field surveys carried out.

Submission: SIG1

The supporting information from the 'ground-truthed' (i.e. field) observations was omitted from the SLCIA to maintain brevity and succinctness. This information has been collated and is presented in **Appendix I**. Soil observation depths ranged from 0.3 m to a maximum of 4 m from the soil surface, as opposed to the depths of 0.3 – 0.4 m stated in the ACA's submission. This reflected the actual depths of the soil material itself. No laboratory data was undertaken which is a requirement of the Australian Soil Classification (ASC) (Isbell 2002). However, field soil pH was measured and other properties such as sodicity and salinity were observed to support publish data. Susceptibility to salinity was determined by studying the position of the soil profile within the landscape, drainage and vegetation indicators. Soil sodicity was determined by examining the soil structure, feel of the soil and presence of pale A2 (Isbell 2002).

3.18.6 Verification of Australian Soil Classifications

This section addresses the submission from the ACA stating that the Australian Soil Classifications are unable to be verified with the data presented.

Submission: SIG1

Due to the small disturbance area associated with the Project, the use of mapping and limited ground-truthing to determine soil types is considered sufficient. The published soil landscape of Gosford 1:100,000 map was based on the great soil groups (Stace et al, 1968) so the reliance on laboratory data was not as critical as for the Australian Soil Classification (Isbell, 2002).

The information presented within the SALIS soil profile logs supports the description of Kurosols used in the SLCIA. The majority of the soil profiles have a pH of less than 5.5 in water, which is required to represent the strongly acidic subsoil of a Kurosol. These soil profiles have been presented in **Appendix I.**

The classification of certain soils as Sodosols was based on the initial assessment of the soil profiles as being classified a Soloth (Stace et al 1968), which is described as an acid duplex soil with high sodium content and prismatic structure.

3.18.7 Representative Soil Types

This section addresses the submission from the ACA requesting further detail on the representative soil types within the Project Boundary.

Submission: SIG1

Soil types have been classified to the ASC Order level, as opposed to the 'Family' level contended by the ACA. The classification is based on the assumption that the 20 SALIS sites and the prior mapping were reliable, and that the current assessment confirmed and added to this information.

However, these are basic soil classification types and would ideally require further detail. A more complex classification would support their interpretation and support recommendations for land evaluation and topsoil assessment. Due to the small disturbance area for the Project, this in-depth procedure was not considered necessary. Through the regulatory review process for the EIS, DP&I has deemed the SLCIA to be adequate.

Summary soil profile descriptions for the soil landscapes present within the Project Boundary are presented in **Table 7**. These are obtained from Murphy and Tille (1993) and the SALIS reports. Ratings have been based on classifications from Murphy and Tille (1993).

Table 7
Soil Profile Descriptions

Soil Name (ASC)	Profile description
Dermosol	Dermosols were represented at one soil profile location within the Project Boundary (location 10). Topsoil extended to a depth of 0.3 m and was comprised of a brown silty loam with a pH of 5.5. Soil structure was moderately pedal with a blocky structure. A gradational boundary separated a silty clay loam at 0.8 m in depth. Structure of the subsoil was moderately pedal with a field pH of 6. Fertility was considered moderate to poor due to the lower clay content and nutrient holding capacity. Soil had a moderate water holding capacity due to the deep soil profile >2 m. Gravel content was low throughout the profile < 2%.
Sodosols	Topsoil generally extended to a depth of 0.2-0.3 m with some sites having a bleached A2 horizon. Texture of the A horizon ranged from a silty loam to silty clay loam which was generally brown in colour. Structure was weak to moderate and some hardsetting features were noted. Topsoil generally had a field pH 5.5-6. A distinct boundary separated the B horizon of a medium clay, yellow brown in colour. The B horizon had a weak prismatic structure and the field pH ranged from 5.5-6. Soil was characterised as having a low to moderate permeability, due to the poor structure and dispersive nature. This soil group generally had an acidic profile in the range of 5.5-6. Due to the presence of clay subsoil the soil had a moderate water holding capacity and CEC. Soil has a high erodibility and moderate to poor fertility.

Soil Name (ASC)	Profile description
Kandosol	Topsoil texture ranged from a coarse loam sand to a sandy clay loam to a depth 0.2-0.3 m. Colour was yellow to brown. Structure was weak with a field pH of 6. Minor dispersion was noted at some of the site and potential hardsetting characteristics were observed. Gravel content was low. A gradual boundary separated a B horizon of light medium sandy clay to sandy clay loam. Colour was yellow brown and the structure was generally poor. The subsoil was considered to have a low fertility due to the low CEC levels and low water holding capacity. Kandasol has a potential high erosion risk due to the low cohesional strength of the subsoil and landscape position
Tenosol	Texture of the upper profile (0-0.5 m) generally ranged from a loose brown sand to brown sandy loam. Due to this sandy nature the soil structure was apedal with only minor organic matter content. Field ranged from pH 4.5-6.5. At depth a sandy clay loam, silty clay or sandy clay could be encountered with weak development and subangular blocky structure. Colour ranges from brown to yellow with some localised stones encountered throughout the landscape. Field pH was 5-6.5 and the subsoil had a low fertility, poor water holding capacity and high erodibility.
Kurosol	Topsoil generally extended to a depth of 0.2-0.3 m, with some sites having a bleached A2 horizon. Texture of the A horizon ranged from a silty loam to silty clay loam which was generally brown in colour. Structure of the A1 was moderate. Topsoil generally had a field pH of 5.5-6. A distinct boundary separated the B horizon of a medium clay yellow brown in colour. The B horizon had a moderate structure and the field pH ranged from 5.5-6. This soil group generally had an acidic profile in the range of 5.5-6. Due to the presence of clay subsoil, the soil was considered to have moderate to low fertility and water holding capacity. Similar to the rest of the soil groups the subsoil was considered to have high erodibility potential.

3.18.8 Biophysical Strategic Agricultural Land

This section addresses the submission from the ACA stating that the assessment was not undertaken in accordance with the Biophysical Strategic Agricultural Land Verification Guidelines (OEH, 2013).

Submission: SIG1

The SLCIA was completed prior to the introduction of the *Biophysical Strategic Agricultural Land Verification Guidelines* (OEH, 2013). Furthermore, the Project is located in a region for which there is no Strategic Regional Land Use Policy (SRLUP). As such, no Biophysical Strategic Agricultural Land exists within the Project Boundary. The *Biophysical Strategic Agricultural Land Verification Guidelines* are therefore not relevant to the Project.

3.18.9 Accuracy of Land Capability Mapping

Kandasol Soil Type

This section addresses the submission regarding the Land Capability Classification associated with the Kandasol soil type.

Submission: SIG1

The SLCIA was undertaken in accordance with the Land and Soil Capability Classification System (OEH, 2011), which was the relevant guideline at the time of undertaking the SLCIA. The more recent Land and Soil Capability Classification System (OEH, 2012) was introduced as a guideline in October 2012, which was after the completion of the SLCIA. The 2011 Land and Soil Capability Classification system is less prescriptive on applying criteria and indicators for soil to capability classes than the 2012 Land and Soil Classification system.

The Kandasol soil type is very variable and its erodibility potential and high permeability and drainage can restrict its land use. There may be areas within the Project Boundary where the land capability could be interpreted as a higher (quality) class.

It is not possible to distinguish these variations well enough in this soil type with the current data to vary the land capability assessment at this level. Even if the lower landscape positions were re-evaluated to Class V, but this would have little or no impact on the overall impact of the land use assessment pre- and post-mining.

Gorokan Landscape

This section addresses the submission regarding the Land Capability Classification associated with the Gorokan soil landscape unit.

Submission: SIG1

There may well be areas of this landscape that can be attributed a Class V, or even Class IV classification. Slope gradient is not the only criterion that distinguishes land capability classes, as other factors may restrict the class of land assignment. Using the present level of information and data, these variations cannot be established for all the areas presented in the SLCIA as Gorokan soil landscape. In this study, the Kurosol soil type has been assessed as Class VI, not the Gorokan soil landscape. A reassessment may show some areas to be a higher land capability class. However, it would not affect the overall land use impact assessment in any significant way.

Yarramalong Landscape

This section addresses the submission regarding the Land Capability Classification associated with the Yarramalong soil landscape unit.

Submission: SIG1

A more intensive survey with high sampling densities may identify parts of the overall soil unit that could produce a higher land capability class. There are parts of the alluvial plains that may well qualify as Class II, but at the scale of this survey a more generalised approach has been adopted. Based on field data and observations and historical data, and the overall classification was determined to be Class III.

The ACA contends that the presence of a turf farm is evidence of the land being Class II land. However, the turf farm is close to Jilliby Jilliby Creek and would be an irrigated enterprise. Irrigated agriculture is not part of the standard Rural Land Capability assessment. It is based on rain-fed agricultural systems. As such, irrigated agricultural potential was not required to be part of the SLCIA.

Sodic soils were also not the main determinant of Class III on the alluvial plain. Erosion, potential flooding and poor drainage due to high water run-on from the surrounding slopes were also factors in the evaluation of the land as Class III land. Given the surrounding steep sloping hillsides there is potential for high intensity surface flows which could significantly impact on cultivated land.

3.18.10 Accuracy of Agricultural Suitability Mapping

Agricultural Suitability Class 3

This section addresses the submission regarding the classification of Rural Land Capability Class III land as Agricultural Suitability Class 3 land.

Submission: SIG1

The submission contends that Land Capability Class III is highly suitable for cropping, and therefore warrants a higher Agricultural Suitability classification. Land Capability Class III does not guarantee that the land is ‘highly suited’ to cropping. The term ‘suited’ relates to Land Suitability rather than Land Capability. This distinction is important to understanding the land evaluation concepts. The Land Capability Classification system classes land capability for a suite of land uses. The Land Suitability Classification rates land on its suitability for the cropping land use only. The former is intentionally generalised, while the latter is, by definition, more specific. They have to be interpreted differently.

Land Capability Class III means the land is ‘capable’ of undergoing repeated cropping or cultivation but with many limitations taken into account, including the cost of inputs and resources to maintain productivity (e.g. ‘intensive soil conservation measures required, such as contour banks and waterways’). However, Land Capability Class III is still within the ‘Cultivation’ grouping, albeit the lowest class.

The Land Suitability rating of Class 3 allows for cropping but restricts it to rotations with pastures owing to its inherent limitations for cropping (e.g. 'soil conservation and drainage works may be required', cf. Class III above). It is still 'suitable' for cropping, but it is the lowest grade of the cropping suitability group. Class 4 is consider to be 'severe limitations' to cropping, or the older concept of 'Marginal' for cropping.

Both Land Capability Class III and Land Suitability Class 3 are at the most restrictive end of their cropping potential groups. The same land can be classed as Land Capability Class III and Land Suitability Class 3 depending on the most limiting, or most dominating criteria, whichever is chosen.

Agricultural Suitability Class 5

This section addresses the submission regarding the classification of Rural Land Capability Class VI land as Agricultural Suitability Class 5 land.

Submission: SIG1

As specified in Table 5 of the SLCIA, Agricultural Suitability Class 5 land is "unsuitable for agriculture or at best suited only to light grazing". This is referring to cultivation and cropping (rain-fed) agriculture suitability.

As specified in Table 3 of the SLCIA, Land Capability Class VI land is considered *'Land not capable of being cultivated but suitable for grazing'*.

Although there is some difference between these two definitions, the two classes are not incompatible. There are many examples where Agricultural Suitability Class 5 land can be assessed as Land Capability Class VI land. The classification systems need to be understood as a whole when comparing classes under the two systems, instead of simply comparing definitions.

3.18.11 Topsoil Balance

This section addresses the submission from ACA regarding the undertaking of a topsoil balance on the basis that the Tooheys Road Site will be used for industrial purposes in the future.

Submission: SIG1

The proposed use for the Tooheys Road Site after mine closure is for ongoing industrial use. The conceptual topsoil balance has been conducted on the basis of this proposed use. As a result, only a small area of land (14 ha) would be rehabilitated.

3.18.12 Topsoil Stripping Assessment

This section addresses the submission contending that further details of soil characteristics are required for the topsoil stripping assessment.

Submission: SIG1

Soil characteristics can be inferred from any of the surface observations and prior survey information. However, more explicit procedures to support the topsoil stripping assessment would require further field data for the various soil types and landscape positions. Additional information to assist in achieving rehabilitation objectives mentioned within the EIS will be provided in the Soil and Land Capability Procedure, which will be developed following the grant of Development Consent.

Topsoil will generally be stripped in accordance with the depths presented in Table 8 of the SLCIA. Background information showed that topsoil across all the soil types was generally suitable for stripping and reuse.

3.18.13 Topsoil Management Measures

This section addresses the submission contending that the topsoil management measures are not appropriate for the soil types.

Submission: SIG1

Generic soil management measures are sufficient for the level of assessment required at this stage of the planning process. More detailed soil management measures for the soil types and for rehabilitation management will be provided in the Soil and Land Capability Procedure.

3.18.14 Accuracy of the Acid Sulphate Soil Assessment

This section addresses the submission asserting that the acid sulphate soil assessment was not carried out correctly.

Submission: SIG1

No direct assessment of Acid Sulphate Soil (ASS) was required for this Project. The submission from the ACA refers to the Wyong landscape unit, which is associated with Potential Acid Sulphate Soils (PASS). This landscape unit is a generic description of the soil landscape (soil series/type) and is not location specific. In this instance, reference was made to recent independent assessment for the likelihood of ASS and PASS with areas mapped. These were adopted as the areas to focus on for assessment of PASS.

The area identified by the ACA as containing Wyong landscape unit soils (and therefore potentially containing PASS) does not feature in the recent mapping assessments. Most of the disturbance area for the Project is at an elevation of approximately 4 m AHD, which precludes the likelihood of PASS and ASS underlying this land. Management measures for PASS and ASS, in the unlikely event that they are uncovered, will be provided in the Soil and Land Capability Procedure.

3.18.15 Interactions with Other EIS Studies

This section addresses the submission from the ACA asserting that defects in the SLCIA will affect the findings of the AIS, Rehabilitation Strategy and SWIA.

Submission: SIG1

This submission is based on the ACA's assertion that the SLCIA is inadequate. The SLCIA has undergone the regulatory review process for EISs and has been deemed as adequately addressing the DGRs and relevant guidelines.

3.19 AGRICULTURE

All references to the Agricultural Impact Statement (AIS) refer to Appendix Y of the EIS.

3.19.1 Characterisation of Agricultural Enterprises

This section addresses the submissions regarding the identification of agricultural enterprises that could potentially be impacted by the Project.

Submission: RA9 and SIG1

DPI – Agriculture acknowledges that the AIS has adequately identified the agricultural enterprises that could potentially be impacted by the Project.

3.19.2 Impacts of Subsidence

Impacts on Turf Cultivation

This section addresses the submissions from stakeholders regarding the potential impacts of subsidence on turf cultivation.

Submission: RA9, SIG1

The AIS identified a privately owned turf farm within the SIL. This farm is identified in Figure 7 of the EIS as Property 259. As raised in the submission from DPI – Agriculture, Table 14 in the AIS contained a typographical error stating that the maximum predicted subsidence at the turf farm is 1,1750 mm. The maximum conventional subsidence at the turf farm is predicted to be 1,750 mm.

At any point on the surface of the turf farm, subsidence will generally occur in four episodes over four years, with each episode occurring over approximately six weeks. The first episode of subsidence will occur when the longwall panel preceding the panel directly under the specific point is mined.

The second episode occurs when the panel directly beneath the specific point is mined. The third episode occurs when the next panel is mined (i.e. first panel after the panel directly under the point) and the final episode occurs when the second panel after the panel directly beneath the point is mined.

Table 8 shows the predicted levels of subsidence over time as the longwall face travels under a specific surface point. The predicted subsidence levels occur near the midpoint of the cross-section of the longwall and are based on the conservative subsidence modelling undertaken. Predicted subsidence levels will differ from point to point over the mined panels, subject to many complex factors.

The values in **Table 8** provide a typical understanding of the extent and timing of the likely observed subsidence levels at a point where the total predicted subsidence is up to a maximum of 1,750 mm.

The second episode will generally cause the highest predicted level of subsidence. In the case of the turf farm, the second episode is predicted to result in subsidence of approximately 1,310 mm. Since mining will occur at an anticipated rate of 15 m per day, mining will progress approximately 630 m during the six week episode. The predicted subsidence of 1,310 mm will therefore occur over a distance of 630 m, with a predicted peak rate of settlement or tilt of approximately 11 mm over 1 m (1.1% slope). This peak rate will occur over a small area with average tilts being far less than this maximum rate. This maximum change in gradient is not perceivable to the eye and is less than the existing in situ gradients of less than 3% (Murphy, 1993).

Table 8
Progression of Subsidence

Scheduling	**Predicted Subsidence***	
	(%)	**(mm)**
Two years before longwall panel extracts under point	0	-
One year before longwall panel extracts under point	5	90
Year where longwall panel extracts under point	75	1,310
One year after longwall panel extracts under point	15	260
Two years after longwall panel extracts under point	5	90
Three years after longwall panel extracts under point	0	-

** (Relative to a Typical Surface Point above the Centre of a Panel)*

The changes in slope predicted by the subsidence modelling are not expected to interfere with the efficiency of the turf cutting equipment or the efficacy of other turf farming practices. Subsidence has the potential to affect subsurface infrastructure such as irrigation mains. However, these impacts are predicted to be mitigated by the depth of the alluvial soils (sands and sandy loams, as described by Murphy (1993), and the small magnitude of the changes in slope.

The Subsidence Predictions and Impact Assessments (Appendix H of the EIS) identified the potential for cracking and heaving. However, due to the nature of the alluvial soils present within the Extraction Area, it is expected that these surface impacts will be very minor, isolated and represent a very small percentage of the Extraction Area.

These reasons form the basis for the conclusion that:

> *There is minimum potential that the surface relief of the turf farm may become uneven to the extent that efficient turf cultivation and harvesting bears additional costs (decreased* m^2 *per ha cultivated) or is no longer possible (due to mine subsidence) without remediation* (see Section 7.1.2 of AIS).

The AIS adopted conservative assumptions when calculating the potential financial impact of subsidence on turf cultivation (see Section 7.1.2 of the AIS). These assumptions included:

- The entire turf farm would impacted at the same time;
- Total loss of production would occur; and
- Production would take three years to re-establish.

Turf is harvested an average of three times, every two years. Therefore, six harvests would be expected to occur during the four years that the episodes of subsidence will occur. A particular turf area would be subsiding and settling for 24 weeks of this 208 week period (11.5% of the time). Due to the small changes in grade relative to the existing grades within the turf farm, it anticipated that turf farming would be able to be undertaken without interruption during these subsidence episodes.

WACJV will consult closely with the turf farmer prior to (during the preparation of the PSMP), during and following planned subsidence to ensure turf farming can proceed without interruption.

Impacts on Horse Training Establishments

This section addresses the submissions from stakeholders regarding the potential impacts of subsidence on horse training establishments.

Submissions: RA9, SIG1, P139, P177

Based on a desktop study and roadside surveys, the AIS identified five horse training establishments (thoroughbred and performance horse) located within the Project Boundary. All five of these establishments are privately owned. As is the case for the turf farm, the potential changes in slope are relatively small in magnitude.

The changes to the slope of grazing land, training areas and stock handling areas are not predicted to be of an extent that would impact horse husbandry or performance.

WACJV will consult closely with the each business prior to (during the preparation of the PSMP), during and following planned subsidence to ensure activities can proceed without interruption.

Water Resources

This section addresses the submissions from stakeholders regarding the impacts of subsidence on groundwater bores used for agriculture.

Submission: RA9, P85, P104, P106, P112, P170, P176

There are 12 registered bores within the Subsidence Impact Limit. As explained in Section 6.4 of the Groundwater Impact Assessment, "groundwater levels may fall to 1.4m (alluvial subsidence) but 55% to 75% recovery is expected to occur within 6 months" due to rainfall recharge. The displacement of water levels is not predicted to have a measurable impact on the yield of the affected bores. If impacts on yields do occur, WACJV has committed to replacing the water supply of bore owners.

As stated in Section 6.4 of the Groundwater Impact Assessment, there is the potential for subsidence to cause mechanical damage to registered bores. WACJV has committed to undertake repairs and/or establish water bores if they are damaged.

It has been assumed that all bores are currently being used for their registered purposes. It is noted that although one bore (GW028035, 20BL021424) is registered for poultry use, there are no commercial poultry enterprises in the locality.

All operating bores will be identified during the development of PSMPs and the risk of impact on the operation of these bore will be established. If it is determined that there is a risk of the bore becoming inoperable (e.g. cracking or collapse of casing), mitigation measures will be implemented by WACJV in consultation with the owner and may include:

- Temporary carting of stock and domestic supplies until borehole re-established; and
- Supply of purchased feed to replace lost forage, if any irrigated forage is impacted.

The current PSMP process is described in detail in Section 7.1.4 of the EIS.

3.19.3 Impacts of Biodiversity Offsets on Agriculture

This section addresses the submissions from stakeholders regarding the removal of land from agriculture for biodiversity offsets.

Submission: RA9

The Biodiversity Offset Strategy for Project consists of three offset areas with a total area of 260 ha. The Biodiversity Offset Strategy includes areas both within and outside of the Project Boundary. All of the land proposed to be preserved as biodiversity offset areas is owned by WACJV.

As explained in Section 5.2 of the AIS, the offset areas outside of the Project Boundary contain 21 ha of grassland which is suitable for beef cattle grazing. The offset areas within the Project Boundary contain an additional 10 ha of grassland. This land is low quality grazing land that meets the criteria for Agricultural Domain C, as defined in Section 5.2 of the AIS.

Table 7 of AIS estimates that Agricultural Domain C has a carrying capacity of 1 DSE per ha or has a stocking rate of 1 breeding cow per 27.6 ha for store weaner production. Based on the assumptions used in the AIS (see Appendix 1 of the AIS), the gross value of agricultural production from 10 ha of Agricultural Domain C is $148 per annum and the net value of production is $84 per annum. On a pro rata basis, the expected number of animals sold from this area is 0.3 per annum. The grassland within the offset areas will be permanently removed from agriculture.

3.19.4 Agricultural Support Services and Regional Employment

Processing and Value Adding Industries

This section addresses the submissions from stakeholders regarding processing or value adding industries either within or dependant on production from within the Project Boundary.

Submission: RA9

There are no industries within the Project Boundary or surrounding locality that process or add value to the agricultural production from within the Project Boundary. Similarly, there are no processing or value adding industries that are dependent on production from within the Project Boundary.

The Little Creek Cheese Factory is a boutique cheese maker and is located in the precinct of the former Wyong Milk Factory. This cheese maker sources pasteurised milk from southern NSW and is therefore not reliant on agricultural production from within the Project Boundary.

Regional Employment

This section addresses the submissions from stakeholders regarding the impact of the Project on the available labour supply for agricultural operations.

Submissions: RA9

As stated in the AIS, the labour supply available for agricultural operations is not expected to be impacted as a result of the Project.

Section 7.17.3 of the EIS states that the unemployment rate of 8.0% in the Wyong LGA is 2.8% higher than the NSW state average and that the NSW Government considers chronic unemployment to be a major issue on the Central Coast (Department of Planning, 2011). It was also noted that "the proportion of the adult workforce commuting out of the region for work has increased to over 25 per cent".

The high level of unemployment and the level of the workforce commuting out of the area indicate that the jobs generated by the Project are not expected to reduce the available workforce employed in agriculture. Even if some members of the agricultural workforce becomes employed by the Project, there is an adequate labour resource base available to fill the resulting vacancies.

3.19.5 Impacts on Visual Amenity, Land Values and Tourism Infrastructure

Land Values

This section addresses the submissions from stakeholders regarding the impact of the Project on agricultural land values.

Submissions: RA9

The value of a property represents the present value of the expected stream of benefits that can be obtained from that land (and its associated infrastructure) including the expected future stream of net income from agricultural production. Therefore, the impacts on the value of agricultural land will reflect the impact on agricultural productivity. The impacts of the Project on the productivity of agricultural land were assessed in Section 7 of the SIA.

Visual Amenity

This section addresses the submissions from stakeholders regarding potential impacts on the visual amenity of agricultural enterprises.

Submissions: RA9, P138

The Visual Impact Assessment determined that two rural residential properties along Bushells Ridge Road (Receivers 57 and 58) may experience views of the Project. Neither of these properties is being used for agricultural enterprises that are sensitive to changes in views.

Agricultural Tourism Infrastructure

This section addresses the submissions from stakeholders regarding potential impacts on agricultural tourism infrastructure.

Submissions: RA9, P106, P156

The site visits and desktop studies undertaken for the AIS did not identify any agricultural tourism activities or infrastructure within the Project Boundary. This finding was confirmed by site visits and desktop studies undertaken after the exhibition of the EIS.

3.19.6 Management and Mitigation

Remediation of Turf Farm

This section addresses the submissions from stakeholders regarding remediation measures to restore the turf farm to production.

Submission: RA9

As explained in **Section 3.19.2**, the predicted tilts due to subsidence are not expected to impact the production of the turf farm. Remediation would only be required if the subsidence effects are greater than predicted. If required, remediation of the turf farm would involve re-levelling of the surface topography. As described by Murphy (1993), the deep alluvial soils of the flats associated with the creek flats (sands and sandy loams) have a depth of 300 cm. These soils are well suited to laser levelling, as is carried out in many irrigation areas. The depth of alluvial soils would allow such levelling to be undertaken without removal and stockpiling, as is required in other irrigation areas. Levelling of deep alluvial soils has been carried out when setting up low-pressure spray irrigation systems such as lateral move and centre pivot systems.

The AIS conservatively assumed that if re-levelling was required, it would take 3 years to re-establish production. As shown in **Table 8**, the majority (75%) of vertical subsidence at a location occurs when the longwall directly beneath that location is mined. If remediation is required, it is expected that re-levelling the land surface after this subsidence episode would be sufficient to restore production. Since the subsidence associated with the final two episodes is relatively low, it is considered unnecessary to delay remediation measures until after all subsidence has occurred. Therefore, it is possible that production can be restored earlier than the timeframe stated in the AIS.

WACJV will prepare an Extraction Plan to manage the consequences of subsidence, including impacts on the turf farm. The Extraction Plan process will involve the development of PSMPs for each affected property before mining is commences under a property. The PSMPs will be developed in consultation with property owners and will outline measures for managing and remediating impacts to assets on that particular property.

PSMPs for agricultural properties will outline arrangements for remediating impacts on agricultural infrastructure such as buildings, water bores, fencing, dams and turf growing areas. The existing PSMP process is described in detail in Section 7.1.4 of the EIS.

3.20 FORESTRY

3.20.1 Subsidence Monitoring in Wyong State Forest

This section addresses submission regarding the requirement for subsidence monitoring to be undertaken within the Wyong State Forest.

Stakeholder: RA20

WACJV will undertake subsidence monitoring within the Wyong State Forest to determine any impacts on the forest as a result of mining activities.

3.20.2 Implementation of the Forestry Act 2012

This section responds to the submission from Forestry Corporation of NSW regarding minor changes and name corrections following the implementation of the Forestry Act 2012.

Stakeholder: RA20

Following the implementation of the *Forestry Act 2012* (Forestry Act), the Forestry Assessment (Appendix Z of the EIS) should be read with the following changes:

- 'Forestry NSW' now be read as 'Forestry Corporation NSW';
- The land surrounding the proposed Western Ventilation Shaft is owned by the NSW Government and managed by Forestry Corporation NSW under the Forestry Act;
- Wyong State Forest is located in the Central Forest Management Region; and
- 'Occupation Permit' now to be read as a 'Forest Permit'.

These name changes do not alter any assessments in the EIS.

3.21 HAZARDOUS MATERIALS

3.21.1 Preliminary Hazard Analysis

This section addresses the submission contending that the Preliminary Hazard Analysis did not consider all risks associated with the Project.

Submission: P112

The Preliminary Hazard Analysis (PHA) (Appendix AB of the EIS) was undertaken generally in accordance with the 'Hazardous and Offensive Development Application Guidelines – Applying SEPP 33' (DoP, 2011) (SEPP 33 Guidelines). The purpose of a PHA is to assess the risks associated with the use of dangerous goods during both construction and operations.

The PHA has assessed the risks associated with the dangerous goods that will be stored onsite, including explosives, detonators, diesel fuel and water treatment agents. The scope of a PHA is limited to the risks associated with dangerous goods.

3.21.2 Use of Hazardous Materials

This section responds to a submission which was concerned with the use of detonators, explosives and fuels in the proximity of residents.

Submission: P101

The PHA identifies the dangerous goods that will be used on site, including explosives, diesel fuel and water treatment agents. It outlines relevant mitigation and management measures including the preparation of a Hazard Management Plan, database and compliance with legislation relevant to the handling of hazard materials.

3.22 REHABILTATION AND CLOSURE

This section responds to submissions which requests further detail on rehabilitation and final closure.

Submission: RA5, SIG1, P176

Further detail on rehabilitation objectives to ensure a safe, stable and non-polluting final landform will be included in a Rehabilitation and Closure Plan for the Project to be developed in consultation with relevant regulators. It shall include information on relevant domains and discuss final landuse, rehabilitation objectives, domain objectives, completion criteria and rehabilitation monitoring. The timing of the preparation of the plan will be consistent with any conditions of Development Consent.

3.23 GEOLOGY

3.23.1 Faulting

This section responds to the submissions raised by stakeholders regarding the presence of faults within the Extraction Area.

Submission: RA4

The Geology Report (**Appendix C** of the EIS) provides a detailed description of the exploration undertaken for the Project. Figure 7.4 in the Geology Report showed the locations of exploration boreholes and seismic lines included in the exploration program. This figure has been amended in response to the submission made by OEH. **Figure 22** identifies the boreholes where some evidence of faulting was recognised.

All fractures which exhibited evidence of movement were classified as faults. All of these fractures were steeply dipping. The majority of the features noted as "faults" in boreholes are close to high resolution seismic lines which showed no evidence of their existence as significant structures.

The exploration boreholes and seismic lines have shown that the Extraction Area is a well-defined structural domain between dyke zones to the north and south and seam split zones to the east and west.

3.23.2 Seismic Surveys

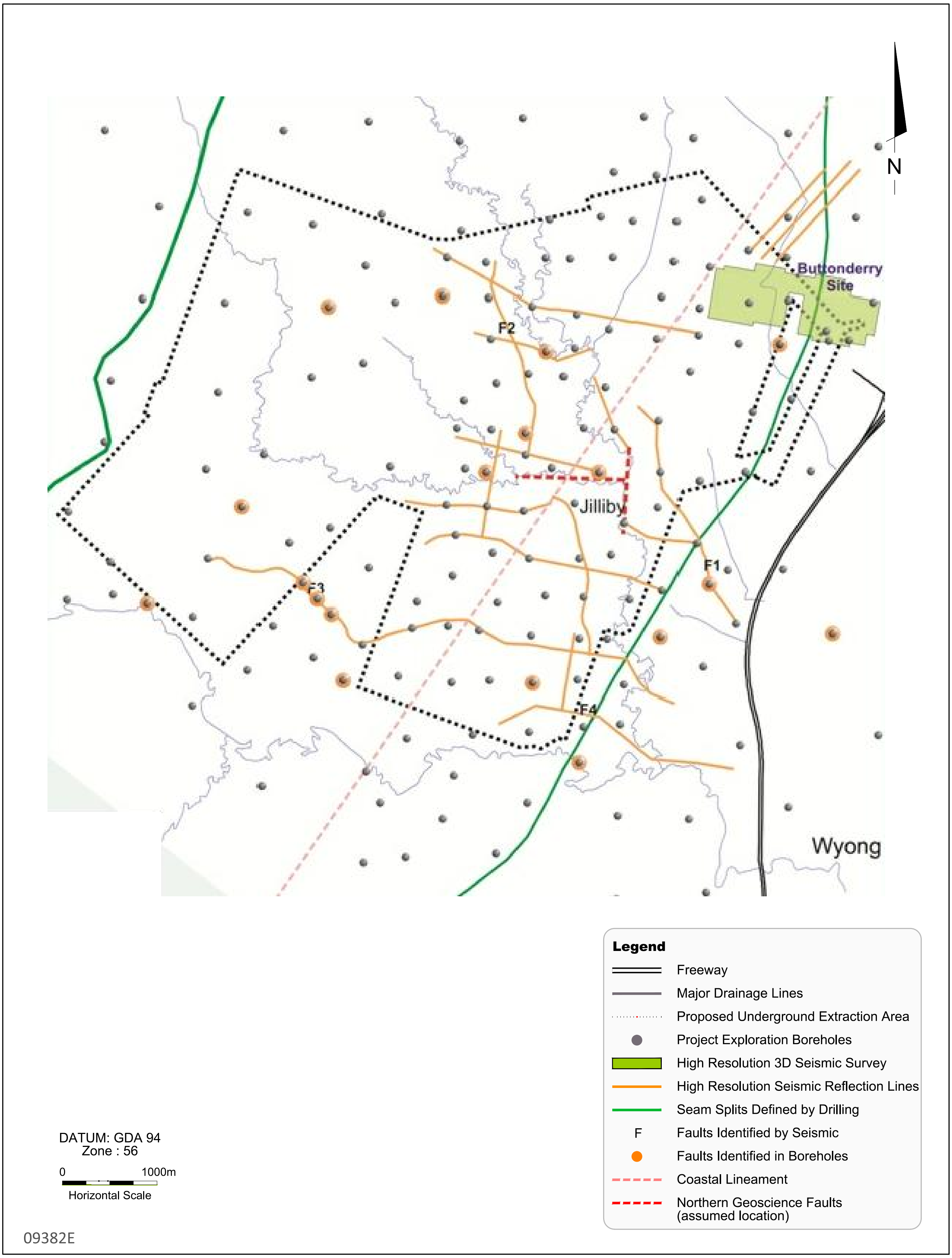
This section responds to the submissions raised by stakeholders regarding the extent of seismic surveys.

Submission: RA4

The eastern half of the Extraction Area has been covered by a grid of high resolution seismic lines. These seismic surveys determined that the eastern portion of the Extraction Area is devoid of major structural elements that would result in anomalous subsidence effects or impacts on aquifers and streams. There is no evidence to suggest significant variations in the structural complexity within the western portion of the domain.

Although the vast majority of the Jilliby State Conservation Area was not included in the seismic survey, one survey line did penetrate the area. Approximately 4 km of a seismic line along Watagan Forest Drive in the adjoining Wyong State Forest traversed very similar topography and geology. This line terminated within 300 m of the boundary of the SCA. The structural complexity within the Jilliby State Conservation Area is not expected to differ from areas in the eastern portion of the Extraction Area.

Mining is not scheduled to occur beneath the western portion of the Extraction Area until at least 2035. It is not unreasonable to expect that the technology of seismic data acquisition and analysis will advance significantly in that time and that that technology will be employed to survey the area prior to mining.



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WALLARAH 2 COAL PROJECT

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Boreholes and Seismic Lines

FIGURE 22

3.23.3 Potential for Acid Mine Drainage

This section responds to the submissions raised by stakeholders regarding the potential acid mine waters to be liberated from the mine.

Submission: RA6

Water causing acid mine drainage (AMD) issues is generally acidified from contact with rocks containing sulphide minerals, the most common being pyrite. Some coal measure rocks do contain significant amounts of pyrite, particularly rocks deposited under a marine influence. A significant example of this is the Greta Coal Measures which are overlain by thick sequences of marine sediments resulting in high concentrations of pyrite in the upper plies of some coal seams; in fact the upper plies of the thick Greta Seam were referred to by old miners as "the brassy tops". Sulphur levels of mined Greta Coal Measures coal were often recorded over 6%. AMD issues have been recorded from old mines which extracted some of these coals.

The Newcastle Coal Measures are not associated with marine incursions. As a result the coal seams and the surrounding sediments do not contain significant concentrations of sulphide minerals. Sulphur content of Newcastle Coal Measure coals is significantly lower than sulphur levels recorded in Greta coals. Analysed values are typically less than 0.3%. There are no recorded events of AMD issues associated with contamination of water which has emanated from mines operating in the Newcastle Coal Measures. The Wallarah 2 Project will extract coal from the Wallarah and Great Northern Seams of the Newcastle Coal Measures. Mining of these seams over a period of more than 120 years has never been associated with AMD issues

3.23.4 Exploration Techniques

This section responds to the submissions raised by stakeholders the need for additional and different exploration techniques investigate the properties of near-vertical joints.

Submission: RA6

World best practice exploration standards for investigating near horizontal coal deposits is to drill vertical boreholes on a grid of decreasing size as more accurate determination of the deposit is required. This philosophy was followed during the exploration undertaken for the Project.

During the drilling of more than 350 boreholes during the exploration phase for the Wallarah 2 Project over 160 packer tests were conducted in 31 bores. Potentially porous/permeable horizons were identified from geophysical logs. Initially (and following normal practice) packer tests were then conducted on these intervals over sections of 3 m to 6 m between pairs of isolating packers. Early in the testing regime it was recognised that almost no water could be injected into the strata over this length.

Subsequently (and for the large majority of tests) packer tests were conducted over much longer intervals representing stratigraphic units. As the hole was being advanced the stratigraphic interval was predicted from surrounding holes, the hole was flushed with clean water to remove drilling fluids and the bottom section of the hole (predefined interval confirmed from current hole) was isolated with a single packer. Typical tests were conducted intervals of 40 metres up to 200 metres.

Joints were identified in acoustic scanner logs which were run in 44 boreholes. Excluding low angle joints (dip below 50 degrees) average dip of joints was 72 degrees. Average vertical spacing of these joints was between 30 to 50 metres (which converts to a horizontal spacing of 10 to 15 metres). Packer tests on average would have intersected between 1 and 4 steeply dipping joints. Drilling of angled holes is therefore not considered necessary to assess the interaction between or the transmission characteristics of joints because as indicated the packer tests conducted in the vertical holes would have intersected jointed sequences.

3.24 STAKEHOLDER ENGAGEMENT

3.24.1 Adequacy of Community Consultation

This section responds to the submissions raised regarding the adequacy of consultation carried out with the local community.

Submission: RA6, SIG1, P106, P111, P112, P126, P145, P146

A number of submissions received suggested that the community consultation process, specifically in relation to the landholders within the SIL, has not been adequate and that the community concerns have not been sufficiently presented in the EIS.

As described in Section 5.3 of the EIS, various methods were employed to engage with the local community including local community meetings, focus groups and telephone surveys, five newsletters, direct correspondence, creation of a community reference group and Project information days.

As a result of the various community engagement strategies, WACJV was able to identify the various community concerns in relation to the Project. These concerns are outlined in Table 19 of the EIS. Additionally, Table 19 also describes where each of the issues is addressed throughout the EIS. Prior to the exhibition of the EIS, WACJV provided a letter and newsletter to all landholders within the SIL inviting them to meet with the company to discuss potential impacts to individual properties either one-on-one or at the four open days which were held during the exhibition period at the WACJV offices. Various landholders took up this opportunity to meet with the company.

WACJV has conducted and will continue to conduct a comprehensive stakeholder engagement program throughout the EIS process aimed at maximising the opportunity for community interaction. WACJV will continue to undertake consultation with stakeholders, particularly the consultation commitments made in this RTS.

3.24.2 Public Exhibition of the EIS

This section responds to submissions which query the period the EIS was available for review.

Submission: P111, P112

The EIS was exhibited from 26 April 2013 to 21 June 2013 and was available at various public locations as well as the DP&I, WACJV and Hansen Bailey websites from 8 am on 26 April 2013.

3.25 ENVIRONMENTAL MANAGEMENT AND MONITORING

This section responds to the submissions regarding the requirement for, and timing of, preparation of the Environmental Management Plans.

Submission: RA3, RA6, RA9, RA14

As outlined in Section 8 of the EIS, WACJV will develop and implement an Environmental Management System in consultation with the relevant regulators (and the Aboriginal community where relevant) consistent with Section 7 of this EIS to the approval of DP&I which shall comprise (at least):

- Environmental Management Strategy;
- Environmental Monitoring Plan (incorporating subsidence, groundwater, surface water, air quality and noise);
- Extraction Plan (and/or SMP under Mining Act);
- Water Management Plan;
- Air Quality Management Plan;
- Energy and Greenhouse Strategy;
- Noise Management Plan;
- Biodiversity Offset Strategy;
- Land Clearance Protocol;
- Traffic and Transport Management Plan;
- Aboriginal Cultural Heritage Management Plan;
- Historic Heritage Management Plan;
- Soil and Land Capability Procedure (including an Acid Sulphate Soils Management Procedure);
- Land Management Plan;
- Bushfire Management Plan;
- Waste Management System; and
- Landscape Management Plan.

3.26 RISK ASSESSMENT FOR JILLIBY SCA

This section addresses the submission from OEH requesting that a risk assessment be undertaken for the key natural features within the Jilliby SCA.

Submission: RA4

3.26.1 Background

The submission from OEH outlines the history of the Jilliby SCA and its significance and states:

> *'Jilliby SCA (12,159 ha) is located in the Lakes Area of the Central Coast - Hunter Range Region, approximately 13 kilometres west of Wyong. Jilliby SCA was identified as an icon forest area in the NSW Comprehensive Regional Assessment process, and after being at the heart of a high profile environmental debate the reserve was created on 1 July 2003 through enactment of the National Park Estate (Reservations) Act 2003. Jilliby SCA was created from four portions of former State Forest, but because of the known coal reserves underlying the area the reservation for Jilliby State Conservation Area was restricted to a depth of 50 metres. Jilliby SCA provides an almost continuous link between Watagans National Park in the north and Brisbane Water [National Park] in the south, and features predominantly wet sclerophyll forests (shrubby and grassy subformations) of the Coastal Dissected Plateau biogeographic subregion. The major creekline within Jilliby SCA is Little Jilliby Jilliby Creek which reaches 3rd order under the Strahler categorization above the proposed Wallarah 2 longwalls. Little Jilliby Jilliby Creek becomes a 4th order stream under the Strahler categorisation downstream of Calmans Gully'.*

In response to the submission from OEH, a risk assessment has been undertaken for all key natural features located within the portion of the Jilliby SCA within the SIL. The Project will not involve any direct disturbance or surface activities within the Jilliby SCA. As such, the only potential impacts within the Jilliby SCA will be related to subsidence effects. Using the OEH submission for guidance, the following key natural features were identified within the Jilliby SCA:

- Little Jilliby Jilliby Creek;
- Groundwater aquifers;
- Steep slopes; and
- Aboriginal heritage sites.

The portion of the Jilliby SCA within the SIL does not contain any wetlands or clifflines.

3.26.2 Little Jilliby Jilliby Creek

Little Jilliby Jilliby Creek is the only third order stream located within the Jilliby SCA. The upland sections of Myrtle Creek are also located within the Jilliby SCA. However, the 3rd order sections of Myrtle Creek are located downstream of the Jilliby SCA.

A risk assessment process for streams was prescribed by the Planning Assessment Commission (PAC) in the 'Bulli Seam Operations PAC Report' (Bulli PAC, 2010) (Bulli PAC Report). This process consists of three steps:

1. Identification of the value and significance of rivers and streams;
2. An assessment of the impact of the Project on the value of rivers and streams in terms of likelihood and consequences of impact, including the effect of mitigation and remediation measures; and
3. An assessment of the acceptability of the outcome.

These are described in the following sections as they relate to the Project.

Identification of Value and Significance

The relevant considerations for evaluating the value and significance of streams are outlined in Section 7.4 of the Bulli PAC Report. The key attributes of Little Jilliby Jilliby Creek are identified below.

Stream Attributes

<u>Hydrology</u>

There is no flow recording station located on Little Jilliby Jilliby Creek. However, recorded flow data downstream on Jilliby Jilliby Creek shows a relatively high average volumetric runoff coefficient for the catchment (24%). Surface flows have been shown to occur for approximately 90% of the time, indicating that there is a significant baseflow contribution within these lower areas of Jilliby Jilliby Creek. With a catchment area of 20 km^2, Little Jilliby Jilliby Creek represents approximately 3% of the total catchment area of the Gosford-Wyong Water Supply Scheme (725 km^2).

<u>Physical Characteristics</u>

The physical characteristics of Little Jilliby Jilliby Creek have been described in detail in Section 2.3 of the SWIA. The stream bed is sand dominated and transitions from a confined valley setting in the upper reaches, to a partly confined valley setting and then to a laterally unconfined alluvial setting with meandering alignment. Riparian vegetation plays a key role in bank stability and supply of large woody debris to the main channel which assist in bed control. Land clearing in the lower reaches of the Little Jilliby Jilliby Creek has reduced the integrity of riparian vegetation.

Little Jilliby Jilliby Creek has been characterised as having a moderate geomorphic condition due to localised areas exhibiting degradation of stream character.

<u>Vegetation</u>

The riparian vegetation along Little Jilliby Jilliby Creek consists of Coachwood Crabapple warm temperate rainforest and Mountain Blue Gum – Turpentine moist shrubby open forest. The Coachwood Crabapple warm temperate rainforest is listed as an EEC under the TSC Act. The Mountain Blue Gum forest is not a threatened ecological community.

Water Quality

Water quality along Little Jilliby Jilliby Creek is best in the upper reaches where the catchment is undisturbed and generally declines further downstream where the catchment has been subject to disturbance by agriculture and other activities. Concentrations of manganese, iron, phosphorus, zinc, ammonia and faecal coliforms often exceed the ANZECC water quality guidelines within the lower parts of the system.

The following environmental values are considered appropriate for Little Jilliby Jilliby Creek:

- Protection of Aquatic Ecosystems in South Eastern Australia;
- Water Quality for Irrigation and General Water Use;
- Guidelines for Recreational Water Quality and Aesthetics; and
- Drinking Water.

Aquatic Life

The biannual aquatic ecology surveys have recorded 43 macroinvertebrate taxa in Little Jilliby Jilliby Creek. The flathead gudgeon (Philypnodon grandiceps) was the only native fish species identified in Little Jilliby Jilliby Creek. No water dependent mammals have been recorded within Little Jilliby Jilliby Creek.

Stream Values

Based on these stream attributes, the following values were ascribed to Little Jilliby Jilliby Creek.

Hydrologic Value

The hydrologic value of Little Jilliby Jilliby Creek is considered high due to its relatively high runoff yield and its location within the catchment of the Gosford-Wyong Water Supply Scheme.

Ecological Value

Little Jilliby Jilliby Creek and its riparian vegetation provide good habitat for a variety of avifauna and mammals. The creek also provides good feeding, shelter and breeding habitat for amphibians.

Little Jilliby Jilliby Creek is capable of providing fish passages for some of its lower length and permanent aquatic habitats in the form of drought refuge ponds.

Environmental Quality

For the upper reaches of Little Jilliby Jilliby Creek within the Jilliby SCA, water quality and overall environmental quality is high due to the minimal disturbance in the Jilliby SCA. The environmental quality of the upper reaches is higher than that of the lower reaches, which have been affected by land disturbance and agriculture.

Amenity Value

Due to the undisturbed nature of the Jilliby SCA, the upper reaches of Little Jilliby Jilliby Creek possess high amenity value. However, access to the stream is limited by dense vegetation and steep terrain surrounding the creek, resulting in limited recreational value.

Significance of Little Jilliby Jilliby Creek

Section 7.6 of the Bulli PAC Report explains that if a stream is considered to be of "*special significance*", mining must not result in a greater than negligible change in the values of the stream.

Little Jilliby Jilliby Creek is considered to be of high significance by virtue of its high runoff yield, contribution to town water supplies and habitat value for native species. However, it is not considered to be of special significance due to the highly disturbed nature of the subcatchment downstream of the Jilliby SCA. The water quality and environmental quality are much lower in the lower reaches of the Little Jilliby Jilliby Creek.

Impacts on Stream Values

The only potential impacts as a result of the Project to the values of Little Jilliby Jilliby Creek will be through subsidence effects and its impacts.

Predicted Subsidence Effects

As stated in Table 5.2 of the SPIA, the maximum predicted subsidence effects for Little Jilliby Jilliby Creek are:

- Maximum conventional subsidence of 2,000 mm;
- Maximum conventional tilt of 12 mm/m;
- Maximum conventional hogging curvature of 0.2 km^{-1};
- Maximum conventional sagging curvature of 0.25 km^{-1};
- Maximum upsidence of 650 mm; and
- Maximum valley closure of 775 mm.

Predicted Subsidence Consequences

The maximum predicted conventional tilt along Little Jilliby Jilliby Creek is 12 mm/m (i.e. 1.2 %), which represents a change in grade of 1 in 85. The average natural gradient of Little Jilliby Jilliby Creek is 5.2 mm/m. However, the gradient is steeper in the upper reaches of Little Jilliby Jilliby Creek within the Jilliby SCA. The predicted conventional tilt may result in minor changes of grade and ponding may occur above the commencing end of LW23N (beyond the life of this Project). Since the predicted tilts and the natural gradients are almost equal at this location, the potential ponding is expected to be very minor and it is unlikely to be noticeable.

Under current conditions, the upper reaches of Little Jilliby Jilliby Creek only provide habitat in the form of drought refuge pools. Therefore, increased ponding in the stream sections within the Jilliby SCA will not reduce fish passage.

The potential for accelerated erosion as a result of subsidence has been discussed in **Section 3.3.5**. WACJV will undertake stream stability monitoring to determine impacts to the geomorphology of Little Jilliby Jilliby Creek. If remediation measures are required, preference will be given to 'soft' engineering techniques.

Subsidence effects have the potential to result in fracturing of the bedrock beneath streams. Fracturing can result in noticeable impacts in rockbar controlled streams. However, Little Jilliby Jilliby Creek is not a rockbar controlled stream. The upland areas of Little Jilliby Jilliby Creek comprise of alluvium and in certain areas sandstone boulders (see **Section 3.3.4**). If fracturing of the bedrock beneath Little Jilliby Jilliby Creek occurs, the fractures are predicted to fill up with the alluvial sediments and will result in little to no change in surface water levels. If the cracks in the bedrock do not fill up naturally, the stream beds can be remediated by infilling cracks with alluvial material or re-grading and re-compacting the stream bed.

Even if surface cracking does occur in the stream channel, the impact on water quality and quantity is predicted to be minor. This is because the volume of water stored in cracks is negligible compared to the flow in the stream.

As explained in **Section 3.2.11**, there is not predicted to be any connectivity between the mine workings and the surface streams. There is predicted to be a significant constrained zone (>100 m thick) that will inhibit downward leakage of water. Therefore, significant loss of surface flows is extremely unlikely to occur.

Acceptability of Impacts

Increased ponding of Little Jilliby Jilliby Creek may occur due to subsidence. However, the sections of the Little Jilliby Jilliby Creek within the Jilliby SCA do not currently provide fish passage. If necessary, remediation of the stream bed can be undertaken to re-create pre-mining conditions. Therefore, the potential increase in ponding is considered an acceptable impact.

Flows in Little Jilliby Jilliby Creek are unlikely to be affected by cracking of the bedrock beneath the stream. Potential impacts are expected to be mitigated by the presence of alluvial deposits which is expected to naturally fill any cracks within the bedrock. Since the volume of water that may be diverted into fractures is negligible compared to the flow in the stream, the consequences of bedrock fracturing are not considered severe. Due to the low probability of impacts to stream flows, and the minor consequences even if this does occur, this impact is considered acceptable.

The consequences of connectivity between the stream and the mine workings would be significant. However, the FLAC modelling of rock fracturing has predicted that there will be a significant constrained zone (free of connective cracking), resulting in an extremely low likelihood of connectivity cracking. As a result, this predicted impact is considered acceptable.

3.26.3 Groundwater Aquifers

Identification of Values

Regional groundwater aquifers that have been identified to exist beneath the Jilliby SCA include:

- The unconsolidated alluvial groundwater system associated with the upper reaches of Little Jilliby Jilliby Creek;
- Shallow weathered rock zone of the Terrigal Formation, which exists in the more elevated portions of the Extraction Area; and
- Deeper regional sedimentary rock and coal measures, of which the WGN seam will be recovered by the Project.

Whilst the alluvial groundwater system is considered the most productive groundwater system within the Extraction Area, the minor areas of the alluvial groundwater system that do exist within the Jilliby SCA are located within the most upper parts of the catchment. Therefore, these areas exhibit smaller storage capacity when compared with those within the lower parts of the catchment, where more extensive alluvial floodplains have developed.

Predicted Impacts

As identified within Section 4.2 of the GIA, water levels within the alluvial aquifers are not predicted to be affected as a result of the Project. Storage and rainfall recharge is able to accommodate the negligible downwards leakage to deeper hard rock strata without measurable impacts on water levels within the alluvial aquifers (MER, 2013).

The GIA identified that there would be a minor transient change in groundwater levels within the alluvial aquifer as a result of subsidence, however these levels would re-equilibrate with the extraction of the subsequent longwall (MER, 2013).

The Project is predicted to result in the depressurisation of hard rock strata and associated groundwater within the Extraction Area. The hard rock groundwater system is generally regarded as a non-productive system due to the very low hydraulic conductivities of the rock strata. The hard rock groundwater system has been identified within the GIA as not being capable of supporting a useful water supply due to its low conductivity and depth of water tables (MER, 2013).

Cumberland Ecology has identified a number of groundwater dependent ecosystems within the vicinity of the major and minor drainage systems within the Project Boundary, including areas of the Jilliby SCA. In these areas, the water table within the hard rock strata is predicted to be deep. The trees and plants within the Jilliby SCA are unlikely to draw moisture from the deeper hard rock groundwater systems that are predicted to be affected by the Project. Instead, they are expected to rely upon soil moisture within the unsaturated zone, which is presently sustained by rainfall and runoff and will continue to do so with the Project. This is supported by the location of these groundwater dependent ecosystems in close proximity to the main drainage lines within the Jilliby SCA.

Therefore, the predicted impacts of the Project on the regional groundwater system are unlikely to result in impacts to the values of the Jilliby SCA.

3.26.4 Aboriginal Archaeological Sites

There are four Aboriginal grinding groove sites located within the portion of the Jilliby SCA within the Project Boundary. Sites 45-3-3040, 45-3-3041, 45-3-3042 and WSF-AG3 are potentially impacted by subsidence.

Predicted Subsidence Effects

The predicted conventional subsidence effects for the four sites are presented in **Table 9**.

Grinding groove sites are potentially impact by fracturing of the bedrock. Therefore, the main mechanisms for impacts to grinding groove sites are curvatures and strains. The predicted conventional strains for the four grinding groove sites in the Jilliby SCA are:

- 45-3-3040 – 0.5 mm/m tensile and 2.5 mm/m compressive;
- 45-3-3041 – 1.0 mm/m tensile and 0.5 mm/m compressive;
- 45-3-3042 – 1.0 mm/m tensile and 3.0 mm/m compressive; and
- WSF-AG3 – < 0.5 mm/m tensile and compressive.

Table 9
Predicted Subsidence Effects for Aboriginal Sites

Site ID	Maximum Predicted Conventional Subsidence (mm)	Maximum Predicted Conventional Tilt (mm/m)	Maximum Predicted Conventional Hogging Curvature (km^{-1})	Maximum Predicted Conventional Sagging Curvature (km^{-1})
45-3-3040	2,350	5.0	0.04	0.17
45-3-3041	2,250	5.5	0.05	0.04
45-3-3042	2,500	6.0	0.06	0.21
WSF-AG4	25	0.3	<0.01	<0.01

Predicted Subsidence Consequences

The heritage values of the grinding groove sites may be adversely impacted if the grinding groove sites experience cracking. Due to the significant depth of cover for mining beneath the Jilliby SCA, fracturing of bedrock is only predicted to occur at isolated locations. Impacts to grinding groove sites will only occur if the location of fracturing coincides with the locations of the grinding groove sites. Given that the grinding groove sites occupy a negligible area within the Jilliby SCA, impacts are very unlikely to occur.

Acceptability of Impacts

Due to the low likelihood of impacts occurring, and the low risk to the heritage value of the sites (if impacts do occur), the predicted impacts to Aboriginal grinding groove sites are considered acceptable.

3.26.5 Steep Slopes

There are no clifflines located within the Project Boundary. However, there are steep slopes located in the portion of the Jilliby SCA within the Project Boundary. The potential impacts on steep slopes are assessed in Section 5.6 of the SPIA.

The maximum predicted tilt for the steep slopes, resulting from the extraction of the proposed longwalls, is 15 mm/m (i.e. 1.5 %), which represents a change in grade of 1 in 65. The predicted changes in grade are small when compared to the natural grades of the steep slopes, which are greater than 1 in 3. Therefore, the predicted tilts are unlikely to result in any significant impact on the stability of the steep slopes.

The steep slopes are also likely to be impacted by ground curvatures and strains. These potential impacts would generally result from the downslope movement of the ground, causing tension cracks to appear at the tops and the sides of the slopes and compression ridges to form at the bottoms of the slopes.

The maximum predicted ground curvatures for the steep slopes above the Jilliby SCA and are 0.15 km^{-1} hogging and 0.20 km^{-1} sagging, which represent minimum radii of curvature of 7 km and 5 km, respectively. No large-scale slope failures have been observed at other mines where similar curvatures have been experience, even for those cases where longwalls were mined directly beneath the steep slopes.

Due to the low likelihood of slope failure, the minor impacts to steep slopes are considered acceptable.

3.26.6 Risk Summary

Based on the analyses above, the following levels of risk have been ascribed to the key natural features within the Jilliby SCA (see **Table 10**).

Table 10
Risk Assessment for Jilliby SCA

Natural Feature	Potential Impacts	Likelihood of Impact	Consequence	Risk
Little Jilliby Jilliby Creek	• Increased ponding • Fracturing of bedrock • Connectivity with mine workings	Rare	Low	Low
Groundwater Aquifers	• Change in water levels • Impacts on GDEs and other vegetation	Unlikely	Low	Low
Aboriginal Sites	• Cracking of grinding groove sites	Rare	Low	Low
Steep Slopes	• Slope instability	Unlikely	Low	Low

3.27 GENERAL

3.27.1 Mine Design and Layout

This response addresses a comment which requests the locations of internal haulage routes to enable the assessment of heavy vehicle movements.

Submission: RA6

As the Project is proposed to comprise an underground mine, very limited heavy vehicle movements within the mine will occur, primarily in relation to deliveries to site from external roads. Internal roads are shown on Figure 19 and Figure 21 of the EIS for each of the Tooheys Road and Buttonderry sites, respectively.

3.27.2 Project Duration

This section addresses the submissions regarding future mining beyond the 28 year Project duration.

Submission: P112

The current development application only seeks development consent for a period of 28 years. Impacts resulting from the construction and operation of the Project during this period have been assessed in the EIS. If mining beyond the 28 year Project duration is to be undertaken in the future, a subsequent development application will be submitted and the environmental impacts of the additional mining will be assessed in that application.

3.27.3 Mining Equipment

This section addresses the submissions regarding the equipment required for the Project and the potential for the actual equipment fleet to vary from the indicate equipment fleet stated in the EIS.

Submission: P112

The Project will be undertaken in accordance with the Development Consent, which requires that the development be carried out generally in accordance with the EIS.

3.27.4 Excavated Waste Rock

This section addresses the submissions regarding the use and disposal of waste rock excavated during the development of the drift and shafts.

Submission: P112

As stated in Section 3.11 of the EIS, approximately 180,000 m^3 of waste rock will be excavated during the construction of the drift and shafts. The majority of this material will be retained on site and utilised in landscaping and bunding and for future rehabilitation, as far as practical. This approach will minimise the need for some of this clean material to be transported offsite for local earthworks or disposal by a licensed contractor.

3.27.5 Connections to Sewer

This section addresses the submissions regarding the proposed connections to the sewer system for bathhouse and general sewer discharges.

Submission: RA2

The Tooheys Road Site will be connected to the municipal sewerage system via an easement in favour of WSC. WACJV will continue to consult with WSC regarding the registration and use of this easement.

3.27.6 EPA Recommended Conditions

This section responds to the submission regarding the recommended conditions of consent.

Submission: RA2

As noted in Section 4.4.4 of the EIS, the Project is deemed to be a scheduled activity under Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act). Accordingly, under Chapter 3 of the POEO Act, an EPL is required for the Project. As such, all relevant activities to be carried out as part of the Project will seek to be in accordance with the conditions of the EPL.

As noted in Section 8 of the EIS and listed by the EPA, particular consideration will be given to:

- Mine water quality and quantity;
- Ongoing geomorphological assessment of Wallarah Creek (including monitoring);
- Noise limitations, monitoring and management; and
- Preparation of an AQMP.

An application for an EPL will be made by WACJV to the EPA (the appropriate regulatory authority by virtue of section 6 of the POEO Act) should Development Consent be granted.

Attachment 3 of the EPA submission lists Possible EPL conditions, should development consent be granted.

WACJV will continue to consult with the EPA in relation to the possible EPL conditions.

3.27.7 Activities within the Jilliby State Conservation Area (SCA)

Section 3.1 in the EIS states that:

> *"Existing roads and surface land access in the Jilliby SCA may be utilised during the Project for a variety of purposes (such as for monitoring, exploration and other surface activities".*

WACJV commits that exploration activities will not be undertaken within the Jilliby SCA.

3.27.8 Buttonderry Waste Facility Interactions

This section responds to a submission which states that gas and leachate leakage due to the proximity of the Buttonderry Waste Facility to the Project has not been addressed.

Submission: RA6

The proposed Buttonderry Site surface facilities occur between Sparks Road and the Buttonderry Waste Management Facility. This facility will include (at least) the main personnel access to the mine, main ventilation facilities, offices and employee amenities.

The longwall panels in the Extraction Area are located over 1 km from the Buttonderry Waste Management Facility. Each of the Waste Management Facility and the Buttonderry Surface Facilities area are located outside the SIL and as such interactions between the waste site and coal extraction are considered highly unlikely.

Section 3.5 of the EIS also notes that WACJV will continue to evaluate the viability of co-ordinated gas management and usage opportunities with WSC and other stakeholders. WACJV will also regularly consult with WSC during the Project life, including the sharing of monitoring data, where practical.

3.27.9 Wyee Subdivision Impacts

This section responds to a submission which states that the Project will have impacts on a proposed subdivision of 750 homes at Wyee (including noise, air and subsidence).

Submission: P76, P136

The proposed subdivision at Wyee is over 7.5 km from the SIL for the Project, therefore will not be impacted by subsidence from the Project. Noise and air quality impacts from the Project will not exceed relevant regulatory criteria at the prosed subdivision, being over 3 km and 12 km from the Tooheys Road Site and Western Ventilation shaft respectively.

3.27.10 Transport of Coal from Neighbouring Mines

This section responds to a submission requesting confirmation that the EIS air quality and noise impact assessments included the assessment of coal being brought to site by third parties.

Submission: RA8, P112

The EIS air quality and noise impact assessments do include the loading and transport of coal from other facilities from the Tooheys Road site within the production limits sought in the application.

The EIS does not include the assessment of extraction, processing or transport of coal from third parties. Any transport of coal by a third party to the site would be required to be assessed under a separate development application by them.

3.27.11 Community Complaints

This section responds to a submission confirming that residents will have a contact point for complaints should noise or air quality issues arise.

Submission: RA8

As part of the Environmental Management System, WACJV will provide a 24 hour per day 7 day per week hotline number on which residents will be able to advise WACJV of any concerns associated with the Project. Each complaint received will be responded to under a complaints management protocol which will (at least): respond record, act (as required) and report on complaints.

3.27.12 Environmental Emergency Planning

This section addresses the submission stating that the EIS does not include contingency plans for potential natural or human induced disasters.

Submission: RA6

Insufficient detail is provided to ascertain the exact nature of this submission, however it has been assumed here that it refers largely to environmental incidents. Should WACJV be granted Development Consent, that instrument (along with various other post approvals' documentation) will include further risk assessment and subsequent procedural notification requirements for any environmental incidents occurring on site.

3.27.13 Bushfires

This section addresses the submission asserting that the Project will reduce ground moisture, resulting in greater incidence of bushfires.

Submission: P106

As explained in Section 6.2 of the GIA, the rate of leakage of groundwater from shallow groundwater systems is very low due to the lack of connected cracking and the extremely low permeability of the bedrock strata. As stated in **Section 3.2.12**, the total leakage loss is predicted to be 7.3 ML/year from alluvial aquifers and 29.2 ML/year from the hardrock groundwater system. The rate of leakage is negligible when compared to the rate of rainfall recharge. Therefore, the Project is not expected to reduce ground moisture.

3.27.14 Reporting and Auditing

This section addresses the submissions stating that the Project should be subject to regular reporting and auditing.

Submission: RA6

WACJV will prepare an Annual Review document and conduct Independent Compliance or other audits as required by conditions of Development Consent.

3.27.15 Updated References

This section addresses the submission identifying more recent reports from International Energy Agency (IEA) and Australian Energy Market Operator (AEMO).

Submission: RA7, P150

Whilst there is expected to be an increase in the contribution of alternate sources of energy in the form of wind and solar as well as the lesser greenhouse contributing natural gas it is predicted that a substantial source of the required energy will continue to come from the burning of coal.

Coal remains a highly sought after global energy source. The International Energy Agency of the United Nations (2012) acknowledges that coal has met nearly half of the rise in global energy demand over the last decade, growing faster even than total renewables. It is anticipated that the demand for world coal is set to rise to approximately 2020 with the key drivers being China and India.

The United States Energy Information Agency (2013) highlights that coal remains the largest source of electricity generation in the world with consumption predicted to reach 14.7 quadrillion British Thermal Unit (Btu) by 2040. Although there is anticipated to be a short term decline in the market share, coal production in the reference case increases by an average of 0.6 % per year from 2016 through 2040 as a result of growing coal exports and increasing use of coal in the electricity sector as electricity demand grows and natural gas prices rise.

As such, the Project Justification provided in Section 9 of the EIS remains relevant in this regard.

3.27.16 Political Donations Disclosure

This section responds to a submission questioning where WAJCV has disclosed any political donations.

Submission: P118

WACJV has noted in Section 8 of its 'State Significant Development Application' dated 18 October 2012 'no' in response to 'have you attached a disclosure statement to this request?' as shown here: https://majorprojects.affinitylive.com/public/aa66fc1b872937c2b1443051288eb362/10.%20Wallarah%202%20Coal%20Project%20-%20Development%20Application.pdf

3.27.17 Environmental Record of the Proponent

This section addresses the submission asserting that the EIS does not satisfy the DGR requiring details of proceedings against the proponent under Commonwealth or State laws.

Submission: P112

The environmental record of the proponent has been addressed in Section 1.4 of the EIS. WACJV has not been subject to any proceedings under a Commonwealth or NSW law.

3.27.18 EIS Risk Assessment

This section responds to the submissions regarding the level of risk assessment undertaken for the Project. It particularly focuses on groundwater and surface subsidence and the consideration of impacts not considered by the assessments. It suggests that the risk assessment is qualitative and not quantitative.

Submission: RA6, P112

Chapter 6 of the EIS provides a summary of Appendix F of the EIS which provides a detailed Revised Risk Assessment of the potential known Project risks in accordance with the WACJV Risk Assessment Matrix. The risk assessment was undertaken in accordance with the DGRs which required they identified the key issues for further assessment.

This process identified issues with a higher risk rating including subsidence, groundwater, surface water, flooding, ecology and Aboriginal heritage. Moderate risk issues including (at least) amenity impacts, greenhouse gas, visual and economics were also identified as areas with higher potential consequence. Significant, best practice studies from leading specialists were undertaken for the EIS in these key areas with the higher risk areas peer reviewed by eminent, independent professionals.

The findings of the ongoing stakeholder engagement undertaken by WACJV during the development of the EIS and as summarised in Table 19 of the EIS, also advised the Revised Risk Assessment as presented in the EIS and ensured that the various studies addressed issues of community concern.

The risk matrix in Appendix F of the EIS contains a typographical error. The descriptions of "Possible" and "Unlikely" should be reversed.

3.28 LEGAL AND REGULATORY

3.28.1 Consent Authority

This section addresses the submissions regarding the need for the Project to be determined by an independent panel.

Submissions: P20, P112, P126

Section 89D of the EP&A Act provides that the Minister for Planning and Infrastructure is the consent authority for SSD. However, section 23(1)(f) of the EP&A Act allows the Minister to delegate any of his functions to the Planning Assessment Commission (PAC). By instrument of delegation dated 14 September 2011, the Minister delegated his functions as the consent authority for SSD to the PAC.

The PAC is an independent panel constituted by experts in the fields of planning, architecture, heritage, the environment, urban design, land economics, traffic and transport, law, engineering, tourism or government and public administration.

3.28.2 Objects of the EP&A Act

This section addresses the submissions regarding the application of the principles of the EP&A Act.

Submissions: P122

The objects of the EP&A Act are listed under section 5 of the Act. The first object of the Act is to encourage:

> *"the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment".*

The Project facilitates the proper development of mineral resources, which is consistent with this object of the Act. One submission has highlighted that the first object of the Act is also concerned with the management and conservation of agricultural land, natural areas, forests, water and villages. It is acknowledged that the absence of the Project does not prevent these aspects of the object from being satisfied. However, the object is not satisfied with respect to the development of minerals if the Project does not proceed.

3.28.3 Principles of Ecologically Sustainable Development

This section addresses the submissions regarding the application of the principles of the Ecologically Sustainable Development.

Submissions: SIG1, SIG7, P1, P5, P80, P115, P136, P141

The principles of Ecologically Sustainable Development (ESD) are defined under section 6 of the *Protection of the Environment Administration Act 1991*. The Project is consistent with the principles of ESD as discussed in Section 9 of the EIS and summarised below.

- ***The precautionary principle** – namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*.
  The impact assessments have adopted a precautionary approach by assessing impacts on a 'worst-case scenario' basis. Where there was scientific uncertainty, it was assumed that the worst case impact would occur. If the worst case impact would result in serious or irreversible environmental damage, mitigation measures were developed to avoid or minimise the harm. In some instances, the Project was re-designed or modified to avoid serious impacts.
- ***Inter-generational equity** – namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations;*

The impact assessments have determined that when mitigation and management measures are implemented, the Project can be carried out without causing serious and enduring impacts on the environment.

As explained in **Section 3.2.13**, the Project is not expected to result in any long-term decline in the water table. The rate of downward leakage of water from shallow aquifers is predicted to be easily replaced by rainfall recharge. Water levels will temporarily decline due to subsidence, but are expected to recovery rapidly due to rainfall recharge.

As explained in **Section 3.2.16**, subsidence will result in a temporary reduction in surface water runoff. The maximum predicted reduction in runoff is predicted to have only a negligible impact on the flow regimes of Jilliby Jilliby Creek and the Wyong River. Furthermore, the reduction in surface water runoff is a temporary impact that only occurs when there is differential subsidence.

The Biodiversity Offset Package will conserve land to offset the impact of the Project on ecological values. The biodiversity offset areas will be protected in perpetuity, resulting in long-term improvement in ecological values.

Therefore, the proposed management and mitigation measures allow the Project to maintain or improve environmental values for future generations.

- ***Conservation of biological diversity and ecological integrity –*** *namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.*

  The Project has been designed to minimise the required disturbance to native vegetation. For instance, the Project will operate without a coal preparation plant to reduce the area required for infrastructure. In addition, the Biodiversity Offset Package will conserve land to offset the residual impacts of the Project, result in a long term improvement in ecological values.

- ***Improved valuation, pricing and incentive mechanisms –*** *namely, that environmental factors should be included in the valuation of assets and services.*

  The Project is consistent with the “polluter pays principle”, given that WACJV will bear the costs of mitigation measures to reduce air quality and noise impacts. WACJV will also bear the costs of its greenhouse gas emissions through the Commonwealth government’s carbon pricing mechanism.

3.28.4 SEPP (Mining, Petroleum Production and Extractive Industries) 2007

This section addresses the submission asserting that the Project is not consistent with clause 14 of State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (SEPP Mining).

Submission: P112

Clause 14(1)(a) of SEPP Mining states that the consent authority is required to consider imposing development consent conditions to ensure that:

> *"impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable".*

The submission contends that the Project has failed to minimise the impact on surface and groundwater resources by adopting the longwall method of mining instead of the bord and pillar method. Section 3.13.2 of the EIS states that although bord and pillar mining results in a lower level of subsidence, this method had safety implications and was not economically viable for the coal resource within the Extraction Area. Clause 14(1)(a) requires that impacts on water resources be minimised to the "greatest extent practicable". Since it is not practicable to utilise the bord and pillar method of mining, the Project is not inconsistent with clause 14(1)(a) of SEPP Mining.

3.28.5 Crown Land

This section addresses the submission regarding the interface between the Project and Crown Land.

Submission: RA19

The construction of the Tooheys Road Site and rail spur will occur on Crown Land. WACJV will consult with NSW Crown Land regarding the necessary acquisitions of Crown Land.

An additional parcel of land (Lot 7305, DP 1165648) immediately to the west of the Main Northern Rail Line is also owned by the Crown and will be included in the final Schedule of Land for the Project.

3.28.6 Water Catchment Districts

This section addresses submissions regarding water related legislation. It particularly responds to a submission which states that the Project occurs within the Proclaimed Wyong Water Catchment District as proclaimed under the Local Government Act 1919 (Section 401 Division 7 Local Government Act Catchment districts and ordinances).

Submission: RA6, SIG1

The SWIA has considered all current legislation relevant to the Project as outlined in Section 4 and Section 6. This includes consideration of impacts from the Project on the taking of water from the catchment in accordance with the *Water Management Act 2000* and *Water Act 1912*.

The *Local Government Act 1919* has been repealed.

The *EPBC Act Water Trigger Amendment 2013* was passed by parliament on 19 June 2013. 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. In its submission, SEWPaC indicated that a decision on whether the water trigger applies to the Project was still pending.

4 MANAGEMENT AND MONITORING SUMMARY

Table 11 *provides a consolidated summary of the proposed environmental management and monitoring measures included in the EIS and its source. Additional management and monitoring commitments from this RTS have been included in '**bold**'.*

Table 11
Project Management & Monitoring Measures

Ref	Measure	Section
Environmental Management		
1	WACJV will develop and implement an Environmental Management System in consultation with the relevant regulators (and the Aboriginal community where relevant) consistent with Section 7 of the EIS to the approval of DP&I which shall comprise: • Environmental Management Strategy (EMS); • Environmental Monitoring Plan (incorporating subsidence, groundwater, surface water, air quality and noise) • Extraction Plan; • Water Management Plan; • Air Quality Management Plan; • Energy and Greenhouse Strategy; • Noise Management Plan; • Biodiversity Offset Strategy; • Land Clearance Protocol; • Traffic and Transport Management Plan; • Aboriginal Cultural Heritage Management Plan; • Historic Heritage Management Plan; • Soil and Land Capability Procedure (including an Acid Sulphate Soils Management Procedure); • Land Management Plan; • Bushfire Management Plan; • Waste Management System; and • Landscape Management Plan Preparation of a Subsidence Management Plan (and Property Subsidence management Plans in consultation with landholders) to the approval of DTIRIS.	EIS 7
2	**WACJV will not undertake exploration or remediation works within the Jilliby SCA unless authorised to do so as conditions of development consent or under other appropriate approvals.**	RTS 3.1.10
3	The existing monitoring program as shown in **Figure 13** shall be revised and updated in consultation with relevant regulators over the life of the Project in consideration of operations and impacts.	EIS 2.8
Subsidence		
4	The Extraction Plan will include a Trigger Action Response Plan (TARP) to allow WACJV to respond to impacts as they arise and enable adaptive management to occur over the life of the Project.	EIS 7.1.4
5	Subsidence monitoring will be conducted before, during and after secondary extraction of each longwall to enable periodic evaluation of environmental consequences against the predictions in this EIS.	EIS 7.1.4

Ref	Measure	Section
6	Monitoring will also be conducted post-mining to evaluate the success of remediation programs.	EIS 7.1.4
7	The Extraction Plan will include Property Subsidence Management Plans for individual properties to manage potential impacts to residential and non-residential buildings.	EIS 7.1.4
8	**WACJV will consult with Transgrid and the Mine Subsidence Board to develop a plan for managing impacts to high angle tension transmission towers.**	RTS 3.1.9
9	**Management plans will include the progression of subsidence associated with individual longwall panels and will present detailed hydraulic and geomorphic assessments to identify erosion risk areas.**	RTS 3.3.5
10	**Consultation between WACJV and the turf farm operator will occur (at least) during the preparation of the PSMP.**	RTS 3.19.2
Water		
11	The Water Management System will be managed as described in this EIS.	EIS 7
12	In consideration of the findings from the groundwater and surface water assessments, the Water Management Plan will ensure that the monitoring program as described is implemented and maintained so that the modelled predictions and assumptions can be verified and any potentially unforeseen water impacts can be identified and managed.	EIS 7.2, 7.3 and 7.4
13	The Erosion and Sediment Control Plan will incorporate control measures to separate runoff from disturbed and undisturbed areas and to treat runoff from disturbed areas.	EIS 7.3
14	A comprehensive monitoring program of the site water management system will be developed as part of the EMP.	EIS 7.2 , 7.3 and 7.4
15	**WACJV will meet the EPL conditions for treated water discharge including any requirements for geomorphological assessment of Wallarah Creek.**	RTS 3.3.4
16	**Water quality monitoring for treated water discharges to Wallarah Creek will include testing for ecotoxic effects.**	RTS 3.10.9
Air Quality		
17	The Air Quality Management Plan shall incorporate the feasible and reasonable air quality controls and details of the air quality monitoring network described in this EIS.	EIS 7.5.4
18	**WACJV will implement best practice load profiling and will water spray the surface of loaded coal wagons.**	RTS
19	An Energy and Greenhouse Strategy will be developed within two years after the commencement of longwall coal extraction. The strategy will address interim and long term energy and greenhouse management plans and initiatives, including monitoring, reporting and continuous improvement.	EIS 7.6.4
20	Air quality emissions will be monitored using the revised EMP to ensure compliance with relevant air quality criteria. The existing monitoring network will be reviewed and augmented for the Project.	EIS 7.5.4
21	**WACJV will investigate the feasibility of beneficial re-use of the captured methane for on-site power generation.**	RTS 3.6.3

Ref	Measure	Section
Noise		
22	The Noise Management Plan will incorporate the feasible and reasonable mitigation and noise monitoring network.	EIS 7.8.4
23	The Environmental Monitoring Program will incorporate regular noise monitoring surrounding the Tooheys Road and Buttonderry Sites which is representative of the closest sensitive receivers.	EIS 7.8.4
Ecology		
24	The Biodiversity Management Plan will incorporate the management and mitigation methods in this EIS.	EIS 7.9.4
25	The Biodiversity Offset Strategy as described in this EIS will be implemented for the life of the Project.	EIS 7.10
26	Prior to the clearing of any native vegetation, the Land Clearance Protocol as described in this EIS will be utilised.	EIS 7.9.4
27	**Further surveys for threatened frog species will be conducted once survey conditions are appropriate.**	RTS 3.9.3
28	**WACJV will contribute $60,000 for relevant research in relation to the Giant Barred Frog, the details of which will be included in the Biodiversity Management Plan which shall be developed in consultation with relevant regulators.**	RTS 3.9.6
29	**Aquatic ecology monitoring will continue to be undertaken in the Autumn and Spring survey periods. Sampling will be undertaken at sites upstream and downstream of sections of streams affected by subsidence in accordance with the BMP.**	RTS 3.10.10
Traffic and Transport		
30	The Traffic and Transport Management Plan (TTMP) will incorporate the management and mitigation in this EIS.	EIS 7.12.4
31	**WACJV will consult with WSC to develop an agreement for addressing road safety issues.**	RTS 3.11.6
32	**WACJV will obtain accreditation of the proposed rail infrastructure from the National Rail Safety Regulator.**	RTS 3.12.3
33	**The Project will not supply coal to domestic power stations.**	RTS 3.12.7
34	**The Project will not transport any coal to port via the road network.**	RTS 3.12.3
35	**Traffic associated with construction will be managed in accordance with Traffic Control at Work Sites (Roads and Traffic Authority, 2010) and the relevant Australian Standards.**	RTS 3.11.7
36	**Prior to Year 13, the TTMP will be revised to include measures for managing the movement of heavy vehicles to minimise the disruption of traffic during the before and after school periods on Jilliby Road in the vicinity of Jilliby Public School in consultation with the school.**	RTS 3.11.7

Ref	Measure	Section
	Heritage	
37	The Aboriginal Cultural Heritage Management Plan will be guided by specific policies and procedures to manage Aboriginal archaeological sites within the Project Boundary and periodically reviewed in consultation with Aboriginal stakeholders and relevant regulators.	EIS 7.14
38	The Historic Heritage Management Plan will incorporate management strategies to limit the potential impacts of the Project on historical heritage items and will be prepared in consultation with relevant regulators.	EIS 7.15
	Visual	
39	Landscape mitigation measures will be undertaken at the Tooheys Road using native vegetation to achieve a reduction in the visual impacts of the Site.	EIS 7.16.4
40	Upon receiving a written request from an owner of privately-owned land with direct views to the Tooheys Road site from a residence within 2 km of the Tooheys Road Site, WACJV will implement reasonable and feasible additional visual impact mitigation measures (such as landscaping treatments or vegetation screens) in consultation with the landowner, to the satisfaction DP&I.	EIS 7.16.4
41	For the Buttonderry Site, effective landscape enhancement will be achieved by screen planting along the Hue Hue Road Boundary and particularly adjacent to the entrance and the access roadway subject to traffic visibility safety requirements.	EIS 7.16.4
	Social	
42	WACJV will use its best endeavours to develop a Voluntary Planning Agreement with Wyong Shire Council in consideration of the findings of the Social Impact Assessment	EIS 7.17
43	WACJV will operate a Project Community Consultative Committee in accordance with relevant guidelines	EIS 7.17
44	WACJV will use its best endeavours to achieve 70% local hires for its operational workforce.	EIS 7.17
	Land Resources	
454	The Soil and Land Capability Procedure (including management of Acid Sulphate Soils) will be developed in consideration of the mitigation and management measures in this EIS.	EIS 7.19
46	The Land Management Plan will include measures to manage weeds and feral animals on WACJV owned land within the Project Boundary.	EIS 7.9 and 7.25
47	In order to reduce the potential for Project related impacts on the publicly owned forest resources managed by Forests NSW, the strategies detailed in this EIS will be implemented during construction and operation of the Project.	EIS 7.21
	Contamination	
48	Remediation of the existing minor hydrocarbon contamination at the Buttonderry Site will be conducted in accordance with this EIS.	EIS 7.22
	Waste	
49	A Waste Management System will be developed for the Project to promote waste avoidance and resource recovery by developing appropriate strategies and programs in accordance with relevant regulations.	EIS 7.24

Ref	Measure	Section
	Rehabilitation	
50	In accordance with the Landscape Management Plan to be developed for the Project, rehabilitation areas will be monitored on a regular basis to ensure that rehabilitation objectives are being met and that sustainable revegetation, remediation and long term landform sustainability is achieved.	EIS 7.25
51	Completion criteria for mine closure will be developed and agreed in consultation with the relevant government agencies and community and incorporated into the final Mine Closure Plan (developed as part of the Landscape Management Plan).	EIS 7.25
	General	
52	**WACJV will continue to evaluate the viability of co-ordinated gas management and usage opportunities, and share monitoring data with WSC and other industry stakeholders.**	RTS 3.27.8
53	**WACJV will consult with NSW Crown Land regarding the necessary acquisitions of Crown Land required for the Project, at the relevant time.**	RTS 3.28.5
54	WACJV will provide regular, relevant training to all employees and contractors in relation to the commitments in this EIS.	EIS 7
55	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, the CCC and report on the Project website.	EIS 7
56	**WACJV will commission Independent Environmental Audits in accordance with any conditions of Development Consent.**	RTS 3.27.14

*   *   *

for
HANSEN BAILEY

Andrew Wu
Environmental Engineer

Dianne Munro
Principal

5 ABBREVIATIONS

Table 12 provides a list of abbreviations used in this RTS.

Table 12
Abbreviations

Abbreviation	Description
µS	Microgram
a	Annual
ABS	Australian Bureau of Statistics
ACA	Australian Coal Alliance
ACHMP	Aboriginal Cultural Heritage Management Plan
AEIA	Aquatic Ecology Impact Assessment
AEMR	Annual Environmental Management Report
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AIP	*Aquifer Interference Policy* (NOW, 2012)
AIS	Agricultural Impact Statement
AMD	Acid mine drainage
ANZECC guidelines	Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)
AQGGA	Air Quality and Greenhouse Gas Assessment
AQMP	Air Quality Management Plan
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
AS	Australian Standard
ASC	Australian Soil Classification
ASS	Acid Sulphate Soil
BCA	Benefit-Cost Analysis
BMP	Biodiversity Management Plan
BOP	Biodiversity Offset Package
CCRS	Central Coast Regional Strategy
CEC	Cation exchange capacity
CFMEU	Construction, Forestry, Mining and Energy Union
CGE	Computable Generated Equilibrium
cm	Centimetres
CO_2	Carbon Dioxide

Abbreviation	Description
CPSS	Certified Professional Soil Scientist
dBA	The peak sound pressure level, expressed as decibels (dB) and scaled on the '*A-weighted*' scale, which attempts to closely approximate the frequency response of the human ear.
DCP	Development Control Plan
DEEWR	Department of Education, Employment and Workplace Relations
DGRs	Director-General's Requirements
DIPNR	NSW Department of Infrastructure, Planning and Natural Resources (now NSW Department of Planning and Infrastructure)
DLALC	Darkinjung Local Aboriginal Land Council
DNG	Derived Native Grassland
DoP	NSW Department of Planning (now NSW Department of Planning & Infrastructure)
DP&I	NSW Department of Planning & Infrastructure
DPI - Agriculture	NSW Department of Primary Industries – Office of Agricultural Sustainability & Food Security
Draft Wyong LEP	*Draft Wyong Local Environment Plan 2012* (WSC, 2012)
DRE	NSW Division of Resources and Energy (within the Department of Trade & Investment, Regional Infrastructure and Services)
EC	Electrical conductivity
EEC	Endangered Ecological Community
EIA	Ecological Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning & Assessment Act 1979*
EP&A Regulation	*Environmental Planning & Assessment Regulation 2000*
EPA	NSW Environment Protection Authority
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
EPL	Environmental Protection Licence
EPM	Equivalent porous medium
ERM	Environmental Resources Management
ESD	Ecologically Sustainable Development
FCNSW	Forestry Corporation NSW
FIA	Flood Impact Assessment
Fisheries NSW	NSW Department of Primary Industries – Fisheries
FLAC	Fast Langrongian Analysis of Continua
FM Act	*Fisheries Management Act 1994*

Abbreviation	Description
Forestry Act	*Forestry Act 2012*
FPL	Flood Planning Level
g	Grams
GDEs	Groundwater Dependent Ecosystems
GHG	Greenhouse Gas
GIA	Groundwater Impact Assessment
GOS	Gross Operating Surplus
GWCWA	Gosford-Wyong Councils Water Authority
ha	Hectares
Hansen Bailey	Hansen Bailey Environmental Consultants
HCRCMA	Hunter Central Rivers Catchment Management Authority
HHMP	Historic Heritage Management Plan
HRA	Health Risk Assessment
IO	Input-output
IPM	Incremental Profile Method
km	Kilometre
km/h	Kilometres travelled per hour
KPIs	Key Performance Indicators
KTPs	Key Threatening Processes
kV	Kilovolt
LA_{eq}	The summation of noise over a selected period of time. It is the energy average noise from a source and is the equivalent continuous sound pressure level over a given period.
$LA_{eq\ 15hr}$	The summation of noise over a selected period of time. It is the energy average noise from a source and is the equivalent continuous sound pressure level over a 15 hour period.
$LA_{eq\ 9hr}$	The summation of noise over a selected period of time. It is the energy average noise from a source and is the equivalent continuous sound pressure level over a 9 hour period.
$LA_{max\ (95th\ Percentile)}$	The noise level exceeded 5% of the time.
$LA_{max\ 24hr}$	The maximum noise level experienced during a 24 hour period
LGA	Local Government Area
LMCC	Lake Macquarie City Council
m	Metres
M	Million
mg	Milligram

Abbreviation	Description
ML	Megalitres
mm	Millimetre
MNES	Matters of National Environmental Significance
MNRL	Main Northern Rail Line
MOD	Mine Operations Dam
MSB	NSW Mine Subsidence Board
MSB	Mine Subsidence Board
MSDs	Mine Subsidence Districts
MSEC	Mine Subsidence Engineering Consultants
NCC	Nature Conservation Council of NSW
NMP	Noise Management Plan
NOW	NSW Office of Water
NSFC	Northern Sydney Freight Corridor
NSW Health	NSW Department of Health
OEH	NSW Office of Environment & Heritage
PAC	Planning Assessment Commission
PASS	Potential Acid Sulphate Soils
PB	Parsons Brinckerhoff
PHA	Preliminary Hazard Analysis
PM	Particulate Matter
PM_{10}	Particulate Matter <10 microns
$PM_{2.5}$	Particulate Matter <2.5 microns
PMF	Probable Maximum Flood
PMST	Protected Matters Search Tool
POEO Act	*Protection of the Environment Operations Act 1997*
PSMP	Property Subsidence Management Plan
PSNC	Project Specific Noise Criteria
RFEF	River Flat Eucalypt Forest on Coastal floodplains of the NSW North Coast and Sydney Basin bioregion.
RING	*Rail Infrastructure Noise Guideline* (EPA, 2013)
RMS	Roads and Maritime Services
ROM	Run-of-mine
RTS	Response to Submissions
SAL	Strategic Agricultural Land
SALIS	Soils and Land Information System

Abbreviation	Description
SCA	State Conservation Area
SEWPaC	NSW Department of Sustainability, Environment, Water, Population and Communities
SIA	Social Impact Assessment
SIL	Subsidence Impact Limit
SiO_2	Silica
SLCIA	Soil and Land Capability Impact Assessment
SMP	Subsidence Management Plan
SMS	Subsidence Modelling Study
SoHI	Statement of Heritage Impact
SPIA	Subsidence Predictions and Impact Assessment
SRLUP	Strategic Regional Land Use Policy
SSD	State Significant Development
SWIA	Surface Water Impact Assessment
TARP	Trigger Action Response Plan
TfNSW	Transport for NSW
Approved Methods	*Approved Methods for Modelling and Assessment of Air Pollutants in NSW* (DECC, 2005)
The Project	The Wallarah 2 Coal Project
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulates
TSS	Total suspended sediment
TTIA	Traffic and Transport Impact Assessment
TTMP	Traffic and Transport Management Plan
WACJV	Wyong Areas Coal Joint Venture
WAL	Water Access Licence
Water Act	*Water Act 1912*
WEZ	Wyong Employment Zone
WM Act	*Water Management Act 2000*
WRCFS	Wyong River Catchment Flood Study
WSC	Wyong Shire Council
WSF	Wyong State Forest
WSP	Water sharing plan
WTP	Water Treatment Plant
Wyong LEP	*Wyong Local Environment Plan 1991*

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Wallarah 2
COAL PROJECT

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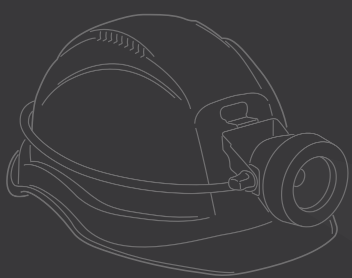
Response to Submissions

September 2013

Appendix A

Stakeholders and
Key Submission Issues



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Wallarah 2 Coal Project
Appendix A - Stakeholders and Key Submission Issues

Stakeholder	Submission ID	Supporting	General	Subsidence	Groundwater	Surface Water	Flood	Air Quality	Greenhouse Gas	Human Health	Noise	Ecology and Biodiversity Offsets	Aquatic Ecology	Traffic and Transport	Rail	Aboriginal Heritage	Historic Heritage	Visual	Social	Economics	Soil and Land Capability	Agriculture	Forestry	Contamination	Management and Monitoring	Environmental Risk Assessment	Stakeholder Consultation	Rehabilitation & Mine Closure	Geology	Earthquakes
REGULATORY AGENCIES																														
NSW Office of Water	RA1		•		•	•	•																						•	
NSW Environment Protection Authority	RA2		•		•	•		•			•		•																	
Office of Environment & Heritage - Heritage Branch, Regional Operations Group	RA3																•													
Office of Environment & Heritage, NSW Department of Premier and Cabinet	RA4		•	•	•	•	•					•	•			•													•	
Division of Resources and Energy, Trade and Investment NSW	RA5		•	•																								•		
Wyong Shire Council	RA6			•	•	•	•	•	•	•	•	•													•	•	•			
Lake Macquarie City Council	RA7		•					•						•	•				•											
NSW Health	RA8		•		•	•	•			•	•																			
Department of Primary Industries	RA9				•	•						•							•			•								
Hunter Central Rivers CMA	RA10					•						•																		
Fisheries NSW	RA11					•																								
Central Coast Water Corporation	RA12			•	•	•	•																							
Transport for NSW	RA13		•	•										•	•					•										
Roads and Maritime Services	RA14													•																
Mine Subsidence Board	RA15																													
Transgrid	RA16			•																							•			
Australian Rail Track Corporation	RA17										•				•															
Department of Sustainability, Environment, Water, Population and Communities	RA18																													
Crown Land	RA19		•																											
Forestry Corporation NSW	RA20																						•							
Department of SEWPaC	RA21		•									•																		
SPECIAL INTEREST GROUPS																														
Australian Coal Alliance	SIG1		•	•	•	•	•	•	•	•	•	•			•				•	•	•	•					•	•	•	
Darkinjung Local Aboriginal Land Council	SIG2		•													•														
Nature Conservation Council of NSW	SIG3		•	•	•	•		•	•		•	•																		
Construction Forestry Mining and Energy Union	SIG4	•	•									•							•											
Economists at Large	SIG5																		•	•										
Climate Future	SIG6		•						•											•										
Wilderness Society	SIG 7			•	•	•	•	•	•			•																		
PUBLIC																														
Form Letter 1	P5		•	•	•			•	•	•		•																		
Form Letter 3	P6		•	•																										
Form Letter 4	P7				•			•		•	•																			
Form Letter 5	P8	•	•																											
Form Letter 6	P9		•			•				•		•																		
Form Letter 7	P10		•			•				•		•																		
Form Letter 8	P11	•	•																											
Form Letter 9	P12	•	•																											
Form letter 10	P13	•	•																											
Form Letter 11	P14	•	•																											
Form Letter 12	P51	•																	•	•										
Form Letter 13	P93	•																	•	•										
Form Letter 14	P150		•			•		•	•	•	•	•			•	•														
David Harris	P1		•	•	•	•		•		•	•	•							•											
David Holland	P2		•			•		•		•	•	•							•	•										
Mark Moffett	P3		•	•	•	•		•		•		•					•			•										
Ken Scales	P4		•	•		•		•		•				•					•	•						•		•		
Elza Eddy	P15							•		•																				
Alexia Martinez	P16		•	•	•	•	•	•	•	•		•																		
Karen Fisher	P17			•		•						•							•	•										
Name withheld	P18					•																								
Corrina Roberts	P19					•																								
Warren Simmons	P20		•			•		•		•										•										
Amanda Austin	P21																		•	•										
Brigit Graefner	P22																		•											
Chris Davies	P23																			•										
Grace Robinson	P24					•													•	•										
Jay Barry	P25	•																	•	•										
Julie-Anne Barry	P26	•																	•	•										
Lindsay Auston	P27	•																		•										
Patrick Walters	P28	•																		•										
Steve Mason	P29	•																	•	•										
Tony Twomey	P30	•																	•	•										
Tony Sager	P31	•																		•										
Victoria Oszko	P32	•																		•										
Name withheld	P33	•																	•	•										
Name withheld	P34	•																	•	•										
Barrie Toepfer	P35	•																	•											
Bruce Meikle	P36	•																												
Chris Velovski	P37	•																												
Clinton Charles	P38	•																	•											
Deborah Burrows	P39	•																	•											
Keith Bartlett	P40	•																	•											
Leigh Smith	P41	•																	•	•										
Michael Jones	P42	•																	•	•										

Stakeholder	Submission ID	Supporting	General	Subsidence	Groundwater	Surface Water	Flood	Air Quality	Greenhouse Gas	Human Health	Noise	Ecology and Biodiversity Offsets	Aquatic Ecology	Traffic and Transport	Rail	Aboriginal Heritage	Historic Heritage	Visual	Social	Economics	Soil and Land Capability	Agriculture	Forestry	Contamination	Management and Monitoring	Environmental Risk Assessment	Stakeholder Consultation	Rehabilitation & Mine Closure	Geology	Earthquakes
Steve Williams	P43	•																		•										
Tim Leeson	P44	•																												
Name withheld	P45	•																	•	•										
Name withheld	P46	•																	•	•										
Name withheld	P47	•																	•											
Anna Mason	P48	•																	•	•										
Bruce McCutcheon	P49	•																												
Brendan Rutherford	P50	•																		•										
Kim Anderson	P52	•																	•	•										
Peter Blanch	P53	•																	•	•										
Robert Burrows	P54	•																												
Rodney Whitaker	P55	•																	•											
Tony Levien	P56	•																	•	•										
Shane Cutcher	P57	•																	•	•										
Name withheld	P58		•																											
Name withheld	P59	•																	•											
Name withheld	P60	•																	•											
Andrew Brook	P61	•																	•	•										
Craig Evans	P62																		•	•										
Duncan Hardie	P63	•																		•										
Esther-Marie Berry	P64								•																					
Greg Burge	P65		•																											
John Edwards	P66	•																												
Leslie Moore	P67			•	•			•			•	•								•								•		
Pamela Rabinau	P68																		•											
Scott Bradford	P69	•																	•											
Mary Goodwin	P70					•				•		•							•											
Name withheld	P71	•																	•	•										
Name withheld	P72	•																	•	•										
Thomas Colley	P73					•			•							•									•					
Name withheld	P74									•										•										
Name withheld	P75	•																	•											
Name withheld	P76									•																				
Ben Belfield	P77	•																	•	•										
Dylan Andrijic	P78			•		•				•		•																		
Graham Sturt	P79			•		•				•																				
Heather Ingram	P80					•		•			•																			
Jim Thomson	P81		•	•	•	•	•	•		•		•							•	•					•				•	
Lois Katz	P82					•		•	•	•		•																		
Ross Campbell	P83	•																												
Tammy Dial	P84									•																				
Shirley Hotchkiss	P85							•	•			•										•								
Name withheld	P86		•																											
Name withheld	P87					•																								
Name withheld	P88			•		•																								•
Name withheld	P89		•																											
Name withheld	P90		•																											
Andrew Thomson	P91			•		•		•	•											•										
Christopher Ellis	P92	•																	•	•										
Doug Williamson	P94				•															•									•	
Dennis Bately	P95				•	•						•																		
Hugh Mansfield	P96		•	•		•		•																						
Jean Bately	P97					•		•		•																				
Michael Lynch	P98					•			•																					
Tim Maddison	P99	•																	•	•										
David Auston	P100	•																	•	•										
Name withheld	P101		•	•		•		•																						
Name withheld	P102		•	•	•			•																						
Name withheld	P103			•		•						•																		•
Name withheld	P104			•	•	•																								
Name withheld	P105					•		•																						•
Alexia Gratelle	P106			•	•	•	•	•	•			•								•					•		•		•	
Kimberley Bushnell	P107		•	•	•	•		•				•								•										
Lyn Axford	P108							•		•	•																			
Megan Hitchens	P109			•		•		•	•	•	•	•																		
Peter & Tanya O'Neill	P110			•		•		•		•		•																		
Philippe Gratelle	P111		•	•								•										•					•			
Wayne McCauley	P112		•	•	•	•	•	•	•	•	•	•	•	•	•			•							•	•	•		•	
Peter Hopkins	P113		•	•		•		•	•			•																		
Name withheld	P114											•																		
Name withheld	P115		•	•		•				•																				
Garry Manwarring	P116	•																	•	•										
Peter Borg	P117		•																											
Sharon Salmi	P118					•	•		•	•	•	•								•		•								
Thais Gratelle	P119			•																										
Bradley Moffett	P120			•																										
Lisa Moffett	P121					•		•																						
Name withheld	P122	•	•																•	•					•					
David Grover	P123				•			•						•																
Name withheld	P124			•		•																								
Greg Piper	P125		•	•	•	•		•	•	•		•							•	•										
Marie Beveridge	P126		•	•			•	•	•		•	•							•	•					•		•			•
Michael Conroy	P127				•	•														•										
Peter Cooke	P128					•																								
Vanessa Vallack	P129		•																											
Name withheld	P130		•																											
Name withheld	P131		•		•	•		•	•		•	•																		

Stakeholder	Submission ID	Supporting	General	Subsidence	Groundwater	Surface Water	Flood	Air Quality	Greenhouse Gas	Human Health	Noise	Ecology and Biodiversity Offsets	Aquatic Ecology	Traffic and Transport	Rail	Aboriginal Heritage	Historic Heritage	Visual	Social	Economics	Soil and Land Capability	Agriculture	Forestry	Contamination	Management and Monitoring	Environmental Risk Assessment	Stakeholder Consultation	Rehabilitation & Mine Closure	Geology	Earthquakes
Name withheld	P132			•		•			•			•																		
Name withheld	P133	•																												
Rae Davenport	P134					•		•																						
Name withheld	P135				•			•			•				•			•		•										
Brian & Carole Donaldson	P136		•	•	•		•	•	•	•		•								•										
Jean & Louise Gaggin	P137	•																	•	•										
Robert Holland	P138		•	•		•		•	•		•	•		•				•	•	•										
Sandy Langsford	P139			•		•						•								•		•								
Machala Family	P140		•			•		•		•										•										
Paul Phillips	P141		•	•	•		•	•			•																•			
Ray Raucscher	P142				•																									
Roger Thomson	P143					•																								
Chris & Lydia Downes	P144			•		•			•	•		•																		
Michelle Campbell	P145			•		•				•		•																		
Alan & Judith Hayes	P146			•		•		•		•		•															•			
Andreas Dalman	P147		•			•		•	•			•																		
Duncan Bourne	P148								•																					
Helen Borland	P149		•																											
Peter Carroll	P151								•																					
Wyong Ratepayers & Residents Association	P152																													
Name withheld	P153								•																					
Adrian Watkins	P154																		•											
Brett Hedger	P155								•																					
Brian Wilson	P156			•		•																								
Ifeanna Tooth	P157																			•										
John Belwood	P158			•	•	•	•																							
Jane Smith	P159					•																								
Cheryl Graves	P160									•										•										
Ian Brown	P161		•	•				•				•								•										
Bateau Bay Progress Association	P162				•							•																		
Rhonda Audsley	P163																								•					
Community Environment Network	P164			•	•	•		•				•																		
Richard & Susan Bell	P165				•	•																								
Brett & Carolyn Huntley	P166				•							•																		
Australian Conservation Foundation	P167																													
Karen Higgins	P168								•			•								•										
Therese Wilkins	P169			•	•	•		•	•	•	•	•								•		•			•					
Alastair & Beverley Sloan	P170		•	•	•	•	•			•		•							•			•								
Carolyn Donnolly	P171								•			•																		
Our Land Our Water Our Future	P172					•																								
Richard Farrell	P173				•																				•				•	
Kevin & Susan Wynn	P174							•		•																				
Bronte Talbot	P175			•		•		•		•																				
Sandra Norman	P176		•	•			•														•	•								
Walker Family	P177			•	•	•						•									•	•			•					
Alexa Coffey	P178			•				•		•		•																		
Ashley Coombs	P179			•		•																								
C Higgins	P180			•																					•					
Halit Adasal	P181			•																					•					
Vikki Tyler	P182																													•
Dooralong Valley Residents Association	P183			•																										
Valerie Williams	P184																													•

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Wallarah 2 Coal Project

Response to Submissions

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Appendix B

Consolidated Submission Issues

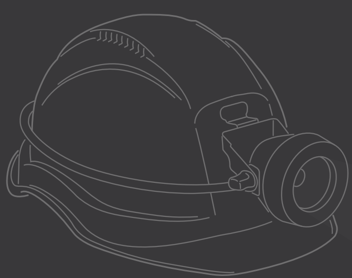

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Table 1 - Summary of Submission Issues

No.	Aspect	Stakeholder	ID	Issue
Regulatory Agencies				
Heritage Council of New South Wales				
1.	Historic Heritage	OEH Heritage Branch	RA3	In providing comment, it is noted that Section 7.15 and Appendix T deal with Historic (non-Aboriginal) Cultural Heritage and the impact of the project on these values
2.	Historic Heritage	OEH Heritage Branch	RA3	It is also noted that the Director-General's Requirements (DGRs) for the project specify that a historic heritage assessment (including archaeology) is to be undertaken and must "include a statement of heritage impact (including significant 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" (p87).
3.	Historic Heritage	OEH Heritage Branch	RA3	The EIS identifies that 13 known heritage items and 19 potential heritage items are located within or adjacent to the project site. Of those identified, no sites will be directly impacted by the project but four known and one potential heritage site will be within the Subsidence Impact Limit and may be adversely affected by subsidence or increased flooding.
4.	Historic Heritage	OEH Heritage Branch	RA3	It is noted that in identifying the known and potential heritage items, the EIS consulted statutory and non-statutory heritage lists including the State Heritage Register and Wyong Council's Local Environmental Plan (1991). Wyong Council is currently preparing a new LEP and the Draft LEP 2012 is available on council's website (http:// www.wyong.nsw.gov.au/building-and-development/local-environmental-plan/draftwyong-lep-dcp-ss-2012/). It is recommended that Wyong Council be consulted to ascertain whether any new heritage items have been identified and included in the draft plan. If so, these items should be considered in the EIS.
5.	Historic Heritage	OEH Heritage Branch	RA3	Upon reviewing numbers alone, the LEP 1991 contains 97 heritage items while the Draft LEP 2012 contains 159 items-an increase of some 52 identified items.
6.	Historic Heritage	OEH Heritage Branch	RA3	A characteristic of Wyong Council's LEP 1991 and Draft LEP 2012 is that no archaeological heritage sites have been identified. It is recommended that the applicant undertake a thorough investigation of potential archaeological sites and the results incorporated into the EIS.
7.	Historic Heritage	OEH Heritage Branch	RA3	It is noted that preparation of a Historical Heritage Management Plan is proposed following development consent. As the implementation of mitigation and management measures are one of the identified DGRs, the applicant is strongly encouraged to prepare the plan prior to the Department of Planning & Infrastructure granting approval of the project.
NSW Transport Roads & Maritime Services				
8.	Traffic and Transport	RMS	RA14	Transport for NSW and RMS primary interests are in the road network, traffic and broader transport issues, particularly in relation to the efficiency and safety of the classified road system, the security of property assets and the integration of land use and transport. With regard to the subject proposal, RMS's main concerns are safety, access and traffic generating impacts on the classified road network and its intersections.
9.	Traffic and Transport	RMS	RA14	**RMS Response and Requirements** RMS has reviewed the information provided and has no objections to the proposed development, provided the following matters are addressed and included in the Minister's conditions of approval:
10.	Traffic and Transport	RMS	RA14	The Traffic and Transport Impact Assessment has identified number of road deficiencies along the proposed access routes to/from the project site. It is recommended that WACJV undertake consultation with Council to develop an agreement to determine mitigation priorities and / or responsibilities and provide appropriate contribution towards addressing the relevant road safety deficiencies and ensure that adequate levels of safety are maintained during construction.
11.	Traffic and Transport	RMS	RA14	Prior to any construction commencing, a Construction Traffic Management Plan (CTMP) should be prepared in accordance with the Roads and Traffic Authority 2010, Traffic Control at work Sites as well as relevant Australian Standards including AS 1742.
12.	Traffic and	RMS	RA14	The CTMP plan should also be used to develop site-specific traffic management measures during each stage of construction once the construction

No.	Aspect	Stakeholder	ID	Issue
	Transport			methods and haulage routes are finalised. The CTMP should also outline procedures to audit implementation of the plan to ensure road safety aspects are observed.
13.	Traffic and Transport	RMS	RA14	The project related traffic may potentially impact on the school bus operation and pedestrian safety on Jilliby Road in the vicinity of Jilliby Public School. It is recommended that the movement of heavy vehicles should be managed so as to minimise disruption to traffic during the before and after school periods.
14.	Traffic and Transport	RMS	RA14	**General Advice** The property has common boundaries with Pacific Motorway (former F3 Freeway) which is declared Freeway and Doyalson Motorway Link (MR 675) which is declared Controlled Access Road. Direct access across these common boundaries is restricted.
Department of Primary Industries				
15.	Agriculture	DPI	RA9	The potential agricultural enterprises that could be affected have been adequately identified. The issues critical to minimising impacts on the agriculture businesses and agriculture landholders that require further explanation are:
16.	Agriculture	DPI	RA9	• The remediation process where subsidence damage to farm infrastructure occurs such as monitoring and compensation for loss of production or loss of water;
17.	Agriculture	DPI	RA9	• The triggers for subsidence remediation of farms such as changes to: water bore depths, drainage, fencing, or turf growing surface relief;
18.	Agriculture	DPI	RA9	• The amount of land removed for agriculture for biodiversity off-sets; and
19.	Agriculture	DPI	RA9	• The future impacts on farmland values
20.	Agriculture	DPI	RA9	**Attachment 1** Specific Agricultural Impact Assessment Issues The following provides a review of the socio-economic and other components of the Agricultural Impact Statement (AIS) provided as part of the Wallarah 2 Coal Project EIS (Project). The AIS and supporting documentation were reviewed with reference to the following material: Strategic Regional Land Use Policy Delivery Guideline - Guideline for AISs (March 2012), AIS Fact Sheet (September 2012), and the Strategic Regional Land Use Policy Guideline for AISs (Re-issued October 2012).
21.	Agriculture	DPI	RA9	**1. Impacts on agricultural enterprises, including farm productivity, land values and potential impacts to regional communities and the environment.** These comments relate to the Land Resources section of the DGRs issued 12-1-2012
22.	Agriculture	DPI	RA9	**a) *Farm productivity*** It is not clear whether the turf farm to be impacted by subsidence due to the Project is owned privately or by the proponent. Discussion in the AIS implies that the land is privately owned and our comments assume this.
23.	Agriculture	DPI	RA9	<u>Turf</u> Page 35 of the AIS indicates that "There is a minimum potential that the surface relief of the turf farm may become uneven to the extent that efficient turf cultivation and harvesting bears additional costs ... or is no longer possible ... without remediation". The meaning of "minimum potential" in this context is not clear even though estimated figures for subsidence under the turf farm are provided in Table 14 in Section 7.1.2 of the AIS plus discussion about remediation once subsidence occurs.
24.	Agriculture	DPI	RA9	The AIS notes that turf production would not be affected until Year 22 and remediation of subsidence could be expected to return the farm to production in 3 years (by Year 25). The latter claims have not been substantiated by either expert opinion or examples of where this kind of remediation activity has been successfully undertaken in other locations. There is no comment on whether the total time frame quoted (3 years) is sufficient given subsidence is required to "settle" before the remediation works on the turf farm could commence; this should be clarified.
25.	Agriculture	DPI	RA9	Table 14 in Section 7.1.2 of the AIS states that expected subsidence under the turf farm will be "1,1750" mm. This seems to be a typographical error (there is either an extra zero in the figure or the comma is in the wrong place), so is the expected subsidence under the turf farm actually 1,175mm (1.175 metres) or 11,750mm (11.75 metres)?
26.	Agriculture	DPI	RA9	<u>Horse Establishments</u> Table 14 in Section 7.1.2 of the AIS refers to "Horse training establishments" that may be affected by subsidence. It is not indicated how many horse training establishments are within the extraction area, nor are any potential impacts on their productivity, infrastructure or costs due to subsidence discussed.

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27.	Agriculture	DPI	RA9	*b) Biodiversity offsets* Biodiversity offsets are proposed within the Project boundary and off-site.
28.	Agriculture	DPI	RA9	Section 1.5 of the AIS (page 8) indicates that there are approximately 206ha within the 4559ha Project boundary that will be used for biodiversity offsets. It is not clear whether any of this land is currently owned by the proponent.
29.	Agriculture	DPI	RA9	Section 5.3.1 of the AIS estimates the total value of agricultural production within the Project boundary, but it is not clear whether the 206ha to be used for biodiversity offsets is to be removed or remain for agricultural production.
30.	Agriculture	DPI	RA9	Section 5.3.2 of the AIS indicates that a small amount of agricultural production (21 ha of grazing) would be foregone in an Offsite Biodiversity Offset Area. Calculations of the value of agricultural production foregone in this area are acceptable.
31.	Social	DPI	RA9	**c) *Potential impacts to regional communities*** **Land values**: There is no mention of agricultural land value impacts in the AIS itself, but there is discussion of the impacts on "property prices" in Section 6.2.7 of Appendix V - Social Impact Assessment. The following refers to Section 6.2.7 of Appendix V.
32.	Social	DPI	RA9	Data from two recent surveys is presented that both indicate that a significant proportion of the community felt that property prices would be negatively affected by the Project. However, there is no attempt to estimate future impacts of the Project on land values once development and production are underway, such as by using similar developments which are now in the production stage elsewhere in NSW or Australia as examples.
33.	Social	DPI	RA9	The titles of Figures 10 and 11 indicate that property value data presented covers the period October 2011 to October 2012. However, the x-axes of both figures refer to much older data from 2007 to 2008. This should be clarified.
34.	Surface Water	DPI	RA9	**2. Water:** There is no discussion in the AIS on the flow on impacts to regional communities. In Section 7.2.3 of the AIS it is stated that the water requirements of the mine will include accessing 'only 20 ML/annum' of town water. There is no discussion as to how this will impact on town supplies, especially in times of drought. There is adequate discussion of the impacts on population, housing, community infrastructure and local business in Section 6 of Appendix V - Social Impact Assessment.
35.	Surface Water	DPI	RA9	Water that is transferred or will no longer be available for agricultural use: This aspect is addressed briefly in Section 7.2.3 of the AIS, where it is claimed that "The Project will not result in any water being physically moved away from agriculture".
36.	Groundwater	DPI	RA9	However, it is stated in Section 6.4 of Appendix I - Groundwater Impact Assessment, that there are 12 boreholes located within the "area of subsidence that may exhibit some loss of yield as groundwater levels initially fall then rebound as a result of subsidence induced strata displacements". Table 5 on page 28 lists the summary details of the 12 bores; one is listed as authorised for poultry, one for irrigation, four for stock and domestic, four for domestic, one for waste disposal and domestic, and one for farm and domestic purposes. The concerns are:
37.	Groundwater	DPI	RA9	• It is not clear if the 12 vulnerable bores are on land owned by the proponent or not;
38.	Groundwater	DPI	RA9	• Seven out of the 12 vulnerable bores appear to be authorised for agricultural enterprise use (poultry, 'irrigation and livestock). It is not clear if the bores are being or will be used for their registered purpose(s);
39.	Groundwater	DPI	RA9	• It is claimed in Section 6.4 that "Groundwater levels may fall by up to 1.4m ... but 55% to 75% recovery is expected within 6 months". Any interruption to water supplies would be expected to adversely affect agricultural production, but this is not quantified; and
40.	Groundwater	DPI	RA9	• The proponent also indicates that the 12 vulnerable bores "could be susceptible to mechanical damage (through subsidence) and may need to be repaired or re-drilled if damaged". It needs to be made clear how the proponent will undertake remediation actions if the quoted damage should occur.
41.	Agriculture	DPI	RA9	**3. Impacts on agricultural support services, processing and value adding industries and regional employment:** a) Agricultural support services Section 7.6 of the AIS states that there are no expected impacts of Project traffic on "support structures utilised by agricultural operations" since the two do not intersect. The EIS notes that support services directly employed by agricultural enterprises will not be shared by the Project and therefore will not be impacted.
42.	Agriculture	DPI	RA9	b) Processing and value adding industries There is no specific indication in the AIS if there are any processing and value adding industries either within or dependent on production from the Project area. It would appear from the Project description that there are not, however this should be stated. Mention is made in Section 5.3.1 of the AIS

No.	Aspect	Stakeholder	ID	Issue
				of the relatively small impact on Maitland Saleyard throughput if cattle production within the Project Boundary ceased.
43.	Social	DPI	RA9	c) Regional employment Section 7.7 of the AIS states that "the labour supply available for agricultural operations is not expected to be impacted as a result of the Project". There is no evidence to suggest that this would not be the case.
44.	Agriculture	DPI	RA9	**4. Impact on visual amenity, landscape values and tourism infrastructure relied upon by local and regional agricultural enterprises.** a) Visual amenity Section 7.5 of the AIS states that there will be "no visual impact on the agricultural industries within the Project boundary". Appendix U of the EIS - Visual Impact Assessment indicates two rural-residential properties along Bushells Ridge Road are likely to be able to partially view the Project, but the visual impact is likely to be mitigated by topography, existing vegetation and the F3 freeway.
45.	Agriculture	DPI	RA9	b) Landscape values As noted in Point 1 c), there appears to be no mention of land value impacts in the AIS. There is some discussion of the impacts on "property prices" in Section 6.2.7 of Appendix V - Social Impact Assessment. There is no attempt to discuss future impacts of the Project on land values once development and production are underway.
46.	Agriculture	DPI	RA9	c) Tourism infrastructure The AIS should discuss whether there are any agricultural tourism infrastructure impacts. It currently does not.
47.	Agriculture	DPI	RA9	**5. Mitigation measures for minimising adverse impacts on agricultural resources, including agricultural lands, enterprises and infrastructure at the local and regional level.** Agricultural lands Section 8.1 of the AIS states that the proponent Wyong Areas Coal Joint Venture (WACJV) "should develop and implement a weed and pest management plan to control the distribution of invasive species and feral animals on WACJV owned land" and "should consult with the Cumberland Livestock Health and Pest Authority as to the appropriateness of the plan".
48.	Agriculture	DPI	RA9	Agree that WACJV *should* undertake these activities. However, the proponent should provide a weed and pest management plan for WACJV owned land at the project approval stage rather than post-approval. The plan should also be approved by the relevant authorities, either the Director General of DPI or DP&I. Cumberland Livestock Health and Pest Authority should have input into the weed and pest management plan, rather than just being consulted after it is written.
49.	Subsidence Agriculture	DPI	RA9	Section 8.2 of the AIS mentions that the proponent will manage any impacts to agricultural enterprises as part of the Subsidence Management Plan and in association with the appropriate Act. It also states that "Monitoring of surface relief shall be carried out during active mining of agricultural areas within the Extraction Area". This is acknowledged as appropriate, however further details should be provided (Point 4 - possible conditions of consent).
50.	Agriculture	DPI	RA9	**6. Documented consultation with adjoining land-users and Government Departments.** Section 5.6 of the AIS mentions that consultation specific to agriculture was made with the Hunter Central Rivers CMA and Agriculture NSW. The concerns raised by the CMA regarding creek beds and acid soils were noted, but there is no indication in the AIS whether they were addressed. Agriculture NSW also raised concerns about the effect of subsidence on general farm infrastructure. It is not clear whether these concerns have been addressed.
51.	Groundwater	DPI	RA9	**7. Possible conditions of consent or further information requirements:** • The proponent indicates that 12 vulnerable groundwater bores "could be susceptible to mechanical damage (through subsidence) and may need to be repaired or re-drilled if damaged." It is recommended that the proponent provide more details on: ○ the ownership of the affected groundwater bores; ○ if the bores are being or will be used for their registered purpose(s}; ○ the extent to which the likely temporary interruption to groundwater supplies due to subsidence would adversely affect agricultural production for which the bores are licensed; and ○ the process for any private landowners to report subsidence impacts and the process for implementation of remediation measures by the proponent.

No.	Aspect	Stakeholder	ID	Issue
52.	Ecology	DPI	RA9	• The proponent should provide a weed and pest management plan for Wyong Areas Coal Joint Venture owned land at the project approval stage rather than post-approval. The plan should also be approved by the relevant authorities, either the Director General of DPI or the Department of Planning & Infrastructure.
53.	Subsidence	DPI	RA9	• The proponent should provide more information on the Subsidence Management Plan such as: ○ the method and timing of monitoring of surface relief; ○ how monitoring of surface relief will be undertaken; ○ is topographical information for the Extraction Area sufficient to establish a current baseline for future reference for subsidence monitoring; and ○ the process for landowners to report subsidence that requires remediation, the process of assessment and whether works will be undertaken under a written agreement with each landowner affected.
54.	Agriculture	DPI	RA9	Further discussion of potential future impacts of the Project on agricultural land values.
Australian Rail Track Corporation Ltd				
55.	Rail	ARTC	RA17	For the avoidance of doubt, it needs to be clear that the additional freight capacity created pursuant to the Northern Sydney Freight Corridor (NSFC) Memorandum of Understanding between the NSW and Commonwealth Governments does not include any additional train paths to support the Wallarah 2 project. The provision of any additional infrastructure to support these operations is not included in the NSFC Program.
56.	Rail	ARTC	RA17	In conjunction with ARTC establish the availability of train paths on the ARTC Network to suit the additional rail traffic generated by the proposal.
57.	Noise	ARTC	RA17	Take into account the cumulative impacts of increased train movements relative to "Appendix 2 of Rail Infrastructure – Noise Guideline" issued by the NSW EPA 2013.
Transgrid				
58.	Subsidence	TG	RA16	Currently, two of TransGrid's existing 330 kilovolt (kV) transmission lines (No. 22 Vales Point to Sydney North, and No. 2M Munmorah Power Station to Tuggerah) currently traverse the project area. In addition, the project would be located less than 500 metres to TransGrid's existing No. 26 Munmorah Power Station to Sydney West 330 kV transmission line.
59.	Subsidence	TG	RA16	The project must ensure the safe, reliable and efficient continued operation and maintenance of TransGrid's electricity network. The structural integrity and operation of the transmission lines and structures shall not be compromised by the construction, operation and/or decommissioning of the mine.
60.	Subsidence	TG	RA16	TransGrid has reviewed the Environmental Impact Statement for the Wallarah 2 Coal Project and provides the following comments in relation to the project's impacts on TransGrid's high-voltage electricity network.
61.	Subsidence	TG	RA16	**Subsidence Impacts on Transmission Towers** Subsidence from the proposed mine would affect some 29 transmission line towers, including 14 tension towers. Section 5.14 of the EIS describes the possible impact of the mine on these towers, including correspondence from TransGrid, and notes that tension towers are much more difficult to protect than suspension towers. This situation is exacerbated where those towers carry larger deviation angles (typically 10 degrees or higher) of the conductors.
62.	Subsidence	TG	RA16	Section 5.14.2 (pg 99) of Appendix H (Subsidence Predictions and Impact Assessment) suggests a number of preventative strategies that might be considered for such towers, including tower strengthening, temporary towers or poles, re-routing the line and installation of underground cables. Whilst some of these strategies may be technically feasible, they are generally not practicable. Most of these options would entail repeated and/or extended shutdown outages of the transmission line. These outages would be restricted to times of low electrical demand (Spring and Autumn) and would most likely impact pricing on the National Electricity Market.
63.	Subsidence	TG	RA16	TransGrid's preference is that the large angle tension towers shall be protected by sterilising coal below or varying the mine layout to limit strains and tilts to an acceptable level.
64.	Subsidence	TG	RA16	If the proponent proceeds with mining under TransGrid's transmission lines, then any transmission structures and/or foundations must be protected from subsidence impacts. TransGrid's electricity network must not be compromised and major redesigning, modification or relocation of the line may be required. Adequate time shall be allowed for feasibility studies, approvals, and construction of the redesign/ modification/ relocation of the transmission line. As mentioned above, construction of the modified/relocated transmission line would be restricted to limited outage periods.
65.	Subsidence	TG	RA16	TransGrid requires access to each transmission structure of the transmission line, for construction, maintenance and emergency situations. Subsidence

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				of access tracks to the transmission structures must be considered, and access must be maintained at all times.
66.	Subsidence	TG	RA16	All costs of any mitigation measures, adjustments, repairs, redesign, modification or relocation of the transmission lines shall be borne by the proponent.
67.	Subsidence	TG	RA16	If the project results in subsidence impacts that undermine any transmission towers during mining activities, any costs from disruptions in the electricity network shall be borne by the proponent.
68.	Subsidence	TG	RA16	**Subsidence Impacts on Ground Clearance** Section 5.14.2 (pg 98) of Appendix H discusses the reduction of cable clearances resulting from subsidence. Identified management strategies include fencing off areas of the easement and earthworks to increase clearances to ground. Given that predicted subsidence levels in some locations are in the order of 2.0-2.5 metres, reductions in ground clearance is likely to be a significant electrical safety and reliability issue, especially for high voltage transmission lines.
69.	Subsidence	TG	RA16	It is also noted that management strategies to achieve acceptable ground clearances may involve substantial disturbance to vegetation, soils and land use in the affected areas.
70.	Subsidence	TG	RA16	Fencing off certain areas of transmission line easements (with ground clearance violations) is not considered to be a reasonable or practicable solution for maintaining safe operational clearances of the transmission line and public safety. Furthermore, current easement conditions with affected property owners continue to allow areas within the easement to be utilised by property owners and occupiers for certain activities. The option for fencing off areas subject to ground clearance violations as a result of mine subsidence would ultimately result in a loss of use of land for affected property owners. TransGrid does not consider it reasonable to bare any costs associated with consequential property owner compensation.
71.	Subsidence	TG	RA16	**Consultation** It is noted that although TransGrid was consulted for the previously refused Wallarah 2 Coal Project (last correspondence in 2009 for preliminary information), consultation has not occurred with TransGrid for this particular project application. As per Section 7.1.4 (pg 111) of the EIS, TransGrid appreciates that the Extraction Plan will include consultation with TransGrid to develop management strategies for the continued safe operation of the transmission line.
72.	Subsidence	TG	RA16	Section 7.1.3 (pg 107) of the EIS states that WACJV will seek to establish a subsidence management committee, with officers from the WACJV, TransGrid and the MSB, so that the appropriate management strategies can be developed. TransGrid shall be appropriately remunerated for any involvement on the subsidence management committee.
Department of Primary Industries – Fisheries				
73.	Surface Water	DPI Fisheries	RA11	Fisheries NSW has significant concerns about the potential impact on Jilliby and Little Jilliby Creeks due to subsidence
74.	Surface Water	DPI Fisheries	RA11	It is the view of Fisheries NSW that the levels of subsidence, combined with the instability of the sandy alluvium, has the potential to create significant erosion and sedimentation issues. A 1-metre subsidence change in the catchment is relatively large in such a flat catchment.
75.	Surface Water	DPI Fisheries	RA11	As such Fisheries NSW would expect the development of a suitable stream modelling and impact mitigation program, as part of the Surface Water Monitoring Plan, before mining commences. This program should also include: • regular (weekly) resurveys of the potentially impacted areas as the longwall approaches and passes the creek lines identified as being at risk. • wider walkover assessments to determine areas of water ponding and active bed and bank erosion. These wider walkovers can be carried out quarterly as proposed by the proponent.
76.	Surface Water	DPI Fisheries	RA11	Fisheries NSW support the proponent's proposed remediation approach of using soft engineering techniques. Examples of the types of works proposed should be included in the Surface Water Monitoring Plan.
77.	Surface Water	DPI Fisheries	RA11	Fisheries NSW is also concerned about the potential impacts on the Wyong River. Due to the importance of the River as habitat as well as its social value, mining should be restricted to ensure that the river is inside the 20 mm subsidence barrier.
Wyong Shire Council				
78.	Groundwater	WSC	RA6	**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 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, the modelling assumes recharge of the water

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				system based on average climatic conditions.
79.	Groundwater	WSC	RA6	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
80.	Groundwater	WSC	RA6	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;
81.	Groundwater	WSC	RA6	• The time it will take for the impact of underground extraction to reflect in surface flows cannot be determined;
82.	Groundwater	WSC	RA6	• The EIS states that the mine will not fully recover groundwater pressures for over 500 years.
83.	Groundwater	WSC	RA6	These points, combined with the uncertainty on the input parameters to the groundwater modelling 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.
84.	Groundwater	WSC	RA6	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.
85.	Surface Water	WSC	RA6	**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.
86.	Groundwater	WSC	RA6	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 recharge.
87.	Groundwater	WSC	RA6	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.
88.	Surface Water	WSC	RA6	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.
89.	Groundwater Surface Water	WSC	RA6	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.
90.	Groundwater Surface Water	WSC	RA6	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.
91.	Surface Water	WSC	RA6	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.
92.	Flooding	WSC	RA6	**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".

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93.	Flooding	WSC	RA6	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.
94.	Flooding	WSC	RA6	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.
95.	Flooding	WSC	RA6	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.
96.	Flooding	WSC	RA6	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.
97.	Flooding	WSC	RA6	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.
98.	Flooding	WSC	RA6	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.
99.	Flooding	WSC	RA6	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.
100.	Flooding	WSC	RA6	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.
101.	Flooding	WSC	RA6	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.
102.	Flooding	WSC	RA6	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.
103.	Flooding	WSC	RA6	At this time, the only indication of the extent of potential mitigation is in relation to the Major and Moderate Impact Categories.
104.	Flooding	WSC	RA6	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.
105.	Flooding	WSC	RA6	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.
106.	Flooding	WSC	RA6	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.
107.	Flooding	WSC	RA6	Council is concerned regarding the longer term maintenance requirements of any mitigation measures.
108.	Flooding	WSC	RA6	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.
109.	Subsidence	WSC	RA6	**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.

No.	Aspect	Stakeholder	ID	Issue
110.	Subsidence	WSC	RA6	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 (i.e. about 1 property).
111.	Subsidence	WSC	RA6	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.
112.	Subsidence	WSC	RA6	The subsidence prediction used for W2CP was developed using three key components: 1. The predictive model developed using the empirical Incremental Profile Method (!PM) 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.
113.	Subsidence	WSC	RA6	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.
114.	Subsidence	WSC	RA6	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.
115.	Subsidence	WSC	RA6	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 modelling undertaken.
116.	Subsidence	WSC	RA6	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
117.	Subsidence	WSC	RA6	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.
118.	Subsidence	WSC	RA6	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".*
119.	Subsidence	WSC	RA6	The use of one predictive model to calibrate another is generally unwise and not widely regarded as best practice.
120.	Subsidence	WSC	RA6	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.
121.	Subsidence	WSC	RA6	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.
122.	Subsidence	WSC	RA6	The EIS acknowledges that pillar compression may not occur but does not quantify the impacts or changes in impact should this not occur.
123.	Subsidence	WSC	RA6	First longwall will prove that this pillar compression assumption is valid.

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124.	Subsidence	WSC	RA6	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.
125.	Subsidence	WSC	RA6	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.
126.	Subsidence	WSC	RA6	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.
127.	Subsidence	WSC	RA6	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.
128.	Subsidence	WSC	RA6	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.
129.	Submission	WSC	RA6	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.
130.	General	WSC	RA6	**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.
131.	General	WSC	RA6	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.
132.	General	WSC	RA6	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.
133.	General	WSC	RA6	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.
134.	General	WSC	RA6	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 judgment/decision can be made.
135.	Groundwater	WSC	RA6	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.
136.	Subsidence	WSC	RA6	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.
137.	General	WSC	RA6	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.
138.	General	WSC	RA6	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.

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139.	General	WSC	RA6	Further, the targets must be accompanied by agreed responses otherwise the management system would be reduced to an impotent and disingenuous process.
140.	General	WSC	RA6	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".
141.	Air Quality Surface Water Traffic and Transport Mine Closure	WSC	RA6	**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.
142.	Economics	WSC	RA6	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.
143.	General	WSC	RA6	An Environmental Management System has not been developed for the Project, nor is there a commitment to develop such a system.
144.	General	WSC	RA6	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.
145.	Stakeholder Consultation	WSC	RA6	**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.
146.	Surface Water	WSC	RA6	**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.
147.	Geology	WSC	RA6	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.
148.	Surface Water	WSC	RA6	The surface water monitoring program does not include a sampling point immediately downstream of the proposed Wallarah Creek tributary discharge site.
149.	Surface Water	WSC	RA6	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.
150.	Groundwater	WSC	RA6	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.
151.	Groundwater	WSC	RA6	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.
152.	Air Quality	WSC	RA6	**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 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.
153.	Air Quality	WSC	RA6	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.
154.	Greenhouse Gas	WSC	RA6	**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.
155.	Noise	WSC	RA6	**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 modelling are only valid if the recommended attenuation measures are committed to and implemented.

No.	Aspect	Stakeholder	ID	Issue
156.	Noise	WSC	RA6	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.
157.	Ecology Aquatic Ecology	WSC	RA6	**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.
158.	Ecology	WSC	RA6	Ecological surveys should have been conducted over a broader survey area to reflect impacts associated with all project components.
159.	Ecology	WSC	RA6	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.
160.	Rail	WSC	RA6	**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.
161.	Visual	WSC	RA6	**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.
162.	Aboriginal & Historic Heritage	WSC	RA6	**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.
163.	Health	WSC	RA6	**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.
164.	General	WSC	RA6	**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.
165.	General	WSC	RA6	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.
166.	General	WSC	RA6	**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.
167.	General	WSC	RA6	Notwithstanding the above it is understood that the latest guidelines provide for Management Plans to be prepared much later in the process.
168.	General	WSC	RA6	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.
169.	General	WSC	RA6	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: <u>Adaptive management regime</u> 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."* <u>It follows that it is necessary for there to be precise limits imposed on the cumulative operations of the colliery.</u> 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

No.	Aspect	Stakeholder	ID	Issue
				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, program 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.
170.	General	WSC	RA6	**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.
171.	General	WSC	RA6	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.
172.	Subsidence	WSC	RA6	**Attachment 1 Table One** **ITEM/AREA OF UNCERTAINTY** Subsidence **IMPORTANCE (Low, Medium and High** High **MEASURES** 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. 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.
173.	Subsidence	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Subsidence Model. **IMPORTANCE (Low, Medium and High** High **MEASURES** 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.
174.	Subsidence	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Subsidence- potential variability in modelling results. **IMPORTANCE (Low, Medium and High** Medium.

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				MEASURES 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.
175.	Subsidence	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Subsidence- impact of pillar yielding on subsidence and the ability to validate predictions. **IMPORTANCE (Low, Medium and High** Medium **MEASURES** A comparison of impacts with and without the influence of pillar yielding. A program of pillar performance measurement including convergence measurements and extensometer readings.
176.	Subsidence	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Mine Plan **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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). 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. A clear process must be set out 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.
177.	Groundwater Geology		RA6	**ITEM/AREA OF UNCERTAINTY** Sampling of rock mass impacts on groundwater modelling **IMPORTANCE (Low, Medium and High** High **MEASURES** 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 degrees 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. These angled holes could also be used to undertake further in-situ permeability testing by means such as Packer or Constant Head testing.
178.	Surface Water	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Permeability of Patonga Claystone - impacts on groundwater modelling **IMPORTANCE (Low, Medium and High** High **MEASURES** 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: • 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 o Jilliby Jilliby Creek upstream of the mine area, upstream and downstream of the confluence with Little Jilliby Jilliby Creek and just upstream of

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				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 Kid mans 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. These points could also be used to monitor water quality as necessary.
179.	Flooding	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Flood Remediation to Access Roads **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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. Further, the method and design of remedial works and the maintenance implications for the future must be understood and agreed with Council.
180.	Surface Water Ecology	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Stream Stability (and ecology) **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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. 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.
181.	General	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Risk Assessment **IMPORTANCE (Low, Medium and High** High **MEASURES** A detailed and comprehensive risk assessment must be undertaken to provide a framework against which reasonable adaptive management programmes can be developed, and assessed.
182.	General	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Adaptive Management **IMPORTANCE (Low, Medium and High** High **MEASURES** Specific, measurable and agreed targets or levels from monitoring **MUST** 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. Targets may include loss of stream flows, lowering of water levels/pressures in monitoring bores and levels of subsidence. 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. 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

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				to streams, users/residents and areas of significant flora.
183.	General	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Independent Impact Monitoring Authority **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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. This body must 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. 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. The records and recommendations of the authority should be available on the public record
184.	Air Quality	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Air Quality **IMPORTANCE (Low, Medium and High** High **MEASURES** Air quality impacts are assessed utilising relevant methodologies to ensure that detailed impact assessments of project phases are conducted effectively.
185.	Greenhouse Gas	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Greenhouse Gas **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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.
186.	Surface Water Groundwater	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Water Quality **IMPORTANCE (Low, Medium and High** High **MEASURES** 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.
187.	Surface Water Groundwater	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** EPBC Water Amendment **IMPORTANCE (Low, Medium and High** High

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				MEASURES The EPBC Act Water Trigger Amendment (2013) is considered by the Proponent.
188.	Ecology	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Ecology **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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.
189.	General	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Mine Design and Layout **IMPORTANCE (Low, Medium and High** Medium **MEASURES** Internal haulage routes are confirmed to allow assessment of potential impacts of heavy vehicle movement.
190.	Stakeholder Consultation	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Stakeholder Engagement **IMPORTANCE (Low, Medium and High** High **MEASURES** A robust Stakeholder Engagement Plan is developed that is inclusive of commitments to ongoing consultation and a structured grievance procedure.
191.	Mine Closure	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Rehabilitation and Closure **IMPORTANCE (Low, Medium and High** High **MEASURES** A comprehensive Rehabilitation and Closure Plan is prepared.
192.	Economics	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Risk Assessment and Cost Benefit Analysis **IMPORTANCE (Low, Medium and High** Medium **MEASURES** The Risk Assessment and Cost Benefit Analysis are reviewed and revised based on detailed findings of further recommended work.
193.	General	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Disaster Risk Management **IMPORTANCE (Low, Medium and High** High **MEASURES** 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 *I* treatment of the Mine Operations Dam (MOD) and spontaneous combustion.

No.	Aspect	Stakeholder	ID	Issue
194.	Health	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Community Health and Safety **IMPORTANCE (Low, Medium and High** Medium **MEASURES** 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.
195.	General	WSC	RA6	**ITEM/AREA OF UNCERTAINTY** Management, Monitoring and Reporting **IMPORTANCE (Low, Medium and High** High **MEASURES** 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.
Central Coast Water Corporation				
196.	Groundwater Surface Water	CCWC	RA12	The Central Coast water supply is highly dependent on the stream flows and water quality in the Wyong River and its tributary Jilliby Jilliby Creek. Any activity which puts at risk the quantity or quality of this source will have significant consequences for the community.
197.	Groundwater Surface Water	CCWC	RA12	A technical review of the EIS for the Wallarah 2 Coal project has been undertaken by Pells Sullivan Meynink (PSM). This technical review raises significant concerns regarding the validity and associated conclusions regarding the potential groundwater and surface water implications of the proposal. A copy of the PSM report is attached.
198.	Groundwater Surface	CCWC	RA12	The CCWC endorses the conclusions of the PSM report and encourages the Department to take into consideration the high level of uncertainty related to the groundwater modelling undertaken as part of the EIS and the high probability that leakage losses from the alluvial lands will impact the surface water available to the water supply. The report by PSM includes guidance in relation to further assessment, validation and monitoring (Table 12) for consideration in assessing the EIS, or if applicable setting conditions for any approval of the Wallarah 2 Coal Project. The CCWC encourages the Department to utilise this guidance in the assessment of the EIS.
Hunter-Central Rivers Catchment Management Authority				
199.	Ecology	HCRCMA	RA10	**Clearing of Native Vegetation** The CMA administers the Native Vegetation Act 2003 (NV Act). One of the objects of the NV Act is to 'prevent broadscale clearing unless it improves or maintains environmental outcomes'. In certain circumstances, clearing is permitted without approval such as the clearing associated with prescribed Routine Agricultural Management Activities or native vegetation that has regrown since 1990.
200.	Ecology	HCRCMA	RA10	The CMA understands that the NV Act does not apply to this project as Development Consent is being sought under Section 89J, Part 4, Division 4.1 of the Environmental Planning and Assessment Act (1979). However, the CMA expects that the 'improve or maintain' principle of the NV Act is adopted in the assessment of the proposal.
201.	Ecology	HCRCMA	RA10	The EIS states that approximately 89 ha of vegetation will be cleared as a result of the project (Volume 1, page 174). In order to offset habitat losses incurred due to the clearing of native vegetation, the project proposes to protect and rehabilitate 261 ha of compensatory habitat. The CMA considers this offset ratio (< 3:1) is inadequate as it does not meet the 'improve or maintain' principle of the NV Act. It should be noted that assessments under the NV Act in similar situations have established offset ratios of between 10:1 and 50:1.
202.	Ecology	HCRCMA	RA10	A portion of the proposed area of clearing includes, four Endangered Ecological Communities (EECs) comprising a total area of 12.2 ha. The NV Act precludes the clearing of EECs except those categorised as in low condition. Given the EECs in the project area have been assessed as being in

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				moderate to good condition, the clearing of this vegetation (12.2 ha) would not be permitted. Notwithstanding this, the CMA considers that compensatory habitat offset ratios should be set at a high level for the loss of EECs i.e. up to 50:1, as determined by a methodology such as applied to Biobanking or the NV Act.
203.	Ecology	HCRCMA	RA10	The EIS states that compensatory habitat has been selected due to similar ecological values as areas proposed to be cleared, but will also involve the rehabilitation of degraded land within the offset area. Rehabilitation of degraded land generally does not meet the 'like for like' requirement under the Environmental Outcomes Assessment Methodology (EOAM), the decision support tool used for assessing clearing proposals, and is therefore unlikely to meet the 'improve or maintain' principle of the NV Act. The CMA considers that any offset areas should ensure compensatory habitat meets the 'improve or maintain' principle of the NV Act.
204.	Surface Water	HCRCMA	RA10	**Accelerated Erosion** The CMA is concerned about the potential for the erosion of the bed and banks of Jilliby Jilliby Creek, Little Jilliby Jilliby Creek and its tributaries. Due to predicted subsidence in the lower reaches of the catchment, the alluvial stream is at risk of developing a rapidly migrating knick-point (head – cut), leading to the systemic erosion of the drainage network upstream
205.	Subsidence Surface Water	HCRCMA	RA10	Subsidence modelling in the Wallarah 2 EIS predicts subsidence induced tilt at a maximum of 1.0% along the lower reaches of Jilliby Jilliby Creek. The current bed gradient in the alluvial stream within the mine footprint is 1.3 mm/m, or 0.13%. The increase in bed gradient as a result of subsidence is by more than 7.6 times. This has the potential to induce bed incision in high flows and the formation of a knick-point or series of knick-points that erode rapidly upstream, beyond the footprint of the mine. Established literature provides many examples of measured rates of knick-point migration in alluvial streams caused by a range of factors, including base level change.
206.	Subsidence Surface Water	HCRCMA	RA10	Although the EIS considers riverbank and bed instability due to subsidence a likely occurrence, it is predicted to remain localised, despite the lack of natural bed controls in the lower catchment. The EIS also proposes several measures to mitigate damage caused by subsidence, however discussion of these issues is brief and the mitigation measures are inadequate; a response is triggered only after erosion has been observed.
207.	Surface Water	HCRCMA	RA10	The EIS recommends baseline surveys prior to mining and quarterly field inspections of the river banks and beds with additional inspections following any significant flow event. In neighbouring Wollombi catchment comprising similar geology and bed sediments a knick-point eroded more than 3.5 km of stream channel in a single flood (Erskine, 2008). Some of the resulting environmental impacts included the loss of productive river flats either through the mass wasting of riverbanks or burial of topsoil by overbank sedimentation, the drying alluvial soils and pasture they supported through lowered groundwater tables, the destruction of key habitats both in-stream and within the riparian buffer and a reduction of water quality.
208.	Surface Water	HCRCMA	RA10	Despite differences in land-use history, climate and the character of riparian vegetation, Wollombi Brook and Jilliby Jilliby Creek share a history of frequent adjustment; both catchments flow through sandy alluvium and display geomorphology consistent with ongoing and potentially rapid channel change. As a consequence, the risk of significant erosion of Jilliby Jilliby Creek and its tributaries before any bed control measures are emplaced needs to be quantified, and effective preventive measures need to be accurately determined.
209.	Surface Water	HCRCMA	RA10	Thorough bank stability geotechnical modelling and baseline surveys are required to identify areas at greatest risk of incision. Following this, the location of likely affected sub catchments needs to be mapped and volumes of sediment available for erosion calculated. This is needed in order to determine overall risk, potential consequences and to accurately calculate budgets and resources required for preventative works and remediation strategies.
210.	Subsidence Surface Water	HCRCMA	RA10	The extensive drainage network flowing into Tuggerah Lakes has received high levels of investment from a range of sources for works to improve riparian and lake health, in-stream biodiversity and to guarantee the delivery of clean drinking water to residents of the Central Coast. Most recently, $20 million from the Commonwealth Government's Caring for Our Country initiative was allocated to Wyong Shire Council to undertake activities leading to improvements in water quality in Tuggerah Lakes. Strategic direction for the project was provided by the Tuggerah Lakes Estuary Management Plan (2006) which listed actions to reduce the impact of accelerated erosion on water quality as a priority area for investment. As a project partner, the CMA in turn partnered with local landholders to successfully deliver $500,000 to priority on-ground works. It is of vital importance that subsidence related erosion poses no threat to these investments or compromises water quality improvements achieved through the implementation of this project.
Lake Macquarie City Council				
211.	General	LMCC	RA7	**Key Findings** Council does not support the use of the local road network/City's road network to transport any Coal between the development and the Port of

No.	Aspect	Stakeholder	ID	Issue
				Newcastle. The development needs to discuss the procedures available for transporting coal under conditions when the rail network is unavailable.
212.	Social	LMCC	RA7	The Social Impact Assessment as currently submitted is not supported by Council
213.	General	LMCC	RA7	The EIS does not adequately consider the likely environmental impacts resulting from the construction of the proposed Awaba rail loop, inclusive of stakeholder consultation and assessment
214.	General	LMCC	RA7	The EIS fails to adequately demonstrate how it meets Council's policies with regard to energy supply and demand and additionally fails to use current available assessment data.
215.	Air Quality	LMCC	RA7	The Air Quality Impact Assessment is inadequate.
216.	General	LMCC	RA7	**Road Transport:** Traffic impacts from coal haulage are not expected unless the proposed rail operations are compromised. However, were such an event to occur, Council would not support alternative road based transport of coal due to the impact on traffic, road condition and the inefficient use of limited petroleum supplies to further the extraction of coal.
217.	Rail	LMCC	RA7	**Rail Transport:** Council is concerned about the level of impact on the Northern Sydney Freight Corridor (NSFC), both in the short term, and over the life of the project as passenger and other freight traffic increases. Council is promoting greater use of rail based freight and passenger transport as a key means of moving to a more sustainable transport system, however, the proposed coal train movements will constrain or conflict with that desired outcome.
218.	Rail	LMCC	RA7	Appendix R – Rail Study (Volume 5) indicates that whilst the proposed movements are predicted to average some 3.8 to 4.3 trains per day, on some occasions, higher numbers will be required to fill large Cape Size vessels (p9). Consequently, the impacts may be larger than predicted for the average conditions. The Rail Study also notes (p7 & 8) that the "South of Newcastle" rail line is already severely constrained, with multiple limitations in the rail infrastructure between the proposed mine and the Port of Newcastle, as well as minimal scope to insert trains between the current commuter passenger train services.
219.	Rail	LMCC	RA7	Page 9 of the Rail Study discards local supply of coal to the Lake Macquarie and Central Coast power stations. This conclusion is apparently based on the commercial opportunity to secure a higher price for export coal over prices for local power station coal, in part due to lower ash content. Council rejects this conclusion on two grounds.
220.	Greenhouse Gas	LMCC	RA7	Firstly, notwithstanding Council's target of reducing greenhouse gas emissions by 3% per capita per year, local fossil fuel power stations should use coal from the closest sources to minimise additional greenhouse gas emissions from the transport of coal supplies. The export of local coal resources close to those power stations is contrary to that principle. Secondly, these local power stations create large dumps of ash tailings from combustion, including that created by Eraring Power Station north of Dora Creek. Eraring's only ash dump will reach capacity in about 2032, well within the life of the proposed mine. Any measures that can reduce the amount of ash would therefore be welcomed by Council.
221.	Rail	LMCC	RA7	In any event that the mine proposal is approved, the proponents should be required to significantly contribute to the upgrading of the line to be used and any ancillary infrastructure, including but not limited to, longer rail sidings (passing areas) to accommodate the longer and more frequent coal trains, tight low speed bends and road over passes. Examples of the last two are the "Teralba bends" and the St James/Glebe road crossing at Adamstown, respectively.
222.	Rail	LMCC	RA7	The infrastructure improvements proposed in the report's conclusions (p22) to overcome the current limitations are inadequate and do not come without detrimental impacts on the City. The report suggests only an additional passing loop and signals at North Awaba, and it is not clear whether these are to be funded and undertaken by the proponent. However, it appears that they are not, as the report does not provide detail around the location and impacts of any such loop. Given that the proposed loop is within the City, Council would also be concerned about potential socio-economic and biodiversity impacts on the area.
223.	Rail	LMCC	RA7	**Awaba Loop** The proposed infrastructure improvement in Lake Macquarie is one additional freight passing loop and signals at North Awaba. This is not considered adequate to address all the potential pressures on the existing rail services south of Newcastle.
224.	General	LMCC	RA7	In addition there is no consideration given to the environmental impacts of the new Awaba loop, particularly if it was necessary to build on land zoned E2 Environmental Conservation. There is no clear indication of who will design, fund or construct this new infrastructure.

No.	Aspect	Stakeholder	ID	Issue
225.	General Rail	LMCC	RA7	In this regard, Council considers that the application has not adequately considered the likely environmental impacts of the proposed development
226.	General	LMCC	RA7	**Energy Supply and Demand** The application does not demonstrate how it meets Council's policies with regard to energy supply and demand and additionally fails to use current data.
227.	General	LMCC	RA7	There are two major issues with this application: 1. Greenhouse Gas Emission Reduction Targets Policy (2008) sets targets to reduce the City's emissions by 3% per year. The application does not address Council's policy. **2.** The Project Justification section 9.2.1 uses old and out of date reports from international Energy Agency (IEA) and Australian Energy Market Operator (AEMO). Both Agencies have more recent reports, which should be referred to instead of the 2011 publications. IEA report Tracking Clean Energy Progress 2013, shows under their 2DS scenario that coal consumption will start to drop in 2015. This directly opposes the assumption for the justification for the project.
228.	Air Quality	LMCC	RA7	**Air Quality** The information presented in the EIS is inadequate in the following areas, specific to Air Quality:
229.	Air Quality	LMCC	RA7	1 - Background pollutant levels for $PM_{2.5}$ were acquired from State supported air quality monitoring stations in the City of Newcastle, located 40-50 km from the site. The AQIA notes that these are the closest state supported monitoring stations to the project site. Given the complex local airshed (mountain ranges, Lake Macquarie, Tuggerah Lake, coastal influences, etc.) and the extensive mining and associated facilities in the region, this background assessment is likely inappropriate for the Wyong region. A State supported air quality monitoring station was opened in Wyong in December 2013, and it is recommended that the proponent confirm background levels of $PM_{2.5}$ using data from the Wyong station, and revise the modelling inputs as required
230.	Air Quality	LMCC	RA7	2 - It is important that emissions from coal movements do not diminish the amenity for adjacent properties, or the surrounding area, during transit. The AQIA did not include a detailed assessment of cumulative air pollution in the rail corridor, and referenced the air quality study commissioned by Queensland Rail (Connell Hatch, 2008) for the Rockhampton (Qld) region and surrounds. This study found minimal risk of adverse impacts due to fugitive coal emissions from coal trains on the network. Similar results were found in the ARTC Pollution Reduction Program 4 - Particulate Emissions from Coal Trains (Environ 2012), however (and as acknowledged within the report), this study did not include compliance level monitoring or health impact assessments, and had other inherent limitations as documented.
231.	Air Quality	LMCC	RA7	With the lack of a comprehensive study on air quality and coal rail movements, specific to the local airshed, including compliance level monitoring, it is recommended to provide for compliance monitoring along the rail corridor, for both loaded and unloaded coal trains as part of this application. It is further recommended that air quality monitoring along the rail corridor be assessed using a suite of Tapered Element Oscillating Microbalance (TEOM, or equivalent) air monitoring systems for PM_{10} and $PM_{2.5}$. Sitting locations of monitors along the rail corridor should be designed to address cumulative impacts for sensitive receptors, including areas likely to have existing elevated levels of particulate air pollution (i.e. close to significant emission sources along the rail corridor) and close to highly vulnerable sensitive receptors (i.e. schools, hospitals, etc.).
232.	Air Quality	LMCC	RA7	3 - It is anticipated that an Air Quality Management Plan will be required for the project. To ensure modelling constraints and other assumptions are appropriate, documented management strategies must be consistent with those defined in the AQIA. This should include pollution monitoring and best practice air pollution management strategies during coal movements (i.e. wetting coal loads during freight, limiting coal load capacities, covered coal trains during transit, etc').
233.	Air Quality	LMCC	RA7	4 - Environmental management for this project will fall under a NSW Environment Protection Authority (EPA) regulated Environment Protection Licence (EPL), and it is anticipated that the EPA will thoroughly review the application. I would request the EPA to ensure that air pollution mitigation measures, and air quality monitoring, as specific to the rail corridor, be included in the EPL prescriptions - along with other air quality requirements for the project.
234.	Surface Water	LMCC	RA7	**Water Quality** The proposal is unlikely to impact on the Lake Macquarie catchment or any watercourses within the Lake Macquarie local government area. However, from a regional perspective the following comments are made:
235.	Surface Water	LMCC	RA7	The Surface Water Assessment identifies plan development & monitoring as the primary means of mitigation. However, as with many mining proposals it

No.	Aspect	Stakeholder	ID	Issue
				fails to address the ability to effectively mitigate an environmental impact should it arise. The practicalities of repairing damaged creek beds/banks and associated hydrological changes can be prohibitive. Monitoring plans imply an ability to 'fix' an issue should it arise. In practice affected creeks may be inaccessible to required machinery and unacceptable damage to vegetation in order to access the site. Should access be available, the ability to repair subsidence impacts effectively is questionable with many examples of ineffective repairs documented.
236.	General	LMCC	RA7	**Economic Drivers** The proposal is for an underground coal mine delivering 5 million tonnes pa of thermal coal to export markets over an operational period of 25 years. The EIS argues that thermal coal is in increasing demand in Japan, Korea, China and India. This conflict with international Energy Agency predictions that coal consumption will drop after 2015. According to the Australian Coal Association, the country's coal industry directly employs 50,000, and the downturn is already clear in its eastern coal towns.
237.	Social	LMCC	RA7	**Social Impacts** The SIA identifies that there would appear to be significant local social benefits arising from the Project. It identifies that the Project will generate additional employment for the area (which will assist with addressing Wyong LGA's continuing employment problem) with a very low risk to any significant change to lifestyles or amenity impacts, from the surface facilities in the Directly Affected Area.
238.	Social	LMCC	RA7	However, whilst the SIA did consider impacts on employment, the population and housing, community infrastructure and local business, this investigation was very brief and the SIA failed to consider the full range of social impacts on both the Directly Affected Area, and the wider Secondary Study Area.
239.	Social	LMCC	RA7	Documented issues and concerns that impact on communities affected by mining projects include: • Declining sense of belonging in the community as a result in changes in the social make-up of the area;
240.	Social	LMCC	RA7	• Shiftwork impacting on many aspects of community life (for example, volunteering);
241.	Social	LMCC	RA7	• Low level of pride in the area;
242.	Social	LMCC	RA7	• Increased living costs, such as housing and food costs;
243.	Social	LMCC	RA7	• Higher rates of domestic violence;
244.	Social	LMCC	RA7	• Increased wealth divide in the local community;
245.	Social	LMCC	RA7	• Increased demand for health and support services, resulting in long wait for doctors appointments, and limited access to mental health services;
246.	Social	LMCC	RA7	• Increased stress on families associated with the 12 hour shifts typically employed by the mining industry;
247.	Social	LMCC	RA7	• Impacts on the population's health particularly through respiratory disease and cancer;
248.	Social	LMCC	RA7	• Increased community anxiety about air quality and health impacts, as well as increased demand for health services;
249.	Social	LMCC	RA7	• Environmental impacts on the community's quality of life;
250.	Social	LMCC	RA7	• Emotional distress associated with changes to the place where people live, and the loss of their attachment or sense of belonging to places and people; and
251.	Social	LMCC	RA7	• Loss of housing affordability (increased housing costs driven by low vacancy rates and high demand from an incoming workforce, makes finding appropriate housing very difficult).
252.	Social	LMCC	RA7	Therefore, without the SIA investigating or providing any evidence to the contrary, then these impacts that are evident in other mining projects, are also likely to occur for this Project.
253.	Social	LMCC	RA7	In addition, the Project is also very close to Wyee (about 6km away), with this area being identified for substantial growth. However, the SIA has not considered any impacts of the Project on this community (both current and future community)
254.	Social	LMCC	RA7	The Environmental Impact Statement also identifies that the Project will result in additional train movements. This will increase delays for road traffic at level crossings, with the closure times at Adamstown Crossing and Islington Crossing increasing by 56 minutes per day. This will have considerable impacts on these local communities, as well as commuters travelling through these areas. However, the SIA also fails to consider/address this concern.
255.	Social	LMCC	RA7	Finally, the SIA also fails to make any recommendations regarding measures that can be implemented by the Project to mitigate any negative social impacts, or enhance any social benefits.
256.	Social	LMCC	RA7	Therefore, due to these issues and concerns, there is no support for the current proposal due to the considerable social impacts that are likely to arise. These will negatively impact on the quality of life of those living in the Directly Affected Area, as well as the wider Secondary Study Area.

No.	Aspect	Stakeholder	ID	Issue
257.	General	LMCC	RA7	**Recommendations** It is recommended that the EIS be revised in consideration of the above-mentioned issues. Council be provided with the opportunity to review the revised EIS prior to determination. Should the Department countenance approval of the proposed development, Council be provided with the opportunity to recommended conditions of consent.
NSW EPA				
258.	Surface Water	EPA	RA2	**General** There is one issue where **EPA** needs more information and discussion with the proponent. This issue involves the establishment of suitable discharge limits from the water treatment plant. **EPA** recommends that consent not be considered until this matter is satisfactorily resolved.
259.	Groundwater	EPA	RA2	**EPA** also requests Department of Planning and Infrastructure to coordinate information from agencies with greater expertise than **EPA** in groundwater movement as to the likely fate of the hypersaline brine proposed to be disposed underground.
260.	General	EPA	RA2	1. **Water and Wastewater** **Sewage Treatment System** EPA notes the EIS has committed to joining the Wyong Shire Council sewer system for bathhouse and general sewer discharges from both the Tooheys Road and Buttonderry sites. **EPA** supports this initiative.
261.	General	EPA	RA2	**EPA** requested evidence that demonstrates that the procurement of the identified easements are possible in a logistical and legal sense. This does not appear to be covered in the EIS. The EPA recommends a condition of consent to restrict any capital works progressing until the entire easement acquisition process is finalised.
262.	Surface Water	EPA	RA2	**Discharges from the Premises** **Run off Dams** The EIS proposes runoff from the Tooheys Road stockpile area will be directed to the "Stockpile Dam". Runoff from the Tooheys Road raw coal stockpile, offices and workshop is proposed to be directed to the "Portal Dam". The EIS notes these dams are to be maintained 'empty if possible' and have been sized so as to comply with *"Managing Urban Storm water: Soils and Construction - Mines and* Quarries" (DECC 2008). Captured water is proposed to be discharged to the "Mine Operations Dam" for further treatment. Flows that exceed the design capacity of the "Stockpile Dam" and "Portal Dam" will overflow to Wallarah Creek.
263.	Surface Water	EPA	RA2	Runoff from the Buttonderry Site is proposed to be treated in the "Sedimentation Dam". The EIS notes this dam will be sized so as to comply with *"Managing Urban Stormwater: Soils and Construction - Mines and Quarries"* (DECC 2008). Captured water is proposed to be discharged to the "Entrance Dam" for reuse. Flows that exceed the design capacity of the "Sedimentation Dam/Entrance Dam" will overflow to Buttonderry Creek.
264.	Surface Water	EPA	RA2	EPA notes from Appendix J "Surface Water Impact Assessment" that ANZECC ecosystem protection default trigger values have been detailed in Table 2.10, and in Table 2.11 a statistical assessment of historical water quality results from ambient monitoring sites has been undertaken. Table 6.2 identifies proposed discharge limits for an Environment Protection Licence. EPA has assessed the abovementioned data and given the characteristics of the water quality in the area and the nature of discharges from "Stockpile Dam", "Portal Dam" and "Entrance Dam" (essentially wet weather discharges) EPA accepts the proposed figures as appropriate limits and has detailed these at Attachment 3.
265.	Surface Water	EPA	RA2	Mine Operations Dam (MOD) The MOD is proposed to store saline water pumped from underground as well as waters received from the Portal and Stockpile Dams. This dam has a proposed storage capacity of 180ML. Waters from this dam are pumped to the Water Treatment Plant (WTP) where the wastewaters are treated through dissolved air flotation, membrane filtration, ion exchange and reverse osmosis at the net rate of 2.7ML/d. Treated water from the WTP is proposed to be reused at the surface or in underground operations, or released to Wallarah Creek. EPA notes the MOD has been designed to accommodate a 100 year ARI, 72 hour storm event. EPA further notes from Appendix J of the EIS "Surface Water Impact Assessment" that *"the water balance model result indicates that there will be no simulated uncontrolled discharges from the mine water management system to Wallarah Creek in any year* of *the Project."* Hence, unless there are extreme rainfall conditions, there should not be uncontrolled discharges of minewater for the life of the project. Figure 32 of the EIS shows a proposed overflow point from the MOD to Wallarah Creek and while good engineering practice is to include a stabilised spillway as a contingency for dam safety, discharge of highly saline untreated minewater direct to Wallarah Creek is unacceptable. Minewater has potential to cause environmental damage and the EPA has therefore formalised no discharge of untreated minewater as a condition of Environment Protection Licence, as

No.	Aspect	Stakeholder	ID	Issue
				detailed in Attachment 3.
266.	Surface Water	EPA	RA2	In regard to water quality of discharges from the WTP to Wallarah Creek the EPA notes from the EIS *"the expected quality* of *treated water is consistent with the existing water quality* of *Wallarah Creek for all key parameters."* While this statement is correct for many pollutant parameters the EPA believes' the water treatment plant will need to be modified to achieve better treatment for some of the parameters (e.g. dissolved oxygen).
267.	Surface Water	EPA	RA2	The EPA advised in our letter of 31 October 2012 on the adequacy of the draft EIS that for the exhibited EIS: • Any proposed discharges to Wallarah Creek should be assessed in accordance with the Natural Resource Management Ministerial Council's *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) regarding the potential impact on the receiving environment. The assessment of pollutants should include, but not be limited to, pH, conductivity, suspended solids and metals;
268.	Surface Water	EPA	RA2	• Water quality that will be achieved post treatment needs to be detailed, making reference to ANZECC water quality criteria and existing water quality of Wallarah Creek. These commitments need to propose standards with regard to: total suspended solids, pH, electrical conductivity, metals and oil/grease. If deemed acceptable, it is EPA's intention to formalise these as environment protection licence discharge standards, should the project be approved.
269.	Surface Water	EPA	RA2	Within Appendix J of the EIS, "Surface Water Impact Assessment", ANZECC ecosystem protection default trigger values have been detailed in Table 2.10. In Table 4.3 some numbers have been presented as "Wallarah Creek water quality", however it is unclear what these individual figures represent (averages, 80 percentile? The note under the table appears to relate to treated water quality not Wallarah creek water quality). Table 4.3 also identifies "Treated Water Quality" post WTP. A number of the water quality levels noted as being able to be achieved in Table 4.3 will be appropriate to protect aquatic ecosystems if achieved 100 per cent of the time, however given that Wallarah Creek is an intermittent watercourse and given that flows from the WTP may on occasions represent a significant proportion of total creek flow, to be more confident of acceptable impacts EPA requires a more detailed assessment of potential impacts than has been presented to date.
270.	Surface Water	EPA	RA2	EPA notes a number of years of ambient water quality data has been collected. This historical ambient data should be assessed using the principles detailed in ANZECC to see if the treated water quality as proposed in Table 4.3 will be appropriate for all parameters. The proponent needs propose appropriate 100 percentile limits that will be committed to for the WTP. In justifying the limits particular attention will need to be given to dissolved oxygen, mercury, copper, zinc, ammonia, and electrical conductivity if limits similar to the levels noted in Table 4.3 are proposed.
271.	Surface Water	EPA	RA2	This issue needs to be resolved and in Attachment 3 EPA has noted that for each parameter that we propose to apply limits for, the limit is still to be determined. This issue needs to be resolved prior to consideration being given to consent.
272.	Surface Water Aquatic Ecology	EPA	RA2	The levels of treatment of minewater that are proposed are commendable. Wallarah Creek is currently in good condition with a diverse macroinverterbate community. Office of Environment and Heritage (OEH) investigations in Wallarah Creek indicate the Creek is in much better condition than the Marine Pollution Research (2012) report suggests. It is acknowledged that the monitoring sites are different, however over about the last 10 years OEH has found an average of approximately 27 taxa - range 23-31, which is in contrast to MPR who found an average of only 11 taxa (range 8-15). Given the good condition of Wallarah Creek EPA proposes a condition as a final check of water quality suitability. This condition requires the treated waters be confirmed to be free of adverse ecotoxic effects, prior to release to Wallarah Creek. This condition is shown at Attachment 2 and 3.
273.	Surface Water	EPA	RA2	If the project is approved EPA will also require, via the Environment Protection Licence, monitoring of waters within Wallarah Creek upstream and downstream of the site to confirm no long term impacts from the discharge. Proposed Environment Protection Licence conditions requiring this monitoring, and an annual report on water quality, are shown at Attachment 3.
274.	Surface Water	EPA	RA2	In regard to increased flows to Wallarah Creek as a result of WTP discharges the EPA notes *"under wet conditions, the flow volumes in Wallarah Creek are predicted to increase by approximately* 2 %. *Under average to dry conditions, flow volumes are expected to increase by approximately* 3 %". It is also noted from the EIS that WTP discharges will have *"negligible impact on the frequency* of *flows greater than 10 ML/d* ..." and *"it is unlikely that releases* of *treated water will cause increased erosion in Wallarah Creek".* Despite these assurances EPA thinks it prudent to condition any consent, requiring a geomorphological assessment of Wallarah Creek each two years to map any existing erosion and identify any induced erosion associated with the Project, including actions that will be taken to remedy any induced erosion.
275.	Surface Water	EPA	RA2	EPA notes in regard to minewater flows that the EIS states *"groundwater inflows are predicted to peak at 2.5 ML/d."* The proposed WTP has a capacity of 2.7 ML/d. Hence all available minewater should be able to be treated in the WTP and as noted above flows in Wallarah Creek should remain similar to historic flows as a result of discharges from the WTP. EPA is however mindful that these groundwater inflows are estimates and notes that at the nearby

No.	Aspect	Stakeholder	ID	Issue
				Mandalong mine, the current mining operation generates an average discharge of 1.59 ML/day (GHD 2013), however during periods of rainfall, discharges at Mandalong can be greater than 10 ML/day (Figure 5.4, GHD 2013). Therefore EPA thinks it prudent to include conditions requiring increased treatment capacity (and investigations of effluent reuse) if minewater flows exceed 2.7 ML/d, these conditions are shown at Attachment 2 and 3.
276.	Groundwater	EPA	RA2	**Brine Disposal** A salty brine will be produced as a by-product of the reverse osmosis plant. It is proposed that this brine will be further treated via a Brine Treatment Plant to reduce its volume to enable efficient disposal to "dedicated underground workings" until about Year 14 of the Project. Between Year 14 and Year 28 the EIS anticipates there will be sufficient capacity in the goaf produced by previously mined areas to allow disposal of brine direct to goaf.
277.	Groundwater	EPA	RA2	In our letter of 31 October 2012 EPA noted that if the proponents intend injecting brine underground then the EIS needs to fully assess the location, volumes and the capacity of the aquifers to absorb/retain this brine and consider environmental impacts of this discharge.
278.	Groundwater	EPA	RA2	EPA notes from the EIS *"the proposed underground storage is located at* a *depth* of *greater than 350 metres below the natural surface. The underground storage is overlain by low permeability geological units forming the Narrabeen Group ... "OEH* looked carefully at MER (2013) to try and understand where the current groundwater aquifers might discharge. OEH could not identify from MER (2013) whether the current coal seam aquifer ultimately discharges into the ocean or whether it has the potential to be intersected by the streams/lakes of the Central Coast floodplain.
279.	Groundwater	EPA	RA2	The concentrated brine proposed to be disposed of underground for the first 14 years of the project has a salinity of about 700,000 mg/L. The unconcentrated brine also has extremely high salt concentrations of about 300,000 mg/L. It is anticipated that 72,000 m^3 of the former and 246 ML of the latter is proposed to be disposed underground.
280.	Groundwater	EPA	RA2	Other agencies have greater expertise than EPA or OEH in determining if the proponent's assessment of the strata surrounding the proposed underground storage is adequate and assessing if the overlying and surrounding geology are able to retain this hypersaline mixture without recharge to receiving waters. If such hypersaline water was to discharge into surface waters, or groundwaters used for commercial purposes, extensive adverse impacts are likely. EPA is aware (and Appendix J part 3.2 details) the proponent is still in discussions with Wyong Shire Council about the potential for brine/minewater disposal to sea via Councils ocean outfall used for its northern sewage treatment plants. If other agencies consider there is a risk of the hypersaline waters recharging then investigations should be run to a conclusion as to whether brine disposal direct to outfall is possible in an engineering sense and if so what would be the impacts of this practice on the marine environment near the outfall.
281.	Noise	EPA	RA2	**2. Noise** EPA notes from the EIS *"noise modelling assumed that fixed and the mobile plant were operating simultaneously with train loading at the Tooheys Road Site, effectively providing* a *worst case modelling assumption. Modelling shows that appropriate Project Specific Noise Criteria will be met under all weather conditions at all private residences surrounding the Tooheys Road Site which is the location* of *the main noise emitting activities for the Project. "*
282.	Noise	EPA	RA2	For the Buttonderry Site the EIS states *"Modelling shows that the Project Specific Noise Criteria are not predicted to be exceeded at any private residence or more than* 25 % of a *contiguous block* of *land in single ownership due to activities from the Buttonderry Site. "*
283.	Noise	EPA	RA2	To ensure noise levels from the Project do not cause adverse impacts on nearby noise sensitive locations the EPA has proposed noise limits at *locations* around the main noise producing sites, including an additional location near to the Buttonderry Site, which was not proposed in the EIS. These limits are shown in Attachments 2 and 3.
284.	Noise	EPA	RA2	EPA has proposed a requirement for the proponent to have real time noise monitors, which must be operated continuously to record noise impacts from the mine on noise sensitive residential receivers. EPA has also proposed conditions requiring quarterly attended noise monitoring to confirm noise limits are being met.
285.	Noise	EPA	RA2	The EIS predicts that airblast overpressure and vibration from blasting activities can be satisfied at the closest private receiver with the employment of controlled Maximum Instantaneous Charge and detailed planning. To ensure these commitments are met EPA has proposed our industry airblast overpressure and vibration limits as conditions of Environment Protection Licence. Our proposed conditions also require monitoring of all blasts.
286.	Noise	EPA	RA2	In regard to increased rail traffic associated with the project EPA notes that when operating at peak production the additional rail traffic generated will only marginally increase the LAeq, 24 hour levels (1-2 dBA) on the Main Noise Railway Line and maximum instantaneous noise will remain unchanged.
287.	Air Quality	EPA	RA2	**3. Air** EPA has reviewed the exhibited Air Quality Impact Assessment (AQIA) and considers that it has been adequately conducted in accordance with the

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				requirements of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.* The assessment has adopted generally accepted emission estimation techniques from Australia and the US EPA.
288.	Air Quality	EPA	RA2	**Predicted Impacts** The AQIA predicts that incremental project related air quality impacts will be below relevant EPA air criteria at identified off site receptors for incremental 24 hour average PM_{10}, one hour average NOx and annual average PM_{10}, TSP and NOx.
289.	Air Quality	EPA	RA2	**Particulates emissions** *PM10* Emissions estimates are presented for two scenarios: 1. A maximum daily production scenario based on the maximum conveyor capacity equating to 48 kilotonnes of coal per day (conservative) 2. An average production day based on an annual production scenario of 5 Mtpa of coal
290.	Air Quality	EPA	RA2	No exceedances of the EPA's annual average PM_{10} criteria (30 *µg/m^3*) and 24 hour average PM_{10} criteria *(50 µg/m^3)* are predicted at any sensitive receptors. The highest predicted incremental ground level concentrations at a sensitive receptor are as follows: • PM_{10} 24 hour average Scenario 1 - 27.2 µg/m^3 • PM_{10} 24 hour average Scenario 2 - 22.1 µg/m^3 • PM_{10} Annual average - 1.6 µg/m^3
291.	Air Quality	EPA	RA2	Assessment of cumulative PM_{10} 24 hour average impacts was conducted using "Monte Carlo simulation" and indicated a very low probability that the project would result in additional exceedances of the impact assessment criterion.
292.	Air Quality	EPA	RA2	*PM2.5* Annual average and 24 hour average $PM_{2.5}$ assessments were undertaken and compared against the NEPM advisory standards of 8 µg/m^3 and 25 µg/m^3 respectively. No exceedances were predicted. The highest predicted 24 hour average incremental $PM_{2.5}$ concentration at a sensitive receptor is 5 µg/m^3, and the annual average 0.46 µg/m^3.
293.	Air Quality	EPA	RA2	*Construction Activities* An emission inventory of estimated TSP emissions for construction activities was compiled and construction emissions are estimated to be less than 35% of operational emissions, for which predicted impacts are below EPA criteria at sensitive receivers. As such construction activities are unlikely to have adverse impacts provided operations are well managed and consistent with those proposed in the EIS.
294.	Air Quality	EPA	RA2	**Flare emissions** It is proposed methane extracted from the mine will initially be flared, with view to future electricity generation once gas flows are assessed. Modelling of one hour and annual average NO_2 has been conducted using emission factors for two scenarios: • Three flares with a gas flow rate of 2600 L/s • A 10MW power station (five 2 MW gas engines)
295.	Air Quality	EPA	RA2	No exceedances of EPA NO_2 assessment criteria were predicted, with the highest incremental one hour average ground level concentration at a sensitive receptor of 35 µg/m^3 (criterion is 246 µg/m^3) and annual average of 0.43 µg/m^3 (Criterion is 62 µg/m^3). Proposed licence conditions for the design and operation of the flares are included in Attachment 3. Additional conditions on any Environment Protection Licence will be required prior to the development of electricity generation plant at the site, which are addressed in Attachments 2 and 3.
296.	Air Quality	EPA	RA2	**Odour** Assessment of the potential for odour impacts from the ventilation shaft was assessed with the highest predicted 99th percentile odour impact of 3 Odour Units at a sensitive receptor, indicating adverse odour impacts are unlikely given the low population density of the area surrounding the mine.
297.	Air Quality	EPA	RA2	Proposed management measures A broad overview of proposed management measures is provided in the AQIA, including: • Speed limits of vehicles involved in construction activities • Use of water sprays/ road watering during road construction • Limiting excavation during periods of high winds • Restricted land clearing

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				• Water sprays on coal stockpiles • ¾ shielded conveyors • Underground coal reclaim system from stockpiles
298.	Air Quality	EPA	RA2	In addition, a broad overview of the proposed monitoring system is provided: • It is proposed to review and expand the existing air quality monitoring network for the project site as part of the development of an Air Quality Management Plan for the project, including the replacement of High Volume Air Sampler (HVAS) monitors with Tapered Element Oscillating Microbalance (TEOM) monitors at locations representative of receivers who may experience short term elevated dust concentrations. • A short term average performance indicator is to be developed to allow for proactive/reactive dust management if dust levels are expected to approach the EPA's 24 hour average impact assessment criterion
299.	Air Quality	EPA	RA2	All proposed management practices must be consistent with best management practice and be quantifiable, measurable, auditable and enforceable. Methods for determining compliance must be clearly identified. As such detailed information will be required to finalise environment protection licence conditions relating to emission monitoring, management and contingencies for the Wallarah 2 project. EPA recommends that the conditions of approval include the development of a comprehensive air quality management plan to be submitted with the application for an Environment Protection Licence, as shown in Attachment 2.
300.	General	EPA	RA2	**ATTACHMENT 2 - RECOMMENDED CONDITIONS OF CONSENT** **Pollution of waters** **1.** Except as may be expressly provided by a licence under the *Protection of the Environment Operations Act* 1997 in relation to the development, section 120 of the *Protection of the Environment Operations Act* 1997 must be complied with in connection with the carrying out of the development.
301.	General	EPA	RA2	**2.** No capital works shall be commenced on the project until such time as all easements necessary for sewerage have been secured.
302.	Surface Water	EPA	RA2	**3.** Prior to construction occurring on surface sites, soil and water management controls must be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities in accordance with the requirements outlined in *Managing Urban Storm water: Soils and Construction* (Landcom, 2004).
303.	Surface Water	EPA	RA2	**4.** There must be no uncontrolled discharges of minewater from the premises to surface waters.
304.	Surface Water	EPA	RA2	**5.** The proponent must investigate the treated minewater to ensure it does not have an adverse ecotoxic effect in accordance with the details below: (i) Within the first year of operation, and prior to treated minewater being discharged to Wallarah Creek, the proponent must engage a person with suitable qualifications in ecotoxicology to take samples of the treated minewater and subject those waters a range of ecotoxicology tests. (ii) Prior to the second year of operation the proponent must submit a report to the Director-General and the EPA detailing the results of the ecotoxicology tests. (iii) Should the tests demonstrate an adverse ecotoxic effect despite the treatment being afforded, the report must detail actions that will be taken (including timelines) to rectify the situation.
305.	Surface Water	EPA	RA2	**6.** Treated minewater that has an adverse ecotoxic effect must not be discharged to waters.
306.	Surface Water	EPA	RA2	**7.** If minewater volumes approach the maximum capacity of the Water Treatment Plant the proponent must install additional water treatment plant capacity to allow treatment of any additional flows of minewater/runoff water above the design capacity of the Water Treatment Plant.
307.	Surface Water	EPA	RA2	**8.** If minewater volumes exceed 2.3 ML/d the proponent must undertake investigations aimed at beneficially reusing any additional volume of minewater greater than 2.5 ML/d and submit a report on these investigations to the Director-General and EPA prior to minewater volumes exceeding 2.4 ML/d.
308.	Surface Water	EPA	RA2	**9.** Prior to the project commencing and then every two years thereafter the proponent must engage a suitably qualified person to undertake a geomorphological assessment of Wallarah Creek to map any existing erosion and identify any additional erosion or induced erosion associated with the Project. Within 60 days of completing this assessment the proponent must supply a report to the Director General that identifies the results of the investigations and includes actions that will be taken to remedy any induced erosion as a result of the Project.
309.	Noise	EPA	RA2	**Noise** **10.** Noise generated at the premises must not exceed the noise limits in the table below. The locations referred to in the table below are indicated by *Figure* 36 *Noise Assessment and Measurement Locations* provided in the Environmental Impact Statement for the Wallarah 2 Coal Project dated April 2013.

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310.	Noise	EPA	RA2	**11.** For the purpose of the above condition: • Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays. • Evening is defined as the period 6pm to 10pm. • Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and Public Holidays.
311.	Noise	EPA	RA2	**12.** Construction activity is permitted between the hours of 7:00am to 6:00pm Monday to Friday and Saturday 8:00am to 1.00pm, with no construction activity on Sundays and Public Holidays. Respite periods shall be implemented to address any noise complaint(s) associated with any construction noise including any loud construction works.
312.	Noise	EPA	RA2	**13.** The noise limits set out in above apply under all meteorological conditions except for the following: • Wind speeds greater than 3 metres/second at 10 metres above ground level; or • Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or • Stability category G temperature inversion conditions.
313.	Noise	EPA	RA2	**14**. For the purposes of the above condition: • Data recorded by the meteorological station identified must be used to determine meteorological conditions; and • Temperature inversion conditions (stability category) are to be determined by the sigma-theta method referred to in Part E4 of Appendix E to the NSW Industrial Noise Policy.
314.	Noise	EPA	RA2	**15**. To determine compliance: **a)** with the Leq(15 minute) noise limits in the above condition, the noise measurement equipment must be located: • approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or • within 30 metres of a dwelling facade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable • within approximately 50 metres of the boundary of a National Park or a Nature Reserve. **b)** with the LA1 (1 minute) noise limits in the above condition, the noise measurement equipment must be located within 1 metre of a dwelling facade. **c)** with the noise limits in the above condition, the noise measurement equipment must be located: • at the most affected point at a location where there is no dwelling at the location; or • at the most affected point within an area at a location prescribed by these conditions.
315.	Noise	EPA	RA2	**16.** A non-compliance of the above limit conditions will still occur where noise generated from the premises in excess of the appropriate limit is measured: • at a location other than an area prescribed by the above conditions; and/or • at a point other than the most affected point at a location.
316.	Noise	EPA	RA2	**17.** For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.
317.	Air Quality	EPA	RA2	**Air Quality** **18.** The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.
318.	Air Quality	EPA	RA2	**19**. Activities occurring in or on the premises must be carried out in a manner that will minimise the generation or emission from the premises, of wind-blown or traffic generated dust.
319.	Air Quality	EPA	RA2	**20.** The proponent must not cause or permit the emission of offensive odour beyond the boundary of the premises.
320.	Air Quality	EPA	RA2	**21.** For all air emission sources at the site the proponent must prepare an air quality management plan that includes, but is not limited to: • Key performance indicator(s); • Monitoring methods); • Location, frequency and duration of monitoring;

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				• Record keeping; • Response mechanisms; and • Compliance reporting.
321.	Air Quality	EPA	RA2	**22.** An air quality management plan must be submitted to the Environment Protection Authority (EPA) in conjunction with the application for an Environment Protection Licence under the *Protection* of *the Environment Operations Act 1997.*
322.	Air Quality	EPA	RA2	**23.** The air quality management plan must detail a real time monitoring network for PM10 , PM2.5 and weather that will record and be used to determine: • Ambient air quality in communities near to the facility, generally north-west and south-east of the site; • Any effect of the Tooheys Road facility on increasing ambient particulate levels; • Weather parameters as detailed in an Environment Protection Licence.
323.	Air Quality	EPA	RA2	**24.** The air quality management plan must detail a predictive weather forecasting system that will be used as the basis to apply additional dust control mechanisms in the event of predicted "adverse" weather conditions.
324.	Air Quality	EPA	RA2	**25.** The air quality management plan must detail adaptive management measures that will be implemented based on monitor(s) exceeding key PM10 thresholds.
325.	Air Quality	EPA	RA2	**26.** The air quality management plan must be implemented prior to the commencement of any dust generating activities at the site.
326.	Air Quality	EPA	RA2	**27.** Prior to the conversion of the flare(s) to an electricity generation plant the proponent must make application to the **EPA** to vary the Environment Protection Licence for the premises to recognize relevant discharge points and add relevant limits and monitoring, where required.
327.	Air Quality Noise Surface Water	EPA	RA2	**ATTACHMENT 3 - POSSIBLE ENVIRONMENT PROTECTION LICENCE CONDITIONS** **1. Location of monitoring/discharge points** The following points referred to in the table below are identified for the purposes of monitoring and/or setting of limits for the emission of pollutants to the air or to waters from the point.
328.	Surface Water	EPA	RA2	**LIMIT CONDITIONS** **2. Pollution of waters** Except as may be expressly provided by a licence under the *Protection* of *the Environment Operations Act* 1997 in relation to the development, section 120 of the *Protection* of *the Environment Operations Act* 1997 must be complied with in connection with the carrying out of the development.
329.	General	EPA	RA2	**3. Concentration limits** For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant must not exceed the concentration limits specified for that pollutant in the table.
330.	General	EPA	RA2	**3. Waste** **3.1.** The licensee must not cause, permit or allow any waste generated outside the premises to be received at the premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the premises to be disposed of at the premises, except as expressly permitted by a licence
331.	General	EPA	RA2	**3.2.** The above condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the premises if it requires an Environment Protection Licence.
332.	Noise	EPA	RA2	**4. Noise Limits** **4.1** Noise generated at the premises must not exceed the noise limits in the table below. The locations referred to in the table below are indicated by *Figure 36 Noise Assessment and Measurement Locations* provided in the Environmental Impact Statement for the Wallarah 2 Coal Project dated April 2013.
333.	Noise	EPA	RA2	**4.2.** For the purpose of the above condition: **a)** Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays. **b)** Evening is defined as the period 6pm to 1Opm. **c)** Night is defined as the period from 1 Opm to 7am Monday to Saturday and 10pm to 8am Sunday and Public Holidays.
334.	Noise	EPA	RA2	**4.3.** Construction activity is permitted between the hours of 7:00am to 6:00pm Monday to Friday and Saturday 8:00am to 1:00pm, with no construction activity on Sundays and Public Holidays. Respite periods shall be implemented to address any noise complaint(s) associated with any construction noise

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				including any loud construction works.
335.	Noise	EPA	RA2	**4.4.** The noise limits set out in above apply under all meteorological conditions except for the following: **a)** Wind speeds greater than 3 metres/second at 10 metres above ground level; or **b)** Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or **c)** Stability category G temperature inversion conditions.
336.	Noise	EPA	RA2	**4.5**. For the purposes of the above condition: **a)** Data recorded by the meteorological station identified must be used to determine meteorological conditions; and **b)** Temperature inversion conditions (stability category) are to be determined by the sigma theta method referred to in Part E4 of Appendix E to the NSW Industrial Noise Policy.
337.	Noise	EPA	RA2	**4.6.** To determine compliance: **a)** with the Leq(15 minute) noise limits in the above condition, the noise measurement equipment must be located: • approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or • within 30 metres of a dwelling facade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable • within approximately 50 metres of the boundary of a National Park or a Nature Reserve. **b)** with the LA1 (1 minute) noise limits in the above condition, the noise measurement equipment must be located within 1 metre of a dwelling facade. **c)** with the noise limits in the above condition, the noise measurement equipment must be located: • at the most affected point at a location where there is no dwelling at the location; or • at the most affected point within an area at a location prescribed by these conditions.
338.	Noise	EPA	RA2	**4.7**. A non-compliance of the above limit conditions will still occur where noise generated from the premises in excess of the appropriate limit is measured: **a)** at a location other than an area prescribed by the above conditions; and/or **b)** at a point other than the most affected point at a location.
339.	Noise	EPA	RA2	**4.8**. For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.
340.	Noise	EPA	RA2	**Blasting** **4.9.** The airblast overpressure level from blasting operations at the premises must not exceed 120dB (Lin Peak) at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.
341.	Noise	EPA	RA2	**4.10**. The airblast overpressure level from blasting operations at the premises must not exceed 115dB (Lin Peak) at any noise sensitive locations for more than five per cent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.
342.	Noise	EPA	RA2	**4.11.** Ground vibration peak particle velocity from the blasting operations at the premises must not exceed 1 Omm/sec at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.
343.	Noise	EPA	RA2	**4.12.** Ground vibration peak particle velocity from the blasting operations at the premises must not exceed 5mm/sec at any noise sensitive locations for more than five per cent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.
344.	Noise	EPA	RA2	**4.13.** Blasting at the premises may only take place between 9:00am-5:00pm Monday to Saturday. Blasting is not permitted on public holidays.
345.	Noise	EPA	RA2	**4.14.** The airblast overpressure and ground vibration levels in the conditions above do not apply at noise sensitive locations that are owned by the licensee or subject to a private agreement, relating to airblast overpressure and ground vibration levels, between the licensee and land owner.
346.	Air Quality	EPA	RA2	**5. General Odour Conditions**

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				5.1. The licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises. Note: Section 129 of the *Protection* of *the Environment Operations Act* 1997 provides that the licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises but provides a defence if the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.
347.	Air Quality	EPA	RA2	**5.2.** No condition of this licence identifies a potentially offensive odour for the purposes of Section 129 of *the Protection* of *the Environment Operations Act 1997.*
348.	General	EPA	RA2	**OPERATING CONDITIONS** **6. Activities must be carried out in a competent manner** **6.1.** Activities must be carried out in a competent manner. This includes: **a)** The processing, handling, movement and storage of materials and substances used to carry out the activity; and/or **b)** The treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.
349.	General	EPA	RA2	**7. Maintenance of plant and equipment** **7.1**. All plant and equipment installed at the premises or used in connection with the licensed activity: **a)** Must be maintained in a proper and efficient condition; and/or **b)** Must be operated in a proper and efficient manner.
350.	Air Quality	EPA	RA2	**8**. **General Dust Conditions** **8.1**. The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.
351.	Air Quality	EPA	RA2	**8.2.** Activities occurring in or on the premises must be carried out in a manner that will minimise the generation or emission from the premises, of wind-blown or traffic generated dust.
352.	Air Quality	EPA	RA2	**9. Air Pollution Controls - Construction Phase** • 9.1. The proposal must be constructed in accordance with the development consent and **EIS** and must include, but need not be limited to: • Adequate location and number of fixed water sprays on all stockpiles; • Water sprays linked to the weather station such that sprays automatically activate upon wind reaching pre-determined speed threshold(s); • Water sprays automatically activated when "adverse" weather conditions are predicted by the weather forecasting system; • Wind shielding to three sides of conveyors; • Water application at conveyor transfer points; • Conveyor belt cleaning and spillage minimisation; • Stacking and reclaiming of coal without the use of dozers or other similar plant, except in emergencies; • Variable height stackers; • Boom tip water sprays; • Telescopic chute with water sprays.
353.	Air Quality	EPA	RA2	**10. Flare(s) conditions** **10.1.** The flare(s) must be designed, maintained and operated so as to prevent or minimise air pollution.
354.	Air Quality	EPA	RA2	**10.2.** The flare(s) must be operated in such a way that a flame is present at all times while air impurities are required to be treated.
355.	Air Quality	EPA	RA2	**10.3**. The flare(s) must not cause a visible particulate emission other than for a total period of no more than 5 minutes in any 2 hours.
356.	Air Quality	EPA	RA2	**10.4.** Prior to the conversion of the flare(s) to an electricity generation plant the proponent must make application to the EPA to vary this Environment Protection Licence to recognise relevant discharge points and add relevant limits and monitoring, where required.
357.	Air Quality	EPA	RA2	Note: No exceedances of EPA N02 assessment criteria were predicted in the EIS, with the highest incremental one hour average glc at a sensitive receptor of 35 up/m3 (criterion is 246 up/m^3) and annual average of 0.43 up/m3 (62 up/m3). If the gas engines are to be constructed as detailed in Table 4.3 of Appendix L of the EIS, the abovementioned application to vary this Environment Protection Licence must include the nitrogen dioxide plus nitric oxide, as N02 equivalent, in stack concentrations in *up/m3* used for this modelling. If the gas engines are to be built differently to that described in Appendix L the proponent must propose limits for in stack concentrations (in up*/m3)* of nitrogen dioxide plus nitric oxide, as N02 equivalent, backed by

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				modelling or justification that these limits are appropriate.
358.	Surface Water	EPA	RA2	**11. Stormwater/sediment control - Construction Phase** **11.1**. Soil and water management controls must be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities in accordance with the requirements outlined in *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
359.	Surface Water	EPA	RA2	**12. Stormwater Management** **12.1.** The drainage from all areas at the premises which will liberate suspended solids when stormwater runs over these areas must be diverted into adequately sized sedimentation basins.
360.	Surface Water	EPA	RA2	**12.2**. Sediment dams known as "Portal Dam", "Stockpile Dam" and "Sedimentation Dam" as shown in Figures 19 and 21 of the EIS must be kept pumped down and kept clean of accumulated sediments as much as possible to allow maximum volumes of stormwater runoff to be collected without discharge.
361.	Surface Water	EPA	RA2	**13. Minewater Management** **13.1.** There must be no uncontrolled discharges of minewater from the premises to surface waters.
362.	Surface Water	EPA	RA2	**13.2.** The proponent must investigate the treated minewater to ensure it does not have an adverse ecotoxic effect in accordance with the details below: **a)** Within the first year of operation, and prior to treated minewater being discharged to Wallarah Creek, the proponent must engage a person with suitable qualifications in ecotoxicology to take samples of the treated minewater and subject those waters a range of ecotoxicology tests. **b)** Prior to the second year of operation the proponent must submit a report to the Director- General and the EPA detailing the results of the ecotoxicology tests. **c)** Should the tests demonstrate an adverse ecotoxic effect despite the treatment being afforded, the report must detail actions that will be taken (including timelines) to rectify the situation.
363.	Surface Water	EPA	RA2	**13.3.** Treated minewater that has an adverse ecotoxic effect must not be discharged to waters.
364.	Surface Water	EPA	RA2	**13.4.** If minewater volumes approach the maximum capacity of the Water Treatment Plant the proponent must install additional water treatment plant capacity to allow treatment of any additional flows of minewater/runoff water above the design capacity of the Water Treatment Plant.
365.	Surface Water	EPA	RA2	**13.5.** If minewater volumes exceed 2.3 ML/d the proponent must undertake investigations aimed at beneficially reusing any additional volume of minewater greater than 2.5 ML/d and submit a report on these investigations to the EPA and the Department of Planning & Infrastructure prior to minewater volumes exceeding 2.4 ML/d.
366.	Surface Water	EPA	RA2	Note: The EIS predicted a maximum minewater flow of 2.5 ML/d, highlighted that a water treatment plant with a capacity of 2.7 ML/d would be built, and assessed the implications of this treated wastewater being discharged to Wallarah Creek and reused in mining operations.
367.	Noise	EPA	RA2	**14. Noise** **14.1.** Real time noise monitors must be operated continuously to record noise impacts from the mine on noise sensitive residential receivers. These monitors must filter sound frequencies so that the noise contribution from the premises can be estimated. These monitors must be alarmed at trigger noise levels in the evening and night-time periods (as defined above). In the event of the filtered noise level at the real time noise monitors exceeding trigger noise levels in the evening or night-time, actions must be taken that will reduce noise levels so that non-compliance with noise limits does not occur. Actions considered must include ceasing operations of certain activities. Actions taken in response to the alarm must be documented at the time of the decision in a manual log of noise control actions and must include date, time, likely main contributor(s) to noise levels and actions taken.
368.	Noise	EPA	RA2	**14.2.** In the event of any apparent exceedance of the noise limits measured by the real time noise monitors the licensee must, within 7 days of the apparent exceedance, provide to the EPA a report on the apparent exceedance which must include: the trend-line from the real-time noise monitor showing the contribution from the premises leading up to the exceedance; a copy of the log of noise control actions showing actions that were implemented in response to an alarm being received prior to the apparent non-compliance; the reason(s) for the noise non-compliance occurring; and actions that will be put in place to prevent a similar non-compliance occurring into the future.
369.	General	EPA	RA2	**15. Emergency response** **15.1**. The licensee must maintain, and implement as necessary, a current emergency response plan for the premises. The licensee must keep the emergency response plan on the premises at all times. The emergency response plan must document systems and procedures to deal with all types of

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				incidents (e.g. spills, explosions or fire) that may occur at the premises or that may be associated with activities that occur at the premises and which are likely to cause harm to the environment.
370.	General	EPA	RA2	**16. Processes and management** **16.1.** The licensee must ensure that any liquid and/or non liquid waste generated and/or stored at the premises is assessed and classified in accordance with the EPA Waste Classification Guidelines as in force from time to time.
371.	General	EPA	RA2	**16.2.** The licensee must ensure that waste identified for recycling is stored separately from other waste.
372.	General	EPA	RA2	**16.3.** All above ground tanks containing material that is likely to cause environmental harm must be bunded or have an alternative spill containment system in place.
373.	General	EPA	RA2	**16.4**. Bunds must: **a)** have walls and floors constructed of impervious materials; **b)** be of sufficient capacity to contain 110% of the volume of the tank (or 110% volume of the largest tank where a group of tanks are installed); **c)** have floors graded to a collection sump; and **d)** not have a drain valve incorporated in the bund structure, or be constructed and operated in a manner that achieves the same environmental outcome.
374.	General	EPA	RA2	**MONITORING CONDITIONS** **17.** Requirement to monitor concentration of pollutants discharged For each monitoring/discharge point or utilisation area specified below (by a point number) the concentration of each pollutant specified in Column 1 must be monitored by sampling and obtaining results by analysis. Specified opposite in the other columns are the sampling method and units of measure to be used and the frequency with which samples are to be taken. The sampling methods are defined in the publication "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW'.
375.	General	EPA	RA2	**18. Requirement to monitor weather** **18.1.** The licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns.
376.	General	EPA	RA2	**18.2.** Monitoring of all parameters listed in Condition 1 must commence prior to earth moving activities being undertaken at the site.
377.	Noise	EPA	RA2	**19. Requirement to Monitor Noise and Blasting** **19.1.** To determine compliance with the Noise Limits shown in this licence, attended noise monitoring must be undertaken in accordance with all relevant conditions of this licence: **a)** at the nearest and/or most affected locations listed in the Noise Limits Table; and **b)** occur quarterly beginning 1 January each year.
378.	Noise	EPA	RA2	**19.2.** To determine compliance with the Blasting Limits shown in this licence, airblast overpressure and ground vibration levels experienced at the nearest noise sensitive location(s) must be measured and recorded for all blasts carried out on the premises.
379.	Noise	EPA	RA2	**19.3.** Instrumentation used to measure and record the airblast overpressure and ground vibration levels must meet the requirements of Australian Standard AS 2187.2-2006.
380.	Noise	EPA	RA2	**19.4.** EPA must be advised within seven days of any airblast overpressure or ground vibration limits being exceeded.
381.	Air Quality	EPA	RA2	**REPORTING CONDITIONS** **20. Annual Air Quality Monitoring Report** **20.1**. The licensee must submit to the EPA, with the Annual Return, an annual air quality monitoring report. This report must detail: • Annual average PM10 and PM25 readings for each site since monitoring began • Any occasions when the 24 hour PM1o and PM25 readings exceeded EPA impact assessment criteria at "community monitors". Included with this information must be details of the wind speed and direction for the 24 hours corresponding to that reading, and the corresponding particulate level of any monitor broadly upwind of the monitor that recorded the exceedance. • The likely reason for any exceedance of EPA impact assessment criteria at "community monitors" • Actions taken and proposed to be taken to address any exceedance likely caused by operations at the premises.

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382.	Surface Water	EPA	RA2	**21. Annual Water Quality Monitoring Report** **21.1.** The licensee must submit to the EPA, with the Annual Return, an annual water quality monitoring report. This report must detail the results of all monitoring required at points 10 and 11. The report must graphically present all results since monitoring began at each site for each parameter required to be monitored under this licence. Sites 10 and 11 must be shown on the same graph and the graph must also include a line representing relevant in-stream criteria. At least two graphs must be produced per parameter, one graph showing actual results and a second graph showing yearly averages since monitoring began.
383.	Surface Water	EPA	RA2	**21.2.** The report must include commentary as to any trends observed and highlight any potentially deleterious effects occurring as a result of discharges from the premises.
384.	Noise	EPA	RA2	**22. Noise Monitoring Report** **22.1**. A noise compliance assessment report must be submitted to the EPA within 30 days of the completion of the quarterly monitoring. The assessment must be prepared by a suitably qualified and experienced acoustical consultant and include: **a)** an assessment of compliance with noise limits presented in this licence; and **b)** an outline of any management actions taken within the monitoring period to address any exceedences of the limits contained in the Limit Conditions of this licence.
385.	Health	NSW Health	RA8	**Air Quality** The PHU notes that modelling predicts that incremental dust deposition and TSP, PM10 and PM2.5 concentrations at the closest residential receivers are below impact assessment criteria. We also acknowledge, as does the health risk assessment, that adverse health effects occur with an increase in particulate pollution, even at levels below the current assessment criteria.
386.	Health	NSW Health	RA8	Our comments are made assuming the appropriate model and assumptions have been used. Particulate pollution (PM10 and PM2.5) are shown in figures 8.1 to 8.6 in Appendix L. They appear to show lower incremental particulate concentrations affecting the community than the previous EIS (2010). It is assumed that part of this may be due to the improved mitigation measures included in the model's assumptions since the previous EIS. It still remains that particulate pollution will be elevated beyond the boundaries of the proposal, which increases the risk of adverse health effects for people exposed to increased levels of particulate pollution. Therefore, should this project be approved, a condition of approval must be that best-practice particulate control measures are implemented, maintained and monitored.
387.	Health	NSW Health	RA8	The Health Risk Assessment (Appendix M) estimates 1.1/100,000 additional deaths per year due to increases in particulate pollution. It estimates an increase in daily hospitalisations for cardiovascular disease and respiratory disease to be 0.008 and 0.016 respectively, per 100,000 population. However, from the information provided in the methods section of the PM2.5 assessment, there are at least two significant errors that bring into question the validity of the results: **1.** The concentration response functions (CRFs) reported in table 3.1 and 3.5 relate to particular age groups. For example, the CRF for all-cause mortality has been taken from a study of people aged over 30 years and the CRF for hospital admission with cardiovascular disease is taken from a study limited to people aged over 65 years. However, from table 3.9, the CRFs have been applied to the whole population. This error is likely to have greatest impact on the results of the cardiovascular hospitalisations rate, because the baseline rate of hospitalisation for cardiovascular disease will be substantially larger among people aged >65 than the rate in the whole population.
388.	Health	NSW Health	RA8	**2.** The daily hospitalisation rate for cardiovascular disease is reported as 1.04 per 100,000 in table 3.9. This is at odds with the rate presented on the Health Statistics NSW website, which reports the annual 2006-07 cardiovascular disease hospitalisation rate as 2270.7 per 100,000 for the Central Coast LHD and 2139.5 for the rest of NSW. These annual rates translate to daily rates of 6.21 per 100,000 and 5.86 per 100,000 respectively.
389.	Health	NSW Health	RA8	The second error means that the reported increased risk of cardiovascular hospitalisations is at least a six-fold underestimate and the first error mean it is probably several-fold more than this. It is likely that the revised estimate of increased hospitalisations due to increased air pollution will be greater than the estimated increase in mortality.
390.	Health	NSW Health	RA8	Attention is also drawn to figure 3.1 in Appendix M, where the 'pyramid' of health impacts shows that it is expected there as health events become less serious, they are likely to be more frequent. It is therefore likely that for an exposed population, less severe health outcomes will be more prevalent than

No.	Aspect	Stakeholder	ID	Issue
				deaths and hospitalisations. People exposed to particulate pollution are likely to experience symptoms of airways irritation - cough, runny nose, irritated eyes. Some will develop localised inflammation, for example, sinusitis or bronchitis and may require medical treatment. People with asthma may experience exacerbations due to particulate or other types of air pollution.
391.	Health	NSW Health	RA8	If the modelling is correct, and air pollution control measures are used effectively, then the size of the population exposed to increased air pollution will be relatively small. It is however noted that there are existing communities within 3 or 4km to the east of the surface facility (Bluehaven, Lakehaven, Gorokan - over 25,000 people), and the proposed Warnervale Town Centre will see a further 50,000 people living only 3 or 4km to the south east of the surface facility. These newer areas tend to attract young families. Children are susceptible to adverse health effects from air pollution because of their higher rate of asthma (about 20%). If the proposal were to go ahead, there should be appropriate levels of monitoring, and safeguards for the community. Consideration may be given to acquiring properties adjacent to the surface facility and exposed to incremental air pollution from this development.
392.	Health	NSW Health	RA8	The proposal to augment or replace the existing HVAS with continuous PM10 and PM2.5 monitoring instruments is commended. An air quality monitoring program that is comprehensive and representative of project emissions is required to ensure the project does not create impacts on the health of the community. PM10 and PM2.5 monitoring is required in locations which can be left in situ to enable annual average values to be obtained. The PHU encourages licensing conditions to ensure ongoing and comprehensive monitoring of PM10 and PM2.5 and effective response to any air quality criteria exceedance or significant increase in air pollution below criteria. The PHU seeks confirmation from the Office of Environment and Heritage that the eventual Air Quality Management Plan is appropriate.
393.	Health	NSW Health	RA8	**Water and Sewerage** The intent to connect water and sewerage services at both sites to Council's reticulated systems is noted. It is assumed that water supplies to employee amenities will be sourced from the town water supply. The proponent is advised to ensure that potable supplies for use during construction (likely to be sourced from water carts) meet the relevant criteria of the *Australian Drinking Water Guidelines.* The proponent should consider the NSW Health *Private Water Supply Guidelines* in the management of this temporary supply.
394.	Health	NSW Health	RA8	The undertaking to obtain all relevant approvals is also noted. The proponent will need to ensure that required approvals are obtained, including with regard to the Water Treatment Plant to be used to treat mine water. In particular, should any on site reuse of waste water be planned, the proponent is advised to consult with the NSW Office of Water and the Independent Pricing and Regulatory Tribunal to ascertain whether any approvals are required. Consultation with the PHU is required should any reuse options involve potable uses, including connection to employee amenities.
395.	Groundwater	NSW Health	RA8	The commitment to repair and/or redrill damaged groundwater bores is noted. Realistic assessment and response protocols are required to ensure that project related impacts are accepted and managed as such.
396.	Surface Water	NSW Health	RA8	**Drinking Water Supply** The Central Coast's drinking water supply has been enhanced recently with a major pipeline to Mangrove Dam. The Wyong River and its major tributary, Jilliby Jilliby Creek, are part of the supply, feeding into Wyong Weir, from where water is pumped. The analysis of streamflows (table 2.8 and 2.9, Appendix J) shows average annual volumes of 22,532ML for Jilliby Jilliby Creek and 39,071ML for Wyong River upstream from Jilliby Jilliby Creek. Jilliby Jilliby Creek contributes of the order of a third of Wyong River's flow as it nears the weir.
397.	Groundwater	NSW Health	RA8	It is proposed to underground mine beneath Jilliby Jilliby Creek, and it is noted the subsidence impact zone includes Wyong River in part. The Public Health Unit seeks confirmation from the Office of Water that the Central Coast's water supply is protected, and is not at risk of compromise from this proposal. Drinking water is fundamental to human health, and the Central Coast's drinking water supply needs to maximise the human and natural infrastructure for current and future population growth.
398.	Flooding	NSW Health	RA8	**On site Waste Management Systems** The increased incidence of flooding at various residential properties may require measures to ensure that on site waste management systems (for example septic tanks) do not pose a health risk due to inundation. The proponent should undertake to ensure this risk is managed.
399.	Noise	NSW Health	RA8	**Noise assessment** It is noted that the EIS asserts that the project specific noise criteria will be met. The PHU seeks confirmation from the Office of Environment and Heritage that the criteria, assessment and the eventual Noise Management Plan are appropriate. The proponent will need to ensure that appropriate criteria are met for the life of the project, given the residential expansion planned for surrounding areas. The PHU encourages licensing conditions to

No.	Aspect	Stakeholder	ID	Issue
				ensure ongoing compliance and avoidance of noise nuisances.
400.	Noise	NSW Health	RA8	It is noted that rail noise, while not expected to result in increases above existing levels, will result in a minor increase in the 24 hour noise level along on the Main Northern Rail line. Although the increase is small, there remains potential for intrusive noise to create a nuisance and lead to adverse health effects, particularly at night. This increase in noise from an additional average of 4.3 rail cycles per day (6 days a week) will affect households and businesses along the rail line for the Central Coast and the Hunter. The cumulative impact from the increased rail movements should be considered in relation to Newcastle's population, from a noise (human health) and traffic perspective.
401.	General	NSW Health	RA8	In evaluating the potential for noise and air quality impacts, the PHU seeks confirmation from the proponent that the assessment, (including modelling) has considered the potential effects from coal being brought to the Toohey's Road site by third parties.
402.	General	NSW Health	RA8	**Resident Feedback** Residents must have a contact point for complaints if noise or air quality issues occur. The proponent should guarantee a prompt and genuine response to any complaints, regardless of the matter.
403.	General	NSW Health	RA8	In conclusion, we note that modelling predicts no significant exceedance of air quality and noise goals. However research indicates that in some instances, for example air quality and noise, there may be health effects even at exposures below guidelines. Additionally, significant health outcomes can arise if guidelines are not met. Accordingly, should the project proceed, we encourage appropriate controls to ensure that adverse impacts are avoided.
NSW Office of Environment and Heritage				
404.	Groundwater Ecology	OEH	RA4	OEH has previously provided an adequacy review (31 October 2012) to the Department of Planning and Infrastructure prior to exhibition of the Environmental Impact Statement (EIS) and notes that many of the issues raised at this stage of the assessment process have not been adequately resolved in the exhibited EIS. Detailed comments on the exhibited EIS are provided in Attachment 1. Recommendations for additional information that is required for this project to be fully assessed are provided below: **1**. In order to prevent permanent damage to sensitive groundwater aquifers, surface water systems threatened ecological communities and the habitat of threatened species, the proponent redesign the longwall layout so as to preventing longwalls being extracted directly under Little Jilliby Jilliby Creek, Myrtle Creek, Armstrong Creek and Jilliby Jilliby Creek or within their angle of draw.
405.	Ecology	OEH	RA4	**2**. The detailed Biodiversity Management Plan be provided to OEH prior to development approval, outlining the final details of the mitigating actions.
406.	Ecology	OEH	RA4	**3.** A finalised Biodiversity Offset Package final offset strategy detailing the amount of biodiversity credits to be retired, the quantum of the proposed offset package and the conservation mechanism to be implemented prior to development approval.
407.	Flooding	OEH	RA4	**4.** The extent of impact in the PMF needs to be included in the assessment so that appropriate management measures for this residual risk are included as part of the assessment process prior to development approval.
408.	Flooding	OEH	RA4	**5.** The proponent work with Wyong Shire Council to identify the properties and update controls in areas impacted by the proposed development prior to development approval.
409.	Flooding	OEH	RA4	**6.** The results of the Wyong River Catchment Flood Study should be compared to the Wallarah 2 flood study for consistency in results, as Wallarah 2 falls fully within the boundary of the Wyong River Catchment Flood Study.
410.	General	OEH	RA4	OEH will reconsider the development proposal in the light of the above concerns being addressed, and if appropriate, provide recommend conditions of approval.
411.	General	OEH	RA4	**SUBSIDENCE AND AQUATIC ECOLOGY** **Introduction** As in the adequacy review for this project, the EIS remains inadequate in a number of areas and has failed to take account of previous comments made by OEH on this proposal. The most obvious demonstration of this failure is that no changes to the mine layout have been undertaken to address concerns related to the impacts of the proposed mine on significant natural features, including 3rd order and above streams, important groundwater aquifers (and their linkage to significant stream networks), groundwater dependent ecosystems (GDEs), protected/threatened species and Jilliby State Conservation Area (SCA). OEH believes that there are significant risks associated with the proposed mine layout and that these risks have been understated and inadequately dealt with in the EIS.
412.	Subsidence	OEH	RA4	The major deficiencies in the EIS that OEH has identified are:

No.	Aspect	Stakeholder	ID	Issue
				• inadequate protection to Little Jilliby Jilliby Creek, the major stream within Jilliby State Conservation Area
413.	Aquatic Ecology	OEH	RA4	• demonstrably inadequate survey and description of environmental assets at risk within Jilliby State Conservation Area, particularly the 3rd order sections of Little Jilliby Jilliby Creek above the proposed long walls
414.	Surface Water Ecology	OEH	RA4	• no mitigation strategy or commitment to rehabilitation of Little Jilliby Jilliby Creek within Jilliby SCA if impacted (or any other 3rd order or above stream over the project area)
415.	Subsidence	OEH	RA4	• inadequate assessment of impacts and presentation of monitoring data from existing and past mining operations (e.g. Springvale Colliery, West Wallsend Colliery, Mandalong, Awaba, Chain Valley, Dendrobium Colliery) to inform risk and provide support for future mining, often with wider longwalls than those utilised in many neighbouring mines where impacts have been identified.
416.	Subsidence	OEH	RA4	• highly speculative and untested assumptions that impacts will be lower at Wallarah 2 than in other mining domains
417.	Subsidence	OEH	RA4	• inadequate assessment of potential stream impacts given approximately 13.7 kilometres of 3rd order or above streams have predicted upsidence > 100 mm (approximately 19.6 kilometres of 3rd order or above streams are predicted to experience upsidence > 60 mm) and approximately 10 kilometres of 3rd order or above streams have predicted closure > 200 mm (approximately 12 kilometres of 3rd order or above streams are predicted to experience valley closure > 100 mm
418.	Geology	OEH	RA4	• inadequate treatment of faults identified within exploration boreholes, some of which are very close to the major 3rd order streams within the Project Area
419.	Surface Water Aquatic Ecology	OEH	RA4	• unsubstantiated conjecture that alluvium within streams will prevent or mitigate impacts. This is compounded by limited mapping of stream features (pools, rockbars, exposed bedrock, boulder fields and alluvium depth) throughout the majority of the mining domain
420.	Surface Water	OEH	RA4	• the use of ill-defined, unquantified and misleading terminology (e.g. ephemeral) to describe third order streams
421.	Surface Water	OEH	RA4	• limited gauging data for 3rd order and above streams (excepting Jilliby Jilliby Creek and Wyong River) above the proposal. This will hinder any assessment of impact (e.g. loss of water) in the majority of 3rd order streams above the proposal
422.	Groundwater	OEH	RA4	• no baseline water level monitoring of the vast majority of GDEs over the proposed mine plan
423.	Aquatic Ecology	OEH	RA4	• inadequate survey methods for fish and limited fish and aquatic or semi-aquatic vertebrate surveys in all 3rd order streams within the Project Area
424.	Groundwater	OEH	RA4	• limited description of groundwater discharge areas or quantification of groundwater contributions to stream flows and the effect lowering of groundwater aquifer levels will have on these discharge areas and stream flows
425.	Groundwater	OEH	RA4	• exceedingly long timeframes suggested for recovery of groundwater aquifers (500 years) compared to the relatively short life of the mine (30 years). Due to these long timeframes, any mistakes in calculations of recovery or unexpected adverse groundwater aquifer outcomes are unlikely to be addressed by the mining company responsible.
426.	Groundwater	OEH	RA4	• extremely limited groundwater information from nearby mines (e.g. Mandalong mine) included to identify the potential magnitude of the *vertical* leakage and pressure losses within overlying or underlying strata
427.	Groundwater	OEH	RA4	• inadequate consideration of vertical leakage and pressure losses from other areas of longwall mining in NSW to help inform risks of the current proposal (e.g. Dendrobium Mine)
428.	Surface Water	OEH	RA4	• uncertainty about the actual *volumes* and quality (compared to predictions) of treated mine water to be discharged to Wallarah Creek. Any new licensed discharge into Wallarah Creek should not lead to major degradation of the streams ecosystem
429.	Surface Water	OEH	RA4	• inadequate investigations of reuse options for the treated water in the EIS
430.	Groundwater	OEH	RA4	• inadequate assessment of the potential for super-saline waste products to migrate into the surrounding groundwater aquifer(s)
431.	Groundwater	OEH	RA4	• inadequate assessment of where the current coal seam aquifer(s) discharge and whether it has the potential to be intersected by the streams/lakes of the Central Coast floodplain. As a result, the ultimate environmental fate of the supersaturated salt solution for the project remains uncertain.
432.	General	OEH	RA4	**Jilliby State Conservation Area** Jilliby SCA (12159 ha) is located in the Lakes Area of the Central Coast - Hunter Range Region, approximately 13 kilometres west of Wyong. Jilliby SCA

No.	Aspect	Stakeholder	ID	Issue
				was identified as an icon forest area in the NSW Comprehensive Regional Assessment process, and after being at the heart of a high profile environmental debate the reserve was created on 1 July 2003 through enactment of the *National Park Estate (Reservations) Act 2003.* Jilliby SCA was created from four portions of former State Forest, but because of the known coal reserves underlying the area the reservation for Jilliby State Conservation Area was restricted to a depth of 50 metres. Jilliby SCA provides an almost continuous link between Watagans National Park in the north and Brisbane Water NP in the south, and features predominantly wet sclerophyll forests (shrubby and grassy subformations) of the Coastal Dissected Plateau biogeographic subregion. The major creekline within Jilliby SCA is Little Jilliby Jilliby Creek which reaches 3rd order under the Strahler categorization *above* the proposed Wallarah 2 longwalls. Little Jilliby Jilliby Creek becomes a 4th order stream under the Strahler ategorization downstream of Caimans Gully
433.	Subsidence Ecology	OEH	RA4	Subsidence predictions identify a high *level* of risk (fracturing and diversion of flow) to Little Jilliby Jilliby Creek. No mitigation strategy or commitment to rehabilitation of Little Jilliby Jilliby Creek within the SCA has been made by the proponent. While OEH does not object to the extraction of the coal resource underlying Jilliby SCA, OEH does not accept the unnecessary damage to the most important stream within Jilliby SCA (i.e. Little Jilliby Jilliby Creek). Loss of flow in this stream (as is likely given subsidence predictions) would *have* a significant impact on the fauna of the area, including a number of recorded threatened frog species. The likely magnitude of such impacts will *have* a direct and *adverse* impact on the conservation *values* of the SCA.
434.	Aquatic Ecology	OEH	RA4	OEH note that there has been no surveys undertaken in the vast majority of Little Jilliby Jilliby Creek within the SCA and the boulder fields, rockbars, bedrock and other features of this stream have not been mapped. One spot measurement of water quality appears to have been made in the first and second order drainage lines of Little Jilliby Jilliby Creek but this does not appear to have been extended to the third order section of Little Jilliby Jilliby Creek overlying the proposed longwalls. In fact, the EIS almost completely ignores the 3rd Order sections of Little Jilliby Jilliby Creek in its description of current state or risk of impact from the mine plan. No aquatic (fish or macroinvertebrates) fauna surveys have been conducted in Little Jilliby Jilliby Creek within the SCA. Further, there has been no monitoring of flows within Little Jilliby Jilliby Creek to assess the potential consequences of loss of flow and aquatic habitat within Little Jilliby Jilliby Creek.
435.	Surface Water	OEH	RA4	Given the potential for damage to Little Jilliby Jilliby Creek, OEH revisited these areas in December 2012 to gain an appreciation of the current state of Little Jilliby Jilliby Creek and what might be lost if significant impacts/modifications occur to the stream network and flow as a result of the planned mine. Some of the relevant stream and aquatic habitats identified by OEH within Jilliby SCA are illustrated below (Figure 1). OEH agrees with WRM's (2013) assessment that the *"upper reaches are in excellent condition",* however, OEH disputes WRM's subjective assessment that it *"will recover quickly from any impact'.* There are plenty of examples in the Newcastle, Central Coast and Southern coalfields where similar streams once impacted have not recovered despite decadal time frames. It is clear that subsidence of the magnitude (see Subsidence Section) predicted within Little Jilliby Jilliby Creek could lead to the loss of these aquatic habitats and cause *the* creek to cease to flow except after significant rainfall *events.*
436.	Subsidence Aquatic Ecology	OEH	RA4	OEH considers the EIS to be demonstrably deficient in its lack of on-ground survey work within Little Jilliby Jilliby Creek, including a complete lack of description of any significant features (pools, rockbars, alluvium) or aquatic or semi-aquatic species in the upper 3rd order reaches of Little Jilliby Jilliby Creek where it flows above the proposed longwalls. Insufficient detail is provided on the flow regime/permanency of water in Little Jilliby Jilliby Creek and the effect longwall mining could have on the permanence of aquatic habitat (e.g. potential for increased frequency of cease to flow days). Based on the subsidence predictions, OEH believes the Creek will be fractured for the majority of its length above the proposed longwall panels. No commitment has been made by the proponent to rehabilitate any part of the creek if it is fractured and drained.
437.	Surface Water	OEH	RA4	OEH believes that Little Jilliby Jilliby Creek is a particularly significant stream within Jilliby SCA with high conservation value and which should have a negligible impact criteria applied (as defined in the Bulli Seam PAC Assessment).
438.	Subsidence	OEH	RA4	OEH does not believe this can be achieved without redesigning the longwall layout and preventing longwalls being extracted directly under Little Jilliby Jilliby Creek or within its angle of draw.
439.	Subsidence	OEH	RA4	**Subsidence** While there remain a number of issues regarding the relatively unique and untested geological conditions at the proposed Wallarah 2 coal mine, it would be difficult to expect a better assessment of potential subsidence due to the proposed mine plan than that provided by SCT & MSEC (2012) and MSEC (2013). The real problem with the proposal lies not with the subsidence predictions *per* se, but with the longwall layout and the failure of the proponent to adjust the mine layout to take account of Government Agency comments/concerns about the significant surface features that are at risk from the current

No.	Aspect	Stakeholder	ID	Issue
				mine plan. While adjustments to longwall panel and pillar widths have apparently been made to limit subsidence in the Hue Hue mine subsidence area, no such protection has been given to Jilliby SCA (reserved for its conservation values) which is proposed to be undermined by the widest longwalls of the whole proposal. OEH does not accept that an area set aside as a State Conservation Area due to its iconic natural assets warrants a lower level of protection than that of the Hue Hue mine subsidence area.
440.	Subsidence	OEH	RA4	It is generally acknowledged in the EIS that there remains uncertainty in subsidence predictions due to the untested geological environment of the area (and unvalidated model predictions), but even accepting such predictions there remains the possibility that the magnitude of subsidence can be well outside the range of those predicted. For example, Gale (2011) describe the case at Tahmoor Colliery where subsidence over a longwall panel was twice that previously measured or predicted using the MSEC incremental profile method. Recent impacts at Springvale Colliery, West Wallsend Colliery and Dendrobium Colliery should also provide grounds for concern about the magnitude of potential impacts of the Wallarah 2 Coal mine. Unfortunately these highly relevant experiences are not discussed in the EIS or consultants reports in 'support of' the Wallarah 2 proposal.
441.	Subsidence	OEH	RA4	While OEH considers the subsidence predictions to be an appropriate base from which to assess potential subsidence related impacts of the proposal, OEH considers the actual assessments of impact likelihood and consequence (i.e. risk) in the EIS to be highly subjective, understated and lacking in scientific rigour given recent experiences at other mines where similar longwall mining techniques have been employed and significant environmental impacts have occurred.
442.	Subsidence	OEH	RA4	<u>Subsidence Predictions for surface streams above the mine</u> The Bulli Seam PAC report (Planning Assessment Commission 2010) described the methodology used by the PAC to assess potential negative environmental consequences of the Bulli Seam Proposal. The Bulli seam PAC report identified a number of thresholds above which fracturing of rock strata was possible leading to potential negative environmental consequences. The PAC noted: • *"As the* [Bulli Seam} *EA also does not provide points of reference for the significance of strain predictions on ground behaviour, the Panel reverted to those provided in Appendix* A *of the Metropolitan Coal Project, being:* *Fracturing of sandstone has generally been observed in the Southern Coalfield where the systematic tensile and compressive strains have exceeded 0.5 mm/m and 2 mm/m, respectively* • *The Panel finds that stream values depend on the recognition of the stream system as a continuum with the value of any segment heavily dependent on upstream and downstream conditions and in higher and lower order components of the system. Pools behind rockbars may be visually dominant features but other stream morphologies including boulder fields and pools behind other channel constrictions are also vital components of the linear system* • *The loss of surface flow to sub surface fracture networks can result in dry periods for otherwise perennial streams and increased periods of zero flow in intermittent streams. The Panel finds that the likely magnitude of this impact would exceed standards generally accepted for allowable impacts on the flow regime in assessment of water resources development projects.* • *In the remote areas of sandstone gorges to the east and south of the Study Area, the Panel finds that the value of the stream network is closely associated with its natural characteristics and its pristine setting. The Panel finds that in these zones even small impacts can have major consequences for naturalness values and may be irreversible.* • *In consideration of the shallow systems, the Southern Coalfield Inquiry determined that the potential impacts of mining included cracking of stream beds and rock bars as* a *result of tensile failure and/or bedding shear associated with normal subsidence,* or *with valley closure mechanisms. Tilt was also noted in relation to upland swamps. Consequences of these mechanisms on stream beds are known to include partial to complete loss of surface flows as water is redirected into underlying fractures, draining of pools upstream of cracked rock bars, erosion of swamp materials as flows are reconcentrated (from tilts), changes to the water table in swamps and associated changes to habitat, and water-rock geochemical interactions along newly exposed fracture pathways. The latter is typically associated with iron (Fe) staining along creek beds and on rock bars, bacterial matting, reduced oxygen levels and unnatural discolouration of stream waters".* There was a great deal of discussion in the Bulli Seam PAC report over the use of non-conventional subsidence (upsidence and valley closure) thresholds to assess additional risks of impact (over and above those from conventional subsidence). Industry advocated a 200 mm valley closure threshold, but the Bulli Seam PAC Panel was concerned about setting a threshold for assessment of risk at >200 mm predicted closure. As knowledge improved the Panel considered:

No.	Aspect	Stakeholder	ID	Issue
				• *"there will undoubtedly be* a *revision of this figure as* a *threshold for triggering concern or investigation (there is already evidence of damage occurring to rock bars in streams at lower predicted closures). The Panel is of the view that the more sensible approach* as *knowledge improves is to develop* a *prediction methodology that is premised on* a *correlation between measured closure and measured impacts".*
443.	Subsidence	OEH	RA4	OEH previously commented that it would prefer to focus assessments of potential impacts of nonconventional subsidence on the basis of maximum observed/predicted closure strains. Closure movement (in mm) but not closure strains *(mm/m)* are detailed in the subsidence assessment. As an illustration of OEH's previous concerns about the valley closure >200 mm threshold, Figure 2 illustrates the upsidence and valley closure graph that appeared in the Bulli Seam PAC review report and the most recent iteration of this graph provided in MSEC (2012). It is clear that Type 3 pool impacts have now occurred at total closure levels well below 200 mm in the Upper Georges River as a result of West Cliff LW33 operations (where the panels did not go directly underneath the river). It is also worth noting that neither of the graphs included the experiences at Waratah Rivulet WRS3/Pool A (Arthur Waddington pers comm. 2012) where Galvin & Associates (2005) identified major pool/rockbar impacts with measured upsidence of only 60mm.
444.	Subsidence	OEH	RA4	While there are clearly geological differences between the Wallarah 2 and the Bulli Seam Project Areas, it is highly speculative to suggest that any impact will automatically be lower at Wallarah 2. If the subsidence predictions in MSEC (2013) are considered for the major streams above the Wallarah 2 proposal, many of these predictions considerably exceed the subsidence thresholds used by the Bulli Seam PAC to predict potential negative environmental consequences. Maximum tensile stresses for Jilliby Jilliby Creek, Little Jilliby Jilliby Creek, Armstrong Creek and Myrtle Creek range from 2.25 *mm/m* to 4.2 *mm/m* (in some cases over eight times the 0.5 *mm/m* PAC threshold for rock fracturing). Maximum compressive stresses for Jilliby Jilliby Creek, Little Jilliby Jilliby Creek, Armstrong Creek and Myrtle Creek range from 3 *mm/m* to 5.55 *mm/m* (in some cases almost six times the 2 *mm/m* PAC threshold for rock fracturing). Maximum valley closure levels for Little Jilliby Jilliby Creek, Armstrong Creek and Myrtle Creek range from 775 mm to 1000 mm (up to five times the industry suggested impact threshold of 200 mm and highly likely to cause fracturing in incised river valleys). Maximum upsidence levels for Little Jilliby Jilliby Creek, Armstrong Creek and Myrtle Creek range from 650 mm to 800 mm (also highly likely to cause fracturing in incised river valleys).
445.	Subsidence	OEH	RA4	Overall, approximately 19.6 kilometres of 3rd order or above streams are predicted to experience upsidence > 60 mm (approximately 13.7 kilometres of streams with predicted upsidence > 100 mm; see Appendix 1). Approximately 12 kilometres of 3rd order or above streams are predicted to experience valley closure > 100 mm (approximately 10 kilometres of streams with predicted closure > 200 mm; see Appendix 1). This is not a trivial extent of potential impact and highlights the risk of serious adverse consequences of both conventional and non-conventional subsidence on the 3rd order and above streams lying above the project area.
446.	Subsidence	OEH	RA4	The conjecture that alluvium within these streams will prevent or mitigate impacts to surfaces flows is speculative, untested and largely unmonitored in the current proposal. Where there is relatively little or no alluvium (e.g. in parts of Little Jilliby Jilliby Creek) there is little scope for the provision of any mitigating effects. Previous impacts on other alluvial streams such as Bowmans Creek and the nearby Diega Creek are testament to the potential for impacts on these alluvium filled streams to occur. It is also worth pointing out that Waratah Rivulet (Pool A behind WRS3) also had significant amounts of sandy alluvium which did not mitigate impacts or prevent the near complete draining of Pool A.
447.	Subsidence	OEH	RA4	In the driest continent on the planet, the long-term sustainability of the surface and groundwater resources of the area is an important issue. Sustainability of these water resources assumes an even greater importance since the water resources being put at risk from mining at Wallarah 2 form part of the Gosford-Wyong Drinking Water Supply. OEH believes that with careful planning and longwall design coal can be productively extracted from the area without putting at risk the water resources that a large part of the community relies upon. However, OEH does not believe such an outcome is possible if the objective is purely to maximise coal extraction without due regard for the long-term integrity and sustainability of flows in the major 3rd order and above streams of the area. OEH reiterates its view that the documentation provided for the Wallarah 2 proposal often understates and underestimates the magnitude of potential impacts and consequences and therefore risks of the current mine plan to these important water resources.
448.	Geology	OEH	RA4	**Faults and lineaments** In response to previous comments on the potential for faults to affect subsidence within the Project Area, the EIS now has a specific volume dealing with Geology (WACJV 2013 Appendix C Geology). This report confirmed the existence and location of the Macquarie and Yarramalong synclines, but found no support for the 'Coastal Lineament' proposed by Mauger et al (1985) or the 'Northern Geosciences Faults' proposed by Jones (2005). Figure 7.4 of the Geology Report illustrates the lineament and faults (and proposed lineaments and faults) as well as exploration boreholes. It is clear from Figure 7.4 that there have been no high resolution seismic investigations undertaken in the western region of the project area (i.e. near or within Jilliby SCA).

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449.	Geology	OEH	RA4	In previous discussions with the proponent about the potential impacts of faults, OEH was provided with a similar figure to Figure 7.4 which also highlighted faults identified within exploration boreholes (see Figure 3). OEH considers Figure 7.4 of the Geology report to be misleading in not additionally identifying the faults within exploration boreholes, some of which are very close to the major streams within the Project Area. The potential for these faults to increase the risk of impact to significant streams receives virtually no attention in the EIS. If a discussion of faults is to be presented in the EIS, all relevant information, including the location of faults identified· within exploration boreholes, should be documented, clearly presented and assessed for their potential to impact major streams within the Project Area. This has not occurred.
450.	Subsidence	OEH	RA4	**Fracture analysis** MSEC (2013) State: • *"Surface cracking and surface water flow diversions are the most visible and well known impacts associated with mining beneath valleys and streams in the Southern Coalfield. However these surface water flow diversion impacts are unlikely to occur within the Study Area because the major watercourses within the Study Area have deep alluvial deposits covering the bedrock and there are few rockbars or exposed bedrock areas within the smaller tributaries to these major streams."* [p73] • *"In the cases of the major streams within the study area, exploration drilling indicates the presence of alluvial deposits of up to 40m deep and; therefore it is unlikely that any fracturing of bedrock would be visible at the surface." {p76]* • *'Fracturing shearing and buckling may occur at the rock head in these valleys. However since this will occur beneath the saturated alluvial deposits, the fracture zone will fill as it develops with little or no effect to the surface water level. Similarly since this increased permeability zone will develop gradually and its volume will be small compared to the volume of the overlying saturated alluvium, the impact on the alluvial and the overall surface stream flow is expected to be small". {p76]*
451.	Aquatic Ecology	OEH	RA4	Since there has been no systematic mapping of most stream features (e.g. rockbars, exposed bedrock areas, pools, boulder fields, depth of alluvium) in the majority of the major streams potentially affected by the proposal, OEH does not agree with the subjective generalization that impacts are *"unlikely to occur'*. OEH notes areas of bedrock outcrop, boulders, pools and shallow alluvium in Little Jilliby Jilliby Creek within Jilliby SCA (see photos). Similar features exist in Myrtle Creek, Armstrong Creek and a number of the other 3rd order or above streams above the proposed longwalls (e.g. see photos in MPR (2013) Aquatic Ecology Report). OEH also notes that shallow alluvium within swamps and streams on the Woronora and Newnes Plateau have failed to protect these features from significant long-term impacts from longwall mining. Previous impacts on other alluvial filled streams such as Bowmans Creek and the nearby Diega Creek are testament to the potential for serious impacts to occur in these alluvial streams. Lastly, there appears to be virtually no monitoring within the proposal (e.g. groundwater levels in the alluvium before and after undermining with a comparison to reference locations (i.e. a BACI design dedicated to assessing whether such optimistic conjecture about 'lack of impacts' holds.
452.	Subsidence	OEH	RA4	OEH further notes SCT & MSEC (2013) statements that: • *"Some enhanced permeability is anticipated in the near surface strata as a result of subsidence related cracking at rockhead. While local areas of horizontal flow and flow redirection may occur within the near surface, these are not directly connected to the mining zone".* • *"The greatest likelihood of potential impacts would be confined to the high relief areas in the western part of the extraction area".* The latter statement in particular is considered highly relevant to appropriately assessing risks to Little Jilliby Jilliby Creek and Jilliby SCA.
453.	Aquatic Ecology	OEH	RA4	MPR (2013 p96) concludes that: • *"With regard to potential subsidence impacts the plasticity of the forested sub-catchment drainages as outlined above means that many of the potential subsidence impacts associated with rock constrained valleys will not occur, are not relevant or will not be exacerbated to any measurable degree. Accordingly, the residual potential combined impacts of subsidence plus tilt and strain that is of concern is the impact on the stability of the vegetation and shallow surface rock along the sides of the gullies and the consequences of increased erosion should the vegetation be destabilised."*
454.	Subsidence	OEH	RA4	Apart from ignoring the potential for rock fracturing from conventional stress and non-conventional valley movements, it also fails to consider the previous record of impacts in the Newcastle, Southern and Western Coalfields and the very relevant experience at nearby Diega Creek. OEH does not consider this summary of potential impacts to be either objective or realistic.
455.	Surface Water	OEH	RA4	**Stream Flow and Modelling** In the Water Sharing Plan for Jilliby Jilliby Creek (DIPNR 2005), Jilliby Jilliby Creek is regarded as a *"stressed river"*. DIPNR (2005) stated:

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				• *"This means that, relative to the natural flows in the water source, the potential demand for extraction by water users is high. If everyone pumped water at the same time there would not be enough water for all existing water users and the environmental needs of the water source. "*
456.	Surface Water	OEH	RA4	Most of the modelling for the Project is based on local data for only three NSW Office of Water gauging stations in the area, one of which (Wallarah Creek), ceased operation in 1976. In numerous places within the EIS streams are described as *"ephemeral'* without any appropriate reference or assessment of flow. A perennial stream or perennial river can be defined as "a *stream or river (channel) that has continuous flow in parts of its bed all year round during years of normal rainfall'."Perennial'* streams are contrasted with *"intermittent'* streams which normally *cease* flowing for weeks or months each year, and with *"ephemeral'* channels that flow only for hours or days following
457.	Surface Water	OEH	RA4	MPR (2013) state: • *"As Wallarah Creek is ephemeral, treated water discharges may occur at times when there is no natural flow in Wallarah Creek."* WRM (2013) state: • *"The upland streams in the Wyong State Forest/Jilliby* SCA *are very steep and ephemeral and major pools are absent... Whenever pools are do occur in the steep upland drainage lines they are ephemeral. During the period of record, Wallarah Creek was ephemeral. .During the period of record, Jilliby Jilliby Creek was ephemeral"* While OEH can agree with the use of the *'ephemeral'* term for the majority of 1st and 2nd order streams in the more mountainous areas, OEH disputes the use of the term *"ephemeral"* to describe third order and above streams (including Little Jilliby Jilliby Creek) over the project area. Indeed if the flow duration curves for Wallarah Creek (Stn 211006) and Jilliby Jilliby Creek (Stn 211010) presented in WRM (2013; Figure 2.19) are considered, it is clear that Wallarah Creek had no flow for approximately 19 per cent of the time period with recorded flows and Jilliby Jilliby Creek had no flow for approximately five per cent of the time period with recorded flows. This is clearly not indicative of an *"ephemeral channel that flows only for hours or days following rainfall'.* As a further illustration of this point, if the low flows for Jilliby Jilliby Creek are analysed in greater detail (particularly during the 2000 - 2008 Millennium drought; see Figure 4), zero ML/day flows were recorded in Jilliby Jilliby Creek on only seven occasions and flows less than 0.01 ML/day on 31 occasions over the last 12 years. The low flows in Figure 4 in earlier years may actually be indicative of an interaction between low flows and extractive use within the Jilliby Jilliby catchment. It is difficult to reconcile these low flow numbers with MPR's (2013) discussion of baseflows in Jilliby Jilliby Creek, particularly the statement that: " .. . *during prolonged drought periods, the creek would rapidly shrink to a series of isolated pools with little extended duration provided by baseflow. "*
458.	Surface Water	OEH	RA4	The use of ill-defined and misleading terminology (i.e. ephemeral) to describe third order streams and the lack of any flow data other than that provided by the NSW Office of Water gauges, points to an inadequate assessment of flows overall for the Wallarah 2 proposal. It is clear that no targeted flow data has been collected for Little Jilliby Jilliby Creek, Armstrong Creek or Myrtle Creek or recent flow data for Wallarah Creek (last record from the old NSW Office of Water gauge was July 1976). It will therefore be impossible to verify/validate subjective assertions of 'no impact' on streamflow throughout the majority of the project area. In particular, there is no capacity to assess any change to the frequency of cease to flow periods for any major stream other than Jilliby Jilliby Creek or the Wyong River.
459.	Surface Water	OEH	RA4	OEH notes that under the Water Sharing Rules for Tuggerah Lakes Water Source, licence holders must cease to pump when there is no visible inflow to, or outflow from, the pumping pool. Within the EIS, there is currently no assessment of the contribution of the Wallarah 2 mine to either: • an increase in the length of disconnected streams and creeks in the area due to fracturing (and what this may mean for aquatic flora and fauna); or • an increase in the number of cease to flow events in these streams (and their effect on downstream Licence holders and the Gosford - Wyong drinking water supply).
460.	Surface Water	OEH	RA4	OEH believes it is the proponent's responsibility to gather the data necessary to enable major decisions on risks to the surface water resources of the Wallarah 2 Project Area. This is particularly important in this case since these streams are part of the Gosford-Wyong Drinking Water Supply and provide significant habitat for important aquatic communities.
461.	Ecology	OEH	RA4	**Other Wetlands** Cumberland Ecology (2013) identifies wetland endangered ecological communities in the study area, specifically: • Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin

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				• *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin.
462.	Ecology	OEH	RA4	It is difficult to obtain a clear picture in the EIS of these wetland communities relative to the longwall layouts. Paperbark and tea-tree communities appear to be potentially within the zone of influence of the longwall panels, but no monitoring of groundwater levels in these areas has been undertaken to see/confirm whether the groundwater aquifers are perched or directly connected to regional aquifers or whether mining is likely to have an impact on these wetlands. In the past major impacts to swamps have occurred on the Woronora and Newnes Plateaux as a result of longwall mining.
463.	Aquatic Ecology	OEH	RA4	**Aquatic Ecology** Survey methods for fish and aquatic or semi-aquatic vertebrates are still not considered adequate to establish the presence or absence of rare species in the Project Area with any degree of certainty. As a result, the sampling and assessment for these species in MPR (2013) is not considered adequate. Further, reference to Figure 5 identifies a complete lack of aquatic fauna/flora sampling in the 3rd order reaches of Little Jilliby Jilliby Creek, particularly within the native forest areas of the Jilliby State Conservation Area. There has also been no aquatic fauna/flora sampling described within Armstrong Creek and Myrtle Creek, both 3'd order streams over the project area. This was pointed out by OEH in previous reviews but has still not been addressed in the EIS. Given the above issues, OEH has significant issues with MPR's (2013) summary of aquatic ecology (p78) that states: • *"There are no listed aquatic species, endangered ecological communities or critical habitat found or known from the total Wyong River study catchment and none are expected."*
464.	Aquatic Ecology	OEH	RA4	1. Page 31 of MPR (2103) states: Estimation of fish occurrence by a combination of overnight or short·term [minimum 1.5 hours] bait-trapping, dip netting and observation with all captured fish identified in-situ and immediately released wherever possible. OEH notes the lack of any backpack electrofishing methodology and the lack of aquatic sampling within Jilliby SCA (including the "oxbow lagoon"; see MPR 2013 Figure 30). See also unsampled aquatic habitat in Armstrong Creek (MPR 2013 Figure 25), Mid Dillons Rd Creek (Figure 27), Little Jilliby Jilliby Creek upstream Splash Gully (Figure 28)
465.	Aquatic Ecology	OEH	RA4	MPR's comments are also contradicted by the Wyong Water Sharing Plan report card (OWE 2009) which identified: • four threatened bird species • one threatened aquatic invertebrate species • eight threatened amphibian species • one threatened herbs and forbs species • platypus have been identified in this water source • high species diversity
466.	Groundwater	OEH	RA4	**Groundwater Aquifers** Three types of aquifers are identified in the EIS: • unconsolidated alluvial aquifers hosted within the Yarramalong and Dooralong valleys (including alluvial aquifers in the coastal areas) • the shallow weathered rock zone • more regional sedimentary rocks and coal measures including the WGN seam.
467.	Groundwater	OEH	RA4	This generally agrees with the findings of Cook (2009), although Cook noted that the dynamics and distribution of the discharge zones for these aquifers were poorly understood; and that the dip of the sedimentary sequence may not be the main driver of the direction of groundwater flow.
468.	Groundwater	OEH	RA4	Shallower hard rock aquifer systems tend to be localized, are rainfall driven and are likely to be perched in many areas (MER 2009). Evidence of pressure driven leakage in the hard rock aquifers was demonstrated at two geological bore sites where artesian pressures were encountered at relatively low elevations. Comments were also made regarding numerous springs throughout the area.
469.	Groundwater	OEH	RA4	In contrast to the hard rocks, the alluvial aquifers associated with the Wyong River and Jilliby Jilliby Creek are suggested to be more dynamic flow systems with rainfall recharge penetrating the silty aquifer materials (MER 2009). Pre-mining upwards leakage from the hard rock strata to the valley fill alluvium was inferred from regional water level monitoring and from aquifer simulation models.
470.	Groundwater	OEH	RA4	**Impacts to Groundwater Aquifers** Impacts to groundwater from longwall mining is mainly through subsidence, strata movements and drainage. Subsidence and strata movements affect groundwater by: deforming existing fractures, enlarging existing fracture apertures, creating new fractures, separating bedding planes, and changing the hydraulic properties of the strata. As a result, the piezometric levels can decline; baseflow discharge to streams can reduce; groundwater flow patterns can alter; aquifers can change from confined to unconfined, causing water quality changes; and upper aquifers can leak to lower aquifers (Booth, 2002,

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				2006, 2007; Booth et al., 1998, Madden and Merrick 2009, Madden and Ross 2009). Few references to this scientific literature and past experiences are found in the Groundwater Assessment (MER 2013).
471.	Groundwater	OEH	RA4	MER (2013) state that: • *"Historical mining operations at other locations (e.g. Mandalong) have preferentially depressurised and dewatered the seam with loss* of *pressure extending over significant distances in advance* of *mining* (+1 *km) and ultimately inducing vertical leakage and pressure losses within overlying and underlying strata".*
472.	Groundwater	OEH	RA4	However, no data from the Mandalong experience are presented in the EIS to identify the potential magnitude of the vertical leakage and pressure losses within overlying or underlying strata.
473.	Groundwater	OEH	RA4	Recent reviews (e.g. Heritage Computing 2012 & 2013, Madden 2008 & 2010, Ziegler and Middleton 2011, Krogh 2012) of groundwater impacts at Dendrobium mine have indicated major changes to shallow and deeper groundwater aquifers above the mine. Drawdowns of up to 40 metres in the Scarborough Sandstone, 50 metres in the Bulgo Sandstone and 25 metres in the Hawkesbury Sandstone were measured above Dendrobium longwalls and require much greater assessment with regards to their environmental consequence.
474.	Groundwater	OEH	RA4	In addition, Tammetta (2012) has recently published estimates and equations for the height of complete groundwater drainage above mined longwall panels. The height of complete groundwater drainage numbers obtained using Tammetta's equation for the mining geometry at Wallarah 2 are similar to Gale's (2008) worst case outcome of fracturing extending up to a height of 1.5 times panel width, but with increasing disconnection of fracturing (see Bulli Seam PAC discussion of this point). It is noted that while some of the calculated numbers roughly agree with MER's (2013) estimate of " ... *of the order* of *200m beneath alluvial lands",* the height of the zone above the wider longwalls beneath the elevated hard rock areas in the west of the project area (not detailed in MER (2013)) are of the order of only 20-30 metres below ground level. If fracturing within creeklines of up to 15 metres occurs due to valley closure effects (e.g. see Forster 1995), there appears to be a very small margin of cover preventing surface to seam fracturing in some areas of the proposed mine plan.
475.	Subsidence	OEH	RA4	SCT & MSEC (2013) noted: • "Some *enhanced permeability is anticipated in the near surface strata* as a *result* of *subsidence related cracking at rockhead";* and • *"It is expected that the bedrock beneath these saturated riverbeds may fracture, buckle or uplift due to the valley closure and upsidence movements creating* a *zone of increased permeability in the upper few metres of rockhead."* MER (2013) also state that: • *"Cracking in non alluvial elevated hard rock areas may lead to localised redirection of groundwater flow paths in some areas. Fissures that transect drainages in these areas may infill from sediment load during periods of surface runoff, or may remain* as *localised conduits redirecting flows down slope (including underflows). It is not possible to predict with accuracy, the location and hydraulic connectivity of such cracking. "* Again this highlights the increased risk of mining with the widest longwalls panels under the incised drainages of Jilliby SCA.
476.	Groundwater	OEH	RA4	Almost all conceptual models of groundwater aquifers suggest that they provide significant baseflow to the many streams within the Project Area; however, groundwater discharge areas and the effect of lowering of groundwater aquifer levels have not been adequately investigated in the EIS. The EIS (MER 2013) notes that panel extraction will result in the dewatering of the deep coal seam and in surrounding strata. It also states that such depressurization could potentially induce leakage from groundwater resources from overlying strata including the alluvial lands hosted within the Dooralong and Yarramalong valleys. Mining company reports for other areas (e.g. GHD Geotechnics 2010 over Dendrobium) also suggests that the recharge pathways for these groundwater aquifers can be altered by longwall mining. This has significant ramifications for the recovery of impacted groundwater aquifers after mining has ceased (if recovery indeed occurs). Given the extremely long timeframes suggested for recovery of groundwater aquifers (500 years suggested in MER 2013) and, by comparison, the relatively short life of the mine (-30 years), any mistakes in calculations of recovery or unexpected adverse groundwater aquifer outcomes from the Project are unlikely to be addressed by the mining company responsible. This point is reiterated in the later section dealing with underground disposal of brine.
477.	Groundwater	OEH	RA4	Apart from their intrinsic value, the ecosystem services that groundwater aquifers provide in keeping rivers and streams flowing during periods of low rainfall are vitally important in protecting downstream ecosystems. Decreases to the groundwater levels in wetland and groundwater aquifers are likely to reduce *and/or* change the location of baseflow discharges, thereby affecting groundwater dependent ecosystems, stream ecosystems and Gosford-Wyong water supply needs. The potential for loss of baseflow (as a result of the alteration of groundwater levels and recharge pathways) to affect

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				catchment water budgets in the Project area needs much greater consideration than that provided in the EIS.
478.	Surface Water	OEH	RA4	**Treatment of waste mine water** The Wyong Areas Coal Joint Venture (WACJV) is proposing to treat mine water on site with releases of treated water to Wallarah Creek as required. Mine water would be treated using a combined reverse osmosis (RO) plant with a capacity of 3 ML/day. At certain times during the operational phase of the project, a brine water treatment plant will be utilised to produce a partly dried mixed salt solid waste product for disposal underground. While OEH considers this a significant improvement on the original proposal (see PB 2008), it still does not fully detail the exact nature and environmental *fate/effect* of either the treated water or brine/salt waste products.
479.	Surface Water	OEH	RA4	**Discharge of Treated Minewater to Wallarah Creek** Wallarah Creek is currently in good condition. The last time OEH sampled Wallarah Creek *(16f10f2012)* as part of the Monitoring Evaluation & Reporting (MER) program, OEH found 31 taxa (over the last 10 years or so OEH have found an average of approximately 27 taxa - range 23-31). This is in stark contrast to Marine Pollution Research (2012) who collected three samples over the last 12 months in Wallarah Creek yielding an average of only 11 taxa (range 8-15). While MER (2102) sampled a different (more disturbed part) of Wallarah Creek, OEH's results identify a diverse macroinverterbate community within Wallarah Creek.
480.	Surface Water	OEH	RA4	WACJV are now planning to treat waste mine water with a Reverse Osmosis treatment plant and release excess treated water into Wallarah Creek. Statements about the magnitude of discharge include: • "Controlled discharges to Wallarah Creek range between approximately 0 ML/a and 230 ML/a" [or o to 0.63 ML/day] p83. • "On average treated water discharges to Wallarah Creek occur for the life of the project" • "Discharges increase up to year 7 and remain fairly consistent thereafter, ranging from 50 to 500 ML/a" [or 0.14 to 1.4 ML/day] p94.
481.	Surface Water	OEH	RA4	OEH has concerns about the actual volumes to be discharged and notes that at the nearby Mandalong mine, the current mining operation generates an **average** discharge of 1.59 ML/day at LPD001 (GHD 2013). However during periods of rainfall, discharges at Mandalong can be greater than 10 ML/day (Figure 5.4: Monitored discharges at LPD001 2010-2012, Water Management Impact Assessment GHD 2013). Under the proposed extension of mining works at Mandalong mine, the **average** discharge was expected to rise to 7.1 ML/day (over four times the current discharge). OEH has concerns that the actual volume of water produced (and required to be disposed of) at Wallarah 2 may be underestimated in the EIS (particularly during wet weather events). It is also noted that flows that exceed the design capacity of the 'Stockpile Dam' and 'Portal Dam' will overflow to Wallarah Creek. At these times highly saline and potentially contaminated water will likely flow to Wallarah Creek.
482.	Surface Water	OEH	RA4	Due to the lack of clarity about the exact volumes and treated and overflow water quality, OEH would like to see additional studies undertaken on the ecotoxicology of the proposed treated and overflow mine water prior to approval. There are currently a number of problematic licensed mine water discharges in NSW (e.g. Brennans Creek Dam, Berrima Colliery, Upper Goulburn River) some of which exhibit toxicity to aquatic species downstream of the discharge and OEH seeks to avoid the potential introduction of additional ones.
483.	Surface Water	OEH	RA4	There is a need for reasonable certainty that the introduction of any licensed discharge into Wallarah Creek will not lead to major degradation of the streams ecosystem. In addition, all potential reuse options should be investigated prior to settling on a discharge to a relatively good quality stream such as Wallarah Creek. Detailed investigations of reuse options for the treated water in the Wallarah 2 project do not appear to have been undertaken for this EIS.
484.	Groundwater	OEH	RA4	**Underground disposal of brine** Contamination of groundwater aquifers can have wide implications for drinking water, stock water, surface water, GDEs and the aquatic environment; particularly if injected water makes its way, or is pumped, to the surface or surface drainage lines (e.g. see discussions in Rail 2000, Zemke et al 2005). Zemke et al (2005) suggested that some of the requirements for the appropriate underground disposal of brine require: • an aquifer reservoir of sufficient areal extent • favourable reservoir properties (e.g. high layer thickness and good porosity) • an aquifer covered by a tight cap rock with areal integrity (particularly where high-pressure gradients occur).
485.	Groundwater	OEH	RA4	Limited information is available in the EIS **to** determine if the aquifers are truly suitable for the discharge of brine.
486.	Groundwater	OEH	RA4	Underground injection of liquid waste materials has not been extensively practised within Australia although it has been used in other NSW coalfields (e.g. near Appin). It is, however, used extensively overseas and, in the USA, is regulated by the US Environmental Protection Agency. Concerns about

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				the safety of deep injection disposal led the US EPA to issue a policy statement in 1974 that opposed storage or disposal of contaminants by subsurface injection *"without strict control and clear demonstration that such wastes will not interfere with present or potential use of subsurface water supplies, contaminate interconnected surface waters or otherwise damage the environment."* In December 1974, Congress enacted the Safe Drinking Water Act (SDWA), which ratified US EPA's policy and required the agency to promulgate minimum requirements for state programs that would prevent endangerment of underground sources of drinking water by well injection.
487.	Groundwater	OEH	RA4	The United States Environmental Protection *Agency* currently groups underground injection into *five* classes for regulatory control purposes (USEPA 2004). Each class includes wells with similar functions, and construction and operating features so that technical requirements can be applied consistently to the class. Class I injects hazardous and non-hazardous fluids (industrial and municipal wastes) into isolated formations beneath the lowermost underground source of drinking water (USDW). Because they may inject hazardous waste, Class I wells *are* the most strictly regulated and are further regulated under the Resource, Conservation and Recovery Act (USEPA 2004). Class" includes injection of brines and other fluids associated with oil and gas production.
488.	Groundwater	OEH	RA4	In general, US EPA's Underground Injection Control (UIC) Program prevents contamination of water supplies by setting minimum requirements for state UIC Programs. A basic concept of US EPA's UIC Program is to prevent contamination by keeping injected fluids within the intended injection *zone,* or in the case of injection directly or indirectly into a USDW, the fluids must not endanger or have the potential to endanger a current or future public water supply. Most of the minimum requirements that affect the siting of the injection well, the construction, operation, maintenance, monitoring, testing, and finally, the closure of the well, are designed to address these concepts. Another basic concept is that all injection wells require authorization under general rules or specific permits. Finally, States are expected to have primary enforcement authority (primacy) for the UIC Program.
489.	Groundwater	OEH	RA4	**Potential movement of supersaturated saline waters into groundwater aquifers** WACJV are proposing to place up to 5270 *m3/year* (see Table 3.1, WRM 2013) of semi-solid salt waste product from the RO and brine concentration plant into underground storage (at least for the first 14 years). Thereafter, the brine solution (not concentrated) will be pumped to a 120 Ml sump. There is no mention of lining the underground storage, so it must be assumed that over time the supersaturated salt solution (707,500 *mg/l* hypersaline solid; 290,500 *mg/l* super saline brine solution; see Table 6, MER 2013) can or will migrate into the surrounding groundwater aquifer(s).
490.	Groundwater	OEH	RA4	OEH looked carefully at MER (2013) to try and understand where the current groundwater aquifers might discharge. OEH could not identify from MER (2013) whether the current coal seam aquifer ultimately discharges into the ocean or whether it has the potential to be intersected by the streams/lakes of the Central Coast floodplain. As identified earlier, groundwater discharge areas and the effects of lowering of groundwater aquifer levels have not been adequately investigated in the EIS. This is considered a major deficiency in the EIS because the ultimate fate of the supersaturated salt solution for the project remains unclear. MER (2013) suggest that: • " ... *after more than 500 years, water levels in the workings are predicted to have recovered (up dip) about 110* m *above* an *initial minimum elevation of -480* m *AHD to about -370* m *AHD. This elevation is above the deepest goaves hosting the brine, but still below the elevation of the stored solid waste. "*
491.	Groundwater	OEH	RA4	It is difficult to find the difference in elevations referred to by MER (2013) for the solid salt and brine disposal areas, and which specific aquifers may therefore be impacted by super-saline waste products. There is also no discussion of uncertainty in MER's (2013) modelling, especially considering the exceedingly long timeframes (well past the life of the mine) involved. OEH questions whether this method of disposal, as currently proposed, will simply end up becoming a legacy problem for future generations.
492.	Flooding	OEH	RA4	**FLOODING COMMENTS** OEH provided comments at the Adequacy Review stage of the application process in October 2012. This was followed up by a meeting with the proponents' representative and their Flood Engineer. OEH's comments primarily related to the lack of detail included in the report with regard to assumptions used in the modelling. OEH also raised concerns with the methodology used for the hydraulic modelling. These issues were not adequately addressed in the subsequent Flood Impact Assessment report submitted as part of the EIS, and have been detailed below. Reference is made to Section 7.4 and Appendix K - Flood Impact Assessment of the Environmental Impact Statement for the components of the development application which I have reviewed.
493.	Flooding	OEH	RA4	**Summary of flooding impacts** The Flood Impact Assessment states that there are 283 properties, which contain 88 structures (83 dwellings and five sheds) that are located within or

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				immediately adjacent to the 1 % AEP design flood extent that may be impacted by the proposed project. Due to subsidence, some of these properties are projected to experience an increase in flood affectation and others a decrease in flood affectation. There are 15 key access points along the roads within the catchment that are projected to be affected by subsidence, some of these projected to have significant impacts on the duration of inundation of floodwaters along the road. One of these roads will have an increase in inundation duration of 31 hours for the 20% AEP and 27 hours for the 1 % AEP design flood events, which will impact 172 dwellings.
494.	Flooding	OEH	RA4	The report states that there are 13 other dwellings located downstream of the study area that 'will be beneficially impacted by the proposed project due to the flood detention affects upstream due to predicted subsidence in the floodplain.
495.	Flooding	OEH	RA4	The impact in the PMF is unknown. The PMF is indicated on Figure 10, however, due to the scale and quality of this figure it is almost impossible to discern from the other information on the figure. The impacts in the PMF are not discussed anywhere in the Flood Impact Assessment or body of the EIS.
496.	Flooding	OEH	RA4	Potential impacts due to climate change have been included in the assessment by way of increased rainfall intensities and increased tailwater levels due to an increase in the water levels of Tuggerah Lakes. The report states that there would be no additional dwellings impacted by flooding due to the proposed development under either of these scenarios however flood affectation at existing flood prone properties would be increased.
497.	Flooding	OEH	RA4	**Comments on Flood Impact Assessment** The NSW Floodplain Development Manual defines the floodplain as that area which is subject to inundation up to and including the PMF. The EIS and Flood Impact Assessment refer to the floodplains of the Wyong River and its tributaries (Little Jilliby Jilliby Creek, Jilliby Jilliby Creek, Hue Hue Creek) however this appears to be referring to the extent of the 1 % AEP design flood and not the PMF. Section 5.6 of the Flood Impact Assessment briefly discusses the modelling of the PMF, however the report does not include any discussion or consideration of the impacts in the PMF. The extent of impact in the PMF needs to be included in the assessment so that appropriate management measures for this residual risk are included as part of the assessment process. The inclusion of the PMF extent on Figures 1 - 12 would have been beneficial.
498.	Flooding	OEH	RA4	The methodology used in the hydrological analysis of 'rainfall-on-the-grid' for this sized catchment is not one that OEH generally supports. Assumptions used in the hydrological and hydraulic modelling have not been clearly indicated. The report continues to advocate the use of "conservative model parameters" however this comment is not substantiated due to the lack of detail included for any of the parameters actually used in the modelling. The results of the model calibration using the three selected years of 1989, 1990 and 1992 do not appear to correlate very well as indicated in Table 5.1. The 2007 flood should have been used as one of the calibration events, considering it is the most recent flood and has significant recorded information available. These results were not verified against any historical floods, which would be expected on a flood study of this size. The comments included in Section 6.5 do not give any indication of where the resultant variations in flood levels occur in the catchment between this study and previous flooding assessments. However, for the sake of an impact assessment, the pre- and post development scenarios have both used the same methodology and modelling parameters (with these concerns), and so the above discrepancies and issues are considered in this context.
499.	Flooding	OEH	RA4	The flood mitigation and management measures proposed as part of the proposal include raising of houses and other structures such as sheds; raising of infrastructure; relocating of homes; construction of levees and voluntary acquisition if no other appropriate mitigation options are suitable. Section 7.3 of the Flood Impact Assessment states that the length of several of the roads that would need to be raised would be over 400 metres in length to re-instate the inundation durations in the 1 % AEP design flood event. The proponent has stated that the detail design of these mitigation options will be developed in consultation with individual landowners as part of the Mine Subsidence Management Plan process. It is expected that this process will occur through the Mine Subsidence Board. The detail design of each of these mitigation options will need to ensure that they do not exacerbate the local flooding and do not impact on flood behaviour of the river or tributary. Section 7.2 should refer to Councils DCP for flood related development controls in the area. The proponent should work with Wyong Shire Council to identify the properties and update these controls in areas impacted by the proposed development.
500.	Flooding	OEH	RA4	Wyong Shire Council is in the final stages of completing the Wyong River Catchment Flood Study, which OEH has worked closely with Council on this project as it was funded under OEH's Floodplain Management Program. The final report is expected in July or August of 2013. The results of that study should be compared to the Wallarah 2 flood study for consistency in results, as Wallarah 2 falls fully within the boundary of the Wyong River Catchment Flood Study.
501.	Ecology	OEH	RA4	**THREATENED BIODIVERSITY**

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				In relation to matters concerning threatened biodiversity OEH has reviewed the Appendix O 'Ecological Impact Assessment' prepared by Cumberland Ecology for Hansen Bailey. OEH has assessed Appendix O in relation to its conformity with the Director General's Requirements (DGRs) (12 January 2012) and the Supplementary DGRs (24 July 2012) in relation to Commonwealth Matters of National Environmental Significance (MNES).
502.	Ecology	OEH	RA4	It is noted that the extent of the impacts upon ecological communities and their species are considered in the EIS to include the removal of 53.4 hectares (ha) of native woodland/forest and 7.3 ha of derived grassland, including four threatened ecological communities (TECs) (13.3 ha in total) and 8.8 ha of Groundwater Dependent Ecosystems (GDEs). The proposal will remove the habitat of at least three threatened flora species recorded during surveys and the habitat of at least eight threatened fauna species recorded during surveys by the proponent. This includes at least three flora species listed as threatened and one migratory species listed under the EPBC Act.
503.	Ecology	OEH	RA4	In addition, there is an area defined as the Subsidence Impact Limit (SIL) of which there are 728.3 ha of TECs and 635.7 ha of GDEs, a significant amount of which lies outside of the 'Project Boundary'. OEH will consider the 'indirect impact' on the natural communities as that lying within the entire SIL. While the proponent provides some figures relating to the areal extent of habitats for various threatened species within this area, it does not provide a breakdown of the extent of the various vegetation communities within the SIL including TECs and GDEs. The SIL contains the habitat of at least 10 threatened flora species and at least 13 threatened fauna species. This includes at least six flora species and two fauna species listed as threatened and six migratory fauna species under the EPBC Act.
504.	Ecology	OEH	RA4	These figures reflect the results of the surveys undertaken by the proponent and the numbers of affected species is likely to be higher, if previous records from other databases are taken into account.
505.	Ecology	OEH	RA4	The proponent has proposed that a Biodiversity Management Plan (BMP) (in consultation with OEH and other regulatory authorities) will co-ordinate the impact mitigation and offset measures for this project. The mitigation measures include avoidance measures, dust minimisation, noise minimisation, management of surface water, erosion and sedimentation, visual lighting management and clearing protocols.
506.	Ecology	OEH	RA4	Three offset sites are proposed, all are near the surface development footprint and combined provide 208 ha of remnant vegetation offset including five TECs totalling 83 ha. No Commonwealth listed TECs are present in the direct impact, subsidence or offsets sites.
507.	Ecology	OEH	RA4	**Review of Survey Effort** OEH has reviewed the methodologies used to inform the ecological assessment and considers these to be generally not consistent with OEH survey and assessment guidelines (DEC 2004; DECC 2007). There are a number of matters that OEH raised in the Adequacy Review (31 October 2012) which have been addressed while others have not been addressed in the EIS.
508.	Ecology	OEH	RA4	Of particular note is the inadequacy of the survey effort. Undertaking a field survey with sites that a stratified according to minimum required effort (DEC 2004) is important for OEH to be able to adequately determine the presence/absence of threatened species, local habitat conditions and overall patterns of biodiversity.
509.	Ecology	OEH	RA4	In the flora surveys, the minimum effort that was required was 53 quadrats. OEH notes that 48 were undertaken but 22 of these were done during 2006-07. OEH generally does not consider surveys undertaken more than five years ago, as stated in the adequacy review. In terms of targeted surveys for threatened flora species, OEH notes that *Angophora inopina* and *Melaleuca biconvexa* were subject to density estimates, no other threatened flora were targeted for specific surveys.
510.	Ecology	OEH	RA4	For fauna surveys, OEH notes that the effort undertaken within the Project Boundary has been a long way short of a minimum standard. If only one site were undertaken for each stratification unit, then Elliot A trapping, Cage trapping, Harp trapping, bird surveys and reptile surveys are well short of a minimum target. For amphibian (a key group considering the high proportion of threatened taxa known to be present in the Project Area) targeted surveys have not been undertaken according to state (DECC 2009) or Commonwealth guidelines (DEWHA 2010). Large areas of potentially suitable habitat associated with the Little Jilliby Jilliby, Jilliby Jilliby, Armstrong and Myrtle Creeks have received virtually no survey effort, despite records of the Commonwealth listed species, Giant Barred Frog *Mixophyes iteratus,* Stuttering Frog *Mixophyes balbus* and Heath Frog *Liloria littlejohni* as well as another state listed species, the Green-thighed Frog *Liloria brevipalmata* and the Giant Burrowing Frog *Heleioporus australiacus* which is known from similar habitat in the locality.
511.	Ecology	OEH	RA4	OEH acknowledges the proponent has undertaken bird sound recordings and camera traps surveys, though notes that the sound recordings did not *catch* the "dawn chorus". With respect to the camera traps, OEH notes that 3 cameras were placed in the Hue Hue Road Offset and 13 cameras were

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				placed in the Development Areas at different times for *four/five* days and nights. Camera traps are good for catching cryptic species, such as potoroos, bandicoots and quolls, though while Spotted tailed Quolls *Dasyurus maculatus* should have been targeted as per the Commonwealth Survey Guidelines for Mammals (DSEWPaC 2011) OEH notes that the baits would not have attracted this species and there is no justification provide for the locations and intensity of effort for the camera traps.
512.	Ecology	OEH	RA4	OEH also notes that the survey effort for the following threatened flora species is not sufficient to identify their presence/absence in the SIL; *Acacia bynoeana, Angophora inopina, Cryptostylis hunteriana, Grevillea parviflora* sp. *parviflora, Melaleuca biconvexa* and *Tetratheca juncea.* Given these constraints, OEH can only assume the presence of local populations of these species in the SIL.
513.	Ecology	OEH	RA4	**Review of Impact Assessment** **Impacts of subsidence** Given the likelihood of significant impacts with the SIL upon 3rd order and higher riparian systems and their associated alluvial communities and species and the uncertainty related to the lack of survey effort, OEH cannot agree with the conclusions put forward in p. 7.3 of Appendix 0 of the EIS and has to use the precautionary principle and identify a significant, residual impact upon the following matters listed under the TSC Act such that their local *occurrence* may be placed at risk of local extinction (areas of potential impact given in brackets): • Swamp Sclerophyll Forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (26.7 ha) • River Flat Eucalypt Forest on Coastal floodplains of the NSW North Coast and Sydney Basin Bioregions (25.5 ha) • Lowland Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions (582.3 ha) • Freshwater Wetlands on NSW North Coast, Sydney Basin and South East Corner Bioregions (1.2 ha) • *Mixophyes iteratus* • *Mixophyes balbus* • *Liloria littlejoni* • *Liloria brevipalmata* • *Melaleuca biconvexa.*
514.	Ecology	OEH	RA4	OEH considers it likely that the proposed levels of subsidence will exacerbate the following Key Threatening Processes: • alteration to habitat following subsidence due to longwall mining • alteration of natural flow regimes or rivers and streams and their floodplains and wetlands.
515.	Ecology	OEH	RA4	In relation to MNES, OEH has determined that the impacts of subsidence will have a significant impact on the Giant Barred Frog as it is likely to meet all of the listed criteria under the Significant Impact Guidelines (DEWHA 2009) for endangered or critically endangered species.
516.	Ecology	OEH	RA4	**Impacts of direct habitat removal** OEH notes that there will be a significant removal of native remnant vegetation and habitat for threatened species and ecological communities within the areas of direct impact (Western Shaft, Buttonderry and Tooheys Road): including the removal of: • River Flat Eucalypt Forest on Coastal floodplains of the NSW North Coast and Sydney Basin Bioregions (5.9 ha) • Swamp Sclerophyll Forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (2.9 ha) • Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion (0.8 ha) • Habitat for at least at least three threatened flora species recorded during surveys and the habitat of at least eight threatened fauna species recorded during surveys, including the Commonwealth listed species Tetratheca juncea, Angophora inopina and the Spotted-tailed Quoll.
517.	Ecology	OEH	RA4	It is expected that the proposal will exacerbate the following key threatening processes: • clearing of native vegetation • loss of hollow-bearing trees • removal of dead wood and dead trees • anthropogenic climate change
518.	Ecology	OEH	RA4	However, no residual impact on threatened biodiversity is expected if the offset package conforms to current OEH Offset policy and/or guidelines. This is assessed in the section below (4).

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519.	Ecology	OEH	RA4	**Review of Avoidance/Mitigation Measures** OEH acknowledges the measures undertaken by the proponent to minimise impacts upon threatened biodiversity by design features of the longwall operations, however does not consider these to be sufficient to avoid impacts such that significant impact on sensitive riparian ecosystems and species is avoided.
520.	Ecology	OEH	RA4	OEH acknowledges the other measures taken in relation to dust minimisation, noise minimisation, management of surface water including erosion and sedimentation, visual lighting management, vegetation restoration and rehabilitation and due diligence measures for clearing procedures. However as the latter two will be detailed in the BMP, OEH reserves judgement on the adequacy of these measures.
521.	Ecology	OEH	RA4	**Review of Compensatory Package** OEH acknowledges the Biodiversity Offset Strategy (BOS) as outlined in Appendix O of the EIS has stated it will include a total of 261 ha remnant vegetation in three adjacent offset areas. The total areas offset for each vegetation community that will have direct impact as a result of vegetation removal is generally of a quantum which would be acceptable to OEH with the exception of: • Mountain Blue Gum - Turpentine moist shrubby forest of the coastal ranges of the Central Coast, Sydney Basin (no offset identified) • Scribbly Gum - Red Bloodwood heathy woodland on the coastal plains of the Central Coast, Sydney Basin (1.2:1 is insufficient under the OEH Interim Offset Policy 2011); • Spotted Gum - Grey Ironbark Open Forest on the foothills of the Central Coast, Sydney Basin (no offset identified) and • Derived Native Grassland (1.5: 1 is insufficient under the OEH Interim Offset Policy 2011).
522.	Ecology	OEH	RA4	The proponent has used the Principles for the use of Biodiversity Offsets in NSW (DECC 2007) and the Commonwealth Principles from the 'Draft Policy Statement: Use of environmental offsets under the Environmental Protection and Biodiversity Conservation Act' (DEWHA 2007) to determine the adequacy of the offsets proposed.
523.	Ecology	OEH	RA4	Of particular concern is that the offset mechanism for the proposed offset package has not been determined and so there is no guarantee that any of these areas can or will be secured in perpetuity. The guidelines state that offsets established prior to development so as to minimise ecological risk through time-lags. OEH has a concern that as this issue has not been finalised, and that some quantification of the offset required needs fine-tuning.
524.	Ecology	OEH	RA4	Principle 5 states that *"Offsets must be underpinned by sound ecological principles',* however, as not all of the vegetation communities to be removed has been offset by a vegetation community that has the same structural elements, this area is deficient.
525.	Ecology	OEH	RA4	Principle 5 also states that the proponent must *"consider the conservation status* of *ecological communities".* While the total area of TEC in the offset areas is 83 ha compared to 13.2 ha to be cleared, the offsets do not provide for an offset of the TEC 'River Flat Eucalypt Forest on Coastal floodplains of the NSW North Coast and Sydney Basin Bioregion'.
526.	Ecology	OEH	RA4	Principle 9 states that offsets must be quantifiable and based on a " ... *quantitative assessment* of *the* loss of *biodiversity ... and* a *gain in biodiversity from the offset."* The only appropriate way, under a SSD scenario, to achieve this quantification is by the use of the BioBanking Assessment Methodology (DECCW 2008) which the proponent has avoided using. OEH recommends that prior to the finalisation of the offset strategy that a BBAM be undertaken so as to give the appropriate level of quantification for the retirement of biodiversity credits in relation to this project.
527.	Aboriginal Heritage	OEH	RA4	**ABORIGINAL CULTURAL HERITAGE ASSESSMENT** A review of the EIS, including Sections 7.1, and 7.14, Table 103 and Appendix S entitled: 'Aboriginal Cultural Heritage Assessment - Wallarah 2 Coal Project - Wyong, NSW' (dated December 2012) was undertaken by OEH to assess the potential impacts of the project on Aboriginal cultural heritage, in accordance with OEH's Aboriginal cultural heritage assessment guidelines and the requirements of Part 6 of the *National Parks and Wildlife Act 1974* (NPW Act).
528.	Aboriginal Heritage	OEH	RA4	**Aboriginal cultural heritage values** OEH acknowledges the significance of the local environment to the local Aboriginal community. OEH notes the existence of numerous registered Aboriginal sites in the immediate locality and acknowledges that the project area contains landforms which have yielded a significant volume of evidence of Aboriginal occupation. These include sandstone engravings, grinding grooves, artefact scatters, isolated finds, culturally modified trees, shelters, middens, burials, camp sites and potential artefact deposits. There is also a possibility that currently undetected cultural material may be present within the project area in those areas where Aboriginal objects have not been previously identified. The proponent's archaeological consultant also supports this view.

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529.	Aboriginal Heritage	OEH	RA4	OEH also acknowledges the results of previous assessments of the project area which identified three grinding groove sites and the recent targeted field surveys of the project area undertaken during November 2006, January 2010 and September 2011 which resulted in an additional eight Aboriginal sites identified, including two artefact scatters, one isolated find, a culturally modified tree and four grinding groove sites.
530.	Aboriginal Heritage	OEH	RA4	OEH reiterates that a search of the Aboriginal Heritage Information Management System (AHIMS) revealed that sites 'WC-OS2', 'WSF-AG1', 'WSF-AG2', WSF-AG3' and 'WSF-AG4' identified during field assessments of the project area conducted in January 2011 and September 2011 have not been registered in AHIMS. It is further noted that additional subsurface investigations were undertaken in March 2012 at site 'WC-OS2' and additional information concerning this site was obtained. However, the results of this assessment have not been supplied to AHIMS to compliment the data available for this site.
531.	Aboriginal Heritage	OEH	RA4	Accordingly, the proponent is advised to promptly complete Aboriginal Site Recording Forms for each site and submit to the AHIMS Registrar, as per the requirements of Section 89A of the NPW Act. Any management outcomes for these sites must be included in the information provided to AHIMS. The proponent is also advised that penalties now apply to corporations for failing to fulfil these requirements. AHIMS contact details: Phone: 9585 6470, address: Level 6, 43 Bridge Street, Hurstville, NSW, 2220, e-mail: ahims@environment.nsw.gov.au.
532.	Aboriginal Heritage	OEH	RA4	**Impacts on Aboriginal cultural heritage** OEH refers to Sections 7.1.3 and 7.14.3 of the EIS. It is noted that the modified project area is likely to be directly disturbed by a range of mining related activities including the development of additional surface infrastructure and subsidence. This is likely to result in the likely impact or harm to a number of Aboriginal objects associated with the project area. These include five grinding groove sites and one artefact scatter. It is therefore expected that the proponent develop culturally appropriate management strategies to alleviate any likely or possible impact on these sites in consultation with the registered Aboriginal parties for the project.
533.	Aboriginal Heritage	OEH	RA4	**Management of likely impact on Aboriginal cultural heritage values** OEH refers to Section 7.14.4 and Table 5.20 of the EIS and Section 10 of the ACHA. OEH notes that the proponent has developed a range of mitigation strategies to manage the likely impact from the project on Aboriginal cultural heritage values.
534.	Aboriginal Heritage	OEH	RA4	OEH acknowledges the proponents commitment to develop and implement an Aboriginal Cultural Heritage Management Plan (ACHMP) for the project area in order to support the management of the potential impacts on Aboriginal cultural heritage. It is also acknowledged that the plan is to be developed in consultation with the registered Aboriginal parties for the project. OEH supports these processes.
535.	Aboriginal Heritage	OEH	RA4	OEH refers to Section 7.14.4 of the EIS. It is understood that the proponent proposes to salvage Aboriginal objects associated with site 'WC-OS2' prior to being directly impacted by the proposal. It is recommended that this process is undertaken in consultation with the registered Aboriginal parties identified for the project. OEH also notes that the objects must be recorded and managed in accordance with the requirements of sections 85A 1 (c) and 89A of the NPW Act. It is also recommended that these actions/procedures are detailed in the proposed ACHMP.
536.	Aboriginal Heritage	OEH	RA4	OEH acknowledges that the proponent proposes to develop protocols for the monitoring of earthworks during construction of the surface facilities. OEH supports this process. However, it is recommended that this procedure is developed in consultation with a suitably qualified cultural heritage specialist and the registered Aboriginal parties. It is also recommended that the proponent provide the registered Aboriginal parties with a fair, reasonable and timely opportunity to participate in this process. Any Work, Health and Safety matters should be addressed prior to implementing the program. Records should be collected of any attendance and results accurately documented in accordance with the requirements of sections 85A 1 (c) and 89A of the NPW Act. The proposed methodology should also include specific archaeological procedures/triggers in the event that significant archaeological/cultural finds are identified during the investigations. For example, hearths, human remains, knapping floor, rare objects, etc.
537.	Aboriginal Heritage	OEH	RA4	The proponent is also reminded that all Aboriginal sites impacted by the project must have an Aboriginal Site Impact Recording Form completed and be submitted to the AHIMS Registrar within 3 months of being impacted (www.environment.nsw.gov.au/resources/cultureheritage/1 20558asirf.pdf).
538.	Aboriginal Heritage	OEH	RA4	**Conclusion** OEH has no additional concerns with the Aboriginal cultural heritage assessment for the project application and recommends that the following conditions of approval for Aboriginal cultural heritage are reflected in any approval conditions for the project.
Department of Trade & Investment				
539.	General	DRE	RA5	**MINING TITLE** As coal is a prescribed mineral under the *Mining Act* 1992, the proponent is required to hold appropriate mining titles from DRE in order to mine this

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				mineral. DRE understands the proposed mining activities for the Wallarah 2 Coal Project are within Mining Lease Applications 342, 343, 346 and 350 previously submitted to DRE.
540.	General	DRE	RA5	Under the *Mining Act* 1992, mining and rehabilitation are regulated by conditions included in the mining lease, including requirements for the submission of a Mining Operations Plan (MOP) and a Subsidence Management Plan (SMP) prior to the commencement of operations, and subsequent Annual Environmental Management Reports (AEMR).
541.	Rehabilitation	DRE	RA5	**REHABILITATION AND MINE CLOSURE** DRE notes that whilst the EIS outlines rehabilitation and final landform strategies and objectives for the project, the detail is very limited. The EIS has identified general rehabilitation objectives that may be considered satisfactory to achieve a safe, stable and non-polluting final landform. However, the EIS should provide an adequate description of the project's functional domains including rehabilitation areas and infrastructure areas. Specific performance objectives for each domain were not satisfactorily described. Decommissioning activities were outlined although only limited detail on completion criteria was provided.
542.	Rehabilitation	DRE	RA5	Whilst a broad foundation of rehabilitation planning has been developed in the EIS, DRE requires functional domains to be identified, incorporating specific domain objectives and closure criteria to be incorporated into the planning approval, if granted. **RECOMMENDED CONDITIONS OF APPROVAL** DRE recommends that the following conditions be incorporated into the planning approval, if granted:
543.	Rehabilitation	DRE	RA5	**Rehabilitation Plan** The Proponent must prepare and implement a Rehabilitation Plan to the satisfaction of the Director General of Department of Trade & Investment, Regional Infrastructure & Services. The Rehabilitation Plan must: **a**. be prepared in accordance with DRE guidelines and in consultation with relevant agencies and stakeholders; **b.** be submitted and approved by the Director General of Department of Trade & Investment, Regional Infrastructure & Services prior to the commencement of activities; **c.** address all aspects of rehabilitation and mine closure, including final landuse assessment, rehabilitation objectives, domain objectives, completion criteria and rehabilitation monitoring.
544.	Rehabilitation	DRE	RA5	The Proponent should liaise with DRE in developing the above documents for their proposed operation.
545.	Subsidence	DRE	RA5	**SUBSIDENCE** The EIS presents a generally clear identification of the potential subsidence issues that may arise from the proposed longwall mining.
546.	Subsidence	DRE	RA5	Major subsidence risks identified in the EIS which may affect the feasibility of the proposed mine layout are: **Structures affected by flooding** Subsidence arising from the proposed mining may affect flood prone low lying areas in the Dooralong, Little Jilliby and Yarramalong Valleys as well the Hue Hue Creek catchment.
547.	Subsidence	DRE	RA5	The proponent has designed the mine layout with consideration for potential subsidence impacts to low lying flood prone areas. Notwithstanding this, it is noted the EIS identifies a number of residential dwellings and public infrastructure that may potentially be adversely affected by flooding as a result of subsidence. The proponent proposes a number of mitigation and management measures, generic in nature, for flood affected structures.
548.	Subsidence	DRE	RA5	There is a need to consider flexibility in mine layout design, to respond to any unexpected impacts or difficulties in implementing the proposed mitigation and management measures.
549.	Subsidence	DRE	RA5	**Residential structures** In addition to flood impacts it is expected that subsidence arising from the proposed mining will affect residential structures.
550.	Subsidence	DRE	RA5	The site of the proposed mining is entirely within the Hue Hue and Wyong Mine Subsidence Districts (MSD). The proponent has designed the mine layout in an attempt to limit subsidence movements in the Hue Hue MSD to within the limits ascribed to this MSD. No such design limits have been ascribed and applied to the Wyong MSD.

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551.	Subsidence	DRE	RA5	The EIS indicates 245 houses in the project area may be affected by the proposed mining of which it is expected that 43 will be damaged to a degree that requires repair, including a number that may be substantially damaged.
552.	Subsidence	DRE	RA5	Damage to residential structures due to subsidence may also create public safety risks where there may be difficulties in implementing management measures, e.g. relocation of residents.
553.	Subsidence	DRE	RA5	The proponent proposes to develop property subsidence management plans post approval to manage subsidence impacts to individual properties.
554.	Subsidence	DRE	RA5	Similar to flood impacts, there is a need to consider flexibility in mine layout design, to address unexpected impacts or potential difficulties in implementing the aforementioned property subsidence management plans.
555.	Subsidence	DRE	RA5	**High voltage transmission lines** Two 330kV transmission lines owned by Transgrid which are an important part of the electricity supply network traverse the project site. The two lines include a number of suspension and tension towers. Of particular concern to the infrastructure owner are two high angled turn towers (21-44-T and 22-52-T). This is a major feasibility issue that should be addressed at the project approval stage.
556.	Subsidence	DRE	RA5	The infrastructure owner has indicated it may not be feasible to undermine the two towers in question based on the subsidence predictions and current technology. If coal barriers are required to protect the towers due to their location a substantial volume of coal would need to be sterilised. The amount of coal sterilised by barriers necessary to protect the towers in question may significantly exceed the proponent's estimate in the EIS (refer to Fig. 5.6, p.100 of subsidence predictions). It follows that the viability of a significant proportion of the proposed mine layout may be questionable.
557.	Subsidence	DRE	RA5	Notwithstanding the above, the two towers in question would not be affected in the first 20 years of mining. The proponent proposes a technical committee be formed including the infrastructure owner and Mine Subsidence Board to investigate alternatives to sterilising coal, including new technologies.
558.	Subsidence	DRE	RA5	Based on DRE experience and understanding of currently available technology there appears at this stage to be only two possible strategies to manage potential impacts on transmission lines: • Modifying the mine layout, which could involve major changes; or • Re-routing the transmission lines
559.	Subsidence	DRE	RA5	Regardless of the final adopted strategy there is a need for adequate time for planning, design and implementation of such strategies. It is recommended that this issue to be addressed in the project approval.
Transport for NSW				
560.	General	Transport for NSW	RA13	<u>Executive Summary</u> The EIS does not appear to address and close out all aspects raised in the Director General Requirements particularly with regard to rail network impacts, and other matters including social and economic assessment.
561.	Traffic and Transport	Transport for NSW	RA13	<u>Traffic and Transport Impact Assessment – Appendix Q</u> The Traffic and Transport Impact Assessment – Appendix Q of the EIS does not appear to address all aspects required in the Director General Requirements, specifically: • A large number of intersection scenarios have been modelled but only partial results are reported. Results presented for Level of Service (LoS) and Degree of Saturation (DoS) are generally for the worst performing leg, however the worst performing leg is not identified. Full intersection summary results should be provided.
562.	Traffic and Transport	Transport for NSW	RA13	• It should be confirmed with Roads and Maritime Services (RMS) that he proposed future intersection layout for F3/Sparks Rd is acceptable. The adequacy of other proposed intersection treatments should also be confirmed by RMS.
563.	Traffic and Transport	Transport for NSW	RA13	• The Tooheys Road Site access is located immediately to the west of one of the balloon loop bridges. In the absence of any further detail regarding the geometry of this intersection it appears that a potential safety issue is Safe Intersection Sight Distances given that the proximity of the bridge and abutments could impede sight distance. What vertical clearing is proposed? Will any high vehicle access be required ruing operation? It is not clear if the F3 underpass is sufficient in this regard. Detail design should address all these issues to the satisfaction of

No.	Aspect	Stakeholder	ID	Issue
				RMS.
564.	Subsidence	Transport for NSW	RA13	• Clarification is sought with regard to subsidence. How many bridges are located in the vicinity of the extraction area? It is not clear if the bridges within the vicinity of the extraction area are included in the subsidence analysis, and if so, what was the outcome of the analysis?
565.	Subsidence	Transport for NSW	RA13	• There does not appear to be any cross reference to zone of mine influence up to the F3 and any potential settlement on the F3 and possible impact to private and freight vehicles using the motorway.
566.	General	Transport for NSW	RA13	• There does not appear to be any reference to Wyong Council's proposal for an airport in this location.
567.	General	Transport for NSW	RA13	While not specifically required by the DGR's but given the type of proposed development it would be expected that some oversize loads will need to be moved to site either during construction or production. While a separate RMS protocol exists for the approval to move oversize loads, the identification of a suitable route or any major constraints to such movement could be identified at this stage.
568.	General	Transport for NSW	RA13	<u>Rail Study – Appendix R</u> The Rail Study – Appendix R of the EIS does not appear to address all aspects required in the Director General Requirements, specifically: • Coal Handling / Loading. Only a general arrangement of the rail loop and coal handling infrastructure is shown. Director General Requirements require detailed description and plans of any proposed building works.
569.	Rail	Transport for NSW	RA13	• It is unclear from the Rail System Capacity Assessment discussion what the demand year is. The RailSys graphs have Wallarah 2 paths superimposed on North Sydney Freight Corridor Stage 1 paths, so presumably this is out to 2028. Mine life is expected until 2041. The proponent should clarify this.
570.	Rail	Transport for NSW	RA13	• The Rail Study provides details on train paths and freight interface as modelled by RailCorp however there is little discussion on passenger network strategic objectives and impacts to availability of freight paths.
571.	Rail	Transport for NSW	RA13	• Does not appear to contain any analysis or description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail network in the surrounding area for the life of the project. That is a minimum period of 28 years and potentially 40 years.
572.	Rail	Transport for NSW	RA13	• There is little discussion regarding wider Transport for NSW interface with the broader rail network. Discussion regarding potential impact on/to proposed New Warnervale Station North, Warnervale new town and possibly Warnervale Stabling as well as any future quadruplication of the Short North. An emerging interface may also exist with Bushels Ridge Aboriginal Lands claim.
573.	Rail	Transport for NSW	RA13	The Rail Study – Appendix R of the EIS appears to contain some contradictory information, specifically: • Rail Study, the second paragraph on page 2 states that analysis of the "Project rail systems impact will be included in the Environmental Impact Statement" – but this analysis does not appear to have been included.
574.	Rail	Transport for NSW	RA13	• Page 4: Mine Operation: "There will be no coal handling and preparation plant …". This is inconsistent with the project description provided in the Introduction. The Introduction mentions "The mine will produce a single thermal coal product to be marketed for export and domestic electricity." While the domestic scenario is unlikely and excluded from analysis, if it were to eventuate how would coal be transported to either Vales Point or Eraring given that the existing turnouts face the wrong way? Would trains travel the Teralba "detour" through Newcastle, require new south facing turnouts, or does road hauling become an option? Again, while unlikely, the scenario is not discussed in either road or rail appendices. While a full analysis is probably not required a most likely method of transport should be identified.
575.	Economics	Transport for NSW	RA13	<u>Economic Assessment</u> The provided documentation does not address the implications of this project as required in the Director General Requirement on the broader rail network or incorporate any assessment of costs. The analysis should include an apportionment of both capital and recurrent costs e.g. Awaba North loops project, upgrade to 30t axle load, increase in maintenance and asset renewal costs.
SEWPaC				
576.	General	SEWPAC	RA21	The department is generally satisfied with the information provided in the EIS, and subsequent water-related information and clarification provided to the department in response to the IESC's advice.
577.	Offsets	SEWPAC	RA21	According to the report the proposed offsets meet the minimum requirements for all the EPBC listed threatened species that will be significantly impacted

No.	Aspect	Stakeholder	ID	Issue
				by the proposal, with the exception of the Giant Barred Frog (Mixophyes iterates). The proposed offset package meets only 91.4% of the minimum offset requirements for this species. The proponent has been advised that the remainder of offset can be met through either further direct or indirect offset. The department generally requires offset packages to be finalized and agreed prior to approval of the action.
Special Interest Groups				
578.	General	ACA	SIG1	Central Coast citizens are greatly concerned about the impact a longwall coal mine will have upon their drinking water catchment, their health, their lifestyle, their amenity and the local Environment.
579.	Surface Water	ACA	SIG1	The Dooralong and Yarramalong Valleys is the largest drinking water resource for the entire Central Coast population, more than 300,000 people, and account for approximately 53% of the drinking water supply, which is drawn from the streams and aquifers. The various streams, creeks and rivers within the water catchment are primarily fed from the underground aquifers, providing approximately 68% of the water to these streams. The water catchment valleys were proclaimed as a water catchment district in 1950, gazette number 153 of the Local Government Act 1919. Mardi Dam was proclaimed water catchment in 1987.
580.	Surface Water Groundwater	ACA	SIG1	The ACA is concerned that Kores' Environmental Impact Statement (2013) of the Wallarah 2 Coal Project is only a resubmission of their previous submission, dealing with some of the matters in a different way but still providing the same conclusions as previously. Because of this, several issues raise herein use information in reports prepared in response to the first Wallarah 2 submission of 2010. The recommended two-year water study, as recommended by the previous State Government before any consideration to the approval of longwall coal mining be given, was not undertaken by the proponent to quantify the dynamics of the surface and sub surface aquifers inter relationships over this period. This required the refurbishment of more than 200 bore holes. The proponent ignored this requirement! Instead they drilled five cluster bores on property owned by the proponent for the two-year study. It would seem that none of these results were used and submitted in the EIS. A study of the EIS bore mapping does not reveal any reference to these borehole results having been used.
581.	Subsidence	ACA	SIG1	There is also concern that all the Wallarah 2 water and subsidence reports were generated using data from the Southern and Northern Coalfields and provides unrealistic assumption due to the unique nature of the geology in the Dooralong and Yarramalong Valleys.
582.	Surface Water	ACA	SIG1	A report on Jilliby Jilliby Creek, prepared in 2004 by River Care, in association with Hunter Central Rivers Catchment Management Authority, National Heritage Trust and the Department o f Infrastructure, Planning and Natural Resources, declared this water system as one of the most pristine in New South Wales. This report also raises concern of the potential damage that may be caused by longwall coal mining directly beneath the creek system and within the catchment area.
583.	Subsidence Surface Water Ecology Air Quality	ACA	SIG1	The ACA is also concerned that coal extraction from beneath the water catchment valleys will have enormous environmental, health, economic and social impacts on the Central Coast. In particular the problem of ground subsidence impacting on the water supply and the habitat of many endangered species of fauna of national significance, flora and fauna that are listed as threatened and endangered and the impact, airborne coal dust particles emanating from the coal loading facility and rail transport will have on human health.
584.	Ecology	ACA	SIG1	There are a number of international waders, recorded under the Australian Government agreements with China, Japan and South Korea, whose fragile habitat is entirely dependent upon the health of the water catchment river systems, and thirty-three (33) State endangered or threatened species of flora and fauna within the catchment valleys. Concern is raised at the threat posed to the habitat of the various endangered and threatened species of flora and fauna.
585.	General	ACA	SIG1	Wyong Shire is the largest urban growth area in NSW, with allowed increased urbanization and clean industry in accordance with the NSW Government's plans, particularly in the adjacent areas and close to the proposed coal handling facility. A coalmine of this magnitude does not fit in with these plans and would tantamount to building a longwall coal mine in the Galston-Dural District o f Sydney with the coal handing facility being located at Castle Hill. It would not be allowed.
586.	General	ACA	SIG1	The previous Minister for Planning Tony Kelly rejected the Wallarah 2 mine proposal because of too many uncertainties. He confirmed his reasons in a letter to the ACA's executive member Mike Campbell on the 21st March 2011 and said, **"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."** Mr. Kelly further said in conclusion in his letter, **"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."**
587.	Consultation	ACA	SIG1	It is also noted that there has been no direct consultation either on a group basis or one-on-one with anyone within the mine footprint area.

No.	Aspect	Stakeholder	ID	Issue
588.	General	ACA	SIG1	The benefit of this proposed project to the State of NSW is questionable. Royalties of less than $22 million per annum, at the current cost of selling coal, would be generated for the life of the mine. The cost of remediating water and health issues to the Central Coast community would more than likely outweigh the expected royalty income. The only benefit derived from this project is to a foreign government, who do not have to accept any of the risk.
589.	Surface Water	ACA	SIG1	**WATER CATCHMENT CONCERNS** The extraction area is part of a major water supply catchment.
590.	Surface Water	ACA	SIG1	The mine footprint is directly under water supply streams and the water supply aquifer.
591.	Surface Water	ACA	SIG1	Potential for interruption to water supply.
592.	Surface Water	ACA	SIG1	Disruption of the aquifer feeding water supply streams. It is directly beneath the major water flow-through of the underground aquifers. The aquifer provides approximately 68% of the water recharge to Jilliby Jilliby Creek and the Wyong Creek (River).
593.	Surface Water	ACA	SIG1	Water quality will be impacted.
594.	Surface Water Groundwater	ACA	SIG1	Significant dependence on Groundwater by residents and agriculture in the extraction area and by Central Coast residences as the major harvesting area for the suburban water supply.
595.	Surface Water	ACA	SIG1	The dependence of the newly completed Mardi-Mangrove pipeline link on the continual availability of water from the catchment area.
596.	Subsidence	ACA	SIG1	**SUBSIDENCE CONCERNS** Potential environmental impact on: • Wetlands. • Cliff/formation subsidence. • Tree root impacts leading to dieback. • Vegetation and eco-systems. • Stream morphology and erosion and sedimentation processes.
597.	Agriculture	ACA	SIG1	Reduction and/or destruction in farm produced income from subsidence and water loss.
598.	Subsidence	ACA	SIG1	Structural damage to water supply infrastructure, such as weirs, irrigation pipelines, pump stations has not been ruled out. Domestic infrastructure: dams, farm bridges, grazing areas and loss of service water.
599.	Subsidence	ACA	SIG1	Wyong weir and the Mardi pump-pool are all within the horizontal subsidence zone.
600.	Subsidence Groundwater	ACA	SIG1	Jilliby Jilliby Creek and Little Jilliby Jilliby Creek that have been mapped are fault lines (trending west to east towards Mt. Alison) and Aquifers are directly above the proposed mine. Subsidence will create additional transient pathways when intersecting these fault lines. It is reasonable to assume that these fault lines and other similar geological structures have been allowing water to seep from surface to coal seam post volcanism, which is how the water reached the coal seam in the first instance. Proof has been found on the bore cores, which show discreet areas of **'rust'** (iron oxide).
601.	Subsidence	ACA	SIG1	Wyong River and Wyong Creek are within the horizontal subsidence zone.
602.	Surface Water	ACA	SIG1	Loss of the drinking water catchment. (The Dooralong and Yarramalong Valleys are the major water catchment area for the entire Central Coast.)
603.	Subsidence	ACA	SIG1	Unacceptable subsidence impacts to 245 homes, outbuildings, agricultural industry, (including turf farms, livestock breeding, orchards, vegetables, bees, cattle) dams and roads within the mine footprint, and without appropriate mitigation strategies.
604.	Ecology	ACA	SIG1	**FLORA AND FAUNA IMPACT CONCERNS** Mining is a "key threatening process" for the extensive vegetation communities in the region that includes many threatened species. There are likely impacts arising on: • Wetlands. • Corridors. • Threatened species and habitats
605.	Ecology	ACA	SIG1	The development is likely to have far reaching impacts on vegetation beyond the immediate area of the mine head and stock piles, e.g., the complete rail loop, introduction of Phytophthora.
606.	Ecology	ACA	SIG1	A likelihood of pollution in Tuggerah Lakes, which would cause an unacceptable loss of its biodiversity.
607.	Ecology	ACA	SIG1	Unacceptable loss of the biodiversity of the two valleys and the pristine nature of the environment.

No.	Aspect	Stakeholder	ID	Issue
608.	Ecology	ACA	SIG1	Potential destruction of the two major riparian corridors.
609.	Social	ACA	SIG1	**SOCIAL IMPACT CONCERNS** A development of this scale has significant impacts on local training, community facilities and services, housing, schools, hospital, etc.
610.	Social	ACA	SIG1	It significantly increases demands on social/cultural/recreational services.
611.	Social	ACA	SIG1	Coal loader will be built adjacent to the largest growing urban area on the Central Coast and NSW, including the planned new city of Warnervale and the Wyong Employment Zone.
612.	Social	ACA	SIG1	Undue angst for people affected by subsidence and coal dust emissions.
613.	Social	ACA	SIG1	Wallarah 2 have not obtained a social licence (acceptance from the community) and have failed to adequately address community concerns or consult with them. In particular there has been a total failure by the proponent to engage in a one-on-one discussion programme with landowners within the mine footprint. Distributed newsletters have done no more than promote Wallarah 2 propaganda, lulling landowners into a false sense of security that there will be no impact upon their properties.
614.	Air Quality	ACA	SIG1	**AIR QUALITY CONCERNS** Potential for significant stack emissions.
615.	Air Quality	ACA	SIG1	Potential for dust generation throughout construction and operation of the project, including along the entire rail corridor, and wide spread emissions of fine dust particles across the urban growth area of the North Wyong Region when the mine is operating.
616.	Air Quality	ACA	SIG1	The potential for release of methane gas despite programmes to extract it in advance of mining operations.
617.	Health	ACA	SIG1	**HEALTH CONCERNS** Problems associated with coal dust (respiratory and skin disease) being transported on the wind. (The Central Coast already has one the highest incident of respiratory ailments in NSW and in Australia due to the proximity of the power stations).
618.	Health	ACA	SIG1	Mortality from fine airborne coal dust emissions as clearly stated in the Wallarah 2 Executive Summary (page xi) and Appendix M, pages 6 - 17 of the Health Assessment Risks.
619.	Noise	ACA	SIG1	**NOISE AND VIBRATION** There is significant potential for generation of noise and vibration arising from construction, operation and coal transport.
620.	Noise	ACA	SIG1	This would be occurring in a quiet rural setting and adjacent to the largest growing urban area on the Central Coast.
621.	Noise	ACA	SIG1	Potential for noise and vibration impacts on local fauna.
622.	Flooding	ACA	SIG1	**LOCAL FLOODING CONCERNS** Local creeks flood rapidly.
623.	Flooding	ACA	SIG1	There is generally poor access for residences in the area of proposed extraction.
624.	Flooding	ACA	SIG1	Increased flooding for many properties due to subsidence and five homes being pushed into the 1 in 100 flooding zone. Since 1981 there has been the equivalent o f six 1 in 100 floods in the Dooralong Valley.
625.	Soil and Land Capability	ACA	SIG1	**SOIL & LAND CAPABILITY CONCERNS** Detailed assessment of soil and land resources insufficient. Does not meet DGR.
626.	Soil and Land Capability	ACA	SIG1	Survey scale of soil and agricultural resources across the Project Area is not reported.
627.	Surface Water	ACA	SIG1	**WATER** **1 The Proclaimed Wyong Water Catchment District** Wyong Water Supply Catchment District was Proclaimed in NSW Government Gazette No.153 29/11/1950 under the Local Government Act, 1919 p.533-534 Section 401 Division 7 Local Government Act Catchment districts and ordinances. 401(2) (b), (2)(h) **are still relevant and enforceable. . .** **(2b)** *"The protection of the Catchment district, or any watercourse therein, from pollution, and the protection of any property of the Council on such catchment district* **and (2h)** *Preventing the diversion of or the taking of water from any natural or artificial watercourse the water of which flows into the Council's works except by or under authority of the Council or of any Statute".*
628.	Surface Water	ACA	SIG1	Documentation of subsidence damage in the Northern, Southern and Western coalfields of NSW from longwall mining indicates that this project cannot satisfy these ***protective statutes*** and recent reassurances by this company - *the security and continuity of potable water resources would be maintained*

No.	Aspect	Stakeholder	ID	Issue
				and protected. ***Recurring residual, active and horizontal subsidence*** is inevitable below Jilliby Jilliby Creek and flood plains, the Yarramalong flood plains and will also intercept Wyong River with a potential loss of potable water resources - some 53% currently supplying Wyong communities and Gosford City.
629.	Groundwater	ACA	SIG1	It is stated in the Wallarah 2 EIS that it will take almost 40 years to complete all the planned longwalls. It must be realised that the workings will remain depressurised until the last longwall is completed.
630.	Surface Water	ACA	SIG1	Figure 1 gives the statistical analyses of the flows in Jilliby Jilliby Creek, upstream of the Wyong River, from records since 1972. The median flow rate is 4.5 Megalitres per day (ML/day). However, the flow is less than 1 ML/day for 24% of the time of record, and less than 0.1 ML/day for 10% of time. The data in Figure 2 shows that for 190 days, flows were less than 2ML/day (less than half the average), and again for different periods of 180, 168, 166 and 135 days.
631.	Groundwater	ACA	SIG1	All science and every experience in groundwater flow, down to depths of at least 500m, 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, Mabee, Boutt and Cooke, Hydrogeology Journal, Volume 21, Number 2, March 2013.
632.	Groundwater	ACA	SIG1	The Mackie 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) which are as follows: *"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 bore field 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 bore fields 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."*
633.	Groundwater	ACA	SIG1	The Mackie 3D groundwater model assumes that there will remain a 150m to 300m thick layer with a very low vertical permeability even after mining is completed. This assumption that there will be a Constrained Zone dictates the findings of the Wallarah 2 model. This assumption that there will be a Constrained Zone of unaffected permeability more than 220m above the level of extraction cannot be justified on the basis of data from the Southern Coalfields and at Ulan.
634.	Groundwater	ACA	SIG1	The assumptions regarding permeability in the Mackie 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.
635.	Groundwater	ACA	SIG1	The hydraulic conductivity values adopted in the Wallarah 2 model are substantially on the low side of reality. Therefore, the computed mine inflows and the rate at which depressurisation progresses through the strata are substantially on the low side of reality. If Mackie had adopted the parameters recommended in the previous chapter in the same EIS, then depressurisation would have been calculated at occurring much faster and to a much greater extent.
636.	Groundwater	ACA	SIG1	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 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. 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:
637.	Groundwater	ACA	SIG1	The following is from the Mandalong, August 2012 Longwall 12 report — *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 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.*
638.	Groundwater	ACA	SIG1	The Mackie assessment of permeability values is based on the assumption that there are no significant fractures (joints, faults, dykes etc) in the

<table>
<tr><th>No.</th><th>Aspect</th><th>Stakeholder</th><th>ID</th><th>Issue</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Narrabeen Formation below the weathered near surface environment</td></tr>
<tr><td>639.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>Leaving aside increases in permeability above extraction areas, there is a fundamental issue in respect to the use by Mackie of the permeability of intact core samples, as being a realistic measure of rock mass permeability.</td></tr>
<tr><td>640.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>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, tunnelling and mining professions that it does not warrant that this writer spring to its defence. All field permeability testing that has been done for dams, tunnels and coal mines in the Sydney Basin over the past 80 years was unnecessary if core permeability was the relevant measure.</td></tr>
<tr><td>641.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>The permeability values adopted for Wallarah 2 model are given in Figure 3 (taken from Appendix G of EIS).
FIGURE 3
NARRABEEN FORMATION (PRE-MINING) PERMEABILITY (HYDRAULIC CONDUCTIVITY) VALUES ADOPTED BY MACKIE FOR THE WALLARAH 2 MODFLOW MODEL
<table>
<tr><th rowspan="2">UNIT</th><th colspan="2">HORIZONTAL</th><th colspan="2">VERTICAL</th></tr>
<tr><th>m/day</th><th>m/sec</th><th>m/day</th><th>m/sec</th></tr>
<tr><td>Terrigal Formation</td><td>2.1 x 10</td><td>2.4 x 10</td><td>x 10</td><td>4.2 x 10-11</td></tr>
<tr><td>Patonga Claystone</td><td>1.8 x 10-5</td><td>2.0 x 10-10</td><td>3.8 x 10</td><td>4.3 x 10-11</td></tr>
<tr><td>Tuggerah Formation</td><td>3.1 x105</td><td>3.5x 10-10</td><td>1.5 x 10</td><td>1.7x 10-11</td></tr>
<tr><td>Munmorah Conglomerate</td><td>3.4 x 10-5</td><td>3.9 x 10-1°</td><td>2.3 x 10</td><td>2.6 x 10-11</td></tr>
<tr><td>Dooralong Shale</td><td>2.0 x 10-5</td><td>2.3 x 10-10</td><td>2.7 x 10-5</td><td>3.1 x 10-11</td></tr>
<tr><td>LOG MEAN</td><td></td><td>2.7 x 10-10</td><td></td><td>3.0 x 10-11</td></tr>
</table>
Analysis of the field measurements from Coffey Partners International[#] (Wyong), Pacific Power (Dooralong) and MER (Ulan) give the following log mean values for the Narrabeen Formation.
[#]The writer has ignored all the Coffey results that are presented simply as <43.2 x 10^{-5} m/day.
Wyong and Dooralong 3.37 x10^{-6}
Ulan 4.69 x 10^{-7}

It can be seen from the above data that the vertical permeability values adopted by Mackie for the Wallarah 2 model are between 100 and 1000 times lower than values suggested by the field testing.</td></tr>
<tr><td>642.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>These values apply to ground that has not been disturbed by subsidence effects and are used by Mackie 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, Mackie assumes that there will remain a 150m to 300m thick layer with a very low vertical permeability even after mining is completed. This assumption dictates 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 cannot be justified on the basis of data from the Southern Coalfields and at Ulan</td></tr>
<tr><td>643.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>2 Physiography and Soils
2.1 Physiography
The physiography of this Catchment records Wyong River Weir Catchment of 436 sq. km and Jilliby Jilliby Creek Catchment of 101 sq. kms. A series of</td></tr>
</table>

No.	Aspect	Stakeholder	ID	Issue
				steep strike ridges and deep gullies are considered the ground water recharge areas (Northern Geosciences, 2005), which form part of the water catchment district boundary under the Water Management Act 2000. Wyong River is a Regulated River and receives a supplementary supply in seasonal needs from Mangrove Creek Dam via the Boomerang Creek Tunnel to maintain Wyong River and environmental flows. *Subsidence conditions will destroy these groundwater recharge areas.*
644.	Soil and Land Capability	ACA	SIG1	**2.2** **Soil and Land Capabilities** **Director General Requirements** Land Resources — including a detailed assessment on the potential impacts on: • Soil and land capability (including land contamination); • Landforms and topography, including cliffs, rock formations, steep slopes etc; • Land use; • Agricultural resources and/or enterprises in the local area, including: o Any change in land use arising from requirements for biodiversity offsets; o A detailed description of measures that would be implemented to avoid and/or minimize the potential impacts of the project on agricultural resources and/or enterprises; and • Justification for the long-term changes to agricultural resources, particularly if highly productive agricultural resources (e.g. alluvial lands) are proposed to be affected by the project. Relevant policies and Guidelines listed in DGRs • Draft Agricultural Assessment Guidelines 2011 (DP&I) • AgFact AC25: Agricultural Land Classification (NSW Agriculture)
645.	Soil and Land Capability	ACA	SIG1	**2.2.1: Insufficient baseline data collected** Required: Detailed assessment of soil and land resources. This baseline data is used for an assessment of potential impacts and feeds into the Agricultural Impact Statement. The Draft Agricultural Assessment Guidelines 2011 specify that detailed information on soil and land resources is required.
646.	Soil and Land Capability	ACA	SIG1	<u>Survey scale is inadequate and fails to satisfy the DGRs</u> • Survey scale of soil and agricultural resources across the Project Area is not reported. • Survey scale is a maximum of 24 observations over 4,558 ha. This equates to 0.005 obs per hectare and in accordance with the reference listed in Section 5 of the report, *Guidelines for Surveying Soil and Land Resources (Second Edition),* means that this observation density is a broad low intensity survey scale of 1:500,000. This scale is the opposite of what is considered to be a detailed assessment and therefore does not satisfy the DGRs. • *Minimum action required by the proponent* should have been to undertake a detailed soil and land resources assessment at an appropriate scale commensurate with the potential project impacts and agricultural resources o f the area.
647.	Soil and Land Capability	ACA	SIG1	**2.2.2: Survey Methodology is inadequate** <u>Survey methodology is inadequate</u> • Survey observations consisted of 20 Soil and Land Information System (SALIS) data points and 4 ground truthed sites. SALIS data is not provided and therefore the level of detail provided by the SALIS records is unknown. There are various levels of data that can be entered into the SALIS system and the dataset used for the project may cover some or all of the parameters listed in the reports Table 1. Further, SALIS data may not have been collected by verified CPSS soil scientists or by technically accredited government staff member as the database is open for submission by the general public. E.g. Farmer Joe Blogs can add data to the file. Therefore transparency on the level of detail provided by the SALIS records and the technical competency of the data collector is required to accompany the use of SALIS data.
648.	Soil and Land Capability	ACA	SIG1	• Section 8.2 states that opportunist ground-truthed observations were assessed in accordance with the parameters listed in the reports Table 1. No evidence has been provided to support this. Further, the authors state that information was collected only down to a maximum of 0.3 — 0.4 m and that no chemical analysis was undertaken on the profiles to assess soil pH, salinity or sodicty characteristics, which are significant

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				drivers of a soils assessment with regards to applying the Australian Soil classification nomenclature and recommending appropriate soil erosion controls.
649.	Soil and Land Capability	ACA	SIG1	• The proponent should have appended soil log data sheets used in the field. I f no chemical laboratory data is available and verifiable (e.g. field chemical data collected by a CPSS scientist or laboratory Certificate of Analysis) then a detailed soil and land resources assessment at an appropriate scale commensurate with the potential project impacts and agricultural resources o f the area, including provision o f sufficient laboratory data should have been undertaken.
650.	Soil and Land Capability	ACA	SIG1	**2.2.3: Soil Survey Assessment is inadequate** Soil type ASC names cannot be verified • The dominant soil type in the Project Area is listed in the report as a Kurosol. This soil type by definition has a strong acidic subsoil. No data has been presented to verify that the soils in the Project Area are strongly acidic. • The second dominant soil type in the Project Area is a Sodosol. This soil type has strongly sodic subsoil. No data has been presented to verify that the soils in the Project Area are strongly sodic.
651.	Soil and Land Capability	ACA	SIG1	Insufficient details on each representative soil type • The soil types are inadequately described. There is none to limited reference to soil texture, soil structure, consistency, effective rooting depth, colour etc. The assessment has not been written up to show that it has been conducted in accordance with the *Australian Soil and Survey: Field Handbook* as specified in the methodology. Conversely the assessment contains less information than the desktop reference *Soil Landscapes o f the Gosford-Newcastle region.* The soil types have been rudimentarily classified to family level, which does not provide enough information for an inherent fertility assessment, a land capability assessment (which is weighted by soil erodible characteristics, such as topsoil texture) or for topsoil salvage assessment. *Minimum action required by the proponent* should have been to provide full profile descriptions of the representative soil types, including valid field and or laboratory data to support the ASC naming.
652.	Soil and Land Capability	ACA	SIG1	**2.2.4: Soil mapping is not consistent with reference material** Soil Map is incorrect • The Yarramalong landscape has alluvial soils as well as red gradational soil, yellow and brown duplex soils and some solodics/soloth soils on terraces *(Soil Landscapes of the Gosford-Newcastle region).* However, the report has identified all o f the land associated with the Yarramalong soil landscape unit as containing sodic subsoil (solodics/soloth soil types). Solodics/Soloths are considered to be a minor soil type by the reference material; however, the report identifies it as being a dominant soil type, which subsequently downgrades the land's potential agricultural productivity. There is no data provided to support the presence of sodic subsoils and the report's mapping conflicts with the reference material. Given that the report's survey scale is significantly broader than the reference material, which is 1:100,000, then the background reference material needs to be used otherwise the assessment is invalid. The proponent should re-assess the land covered by the Yarramalong soil landscape unit using information from a detailed survey. Particular importance to be placed on this unit, as it may be Class II land and is in the disturbance zone of the Project. Therefore a survey scale of 1:25,000 is the standard practice and in line with the best practice guideline *Biophysical Strategic Agricultural Land Verification Guidelines* (OEH, 2013)
653.	Soil and Land Capability	ACA	SIG1	**2.2.5: Land Capability does not comply with DGRs/relevant planning Instruments & policies** Land Capability system applied is outdated • The NSW strategic regional land use policy and associated Strategic Regional land Use Plans have adopted the Land and Soil Capability classification system (OEH 2011, 2012) to appropriately classify rural land for agricultural potential. The Rural Land Capability system applied in the report is not using the latest endorsed assessment guideline, which has been developed specifically to improve the agricultural classification system used to assess land with competing land uses. *Minimum action required by the proponent* should have been to assess the Project Area using the Land and Soil Capability classification system.

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654.	Soil and Land Capability	ACA	SIG1	**2.2.6: Land Capability mapping is incorrect** <u>Land Capability mapping is incorrect</u> • The Kandasol soil type has been assessed as Rural Land Capability Class VI. The information provide in section 9.2 describes a soil type and landform commensurate with a Rural Land Class IV or V classification. Land capability classification should have been associated with the Kandasol soil type.
655.	Soil and Land Capability	ACA	SIG1	• The Gorokan landscape typically has undulating low hills and rises with slope gradients of less than 15% and has low limitation for grazing and high limitations for cultivation. This information, which has come directly from the authors background reference - *Soil Landscapes of the Gosford-Newcastle region,* describes a soil landscape unit that has a Rural Land Capability classification of Class IV or V – refer Table 3 of the report. The assessment potentially incorrectly classifies the Gorakon landscape unit as being Class VI, which is generally commensurate with land that has slopes >20%. Land capability classification assessment should have been associated with the Gorokan soil landscape unit.
656.	Soil and Land Capability	ACA	SIG1	• The Yarramalong landscape typically has low limitations for both cropping and grazing. This information, which has come directly from the author's background reference - *Soil Landscapes o f the Gosford-Newcastle region,* describes a soil landscape unit that has a Rural Land Capability classification of Class II or III – refer Table 3 of the report. The assessment potentially incorrectly classifies the Yarramalong landscape unit as being Class III rather than Class II. The existing land use of a turf farm within this vicinity validates that land is capable of being regularly cultivated. Land capability classification assessment should have been associated with the Yarramalong soil landscape unit. The proponent should have assessed land capability classification associated with the Yarramalong soil landscape unit.
657.	Soil and Land Capability	ACA	SIG1	**2.2.7: Agricultural Suitability mapping is incorrect** <u>Agricultural Suitability mapping is incorrect</u> • The land area classified as Agricultural Suitability Class 3 land that is associated with the Jilliby Jilliby Creek (refer Figure 8 of the report) does not correlate with the assigned classification Rural Land Capability Class III land (refer Figure 6 of the report). This Agricultural Suitability Class classification means that it is considered suitable to grazing and limited for cropping whereas the assigned Rural Land Capability classification means that is highly suited to cropping. These two assessments using the two classification systems are contradictory and highlights that the report has not been authored by a technically competent person. No validation has been provided, such as the lack of transport links, with the exception of one sentence in Section 10.2.3, which says, "human elements such as viability of regional infrastructure to support activities are also taken into account". Further detail on these human element(s) is required to justify the agricultural downgrading of the land. The proponent re-assess Agricultural suitability classification o f the Class 3 land!
658.	Soil and Land Capability	ACA	SIG1	• The land area classified as Agricultural Suitability Class 5 in the west o f the site (refer Figure 8 of the report) does not correlate with the classification Rural Land Capability Class VI land (refer Figure 6 of the report). This Agricultural Suitably Class 5 capability classification means that the land is considered *unsuitable* for almost any agricultural use whereas the Rural Land Capability classification means that is suited to light grazing. These two assessments using the two classification systems are clearly contradictory. The proponent re-assess Agricultural suitability classification of the Class 5 land!
659.	Soil and Land Capability	ACA	SIG1	**2.2.8: No potential assessment of potential Biophysical Strategic Agricultural Land** • The DGRs do not specify that verification of Biophysical Strategic Agricultural land (BSAL) is required; however, it is highly likely that some of the alluvial derived landscapes will be BSAL. Therefore it would be deemed reasonable and appropriate for the proponent to verify if BSAL is present such that mitigation and/or avoidance strategies can be employed. The Project Area should have been assessed for BSAL in line with a precautionary principled approach.
660.	Soil and Land Capability	ACA	SIG1	**2.2.9: Topsoil balance is invalid** • The topsoil balance only includes rehabilitation of 14 ha of land as it is assumed that the proposed land use of industry at the Tooheys Road

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				Site will be approved. Given, that there is no rehabilitation strategy a full topsoil balance should have been undertaken to ensure that sufficient resources are available for full rehabilitation of the site, and developed in consultation with the community and government stakeholders. The proponent should have developed a rehabilitation strategy and revised the top soil balance. Strategy should have been developed in consultation with both community and government stakeholders.
661.	Soil and Land Capability	ACA	SIG1	**(i): Topsoil stripping assessment is inadequate** • There is no description of soil pedality, structure, texture to back up the topsoil salvage assessment in Section 11. Specific soil characteristics, as detailed in the reports Table 7, are required for assessing topsoil suitability using the Elliot & Veness procedure. The report does not provide supporting information to verify the assessment and given the lack of information provided for each soil type in Section 9 of the report it is likely that the Elliot & Veness procedure has not been applied properly. The proponent failed to provide full profile descriptions in accordance with the ASC nomenclature (Isbell, 1996) and the *Australian Soil and Survey: Field Handbook* as specified in the reports methodology to support the topsoil stripping assessment.
662.	Soil and Land Capability	ACA	SIG1	• The soils differ in their suitability for stripping and re-use in rehabilitation operations. These limitations are based on soil structure, soil texture, pH, dispersibility, etc. characteristics. There has been no assessment that details the limitations of each soil type and which ones are to be preferentially stripped. The proponent has not provided information to support the recommended soil depth stripping assessment, nor provided preferential stripping information to support rehabilitation success.
663.	Soil and Land Capability	ACA	SIG1	**(ii): Topsoil management measures are inadequate** • The soil management measures are inadequate and generic. For example the Kurosol detailed in section 9 is as being moderately to highly erodible and possibly dispersive. This soil type will require soil amelioration measures such as gypsum and organic amendments to improve soil structure and prevent/reduce dispersion when stockpiled. For example the Sodosols will likely have hard setting surface characteristics, which means that the stripped soils will require special handling. The proponent did not provide soil management measures that are applicable to the soil types as described for the Project Area.
664.	Soil and Land Capability	ACA	SIG1	**2.2.10: Acid Sulphate assessment is inadequate** • The soil type associated with the Wyong landscape unit is described in the reports reference material *(Soil Landscapes of the Gosford-Newcastle region)* as being a potential acid sulphate soil. This soil type comprises a significant portion of the Tooheys Road Site, which is to be disturbed — refer Figure 5 of the report. The report states in section 12.2 that areas of acid sulphate potential are outside of the disturbance area. This is in direct contrast to the reference material that the desktop assessment has been predominately based on. The proponent did not assess the potential for acid sulphate soil to occur within the Project Area correctly.
665.	Soil and Land Capability	ACA	SIG1	**SUMMARY** • Broad scaled survey design fails to satisfy the DGRs • Limited detail on key soil and land characteristic • Contradictory soil mapping • Contradictory Rural Land Capability and Agricultural Suitability Classes • Incorrect Rural Land Capability and Agricultural Suitability Class classifications • Outdated land capability system applied • No consideration of the Strategic Regional Land Use Policy • Topsoil balance invalid • Contradictory Acid Sulphate assessment
666.	Soil and Land Capability	ACA	SIG1	***Flow on effects:*** • Invalid Agricultural Impact Assessment as the soil and agricultural information used to assess agricultural impact is obtained from the soil and land capability report.

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667.	Soil and Land Capability	ACA	SIG1	• Invalid Rehabilitation strategy as the return to post-mining classes is dependent upon an appropriate pre-mining assessment. Further topsail balances will be incorrect and invalid.
668.	Soil and Land Capability	ACA	SIG1	• Surface water report if it has referenced alluvial information derived from the soil and land capability report will also be invalid unless significant in field testing was undertaken by the surface water specialists.
669.	Rehabilitation	ACA	SIG1	**2.3 Rehabilitation Strategy** **Director General Requirements** **Rehabilitation -** including the proposed rehabilitation strategy for the site, having regard to the key principles in the Strategic Framework for Mine Closure , including: • rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria; • nominated final land use, having regard to any relevant strategic land use planning or resource management plans and policies; and • the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
670.	Rehabilitation	ACA	SIG1	**Relevant policies and Guidelines listed in DGRs** **Rehabilitation** Mine Rehabilitation — Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia) Mine Closure and Completion — Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia) Strategic Framework for Mine Closure (ANZMEC-MCA)
671.	Rehabilitation	ACA	SIG1	**2.3.1 No Rehabilitation Strategy** Required: Rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria No rehabilitation strategy has been provided. The main EA document and the soil and land capability report provides limited information on proposed decommissioning strategies. No rehabilitation objectives, methodology, etc have been provided. The commitment to develop a strategy within 5 years of mine closure is not sufficient given the Mining Operations Plan will need to address rehabilitation actions through time. Further, the post-mining land capability and land use assessment for the Project are required to be integrated with the rehabilitation strategy otherwise post-mining land capability/land use cannot be nominated and verified. The absence of a rehabilitation strategy means that the nominated land use/land capability classifications in the soils and land capability report lack a supporting validation and require further assessment.
672.	Geology	ACA	SIG1	**3 Geology, Tectonic Activity, Connectivity** Valley areas are of consolidated segments of Triassic Hawkesbury Sandstone and Gosford Formation within Hornsby Plateau subdivision of the Sydney basin. Extensive areas of unconsolidated alluvial soils occur along major valleys and streams. Several sets of high angle (near vertical), well-developed joints are identified in the valleys crush zones of permeable Hawkesbury Sandstone to create *transit pathways for horizontal and vertical water distribution.* A thick sequence of deeply weathered gravels alluvial scree residual clay and sandy soils at 10-20m overlay fractured and faulted weathered and fresh sandstone of the Hawkesbury and Gosford formation to a depth of 400m.
673.	Geology	ACA	SIG1	Geological factors influence stability and instability within soil profiles. Longwall mining creates major stress factor changes, within soil profiles, which are considered permeable . . . " *tectonic activity opened up overlying strata which provided an escape route to the possibility o f groundwater flow between the coal seams and the shallow aquifers. The role of meteoric water migration through the coal seams in the enhancement of methanogenesis processes carrying bacteria and nutrients, has ready access to flow through the coal seams". . . (Faiz et. al. 2003, Evans, R. 2005).* Connectivity is clearly established!
674.	Geology	ACA	SIG1	**3.1 Geophysical Fault Zone** A major geological feature of Jilliby Jilliby Creek is a fault zone approximately 1.3km west of Mount Alsion. The drainage runs along this fault line in almost a direct line south for approximately 1.5km midway along this feature Little Jilliby Creek converges into Jilliby Jilliby Creek. The whole of the Little Jilliby Creek is at right angles from Jilliby Jilliby Creek and is interpreted as a *conjugate fault zone. The significance o f this feature is that it provides a significant pathway to groundwater movement and discharge into surface steam flow regimes o f Jilliby Jilliby Creek Subsidence has the potential to destroy this flow and intercept polluted coal seam waters prior to final discharge (after the confluence of Jilliby Jilliby Creek with Wyong River) into Tuggerah Lakes estuary. Northern Geosciences, 2005).*

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675.	Surface Water	ACA	SIG1	**4 Interception and Loss of Potable Water Flows** Jilliby Jilliby Creek, Wyong River, flood plains and drainage zones will be undermined by longwall coal panels resulting in surface subsidence - *a significant pathway to potable groundwater movement before confluence.* Interception, arising from "subsidence and cracking", will divert these waters into a lower polluted coal seam aquifer. Longwall coal panels *are located dangerously close to Wyong River creating a high probability that horizontal subsidence will intercept this river and provide transit pathway/s to heavily polluted coal seam aquifer and natural drainage into the estuarine sediments of Tuggerah Lake.*
676.	Ecology	ACA	SIG1	**5 Longwall Mining (LWM)** Attention is drawn to the *State Scientific Committee report* commissioned by NSW government, regarding the Threatened Species Conservation Act 1995 (Chairperson Dr. L. Hughes) in relation to longwall coal mining in NSW. Their Final Determination listed *Alteration of Habitat,* following subsidence due to longwall coalmining, *a Key Threatening Process in Schedule 3 Part 2 of the Threatened Species Conservation Act 1995 (Gazettal.15/07/05).* Members of the Expert Panel are invited to familiarise themselves with determinations by the *State Scientific Committee* that are considered relevant to KORES project proposals for Wyong Water Catchment District. Long-term studies of LWM in USA also indicate reductions in diversity and abundance of aquatic invertebrates may still be evident 12 years after mining.
677.	Subsidence	ACA	SIG1	**5.1 ACARP Research on Longwall Coalmining (LWM)** The Australian Coal Association Research Programmes (ACARP) research reports: C8005 Stage 1 March 2001, C9067 Stage 2 June 2002, and C1023 of September 2003 details serious impacts arising from longwall coal mining subsidence in the Northern, Southern and Western coal fields o f NSW. Particular reference is drawn to *strata and hydrology of river valleys and river systems, lithology, sub-surface fracturing bed cracking and groundwater analysis.* Determinations in these two reports could be applied to proposals for coalmining in Yarramalong and Dooralong Valleys within Wyong Water Catchment.
678.	Subsidence	ACA	SIG1	A Department of Primary Industry (DPI) publication **PRIMEFACTS MINE SUBSIDENCE February 2006** is also relative to this submission due to explicatory considerations on longwall coalmining pertinent to the Wyong Water Catchment District supplying potable water resources to and from Mardi Dam. Longwall underground panels 4.4 km long x 250/300m.wide x 4-4.5m.high will penetrate 81(m. westerly into the Catchment District within the Yarramalong and Dooralong Valleys. *Repetitive longwall "coal panel air voids" (excavated coal areas) will cause major subsidence to undermine flood plains, drainage lines, creeks and rivers which supply some 50% o f potable water resources to Mardi Dam for community services.*
679.	Subsidence	ACA	SIG1	**6 MINING SUBSIDENCE** Kores state in their May 2013 newsletter that, *"The only direct impacts from the project will occur on suitability zoned land generally owned by W2CP at Buttonderry and Tooheys Road"* This statement is deceptive and would lead the lay person to believe that there will be no subsidence impacts on private land. The Department of Planning and Infrastructure has further exacerbated this confusion by declaring in a recent press release, *"The mining area is predominantly underneath Wyong State Forest".* Only one-fifth of the mine will be beneath the State Forest. Approximately 25% of the mine footprint will be under the Jilliby Conservation Area, and the balance of the mine (more than 50% of the mine surface area) will be directly under private property and the water catchment. New brick homes in the Hue Hue area subdivision through to the houses and farms of Jilliby, Dooralong and Wyong Creek will be affected by subsidence.
680.	Subsidence	ACA	SIG1	Wallarah 2 state in their EIS 245 private homes will be impacted by subsidence. In their newsletter and in presentations to local government they state, *"The large majority of these (homes) will experience only negligible to minor impacts from subsidence".* The way in which the subsidence information has been presented makes it impossible for property owners to determine which houses will be impacted by subsidence and to what extent. Kores distributed a leaflet that had on one side a map which could not be deciphered and therefore had no real benefit for property owners in the affected mine area. On the reverse side no mention was made as to the substantial impacts contained in their own Appendix H of the EIS. They merely said, *"homeowners should lodge a submission to the EIS".* Without any supporting data as to the true facts and without any personal consultation meant little to the person receiving it. The Wallarah 2 Project has not made any direct approach for consultation with local groups (i.e. Dooralong Valley Residents Association), and the property owners within the mine footprint.
681.	Subsidence	ACA	SIG1	Analyses of Appendix H subsidence data by our geo technical engineer, has revealed that the subsidence impacts will be catastrophic. 118 homes will be subsided from one metre up to 2.3 metres, 65 homes will be subsided from 200mm to 950 mm, and the balance of the homes by a lesser amount. (See Appendix 3)

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682.	Subsidence	ACA	SIG1	The EIS also reveals that insufficient consideration and mitigation strategies have been given to impacted properties, agricultural industry and Council assets, such as roads. Wallarah 2 merely states that the impact is within a subsidence zone and that Mine Subsidence Board will make good on the damages. History clearly reveals the problems and difficulty foisted upon property owners in trying to extract compensation from the Mine Subsidence Boards. Lives are destroyed for a generation or more.
683.	Subsidence Agriculture	ACA	SIG1	There has also been given no consideration to the impact of subsidence of the local agricultural industry. Page 17 of the Wallarah 2 EIS Executive Summary says, *"...a turf farm could require mitigating works and have a reduced production capability after subsidence impacts... The complete loss of turf farm production over a two-year period is estimated to have a maximum value of $0.86 Million per annum."* The document further doesn't place any significance of the impact that the disruption from subsidence has caused to ongoing viability of the turf farm and other agricultural businesses. It says, *"The overall total impacts to the agricultural contribution of the Disturbance Area, Subsidence Impact Limit and the biodiversity offset area is very small when compared to total agricultural production on a regional, state and national scale."* **This is nothing more than arrogance on the part of the proponent in demeaning the worth of those businesses and what their worth is to the local community and the business owner.** Any disruption, such as described, would make it extremely difficult, if not impossible, to recover from loss of clientele during the disruption period, and who would be forced to establish alternate business arrangements.
684.	Subsidence	ACA	SIG1	It is also noted that there has been no mitigating strategies from subsidence in respect of the transmission lines that cross the valley floor. The proponent merely says that they will continue to talk with Transgrid, but offer no viable solution to towers that may collapse, nor say how they would be re erected on unstable ground.
685.	Subsidence	ACA	SIG1	**6.1 Empirical Curve Assessments and Dichotomy** Dr. Gang Li, Principal Subsidence Mining Engineer, Department of Primary Industry NSW, clarified Dr L Holla's empirical curve determinations in assessing mining subsidence arising from longwall coalmining, i.e. ... *"that calculations cannot take account o f the constant unknown factors o f the geophysical change and range o f soil types within a mining lease".* Irrespective of any new sophisticated assessment technology, this unknown factor must, and will always dominate in subsidence assessments - *an assumption and hypothetical determination subjected to unknown variants that can cause unidentified serious major geophysical changes in the overburden above the valleys longwall coal panels within the 37sq. km o f mining areas.*
686.	Subsidence	ACA	SIG1	The question of a dichotomy does not arise. Dr. L. Holla's subsidence predictions were based upon perceived geophysical correlation between the Wallarah 2 coal zone areas and those of the Southern Coalfields of NSW at recorded mining depths of 300m-650m. Dr. L. Holla 0(.61m9-2.99m6) divided Wallarah 2 coal areas into 8 subsidence assessment zones ranging from 0.6m-2.9m and declared, *"there are no geological anomalies or topographical features modifying the standard subsidence behaviour".* Subsidence levels were assessed at coal depths of 2x600-650m, 1x500-600m and 5x 250-500m at a coal seam thickness of 2-6m and Pillar widths were @ 10% of mining depths. KORES statement . . . *"subsidence over longwall panels could be expected to cause transient (temporary) changes in groundwater storage components in shallow aquifers systems which will lead to very short term depletion of alluvial groundwater storage followed by a rapid recovery"..,* is extraordinary and misleading in view of excessive subsidence levels that were determined by Dr L. Holla. No research has been produced in support of this determination, which we consider erroneous and uncertifiable. KORES confirmation of *safety of catchment water* supplies conflicts with indisputable evidence, which demonstrates a catastrophic loss and severe destruction of water resources.
687.	Subsidence	ACA	SIG1	Subsidence predictions for areas in these two valleys reinforce an understanding of the "common system of procedural interpretation by *empirical curves' assessments".* The ACA has no reason to question these assessments in the knowledge that Holla's assessments were as a result of some 30 years experience in the industry in which he was held in very high esteem. They are at best, only a guide to events, providing that associated factors are relevant, **and that is the unknown factor and will always be so.**
688.	Subsidence	ACA	SIG1	**6.2 Subsidence Research** Research undertaken by Australian Coal Associations Research Programme (ACARP) and NSW State Scientific Committee clearly enunciate the damaging consequences arising from longwall coal mining. In a NSW publication - *Primefacts 2 Mining Subsidence Department of Primary Industry NSW February 2006* - details of this damaging mining procedure are discussed. *Ecological Sustainable Development* (ESD) and the *Precautionary Principles* are compromised if longwall mining occurred in this Proclaimed Catchment.

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689.	Subsidence	ACA	SIG1	**6.3 Subsidence Impacts** Horizontal subsidence is recorded extending to some 3km. This would negatively impact upon catchment areas and ***establish "additional" permeable transit water conduit pathways*** (identified in earlier geophysical surveys). These new "conduits" facilitate the ingress and drainage of raw water, which would adversely impact upon the dynamic water balance. The occurrence of subsidence was acknowledged although KORES have stated ***a)*** *"we will see and deal with this matter when it occurs and we will see what happens in the rock similar to those in the valleys where research is continuing"* and **b)** *"the local water catchment would not be damaged and subsidence was not expected to damage nearby rivers and aquifers".* These are misleading statements and have no validity. Detailed published evidence from the experience in the northern and southern coalfields of NSW is contrary to KORES statement/s.
690.	Subsidence	ACA	SIG1	Diega Creek in Lake Macquarie LGA is a classic example of the destruction of a creek system as a result of longwall coal mining. A recent Hunter-Central Rivers Management Authority report on Diega Creek *(Diega Creek Rivercare Plan, October 2003)* revealed that subsidence from longwall coal mining cracked the creek's rivers and beds, leaving it now no more than a dry river bed. *Cracks of up to 10cm wide formed after longwall mining under the creek between 1999 and 2005. (Impacts of Longwall Coal Mining in NSW. Total Environment Centre, January 2007. See appendix 4).*
691.	Subsidence	ACA	SIG1	Even the mining company, Oceanic Coal, has acknowledged in the Newcastle media its contribution to the serious decline in the health of the creek.
692.	Subsidence	ACA	SIG1	The Rivercare Plan addresses the result of longwall mining starting at Part 3.3 on page 30.
693.	Subsidence	ACA	SIG1	**3.3 *Mine* Impacts** Underground longwall mining commenced beneath certain sections of Diega Creek in 2000. Changes to the creek hydrology and geomorphology (geo=earth, morph=shape) took place as a result of subsequent land subsidence and tension cracking. These changes included creek bed fracture, subsequent creek flow interruption, bed-lowering and bank erosion. The most noticeable change to the creek setting, which has taken place as a result of those impacts in the loss of pools over more than half the study area. Holla and Barclay, 2000 state that cracks due to mine subsidence are associated with edges of longwall panels. The loss of flow and pools in the creek is caused by the effects of subsidence cracking on surface permeability and an increase in infiltration of precipitation and runoff. The impacts of the mining on Diega Creek became an increasing concern to the Department of Planning and Infrastructure. In its draft guidelines for mining operations on riverine corridors, DoPI lists the following as potential impacts of underground mining on stream systems: • Fracturing in stream beds and capture of stream flows • Bed cracks and fractures leading to incision, bed lowering and bank erosion • Sedimentation of stream systems as a result of induced erosion on bed and banks • Groundwater movement away from streams and alluvium"
694.	Subsidence	ACA	SIG1	The response from Kores to this issue is that - "The risk has been avoided in the case of Wyong River by excluding longwall panels under or in immediate proximity to the river."
695.	Subsidence	ACA	SIG1	The assertion regarding the geological setting of the overburden is not that there will be no subsidence. The assertion is a confirmation that there will be subsidence the magnitude of which is presently not known. It is cold comfort to the community to know that the geological setting "enhances the accuracy of subsidence prediction" when the magnitude is not known, but is likely to exceed 2.4 metres.
696.	Subsidence	ACA	SIG1	In 2001, the issue of water loss and damage was highlighted at the Commission o f Inquiry into the proposed Dendrobium Mine. In its submission, Sydney Catchment Authority said *"There is evidence of pools being drained, reduced flows and a reduction in water quality, a potential for cracking beneath swamps to drain a significant amount of water contained in the swamps. This could lead to drying of swamps - adversely affecting their ecological integrity but also reducing water flows down-stream. Practical means of remediation are generally not available".*
697.	Subsidence	ACA	SIG1	Recorded damage too many creek and river systems has been associated with *subsidence induced cracking within the stream bed. This was followed by significant dewatering of permanent pools and in some cases complete absence of flow, due to longwall coal mining. Water that re-emerged downstream was notably deoxygenated and heavily contaminated with iron deposits; no aquatic life was found in these areas. Reduction o f surface river flow was accompanied by the release of gas, fish kills, iron bacteria mats and deterioration of water quality. (Everett et. al. 1998).*

No.	Aspect	Stakeholder	ID	Issue
698.	Subsidence	ACA	SIG1	**At the June 2006 Wallarah 2 Coal Project community liaison meeting, Mr Graham Cowan, a senior engineer with the Department of Primary Industries, said (which appears in the minutes of that meeting) this about subsidence predications and subsequent damage:** ***"Until it (the longwall coal mine) is mined you won't know, things will change and they will be dealt with".***
699.	Subsidence	ACA	SIG1	The coal industry portrays longwall subsidence impacts as being a short-term problem, but subsidence problems, which has caused cracking of creeks and riverbeds and the subsequent compromise of their integrity, has been well recorded as a long-term problem (see Appendix Four). Once subsidence begins, the majority o f the ground movement does usually occur within the first three to nine months, however, experience has shown that sufficient ground movement to damage structures and thwart repair efforts often continues for many years. In the case of disrupted water tables and aquifers, no one can accurately forecast how long it will be, if ever, before usable water will once again be available.
700.	Subsidence	ACA	SIG1	The surface cracking associated with longwall mining degrades streams and groundwater resources. The cracking causes a large volume of rainfall and stream flow to sink into the ground; history shows that groundwater levels drop.
701.	Subsidence	ACA	SIG1	Given the documented experiences in recent years of the impacts of longwall coal mining on river and creek systems, such as Diega Creek, river bed cracking associated with the Dendrobium Mine, the Cataract River, the Upper Cataract River, and the Georges River, and as recently as the Mandalong mine in 2012, it beggars belief that in 2013 – • any responsible mining company • any competent mining engineer • any reputable hydrogeologist • any subsidence expert • any properly advised inquiry panel • any responsible Minister with any concern for the environment and properly understanding their respective functions could propose, support, recommend or approve a longwall mining proposal within, or even in proximity to, the riverine corridor o f two streams that account for some 53% of the combined Central Coast Water Supply. The material available reporting the experiences of the effect on longwall coal mining in the last decade leads to the inevitable conclusion that such mining under and immediately adjacent to Wyong Creek and Jilliby Jilliby Creek will cause catastrophic creek bed fracture, creek flow interruption, bed lowering and bank erosion. In short, there will be a devastating loss of a vitally important water supply
702.	Flooding	ACA	SIG1	**6.3.1 Flooding** Subsidence damage to the floodplain (Dooralong and Yarramalong Valleys) area can range from sinkholes to more than two-acre water traps. Large widespread troughs over mined out panels can severely disrupt surface drainage patterns making fields too wet to farm or carry out the various rural activities such as organic vegetable growing, orcharding, cattle grazing, turf farming and usefulness for the various horse studs and spelling facilities.
703.	Flooding	ACA	SIG1	Farm dams and major impoundments can have banks and shorelines disrupted and can even be drained. Cracks and deep fissures arising from subsidence would pose hazards to livestock, farm equipment, and vehicles on damaged roadways.
704.	Flooding	ACA	SIG1	Within the valleys catchment mining zones cracking, fracturing and faulting, arising from subsidence in these weakened geological areas, would create further "conduits" into the lower aquifers that would be subjected to "forced feeding" by volumetric water displacement and pressure gradients during seasonal flooding conditions and compounded by ponding in association. The major flood-prone low lying areas of Jilliby Jilliby Creek and Wyong River are subjected to extensive flooding from abnormal heavy recurring precipitation or from repetitive prolonged general rainfall periods when soil saturation is evident causing destructive and increased drainage flows, extensive scouring and property damage.
705.	Flooding	ACA	SIG1	Major subsidence throughout the catchment would compound flooding and ponding on access roads and properties. Geological faulting is exacerbated by "flood water pressure penetration" through "vertical drainage subsidence cracking" would open up further conduits to create weakness in the sub-strata and compounding the "draw angle"(limit of mining influence outside an extraction panel). Although longwall mining is designed to final collapse, fault lines and cracking areas would present a pathway for an uncontrollable "driving water force pressure" of some 1-tonne per cubic metre to penetrate and exploit these weakened areas. Depressed subsided landforms will retain, divert or impede raw water drainage and contribute to flooding hazards and increased water retention

No.	Aspect	Stakeholder	ID	Issue
				throughout both valleys. *The magnitude of such an occurrence will contribute adversely to the dynamic water balance within longwall mining areas.*
706.	Flooding	ACA	SIG1	At a minimum five homes would be forced into the 1 in 100-year flood zone. This situation is further exacerbated by the fact that since 1981 there has occurred the equivalent of six 1 in 100-year flood events.
707.	Groundwater	ACA	SIG1	**6.3.2 Groundwater Withdrawal** "A small change in effective stress of an engineering soil at depth is accompanied by a small change in volume when considering a column of soil. The application of a sustained "constant head" draw down to a groundwater regime triggers a subsidence process, which does not occur immediately. The response of the ***porous sediment, that forms the subsidence rate,*** will taper off gradually ***and can take many years before stability is re-established.*** The magnitude of the "draw down head" influences the resulting duration of subsidence and its limits conditioned by joints, reactivated joints, fractures and mining induced cracks etc.
708.	Groundwater	ACA	SIG1	Geological factors influence the stability, or instability of the site even in the absence of mining activities. Natural changes in the level and lateral movement of the ground surface are features that arise from seasonal changes. The type of geological conditions encountered at the surface overlying LWM operations strongly influences the general character and magnitude of the resulting subsidence. The presence of faults and natural fissured rocks can appreciably influence the nature of subsidence and strain profiles. Strength and rock type conditions can greatly influence the magnitude and limits of longwall mining". *(Whittaker, B.N. & Reddish, D. I Dept of Engineering University of Nottingham U K Elsevier Science Publications Amsterdam, Oxford, New York, Tokyo 1989 IBSN 0-444 8724-4. Vo156).*
709.	Groundwater	ACA	SIG1	"In lowering of the water table, drainage leaves "soil pore spaces" which allows particles to settle into voids vacated by water and the permeability is dependent upon soil type. ***A subsidence process is not reversible even on restoration of the water table to its original position and a fluctuating water table can weaken soil structures to induce structural collapse of soils resulting in subsidence.*** Further, soil shrinkage arising from reduced moisture content results in changes overall". *(Holla, L. Empirical Predictions Subsidence Movement Southern Coalfields NSW Int. Congress] 985a).*
710.	Groundwater	ACA	SIG1	Detailed research by ***L Razowska of the Polish Geological Institute, Upper Silesian Branch,*** recorded in the ***Journal of Hydrology No.244 6th December 2000*** the *Changes in Groundwater Chemistry caused by flooding of iron mines (Czestochowa Region, Southern Poland).* The emphasis is of course to water regimes and flooding arising from mining which can be applied to the KORES project: ***The hydro geological environment is always altered by mining activities due to drainage o f the aquifer, which results in the formation o f a cone of depression (Rubio and Lorca 1993) and the reduction of groundwater resources. The lowering o f the groundwater table changes groundwater recharge and discharge (Pigati and Lopez 1999) and causes catchment modifications (Dudgeon 1999). Flooding of the mines causes the rebound of the cone of depression but it also leads to significant pollution.***
711.	Groundwater	ACA	SIG1	The object of recording this study in this submission is to identify the dominant hydro geological and hydro geochemical processes ***operating in a disturbed aquifer*** and the attempt to predict any quality changes o f ground waters. Most certainly, this KORES project ***will cause serious subsidence and upsidence of valley floors and cracking of creek beds over the 37sq. km. mining zones.***
712.	Groundwater	ACA	SIG1	Subsidence will also destroy the riparian corridors in the Yarramalong and Dooralong Valleys due to interruption to the aquifers and the termination of normal flow regimes within these two corridors and their "drainage feeder creeks". It is also recognised that ***an environmental flow regime*** may not necessarily be a constant flow when such a flow, may be ecologically unsound as it fails to recognise natural variability - species in terrestrial and aquatic environments may be dependent upon seasonal variability, i.e., interrupted flow regimes but not cessation of flow in perpetuity, from a disturbed aquifer.
713.	Ecology	ACA	SIG1	**6.4 Subsidence and Biodiversity** Subsidence threatens biodiversity, ecological integrity, habitats, rivers, streams, creeks, flood plains, wetlands and species of national and international significance in the terrestrial and/or aquatic environments. *Subsidence will cause major destruction and permanent changes* to refuge areas, transit zones, food resources, habitats, ecosystems, community structures and composition in two major riparian river corridors of Yarramalong and Dooralong valleys. *A dramatic loss of aquatic species will occur from "drying out of critical aquatic habitats as normal and/or environmental flows are displaced or diverted into subsidence areas. Soil erosion, turbidity and changed stream chemistry will arise from subsidence impacts.*
714.	Ecology	ACA	SIG1	The Hunter-Central Rivers Catchment Management Authority expressed concern on the impact of longwall coal mining on Jilliby Jilliby Creek and Little Jilliby Jilliby Creek in the Jilliby Rivercare Plan, 2005.
715.	Ecology	ACA	SIG1	*"Conditions permitting longwall coal mining may be carried out in the future and this may have implications to the functioning of Jilliby and Little Jilliby Creeks. . . The impacts of the mining on Jilliby Creek are consistent with those which have become an increasing concern to the Hunter-Central Rivers*

No.	Aspect	Stakeholder	ID	Issue
				Catchment Management Authority (HCRCMA). In its draft guidelines for mining operations on riverine corridors, HCRCMA lists the following as potential impacts of underground mining on stream systems: • Fracturing in stream beds and capture of stream flows • Bed cracks and fractures leading to incision, bed lowering and bank erosion • Sedimentation of stream systems as a result of induced erosion on bed and banks • *Groundwater movement away from streams and alluvium*
716.	Surface Water	ACA	SIG1	**6.5 Subsidence and Hydrological Characteristics** The Minister for Mineral Resources (1988) instructed curtailment and authorised only partial extraction of coal resources in the Hue Hue Mine Subsidence Zone due to perceived subsidence problems arising. There was a clear understanding of serious deficiencies in general knowledge of hydrological and hydrogeological characteristics of these two valleys. The quantifiable level and time frame for recharge, from precipitation into these valley aquifers, in unknown but is considered to be over an extensive period. Current water balance and maintenance of this need still remains to be defined although it is recognised that seasonal precipitation over the Watagan Mountains, is the "recharge supply engine" to the catchment aquifers and coal seams together with natural flood plain surface and sub-surface drainage and permeation.
717.	Surface Water	ACA	SIG1	The recommended two-year water study, as recommended by the previous State Government before any consideration to the approval of longwall coal mining be given, was not undertaken by the proponent to quantify the dynamics of the surface and sub surface aquifers inter relationships over this period. This required the refurbishment of more than 200 bore holes. The proponent ignored this requirement! Instead they drilled five cluster bores on property owned by the proponent for the two-year study. It would seem that none of these results were used and submitted in the EIS. A study of the EIS bore mapping does not reveal any reference to these bore hole results having been used.
718.	Subsidence	ACA	SIG1	**6.6 Subsidence Cracking and Sealing** Media statements by KORES that *"subsidence will happen but self sealing of subsidence cracking will automatically occur from "plastic sedimentary deposition" o f alluvium, during sub-surface water movements,* is un certifiable, assumptive and inconclusive in a major fractured subsidence zone at mining depths of 320-500m. ***This supposition is flawed, without foundation and can be dangerously misleading in a sensitive high risk and critical public water supply resource zone.*** Temporary sealing is *"prone to collapse and wash out"* from trapped water pressures compounded by leaking aquifers in "cracking fracture zones" within subsidence areas. Subsidence will also *significantly and adversely impact on* ***the natural dynamic water balance*** *in local and regional groundwater regimes.* Longwall coalmining can be likened to an *"engineered discharge"* causing subsidence and connectivity between these water regimes as "panel voids" are repetitively established after coal recovery throughout the coal fields. *Very high conductivity and subsequent losses in water flow is a major feature arising from a dynamic subsidence wave. (ACARP)*
719.	Subsidence	ACA	SIG1	**6.7 Subsidence and Altered Chemical Properties** Subsidence cracks, joint sets and discrete fractures allow surface waters to mix with waters of altered chemical properties. *Loss of terrestrial and aquatic species will occur as a result of iron toxicity pollution i.e. . . . "bacteria commonly occur in Hawkesbury Sandstone where seepage through the rock is rich in iron compounds and able to grow in water lacking dissolved oxygen"* (Jones & Clark 1991). Subsidence induced cracking within a stream bed was followed by water that emerged downstream *"was notably deoxygenated and heavily contaminated with iron deposits; no aquatic life was found and the reduction of surface river flow was accompanied by release of gas, fish kills, iron bacteria mats and deterioration of water quality". . .* (Everett, et. al. 1998).
720.	Subsidence	ACA	SIG1	**6.8 Subsidence and In-stream Biota** Longwall mining (LWM) subsidence can dramatically change the diversity and abundance of aquatic organisms, which occur in rivers/streams. The recovery of in-stream biota communities in *our rivers, creeks and streams, which form part of the ecosystem and supporting food chain, must be considered as highly improbable. There will also be a further dramatic loss of aquatic organisms if the salinity and the electrical conductivity of these waters are changed as many organisms are* ***stenohaline -*** *tolerant of only small variations in salinity.*
721.	Groundwater	ACA	SIG1	**7 POLLUTION** **7.1 Coal Seam Waters** A heavily polluted ***"coal seam methane saturated saline, and highly mineralised (with anolytes) aquifer,*** represents a dangerous threat from

No.	Aspect	Stakeholder	ID	Issue
				"subsidence cracking." *"Cracking" will permit alluvial aquifer flow to intercept polluted coal seam waters prior to their discharge into the Wyong River.* ***Natural drainage flow is not trapped by alluvium translocation*** during surface/sub-surface drainage flow. The ecological health of water resources is predicated upon land use management, protecting stream health and the environmental flows requiring management and maintenance of high conservation and environmental values. ***Subsidence will compromise/destroy the ecological health o f potable water resources drawn from this catchment and seriously impact upon the environmental integrity within the catchment.***
722.	Surface Water	ACA	SIG1	**7.2 Wyong River and Tuggerah Lakes Estuary** The Tuggerah Lakes Barrier Estuary is a major food resource habitat for nineteen International and National avifauna migratory waders protected under NSW State and Commonwealth Regulatory Acts and the China/Australia and Japan/Australia International Bird Treaties (CAMBA and JAMBA) under the Bonn Convention. *The pollution of Wyong River will occur (from subsidence and cracking) at the interception of heavily polluted coal seam water, which will poison aquatic organisms during discharge into the estuarine sediments and aquatic habitats of Tuggerah Lakes.*
723.	Ecology	ACA	SIG1	**8 TUGGERAH LAKE MESOTROPHIC BARRIER ESTUARY** An independent enquiry into the NSW Coastal Lakes - Healthy Rivers Commission April 2002 - reports Tuggerah Lakes as at extreme risk, modified, of high conservation value with a potential for rehabilitation of modified ecosystem processes. *Longwall coal mining would negate* and *compound progressively* ***proposed rehabilitation processes as longwall coal panels penetrate*** westerly beneath valley flood plains, rivers and creeks. Ecological processes, which maintain the biological diversity, are dependent upon periodic inundation of the flood plains and wetlands and continuity of movement of aquatic organisms between fresh water inflow and estuarine habitats. ***These requirements are compromised by longwall coalmining.***
724.	Ecology	ACA	SIG1	Estuarine benthic habitats depend upon ecologically sustainable foreshore management and Catchment management - ***two critical pivotal roles to maintain this interdependency*** between the catchment, the barrier estuary and Tuggerah Bay (identified as an ecological sensitive habitat within the estuary). *Polluted coal seam waters will destroy this sensitive environment. It* is clearly evident that the ecological integrity of stream corridors and their flow regimes must be protected and actively managed if these water resources are to maintain their qualitative ecological integrity. It is clearly evident that ***Ecological Sustainable Development and the Precautionary Principles will be compromised by longwall coalmining.***
725.	Ecology	ACA	SIG1	**9 RIPARIAN GREEN CORRIDORS** Protection of raw water in the catchment, and flow regimes within the two Riparian Corridors (providing transit lanes, habitat, food and refuge areas) is paramount in any catchment management plan. The need for ***ecological sustainable development (ESD)*** and applications of ***the precautionary principle (PP)*** are compromised by ***longwall mining (LWM).*** When researched by Department of Primary Industry NSW and the State Scientific Committee in 1994/95 it was determined that LWM is a ***Key Threatening Process*** under the ***Threatened Species Conservation Act 1995*** in view of the excessive environmental damage it creates.
726.	Ecology	ACA	SIG1	Maintaining the ecological integrity of riparian corridors is critical as these waterways also assist in controlling drainage flow from excessive flood levels after heavy seasonal precipitation. A healthy corridor of native vegetation including grasses, rushes, trees shrubs and vines, assists in maintaining river bank stability against high stream flows and also reduces turbidity within the flow. Native vegetation provides an important food source (for macro vertebrates and terrestrial animals) and acts as a buffer and filter assisting to prevent contaminant movements. ***LWM subsidence will destroy critical sensitive environmental areas.***
727.	Ecology	ACA	SIG1	**10 CONNECTIVITY** Connectivity between pools provides refuge for aquatic fauna and aquatic flora - the latter are a stabilisation factor of sediment and oxygenated waters to form the basis o f aquatic food chain and channel stability - the Geomorphic factors - which may be reduced from recurring subsidence. Changing water balance influences' soil shrinkage behaviour, its permeability and lowers a water table creating instability. ***Subsidence will destroy these attributes and environmental flows, which are essential for maintenance and protection of wildlife, ecosystems and habitats within these two essential wildlife corridors.***
728.	Surface Water	ACA	SIG1	**11 POLLUTED COAL SEAM WATER STORAGE DAMS** The polluted coal seam waters Mine Operations Storage Dam will be responsible for the retention of some 30ML/per month rising to some 900ML/per

No.	Aspect	Stakeholder	ID	Issue
				month. *These extraordinary high levels of heavily polluted coal seam waters present "a life of mine immediate danger" from leakage within their storage area and consequent interception of natural drainage flow into Wallarah Creek wetlands to discharge into Budgewoi Lake.* There is no evidence of secure containment" and/or "protective impervious sealing procedures" to prevent leakage of these stored polluted coal waters.
729.	Surface Water	ACA	SIG1	A storm event, such as that which occurred on the June 2007 long weekend, could present problems in the containment o f this contaminated mine water and preventing it from entering the Porter's Creek wetlands. Storm and flooding events o f similar magnitude, 1/100 year events, have occurred in recent times in 1974, 1981, 1989, 1991 and 1996. The Insurance Australia Group web site now predicts those previous 1/100 storm events (such as was experienced in June 2007) can now be expected every 17 years. However, from the climatic charges now occurring due to global warming and the evident previously recorded dates, this type of event is likely to be far more frequent.
730.	General	ACA	SIG1	**12 ENVIRONMENTAL RESOURCE MANAGEMENT** **12.1 Natural Resource Management** The granting a license to operate longwall coal mining in these two valleys *would be in direct conflict with the NSW Government decision in April 2003 to introduce* ***"A new Approach to Natural Resource Management".*** This decision resulted in the appointment, by The Hon. Premier B. Carr M.P. of a Native Vegetation Reform Implementation Group (NVRIG) Chaired by the Right Honourable Ian Sinclair AC together with NSW Farmers' Association, peak environmental interests, the Wentworth Group and representatives of key Government agencies. The object was to ". . . *ensure a solid foundation for better protection of our native vegetation and natural resources"* with an allocation of $406.3 million dollars to fund locally driven organisations and land managers. Most certainly, the authoritative responsibility of this new body must be clearly directed to maintaining the ***Charter,*** clearly laid down in a number of determinations in the document - ***A New Approach to Natural Resource Management*** and particularly regarding: *"providing protection for significant areas of native vegetation, including areas that are classified as endangered or vulnerable under current arrangements"* and *"providing exemptions which will be restricted to clearly defined routine agricultural activities"*
731.	General	ACA	SIG1	**12.2 Proclaimed Wyong Water Catchment Act and Statutes** Attention is drawn to Page 1.Section 1 of The Proclaimed Wyong Water Catchment Statutes 401(2)(b) and 2(h) and the following Threatened Species Protection legislation for species protected under the Commonwealth EPBC Act 1999 and the NSW Sate Act 1995 (Refer Section 17 below). This submission has indicated the adverse nature of longwall mining technology and the serious environmental degradation arising which must surely raise the question o f due diligence being exercised by the Expert Panel, in advice to the NSW Government. The granting of a license to operate a coal mining operation in this proclaimed water catchment, in the full knowledge of the serious adverse outcomes which can arise, is in direct contradiction to the aims, expectations and need for maintaining intergenerational equity. It would also contradict clearly defined environmental standards both scientific and social in the protection o f wildlife species of International and National Significance on the Australian continent. The Natural Resources Commission and Advisory Council is the consulting authority.
732.	Ecology	ACA	SIG1	**13 THREATENED SPECIES PROTECTION** **13.1 Commonwealth Environment Protection and Biodiversity Conservation Act (EPBC Act1999)** Australia's international bird treaty obligations (Bonn Convention) to JAMBA, CAMBA and ROKCAMBA protecting 19 avifauna migratory waders of National and International and Significance whose fragile habitat is entirely dependent upon the health of the water catchment river systems. Alteration to Habitat, following uncontrollable subsidence (active and residual) arising from long wall coal mining, has been determined by the NSW Scientific Committee as a Key Threatening Process under Schedule 3. Part 2. of the Threatened Species Conservation Act 1995. (Gazzetal date 15/07/05). Current Listing

Scientific Name	Common Name	CAMBA Annex	JAMBA Annex	Wader

No.	Aspect	Stakeholder	ID	Issue
				(nested table below)

Ardea alba	Great Egret	*	*	*
Ardea ibis	Cattle Egret	*	*	*
Plegadis falcinellus	Glossy ibis	*		*
Hallaeetus leucogaster	White Bellied Sea Eagle	*	*	*
Gallinago hardwickii	Lathams Snipe	*	*	*
Limosa lapponica	Bar-Tailed Godwit	*	*	*
Numenius madagascariensis	Eastern Curlew	*	*	*
Tringa stagnatilis	Marsh Sandpiper	*	*	*
Tringa nebularia	Common Greenshank	*	*	*
Calidris canutus	Red Knot	*	*	*
Calidris ruficollis	Red-necked Stint	*	*	*
Calidris acuminata	Sharp-tailed Sandpiper	*	*	*
Calidris .ferruginea	Curlew Sandpiper	*	*	*
Pluvialis fulva	Pacific Golden Plover	*	*	*
Sterna caspia	Caspian Tern	*	*	*
Sterna albifrons	Little Tern	*	*	*
Chlidonias leucopterus	White- winged black Tern	*	*	*
Hirundapus caudacutus	White-throated Needletail	*	*	*
Apus pacificus	Fork-tailed Swift	*	*	*
	TOTAL	19	17	

Reference Data:

- *New Atlas of Australian Birds. 1998-2005. NSW.*
- *Australian Government Department o f Environment and Heritage, Canberra.*

<table>
<tr><th>No.</th><th>Aspect</th><th>Stakeholder</th><th>ID</th><th>Issue</th></tr>
<tr><td></td><td></td><td></td><td></td><td>• Marine Division. Listed Migratory Species under JAMBA and CA MBA. 24/08/06</td></tr>
<tr><td>733.</td><td>Ecology</td><td>ACA</td><td>SIG1</td><td>13.2 NSW Threatened Species Conservation Act 1995(TS Conservation Act 1995.)
Ref: Data Exchange SIAS Group NPWS 16/07/07 advise: 23 species of fauna and 4 species of flora re registered under the TS Con. Act 1995. 9 species of fauna are also protected under the EPBC Act 1999 and are additional to the 19 species of migratory waders of International significance.
Species Protected under the EPBC Act
<table>
<tr><td>Myobatrachidae</td><td>Mixophyes balbus</td><td>Stuttering Frog</td><td>Endangered</td></tr>
<tr><td></td><td>" "</td><td>Giant Barred Frog</td><td>Endangered</td></tr>
<tr><td>Cacatuldae</td><td>Calyptorhnynchus lathami</td><td>Glossy Black Cockatoo</td><td>Vulnerable</td></tr>
<tr><td>Mellphagidae</td><td>Xanthomyza phrygia</td><td>Regent Honeyeater</td><td>Endangered</td></tr>
<tr><td>Tytonidae</td><td>Tyto novaehollandiae</td><td>Masked Owl</td><td>Vulnerable</td></tr>
<tr><td>Dasyuridae</td><td>Dasyurus maculatus</td><td>Spotted-tailed Quoll</td><td>Vulnerable</td></tr>
<tr><td>Petauridae</td><td>Petaurus australis</td><td>Yellow-bellied Glider</td><td>Vulnerable</td></tr>
<tr><td>Pteropodidae</td><td>Pteropus poliocephalus</td><td>Grey-headed Flying Fox</td><td>Vulnerable</td></tr>
</table>
It should be noted that westerly and southerly sections, of the 37sq.km of longwall coal mining, pass under Jilliby Jilliby State Conservation Area and Wyong State Forest. These exceptional communities of Vulnerable and/or Endangered wildlife will be threatened by LWM subsidence causing serious environmental degradation throughout the coal zones in the Yarramalong and Dooralong Valleys within the Proclaimed Wyong Water Catchment District. It would be considered an act of criminal negligence to permit coal mining, and then compound the situation by allowing venting of coal seam methane into environmentally species sensitive areas, of exceptional significance, for the Eastern Pygmy Possum, Greater Glider, Koala, Squirrel Glider and Yellow Bellied Glider (also refer 16.1).</td></tr>
<tr><td>734.</td><td>Social</td><td>ACA</td><td>SIG1</td><td>14 SOCIAL ACCEPTANCE
Social Implications of a large scale coal mine
Kores had failed in their duty to obtain the "Social Licence to Operate" and win the hearts and minds of the affected populous. The subsidence parameters have never been discussed in open forum. Kores deliberately remain silent on this and many others issues.</td></tr>
<tr><td>735.</td><td>Social</td><td>ACA</td><td>SIG1</td><td>Various issues, unfavourable to the social amenity of Wyong and to residents who would be directly impacted by the Wallarah 2 mine, has now been uncovered from the recesses of the E.I.S, heavily camouflaged, and have conveyed a very distressing message to those who live over the footprint of the mine.</td></tr>
<tr><td>736.</td><td>General</td><td>ACA</td><td>SIG1</td><td>The water study is consistent with that found within their first submission. Other essential material was also found.</td></tr>
<tr><td>737.</td><td>General</td><td>ACA</td><td>SIG1</td><td>Kores demonstrate in their actions a belief that they are owed a mine by the State Government, and further believe that the water issue will go away if it is not discussed in open forum.</td></tr>
<tr><td>738.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>They continually espouse their belief that aquicludes exist in the upper surface alluvials, which will prohibit vertical downward water migration. This myth has again been debunked by Professor Philip Pells, who clearly demonstrates that the water table will drop around 100 meters. Several other experienced geoscientists and water consultants have as well rallied against the aquiclude theory, including ERM Mitchell McCotter (consultants for the original proponents BHP Billiton) and have determined independently that longwall mining will destroy the surface aquifers.</td></tr>
<tr><td>739.</td><td>Groundwater</td><td>ACA</td><td>SIG1</td><td>ERM Mitchell McCotter said that "silt and clay lenses are not anticipated to impede the transmission of bulk water" down to the coal seam.</td></tr>
<tr><td>740.</td><td>Subsidence</td><td>ACA</td><td>SIG1</td><td>Clearly identified within the voluminous Wallarah 2 EIS was the following:
• 245 houses will be subjected to vertical subsidence of up to 2.3 metres. The breakdown being
    o 13 houses will subside more than 2 metres</td></tr>
</table>

No.	Aspect	Stakeholder	ID	Issue
				o 105 houses will subside from between 1 metre and 2 metres o 65 houses will subside from 200mm up to 1 metre. • The balance of the houses to a lesser amount. • 755 rural structures are listed in the EIS as being affected by subsidence. • 420 farm dams will be affected by subsidence. A high price to pay!
741.	Consultation	ACA	SIG1	Against this Kores have continued to publish statements proclaiming that this mine will not impact on the community. Water, dust, subsidence are manageable and pose no problems. An outright lie deluding no-one.
742.	Consultation	ACA	SIG1	Not once in the 8 years that the ACA have been involved in opposing the Wallarah 2 proposal has Kores produced logical, accurate and believable facts. Not once has Kores involved itself with the local valley populations as suggested within the E.I.S. Kores is apprehensive in meeting the local people.
743.	General	ACA	SIG1	We believe Kores has not been candid in producing vital information to the general public.
744.	General	ACA	SIG1	Kores should not be granted a mining licence
745.	General	ACA	SIG1	That the process of evaluation should involve the "Precautionary Principle”
746.	General	ACA	SIG1	That failure to implement this procedure will have devastating consequences on the environment, the shallow surface aquifers providing water for over 300,000 people and the decimation of 1 if not 2 pristine valleys and their eco systems.
747.	General	ACA	SIG1	That adaptive conditions should have no consideration in the decision making process as it did in the last submission where 42 latent conditions were tabled.
748.	General	ACA	SIG1	That a public arena be provided in order to debate the real issues involved with this mine together with the Planning Assessment Commission.
749.	General	ACA	SIG1	That longwall mining has no place in a burgeoning area such as the North Wyong Region with its exploding population, under a proclaimed water catchment area and its surface facilities impacting on the fastest growth area in the State.
750.	Air Quality	ACA	SIG1	**15 COAL DUST AND HEALTH** **15.1 Coal Dust** Against a backdrop of the increasing influx of young families and an aged population, there are other factors arising from the proposed coal development with the potential to affect the social capital of the newly created area. With reference to the NSW Health - Mine Dust and You - fact sheet, Issued January 2006 the potential for amenity impacts will become apparent
751.	Air Quality	ACA	SIG1	Dust settling on fresh laundry and ear's duco will be some aspect of the proposed development that a resident will have to deal within the home, but of equal importance in a distance of 2.4 - 3.2 kilometres of the proposed stockpile facility are the schools of Blue Haven Public, Lake Haven, Woongarrah and Warnervale. At times of high dust levels, the department's advice is to keep Windows and doors closed - outdoor activities should be limited.
752.	Air Quality	ACA	SIG1	What advice does the Department of Planning and Infrastructure suggest should be given to the new schools, sporting groups and open space users that already will be in existence prior to any approvals given for an above ground facility? What monitoring will/could be done and what if levels of dust are unsafe and how will the open space users or be notified and/or restricted?
753.	Air Quality Health	ACA	SIG1	People who may be susceptible to the health effects of airborne coal dust are: • infants, children and adolescents (there is an increase of young families moving into Wyong Shire and an increase in child-care facilities) • elderly (there a large aged population in Wyong Shire) • people with respiratory conditions such as asthma, bronchitis and emphysema • people with heart disease people with diabetes The impact on your health from breathing in coal dust can be: • cough • wheeze, or worsening of asthma • increased need for medications (e.g. puffers, antibiotics) • increased breathlessness High levels of Total Suspended Particulate Matter (TSP) may also cause coughing, sneezing and sore eyes.

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754.	Air Quality	ACA	SIG1	**15.2 Coal Dust Pollutants and Coal Handling Facility** Coal Dust Pollutants, both respirable and inspirable suspended particulate matter indicates a health hazard as coal dust entering the respiratory tract may be further divided into respirable (very fine dust) which reaches the lower bronchiales and alveolar regions of the lung. Local Meteorology — wind speed direction and stability from the Tooheys Road rail loop coal dump and infrastructure site - would most certainly transport particulates from the 250,000 tonnes product stockpile, the 4000 tonnes' p/hr. constant traffic input from the minehead into Tooheys Road coal dump, a 2000t.p/hr. overhead tripper to stack crushed coal on the 250,000 tonne product stockpile and a 4500t/phr. train loading system. Coal dust particulates will, under suitable wind pressures, extend to some 10kms from Tooheys Road rail loop, which will inundate Wyong Hospital, schools, the new Warnervale Township, and the urban expansion around it, and extending into the outer urban areas and Wyong Township. Coal loading, dust and noise will be a repetitive 24hr. cycle operation continuing for 42 years. The ACA has viewed coal dust problems in the Hunter mining area and note that although dust suppression requirements are in force, it is quite inadequate to control. We consider that these polluting conditions will prevail in the Wallarah 2 project and this will compounded by uncovered coal trains permitting continual release of coal dust particulates throughout their transit areas to Newcastle docks.
755.	Air Quality	ACA	SIG1	Coalmine dust is heterogeneous mixture containing more than 50 elements and their oxides, which cause severe lung disorders and other invasive registered dangerous medical conditions.
756.	Air Quality	ACA	SIG1	The current National Environmental Protection Measures (NEPM) for ambient Air regarding particulate matter specifies a goal of 50 ugm-3 with a diameter of less than 10 microns (PM10). Recent studies confirm that in urban areas, PM 2.5 is overwhelmingly the most significant fraction-60%- of total suspended particulates (TSP) taking into consideration particle size, weight and wind velocity, which determines distance to a receptor. Particle fractions (PM10 and PM2.5) are capable of entering the human respiratory tract whereas coarse particulates - larger particles - although considered a nuisance is unable to enter the human respiratory tract and are not generally considered to pose a health risk. It is recorded that sensitive receptors, at less than 3km. distance from active areas of the mine, is at risk as air quality standards deteriorate with greater concentrations of heavier particulates. Transport of fine particulates leads to higher proportionate of distribution at some distance from the coal mine/ workings. The new Wamervale town site and other residential areas will be subjected to serious coal dust particulates/pollution.
757.	Air Quality	ACA	SIG1	**15.2.1 Control of Coal Dust** The experience in other areas has shown that it is impossible to control the spread of airborne coal dust. In Gladstone, Queensland, it has been clearly demonstrated that control of dust is not successful. Anger is growing in Central Queensland that black coal dust is blanketing the community of Gladstone. The community is seeking answers as to what they see as a growing problem. *"The coal dust is coming into my house and into my cupboards, **I** have to wash my plates before I even use them,"* one resident said. *"I'm going to court and I'm seeking massive damages,"* said local business owner Evan Ryan. This example in Gladstone demonstrates that it is not possible to guarantee that coal dust won't be emitted from the area causing adverse effects.
758.	Air Quality Health	ACA	SIG1	The medical profession views the potential risk of coal dust as serious and this would add to the already high levels of respiratory problems experienced by residents on the Central Coast. Avoidable deaths from respiratory system diseases are already above State and Australian averages. Central Coast children have high rates of Asthma. *(Population health profile, Central Coast NSW Division of General Practice: supplement. March 2007).*
759.	Air Quality Health	ACA	SIG1	**15.3 Health Impacts and Air Quality** Page 11 of the Executive Summary candidly points to the expected death ratio associated with this development caused by exposure to dust and contaminants. It states, ***"Analysis provided conservative estimates o f the increase in annual and daily mortality due to dust emissions from the Project at the most affected receiver on the worst day. The increase in risk of daily mortality on the worst day of the life of the Project is estimated to be approximately I in 100,000 and as such represents a small risk"***
760.	Air Quality Health	ACA	SIG1	Pages 9 to 17 of the Health Assessment Risk Report, again candidly points to the expected death ratio associated with this development caused by exposure to dust and contaminants. It again states there is a chance of an increase in mortality of 1 in 100,000 of the population. This is a conservative estimate only and does not take into account the increasing population growth o f the northern suburbs of Wyong Shire, nor does it take into account people with diabetes, heart disease and respiratory ailments, all o f who are extremely susceptible to debilitating and terminal illness from fine airborne coal dust particulates.
761.	Air Quality	ACA	SIG1	Further, the EIS does not seem to be based on localised data even though for decades the medical profession has voiced its concern over the higher

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	Health			rates of respiratory diseases particularly in the northern areas o f Wyong Shire. Surely the rate of mortality and morbidity would be greater given the following data being taken into account.
762.	Air Quality Health	ACA	SIG1	As far back as 1985, Lake Munmorah Public School respiratory conditions were evident in about 40% of children, including 76 children having asthma. Doctors at Lake Munmorah recorded 30% of children attending their surgery had respiratory problems, which was double the national average, and they signed a letter to suggest that, from their own research, the source of this problem was the power industry (including coal stockpiling and handling) complexes existing in near proximity.
763.	Air Quality Health	ACA	SIG1	Since that time the broad community has called on successive governments to begin a cumulative air quality study of the area but each time this has failed to emerge. This was clearly pointed out at the 2010 PAC Hearing into this same Wallarah 2 proposal.
764.	Air Quality Health	ACA	SIG1	According to Wyong Council State of the Environment Report 2008/9 Total Suspended Particles (TSP) in the shire DOUBLED between 1994 and 2008.
765.	Air Quality Health	ACA	SIG1	Dr. Peter Lewis, Director of Public Health for the Central Coast and Northern Sydney in his submission to the previous PAC in 2010 (which was incidentally hidden out of public view by the Department of Planning at the time) states: *"A major concern is the level of increased particulate pollution experienced well beyond the boundaries o f the land owned by the proponents at both Buttonderg and Tooheys Road sites. This concern exists because any increased exposure to particulate pollution is associated with increased adverse health outcomes, EVEN IF the levels are BELOW the current guidelines."* "The predicted lOug/cm increase in PM10 will produce increased respiratory and morbidity among residents. "Assessment focuses on deaths and hospitalisations, ignoring the more commonly seen increase in respiratory symptoms associated with increasing particulate pollution, e.g., children having chest colds, night-time cough and trips to the doctor. There is little acknowledgement of population growth in the areas with increased particulate pollution for the Health Risk Assessment". "Projects of the scale of Wallarah 2 Coal Project must be considered in the context of the whole region, not as a standalone project". Doctor Lewis is highly qualified to comment as he did. He won the Medical Journal of Australia Wyeth Award for his research on the effects o f particulate pollution on children in Newcastle and Wollongong. One would have thought that on the basis of history of health issues in the northern area of Wyong that the previous PAC would have rejected the project. It must be remembered that the previous Government in March 2011 eventually rejected this mine proposal on the basis of unacceptable impacts to the region. It continues to astound residents of this region that companies such as Kores and Governments themselves are prepared to push on regardless knowing full well that major impacts will almost certainly result in growth o f respiratory diseases and other more serious diseases perhaps various cancers in the local population as time proceeds. Disappointingly, the current NSW Government, without any on ground consultation with those o f us involved in expressing public health concerns over decades, decided to place an air monitor system to evaluate Wyong air quality on the Wyong Racecourse complex. This location is remote from emitting industries in the north, and is an isolated and benign atmosphere with only the nearby railway to impact upon it. Lower range pollutant readings are highly likely to result.
766.	Air Quality Health	ACA	SIG1	The Tooheys Road complex is only 2kms from nearby Blue Haven which contains schools and several pre-schools and only 3klms to the new expanding Wyee township, where only recently a 1000 housing lot development has been planned right next to the railway upon which the coal trains will travel. The EIS states that Annual Coal Dust emissions from the Tooheys Road stockpiles, works and conveyor systems will total about 68,000 kilograms of TSP's and at Buttonderry another 23,337 kilograms of TSP's will emanate from the ventilation shaft. In both circumstances that is a huge impost into the air in which the associated population must endure. The EIS (in Appendix M page 6) states that: "Over the last few decades, there has been a substantial amount of research that added to the evidence that breathing PM is harmful to human health". The EIS lacks a proper map of probable deposition of dust particles encompassing the broad area including addressing the deposition of coal dust along the rail corridor. It is known that the coal trains will not be covered and so coal dust will be of a concern both in the loaded trip and the return trip. Recent revelations along the Hunter rail corridor emphasise that this problem is downplayed.
767.	Air Quality Health	ACA	SIG1	The PAEHolmes report (Appendix L, page 55) suggests that the trip from Tooheys Road to the Port of Newcastle is "relatively short" (Relative to what, at trip through deserted regions of WA?). Any casual observer would laugh that this be considered a truthful statement and suggest that the author should

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				take this trip through the southern suburbs of Lake Macquarie and Newcastle.
768.	Air Quality Health	ACA	SIG1	The accumulated Greenhouse Gas Emissions from this project over an extent of 38 years are totalled as 360,866,275 tons of CO2 expressed as (t CO2-e). (Appendix L, page 59). It would seem that for the sake of future generations and for the general health o f the planet, that this mine should never be considered. The costs are too great. The cost to our health and our environment is never expressed in valued cost to us now or for the future.
769.	Air Quality Health	ACA	SIG1	**15.3.1 Airborne Coal Dust** Population projections in the northern suburbs of Wyong Shire (the area that would be most affected by airborne coal dust) show a staggering 100% increase in growth in the 10-yearperiod to 2106. With diabetes for the Central Coast matching the NSW prevalence, the projected growth will place greater demands on the health system and that need must be supplemented. A NSW Health publication (issued January 2006) indicates that people such as those with diabetes may be ***"more susceptible to the health effects of fine and coarse particles".*** Further, the department of Health advise that those more susceptible to health effects of dust missions in the air as a result of mining activities include infants, elderly, those with respiratory conditions such as asthma and heart disease.
770.	Air Quality Health	ACA	SIG1	The northern area of Wyong Shire has a high prevalence of young families moving into the area, and an extremely high aged population - the two groups most susceptible to disease and respiratory ailments from coal dust.
771.	Air Quality Health	ACA	SIG1	Twenty years ago it was firmly established that the incidence of asthma and other respiratory ailments was high in the northern part of Wyong Shire due the placing of the power stations and their coal facilities. A coal handling facility adjacent to the largest urban growth area in NSW would only exacerbate this problem.
772.	Noise	ACA	SIG1	**16 NOISE** Another consideration in terms of noise must be on the employment activities of current and future residents. Residential suburbs such as Blue Haven have a high number of commuter residents. People choose to live there because of its proximity to the F3 Freeway. The people characteristically leave home early in the morning and return in the early evening. Many may also be involved in night work. Sleep patterns for these residents are very important and reduced sleep resulting in noise related activities may result in heightened levels o f stress and associated productivity losses. The most consistent impact of insomnia is a high risk of depression. *(I. Insomnia: Epidemiology, Characteristics, and Consequences. Clinical Cornerstone Vol. 5, No. 3. 2003 Excerpta Medica, Inc.* *(2. Maria Thomas, Helen Sing, Gregory Belenky, Henry Holcomb, Helen May berg, Robert Dannals, Henry Wagner Jr., David Thorne, Kathryn Popp, Laura Rowland, Amy Welsh, Sharon Balwinski, Daniel Redmond (2000) — Neutral basis o f alertness and cognitive performance impairments during sleepiness. 1. Effects of 24 h of sleep deprivation on waking human regional brain activity. Journal o f Sleep Research 9 (4), 335-352 .)*
773.	Greenhouse Gas	ACA	SIG1	**17 INTERGENERATIONAL EQUITY & CLIMATE CHANGE** The topic of green house gas production is one that cannot be dismissed. Whilst the proposed final destination of the coal to be extracted is overseas, the proposed development will generate as a final end, produced green house gas. The two forms of green house gas concerns lodged by the Alliance are the burning of the coal and the coal seam methane released as the coal is extracted. Australia has the highest per capita green house gas emission's figure in the world (Australian Institute Figures) and coal accounts for approximately 35% of Australia's greenhouse emissions (2003 Australian Greenhouse Office figures) with coal being the fastest growing source of greenhouse gas emissions in Australia.
774.	Greenhouse Gas	ACA	SIG1	For the next 42 years of the proposed development, coal will be burnt, green house gas, both in the extraction and the burning o f the product, will occur and the generations of successive Australians will suffer as result of this.
775.	Greenhouse Gas	ACA	SIG1	The ruling, by Justice Nicola Pain, has ramifications when considering major projects such as the KORES proposal. The ruling requires that the Government will now have to take account o f the greenhouse gas emissions from burning the mine's output. There seems to be no calculations made in regards to the Wallarah 2 proposal at this stage. The Panel might like to explore this area, as the final project would impact heavily on Climate Change issues, to determine the total amount of CO2 that will be produced and how the proponent seeks to modify or ameliorate the greenhouse gases as a result o f this development.
776.	Greenhouse Gas	ACA	SIG1	Similarly, Central Coast residents have raised very strong concerns by the use of desalination plants for water purifying. These water-purifying plants are themselves large users of power as well as noise production. The Alliance seeks more information on the total power consumption of the mine's operation.
777.	General	ACA	SIG1	Intergenerational equality questions arise from the alienation of the State Forests for mine ventilation stacks for the proposed 42 years of the lease. How

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				will these ventilation stacks be monitored and what impacts will they have on flora and fauna in the State forests? What height are these units and what noise do they produce from operation?
778.	General	ACA	SIG1	Other intergenerational equality concerns are the proposed rezoning and alienation of 6(a) open space lands. Can the proponent outline the cost to the community of the alienation of these lands for 42 years?
779.	General	ACA	SIG1	Further amenity issues arising from the preliminary report by the proponent are the use of lighting. Lighting in what areas and for what times? And how is the lighting to be diffused so as not to disrupt local amenity?
780.	General	ACA	SIG1	Further concerns of intergenerational equality are the subsidence issues as a direct result of the proposed development. Whilst water is one area of potential damage by subsidence, the Alliance raises issues of road construction and maintenance, building construction and restrictions (reference is made to the Valleys Studies of Wyong Shire Council) and any damage done to local open space and recreational areas such as the State Forests and sporting fields.
781.	Greenhouse Gas	ACA	SIG1	**17.1 Climate Change** The mine is unacceptable from changes to climate. These impacts include: • Increased global average temperatures — unacceptable • Increased acidity of the ocean — unacceptable • Direct economic cost — unacceptable • Increased human suffering — unacceptable • Decreased rainfall — unacceptable • More intense drought — unacceptable • Increased storm intensity — unacceptable • Increased flooding / storm surge — unacceptable • Loss of biodiversity — unacceptable • Decreased water supply — unacceptable • Decreased food supply — unacceptable • Loss of coastal land / property — unacceptable • Decreased human health — unacceptable • Increased human disease — unacceptable • Decreased fish and other ocean resources — unacceptable • Political unrest — unacceptable • Destabilization of human society — unacceptable
782.	Greenhouse Gas	ACA	SIG1	The EIS and the Statement of Commitments does not adequately address the impact of the mine on global warming or on ocean acidification.
783.	General	ACA	SIG1	It is noted that the conditions imposed on mines are not enforced and mines break their conditions as a matter of course. This makes the proposed mine even more unacceptable. The EIS has not provided sufficient justification for approval
784.	Greenhouse Gas	ACA	SIG1	**Detail** We consider there is plenty of evidence to support the following contentions that form the basis of our submission: a) Green house gases have been significantly increased in the atmosphere by human activities. In this case the green house gas under consideration is CO2 which has increased approximately 40% as a result of human burning of fossil fuels, mostly in the last 30 years.
785.	Greenhouse Gas	ACA	SIG1	b) The scientific evidence is incontrovertible that increased CO2 in our atmosphere is causing increased global average temperatures, which will continue to rise into the future.
786.	Greenhouse Gas	ACA	SIG1	c) There is sufficient scientific evidence that the increase currently threatens to be more than 2 degrees (average global temperature rise) and that under current policies 3 to 6 degrees is likely.

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787.	Greenhouse Gas	ACA	SIG1	d) The results of such a rise represent a catastrophe for the human race and must be avoided.
788.	Greenhouse Gas	ACA	SIG1	A short list of the impacts under a warming global temperature, include all the objections listed above. It would appear to be madness to continue to increase our burning of fossil fuels under these conditions but that is exactly what is proposed under the Wallarah 2 Coal Mine project. In this case we are actually to expand the use of fossil fuels by opening up a new resource.
789.	Greenhouse Gas	ACA	SIG1	Recent reports by Price Waterhouse Coopers, the International Energy Agency and the World Bank indicate that we are taking insufficient action to reduce emissions. A report issued in May 2013 (Unburnable Carbon) indicates that to have an 80% chance of remaining below the 2 degree threshold agreed by countries at the Copenhagen 2009 UN conference, total fossil carbon burned by 2050 must be less than 900 Gt. Current recognized global assets of fossil carbon amount to more than 2,500 Gt. This effectively means we must leave most o f the currently 'banked' fossil fuel assets in the ground.
790.	General	ACA	SIG1	In this submission we intend to focus on the economic costs of the mine but it should be borne in mind by the approver of this mine that the social, human and environmental impacts of our current path towards more and more combustion of fossil fuels are too huge to quantify.
791.	General	ACA	SIG1	Just taking one example, how do we value the cost to a thousand generations into the future of the loss of land to sea level rise. A rise of more than 5 metres (likely in the longer term of hundreds of years if we continue on our current path) would result in the loss of all the major river deltas of the globe: Lower Egypt, Amazon delta, Bangladesh, Yellow River delta, and many more. Such losses would displace hundreds of millions of people from the most productive agricultural lands of this planet. We do not believe this could be evaluated purely on an economic basis.
792.	Economics	ACA	SIG1	**Economic impacts** Many economists have estimated the economic impact of climate change! A reasonable range of estimates is from \$20 to \$150 per tonne. The value depends on the discount rate and the actual effort to reduce emissions that is undertaken. The Wallarah 2 mine intends to mine 150.9 million tonnes of coal which results in emit 369 million tonnes of CO2-e green house gas emissions. This value does not appear to include transport outside Australia. All but 2.5% of the 369 MtCO2-e comes from burning the coal (equivalent to 100.64 MtC). Adopting a value of \$40 It for social cost of carbon gives a total of: \$4.03 billion If the social cost of carbon were to be in the upper range of assessments (\$150/tC) the total cost of this mine relating to climate change would be: \$15.1 billion. To put this into perspective:- this single mine, not large when considered in the context of coal mines in Australia, could cause climate change costs equivalent to the entire military budget of a mid-sized developed country (e.g., Israel's military budget is \$15 billion).
793.	General / Economics	ACA	SIG1	A decision to allow this mine will unleash costs of billions of dollars onto future generations. This must be taken into consideration in the economic assessment of this mine. This mine will see the likely costs per tonne of carbon to go up as will the likely trend in temperature increase into the next century and beyond. The costs associated with a rise of 4 degrees will be increased enormously over the costs of a 2-degree rise due to the disruption of society and collapse of nations.
794.	General	ACA	SIG1	As the recent statements by the Chief Economist of the International Energy Agency, Fatih Birol (to the UN climate talks conference of parties in Bonn, June 2013) — Two-thirds of all proven reserves of oil, gas and coal will have to be left undeveloped if the world is to achieve the goal of limiting global warming at two degrees Celsius:
795.	General	ACA	SIG1	"We cannot afford to burn all the fossil fuels we have. If we did that, it [average global surface temperature] would go higher than four degrees." "Globally, the direction we are on is not the right one. If it continues, the increase would be as high as 5.3 degrees and that would have devastating effects on all of us." It is better to leave this coal un-developed rather than expose future generations to huge costs for adapting to the impacts of climate change. It is highly likely that the State Government will to have to buy the mine back in 10 years time when we finally realize the madness of allowing it to start in the first place.
796.	General	ACA	SIG1	**Conclusion**

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				This proposed coalmine is not in the local community, the State's or the wider global public interest. The Environmental Impact Assessment (EIS) does not provide sufficient justification for it to be approved considering the huge costs both economic and in human terms from the impacts of climate change.
797.	Ecology	ACA	SIG1	**18 FLORA AND FAUNA ISSUES** Whist the submission contains a detailed section of the use and potential damage of the groundwater supplies, similar concerns are raised on the potential damage to the local creeks such as Wallarah Creek from dust emissions and transfers. How are these emissions to be calculated? What effect will they have on the local streams and creek? How are they to be monitored for subsequent effects on the fauna in the area?
798.	Economics General	ACA	SIG1	**19 ECONOMIC CONSIDERATIONS** Significant concerns are raised over the numbers proposed by the applicant. Startling figures show those job numbers in the coal industry are falling in the face of larger production and booming export numbers. *"Between 1996 and 2001, the number of coal mining jobs in the Lower Hunter in NSW fell to 3,560, a drop o f 27%. In the rest o f the Hunter, the number fell 18% to 2,443. Mining o f all kinds (which is mostly coal) makes up just 2% of the employment in the Lower Hunter (of 4,099 jobs) and 8% in the rest of the hunter (2,717 jobs)."* (www.australiancoal.com.au/industrystats.htm#employment).
799.	Economics General	ACA	SIG1	Remediation of the proposed ventilation sites, subsidence sites, road and open space damage, flora and fauna impacts, amenity (specifically including health costs) and property values are just some of the economic criteria that the proponent should be examining and forecasting some type of recompense to the community as a result of the proposed development if it were to proceed.
800.	Social	ACA	SIG1	**19.1 Social and Economic significance to the local community, the region and State** The draft Central Coast Regional Plan provides for future growth in population of between 68,000 and 100,000 new residents. Underground mining and/or any surface facility would not be compatible with a large population interface and other desirable employment opportunities, but would be counter productive in attracting business and residential investment.
801.	General	ACA	SIG1	Potential negative effects from coal dust and subsidence, in fact are not denied by proposed mining plans currently put forward for consideration. Instead the Preliminary Risk Assessment for the Wallarah 2 proposal talks about minimising and monitoring. This clearly indicates that it can't be prevented.
802.	Social	ACA	SIG1	**19.2 Negative Impacts on Employment** The Wyong Employment Zone, which extends from Sparks Road through to the Link Road, (adjacent to the Kores coal handling facility site) has the potential to create 6,000 new jobs. Both the Wyong Council and the Wyong-Tuggerah Chamber of Commerce are campaigning to attract clean industry to this area, in particular the food industry to compliment the already existing Woolworths food distribution centre.
803.	Social	ACA	SIG1	The existence of a coal mine and coal loading facility close by would discourage industry into the area and would mean the sacrifice of many jobs for the sake of the few generated by the mining company.
804.	Social	ACA	SIG1	The Central Coast Regional Strategy states in regards to future employment growth: Key opportunities for the Region include — • *Intensified economic activity and provision of quality office space to increase local business services such as accounting, financial management, IT service and legal firms* • *Significant retail growth, including more speciality shops, bulky goods outlets and department stores* • *Growth in health services, driven by population growth, lifestyle preferences, an aging population and growing sophistication and complexity of services. The number of health-related jobs is forecast to increase substantially over the life of the Strategy.* • *Growth in education services, with a corresponding increase in the associated employment in this sector. New schools, vocational education and higher education infrastructure will be required to support a growing population with participation in education and skills training* • *Development of business parks, which provide good building design and layout, emphasis on light industrial and value-adding industries and integration o f industrial, warehousing and office activities. Significant opportunities also exist to expand technology-based jobs in the Region* • *Forecasted high rates of growth for cultural industries as well as accommodation and hospitality. The Region's tourism advantages are also likely to increase* • *Growth of home-based businesses*

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805.	Social	ACA	SIG1	The Strategy also says: *The Department of Primary Industries, the Department of Energy, Utilities and Sustainability and the Department of Planning, in conjunction with the Department of Natural Resources, to review planning for the Central Coast plateaus and Wyong valleys to consider agriculture, extractive resources, water supply values and tourism uses and address any conflict between these uses.* The proposed mining activities and in particular the pit head near Blue Haven would be incompatible with the Strategy. It is reasonable to conclude that while it is predicted that mining will generated a limited number of jobs this type of industrial use will discourage other industries mentioned in "Key Opportunities" listed previously, including the proposed Wyong Employment Zone. Many of the proposed employed lands are within 2.5 kilometres of the Tooheys Road site and are well within zones for noise and coal dust issues.
806.	Socail	ACA	SIG1	Further, the Strategy also states: *The Wyong Employment Zone is a major employment opportunity for the Central Coast Region. Planning for this area will include investigation of land to the immediate west of the Sparks Road - F3 Freeway interchange for future employment opportunities that take advantage o f this key transport interchange.* The intent of the Central Coast Strategy is to create employment opportunities that meet the needs of the increased population. Using the principles of "sustainable communities", residential development needs to be close to transport hubs and employment opportunities. This type of employment use needs to also provide a healthy environment that is compatible with being close to residential development, making the area attractive to both business and potential population movement. An extractive resource industry, such as the Wallarah 2 coal proposal, would be in conflict with other possible employment/residential uses and in fact that land at Tooheys Road would be more valuable for other use that would be more compatible with interfacing residential developments at Blue Haven, Warriervale and proposals at Wyee.
807.	Social	ACA	SIG1	**19.3 Potential Negative Impacts on Current and Proposed Residential Areas** Any potential mining and above surface related infrastructure by their mere nature has the potential to adversely effect the values of residential property. Subsidence, noise and dust can severely lower house and land values across the northern suburbs of Wyong and in those suburbs of Jilliby, Dooralong and Wyong Creek.
808.	Social Economic	ACA	SIG1	This would occur at a particularly bad time with many residents already suffering from increased mortgage commitments and already falling house values. In many cases, a large number of people would owe more than their property is worth. This could have a serious impact on the Central Coast economy.
809.	Social	ACA	SIG1	This same problem could also impact on new housing developments, making them less attractive and not drawing necessary investment. The Central Coast does not have an existing mining culture mentality, and the general community would see so new mining projects in the Wyong LGA as a negative.
810.	General	ACA	SIG1	The Wallarah 2 proposal would have its main surface facility in close proximity (2.4 kilometres) to the new Warnervale Township and hub. This development could be heavily impacted by a coal loading facility, pushing much needed investment elsewhere.
811.	General	ACA	SIG1	Other considerations are: • Proximity of Tooheys Road site to Blue Haven and Wyee Schools • Proximity to new residential area at Warnervale and Charmhaven • Increased health impacts related to dust and noise in residential areas • Decreased tourism leading from adverse publicity and public perception • Location of Tooheys Road site to "gateway" off F3 to Northern Wyong Suburbs
812.	General	ACA	SIG1	**20 LAND USE AND MANAGEMENT STRATEGY IN THE WATER CATCHMENT VALLEYS** Closer rural settlements are envisaged in a selection over 15 sites in the Dooralong Valley and one site in the Yarramalong Valley.
813.	Ecology	ACA	SIG1	Adverse environmental impacts will arise from subsidence and *it will be impossible to maintain a healthy fresh water river system,* which is envisaged as and when ***new Riparian Corridors are created*** under this new management strategy. Subsidence will create addition flooding over the 37 sq. km of sub-surface mining zones. This will adversely impact upon groundwater levels, flood levels, wetlands, streams, and have potential impacts upon environmentally significant areas, which are vulnerable to land subsidence and changed groundwater levels. It is envisaged there will be serious

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				pollution arising from fractures in the subsurface overburden allowing interception of heavily polluted coal waters to discharge into local streams and rivers. The potable water system will be destroyed by mining subsidence.
814.	Ecology	ACA	SIG1	The distribution of plant communities is strongly influenced by the geological features and soil types that are evident in the two valleys that contain five (5) soil landscapes. ***The two valleys present an ecological overlap of two climatic zones,*** which results in a ***"uniqueness*** *of habitat"* between species *of tropical areas from the North and the temperate areas from Southern Australia.* It is recorded that *the ecological phenomenon of plant and animal diversity is extremely high.* These attributes are considered to be of the highest conservation value and must be protected.
815.	Surface Water	ACA	SIG1	The following points must be considered: • Will longwall coal mining activities be compatible with the aims and ideals of the water catchment? No.
816.	Subsidence	ACA	SIG1	• Is it possible to constrain and/or manage subsidence? No, it is indeterminable
817.	Surface Water	ACA	SIG1	• Will this mining project satisfy the STATUTES of the Proclaimed Catchment Protective Act? No.
818.	Ecology	ACA	SIG1	• Can Kores quantify, qualify and satisfy o The Threatened Species Conservation Act 1995? No. o The Commonwealth Environment Protection and Biodiversity Conservation Act 1999? No.
819.	Surface Water	ACA	SIG1	• Will coalmining pollution waters be controllable? No.
820.	Subsidence	ACA	SIG1	• Will active, residual and horizontal subsidence perpetuate? Yes
821.	General Agriculture	ACA	SIG1	**20.1 Current Dooralong and Yarramalong Valley Land Use Activities** The following business activities identified as occurring in the valleys and would be subject to adverse environmental impacts caused by subsidence (see 23). • Hydroponics vegetable growing • Organic Vegetable Farming and Orchards • Farm riding trails • Farm tours (lavender farm) • Stain glass manufacture • Vineyards • Macadamia farm • Turf farms • Cattle farms • Horse studs • Horse spelling farms • Orange orchards • Apiaries
822.	Agriculture	ACA	SIG1	**20.2 Agricultural, Equestrian, Rural and Tourist Activities** Yarramalong and Dooralong Valleys are the rural hinterland of the Wyong LGA. Wyong Council and those who live and work in the valleys are committed to maintaining the rural character of the area. Within the valleys there are thoroughbred horse breeding, spelling and training establishments, turf farms, cattle breeding properties, a lavender farm, alpaca farms, riding schools, hydroponic farming and orchards. There are also tourist destinations such as Dooralong Valley Resort, Yarramalong Macadamia Farm and Cedar Park Lavender Farm. These destinations are attracting visitors not only from the Central Coast and Sydney, but increasingly inbound tourists from eastern Asian countries such as mainland China and South Korea.
823.	General	ACA	SIG1	To a greater or lesser extent all of these activities are dependent, and rely, on an assured water supply from Wyong Creek, Jilliby Jilliby Creek or the aquifers within the valleys.
824.	Surface Water	ACA	SIG1	Reducing the streams in the valleys to the condition of Diega Creek, as shown in the Rivercare Plan would decimate these activities. Even assuming it

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				were available, the purchase of water from the town water supply system would not be an economically viable option for most of these activities.
825.	Agriculture Surface Water General	ACA	SIG1	Without the investment required to support ongoing agricultural and rural activities, in the absence of water, properties would fall into disrepair and become unkempt and overgrown. Noxious weeds would proliferate, as property owners would have no incentive to eradicate them. The attractive and scenic quality of the valleys would be lost and the area would cease to be a desirable attraction for tourists. The proprietors of the various business activities in the valleys and their staff will lose their livelihoods and the contribution made by these businesses to the economy of the Central Coast would be lost. In short, the two valleys would be devastated.
826.	Rail	ACA	SIG1	**21 OTHER CONCERNS** **21.1 - Rail Capacity** There is concern as to whether the extra coal trains using the already busy Main Northern Rail line between Sydney and Newcastle would adversely affect current freight and passenger services. The Panel should examine in detail capacity issues and whether the current line could cope with additional coal trains, as well as increasing freight and passenger needs over the life of the project.
827.	General	ACA	SIG1	**21.2 - Foreign Export** Concern is also expressed that this coal is destined for foreign export. We have more than 50 ships sitting off our coast on a regular basis, waiting to be loaded. Even with the newly touted third coal loader in Newcastle, the port is already at capacity. Bringing on line a new coal mine on the Central Coast would further choke this system.
828.	General	ACA	SIG1	**CONCLUSION** Longwall coalmining is incompatible with environmental management as a result of the excessive damage caused from subsidence, which will destroy the water catchment in perpetuity. The environmental degradation arising from this coal recovery processes is inestimable and will be progressively and adversely compounded by coal recovery. The registered environmental attributes of these two catchment valleys and public water resources are, therefore, clearly unsustainable in any introduced longwall mining environment
829.	General	ACA	SIG1	The desired objective - ecological sustainable development - is compromised by this form of mining, which causes uncontrollable active, residual and horizontal subsidence extending over indeterminable periods before, and if ever, overburden resettlement is established. There is ample evidence in NSW that this mining technology causes massive geological faulting/fractures destroying wetlands, creeks, flood plains, rivers, increased flooding and private property damage and serious water loss.
830.	General	ACA	SIG1	The strong argument that an extractive industry will bring benefits to the State and local economy is highly questionable when put into perspective with the potential negative effects on families, health, environment, tourism, local industry and small business. Tourism for example will generate far more jobs than mining and have a far more positive impact on public perception.
831.	Social General	ACA	SIG1	The Central Coast already has a population of more than 300,000 people and this is expected to grow to more than 420,000 by 2031. There has to be the correct synergy of investment, employment, social issues and environment for this region to successfully integrate this population.
832.	Surface Water	ACA	SIG1	It is illogical and irrational to even contemplate longwall coal mining beneath a water catchment area given the recent experiences in other areas where streambeds have been fractured and stream flows compromised and lost.
833.	General	ACA	SIG1	Statements of Commitment, such as Kores issues, are not a substitute for properly researched and analysed expert reports confirming that a project will not have a particular impact. Statements of the "trust me, it will be alright" nature are not an acceptable basis for recommending approval of a project with the real potential for devastating consequences affecting, among other things, the water supply and lifestyles of 300,000 people
834.	General	ACA	SIG1	When viability is dependent on, among other things, environmental considerations how can there be a claim that a viable mine is possible?
835.	General	ACA	SIG1	There is no demonstrated basis upon which coal mining under the Yarramalong and Dooralong Valleys can be permitted.
836.	General	ACA	SIG1	Proposed mining and its inherit risks through subsidence and health issues, not denied by the industry, comes only with a commitment to try and "manage" potential problems
837.	General	ACA	SIG1	This is not sufficient to risk our vital water catchment and risk the health of Central Coast residents
838.	Ecology	ACA	SIG1	**Executive Summary** **Appendix 1** **Biodiversity** KORES proposals are incompatible with the Threatened Species Conservation Act 1995, the Commonwealth Environment Protection and Biodiversity

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				Conservation Act 1999 (EPBC Act 1999) and the NSW Water Act 2000. Longwall coalmining will also destroy wildlife of National and International significance (registered under protective ordinances) within the Catchment district and the ecological integrity of the Wyong Water Catchment. High conservation values must be paramount and practised ***as stream health and environmental flows*** are critical to ensuring the continuity of potable water resources. These essential public water resources are immediately threatened by longwall mining subsidence occurring in the catchment.
839.	Ecology	ACA	SIG1	Ecological processes maintain the biological diversity and ecosystems in the Tuggerah Estuary are dependent upon periodic inundation of the flood plains and wetlands and a continuity of the movement of aquatic organisms between fresh water inflow and estuarine habitats. Subsidence will cause pollution of these habitats, which are of National and International significance as food resources for international migratory avifauna waders. Coal seam waters that will destroy sedimentary organisms within the Tuggerah Lakes Barrier Estuary will pollute the two riparian corridors of Wyong River and Jilliby Jilliby Creek
840.	Ecology	ACA	SIG1	The Strategic Assessment Report - *Coal Mining Potential in the Upper Hunter valley December 2005 Department of Planning* - describes the potential short and long term impacts of mining in the Upper Hunter Valley, which is considered relevant to the Yarramalong and Dooralong Valleys. The ecological integrity of stream corridors and their flow regimes is predicated upon the assessment and management of activities in the catchment, which would otherwise have recognised adverse impacts throughout the coal zones.
841.	Ecology	ACA	SIG1	The Commonwealth Minister for Sustainability, Environment, Water, Population and Communities has determined the Wallarah 2 Coal Project, involving the development and operation of the Wallarah 2 underground coal mine, is deemed to be a 'controlled action' under Section 75 of the Environment Protection & Biodiversity Conservation Act 199/EPBC Act.
842.	Ecology	ACA	SIG1	As such, the action is likely to have a significant impact on the EPBC Act listed threatened species including Charmhaven Apple (Angophora inopina) and Black-eyed Susan (Tetratheca juncea), listed as vulnerable under the Act and Spotted-tail Quoll (Dasyurus maculates) and Giant Barred Frog (Mixophyes iteratus) listed as endangered under the Act.
843.	Groundwater	ACA	SIG1	**Executive Summary:** **Appendix 2** **Environment Impacts** We also draw your attention to statements by ***John Williams, former NSW Land and Water Conservation Department (1999), from his document Coal Mining and Groundwater Management.*** *"Mining the coal resource has potential to result in a number o f environmental and social impacts most of which is related to aquifer depressurisation. Groundwater impacts include reversal of flow directions, increased aquifer infiltration, water quality changes, potential impacts on stream base flow conditions and possibly aquifer collapse due to removal o f fluid void pressure."*
844.	General	ACA	SIG1	Attention is also drawn to the Mineral Resources Department's own document ***"Strategic Study o f Northern New South Wales Coalfields - Executive Summay (Nov 1999) (3)."*** We refer you to page 10, last paragraph: *" • . mining that is likely to adversely impact either the agricultural potential or groundwater integrity to a significant degree, will not be permitted."*
845.	General	ACA	SIG1	The following analysis of **Coal Seam Water** was obtained from samples of water drawn from the two Sydney Gas test wells in the Dooralong Valley, and analysed by the University of New South Wales water testing laboratories. The two test wells, Jilliby 1 and Jilliby 2, were way outside limits on several parameters Iodide, Total Dissolved Solids (TDS), Barium, Aluminium, - Chloride and pH. A comparison of the results of the two Jilliby wells was made with the Australian Drinking Water Guidelines and water extracted from coal seam methane wells in the Powder River Basin, Wyoming, USA.
846.	General	DLALC	SIG2	The proposal is located within the boundary of the Darkinjung Local Aboriginal Land Council (LALC), and in fact, critical infrastructure for the development is a proposed rail spur across Darkinjung LALC owned land, being Lot 195 in DP 1032847.
847.	General	DLALC	SIG2	The Darkinjung LALC is constituted under the *Aboriginal Land Rights Act* 1983 (NSW). Section 51 of the Act defines the role of the Land Council as *"... to improve, protect and foster the best interests of all Aboriginal persons within the Councils area and other persons who are members of the Council."*
848.	Aboriginal Heritage General	DLALC	SIG2	The way in which it does this is to properly identify and manage its land holdings to establish and create meaningful outcomes that add value to the growing Aboriginal community. For these outcomes to be achieved, Darkinjung LALC must be provided an opportunity to exercise its functions under Section 52 of the NSWALR Act which are:

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849.	Aboriginal Heritage General	DLALC	SIG2	1. Land Acquisition 2. Land use and Management 3. Aboriginal Culture and Heritage 4. Financial Stewardship 5. Other functions prescribed by regulations
850.	General	DLALC	SIG2	The Darkinjung LALC has viewed the exhibited material and recognise the significance of this project for the region. In terms of what the proposal means for the local Aboriginal community, the following comments are provided.
851.	Aboriginal Heritage	DLALC	SIG2	**Aboriginal Culture & Heritage** The potential impacts from the proposal upon Aboriginal Cultural & Heritage have been investigated and documented within the Aboriginal Cultural and Heritage Assessment report, prepared by OzArk, dated December 2012, and forming Appendix S of the Environmental Impact Assessment for the proposal.
852.	Aboriginal Heritage	DLALC	SIG2	The Darkinjung LALC was consulted during field work and preparation of this report. A copy of Darkinjung LALC's comments are provided in the Appendices to the OzArk report.
853.	Aboriginal Heritage	DLALC	SIG2	It is noted that a number of cultural sites have been recorded within the area of potential impacts. Some of these sites may be susceptible to adverse impacts, particularly from subsidence. The extent of possible impacts can only be estimated at this stage
854.	Aboriginal Heritage	DLALC	SIG2	It has been recommended that further survey, monitoring and documentation occur for these sites and other possible sites in the vicinity. It is also recommended that an Aboriginal Cultural Heritage Management Plan be prepared for proposal, and include further consultation with Registered Aboriginal Parties, including Darkinjung LALC
855.	Aboriginal Heritage	DLALC	SIG2	The Darkinjung LALC requests that the recommendations contained in the OzArk Aboriginal Cultural and Heritage Assessment report, including previous correspondence from the Darkinjung LALC, be included as a condition on approval on any consent which may be issued for the project, to ensure appropriate measures are taken to preserve cultural records in the locality.
856.	General	DLALC	SIG2	**Access for critical infrastructure** The Darkinjung LALC is the registered owner of Lot 195 in DP 1032847, through and upon which Wallarah 2 Coal Project, is require to construct a rail line to transport coal from the stockpile area located off Tooheys Rd to the main northern rail line and then to the port of Newcastle.
857.	General	DLALC	SIG2	We note that, despite part of the development intended to be constructed upon Darkinjung LALC's Lot 195, *"Landowner's consent"* (for Darkinjung LALC's Lot 195) was not considered necessary to enable lodgement of the development application with the Department of Planning, since the proposal has been lodged pursuant to SEPP (State & Regional Development) 2011, and is therefore not required under Cl. 49(2) of the Environmental Planning & Assessment Regulations 2000.
858.	General	DLALC	SIG2	**It should be noted that the requirements of Cl. 49(2) (lack of need to obtain *Landowners consent)* to the extent that they apply, should not be construed as satisfying the issue of 'informed consent' by the Darkinjung LALC for the proposal, including access across Lot 195.**
859.	General	DLALC	SIG2	The Darkinjung LALC reminds the Department of other obligations which, if the development is approved, will need to be in order before the rail corridor is physically constructed through Lot 195. This includes
860.	General	DLALC	SIG2	• Any compensation payable to the titled landowner, under the Mining Act 1992, and
861.	General	DLALC	SIG2	• Any requirements of a *dealing approval certificate* and/or *registration approval certificate* issued under Division 4 of the Aboriginal Land Rights Act, 1983.
862.	General	DLALC	SIG2	The Darkinjung LALC requests that in consideration of this matter and any consent which may be issued in respect to the proposal, contain relevant condition(s) to the effect of; *Satisfactory arrangements be made between the proponent and the Darkinjung Local Aboriginal Land Council prior to the commencement of any works through or upon Lot 195, or other land owned or vested to the Land Council and affected by the proposal, having regard to the relevant provisions of the Mining Act 1992, the Aboriginal Land Rights Act, 1983, or other similar and relevant legislation.*
863.	General	DLALC	SIG2	To date, the Darkinjung LALC has been involved in a number of meetings with the proponent to discuss various aspects of the proposal. These discussions are ongoing, particularly in relation to the development of a Memorandum of Understanding, Cultural Heritage and Access through Lot 195 as noted previously. The Darkinjung LALC will continue discussions with the proponent to find resolutions to these matters, which will be necessary, in

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				the event that the Department approves the proposal.
864.	General	NCC	SIG3	This project was refused in 2011 and most of the concerns raised in regard to the previous submission have not been remedied in this second application. The proponent has failed again to adequately address issues associated with the impact of the project on water quality, subsidence, and the ecological and heritage values of the area. The project also poses significant threats to the region's drinking-water catchment
865.	General	NCC	SIG3	NCC objects to this development application on the following grounds
866.	Surface Water	NCC	SIG3	**Water impacts** If it proceeds, the Wallarah 2 Coal Project would undermine a catchment that supplies 53% of the Central Coast's water supply, upon which a population of 300,000 people depends. Any development that jeopardises this vital community resource should be rejected.
867.	Surface Water	NCC	SIG3	The project may also have a serious negative impact on the recently completed $80 million Mardi-Mangrove pipeline, which relies on the sustainable supply of water from this water catchment to enable the transfer of water from this system to the Mangrove Dam for water banking. Any development that threatens the volume or quality of water from the catchment would compromise this substantial investment of public funds.
868.	Groundwater	NCC	SIG3	The project proponent, Kores, claims the existence of impervious layers between the surface and the mine seam water supply would ensure the water supply was not affected. However, the company has admitted in its own technical submissions that water will be lost at a rate of 2ml a day for every square metre of mine surface area. This amounts to about 8 megalitres a day or 3000 megalitres a year.
869.	Groundwater	NCC	SIG3	Water loss may however be worse than the company's modelling predicts. Professor Bruce Hepplewhite (Appendix H. p258) has questioned many of the assumptions used in the geological modelling upon which water loss forecasts were based. The fact that the Kores submission is littered with uncertainties and questionable modelling must cast doubt on the value of the information provided by the proponent as a basis for decision making, especially when any miscalculation could have serious consequences for the Central Coast's water supply.
870.	Groundwater	NCC	SIG3	The Wyong Water Catchment is protected under a NSW statute proclaimed in 1950 (Gazette No.153 of the LGA 1919, 1950). Currently, the site water management is inadequate because almost all management plans are merely observational. Some of the monitoring plans are not due to be created until two years into the operational life of the mine.
871.	Air Quality	NCC	SIG3	**Air quality and community impacts** This proposed mine will be in the midst of new suburbs and will put the health of residents at risk. Short-term exposure to particulate pollution can lead to diminished lung function, damaged and inflamed lung tissue, increased mortality rates in children and young adults, aggravation of asthma symptoms, and heightened risk of cardiac arrhythmias, heart attacks and other cardiovascular issues. Kores has admitted in the EIS that these links exist. (Appendix M, p153)
872.	Air Quality Noise	NCC	SIG3	The dust and noise from stockpiling and rail movements will affected the amenity of the established suburbs of Blue Haven and Wyee and settlements all along the rail corridor from Morisset through Cardiff and southern suburbs of Newcastle to the port. The EIS fails to adequately address how these impacts will be mitigated. Consequently, this project should be refused based on the health risks associated with air pollution from mining, stockpiling and transporting coal.
873.	Subsidence	NCC	SIG3	**Subsidence** Another risk to surrounding suburbs is subsidence. A total of 245 houses (Appendix H, p130), 755 rural building structures (Ibid. p179) and 420 farm dams (Ibid. p187) could suffer some degree of subsidence. It is estimated the hinterland of the valleys will subside 2.6 metres; Little Jilliby Jilliby Creek at the southern end is predicted to fall 2 metres; and the main artery into the Jilliby/Dooralong Valley, Jilliby Road, is destined to subside 1.75 metres in places. These valleys already flood regularly. The potential subsidence from the proposed mining activities risks leaving residents even more isolated during heavy rainfall events.
874.	Ecology	NCC	SIG3	**Threatened species** The proposed mine will have a significant adverse impact on native plants and animals in the region. Thirty-seven threatened and migratory fauna species and six vulnerable or endangered flora species are recorded within the project site. These species are protected under state and federal legislation. Furthermore, 19 species of avian migratory waders in the area are also protected under the *Environmental Protection and Biodiversity Conservation Act* by virtue of binding agreements with China (CAMBA), Japan (JAMBA) and South Korea (ROKAMBA). There are also within the proposed mining area that are flora species listed as threatened and local fauna species listed as endangered under the Act. The key threats to these species include land clearing, change in habitat due to subsidence and alteration of water flow, wetlands and floodplains, all of which are likely effects of

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				this project.
875.	Ecology	NCC	SIG3	While the site is located wholly within the Tuggerah Lakes Basin, the extraction area lies in the Jilliby Jilliby Creek catchment. The mine and rail link will have an impact on Crown Land, land owned by the Darkinjung Aboriginal Land Council, protected species habitat and historical and Aboriginal cultural heritage sites.
876.	Greenhouse Gas	NCC	SIG3	**Climate change** The five million tonnes of export-grade thermal coal per annum that the proponent intends to extract contributes to NSW's total carbon emissions and is in conflict with state and federal programs to reduce our contribution to global climate change.
877.	General	NCC	SIG3	The argument for continued coal-fired electricity in comparison with the long-term investment in renewable energy sources has not been adequately investigated. The government should perform a cost-benefit comparison of investing the equivalent amount in renewable energy sources.
878.	General	NCC	SIG3	**Failure to address previous concerns** The Wallarah 2 Coal Project application has been refused once for failing to adequately address issues of water quality, ecological, subsidence and heritage impacts. There have not been any substantial changes to this second proposal and Kores has again failed to meet the Director- General's Requirements adequately.
879.	General	NCC	SIG3	**Conclusion** This proposal has the potential to cause long-term damage to the water, threatened species, and the health of people in the surrounding region. This proposal does not benefit the Central Coast, with the coal being mined mainly for export to South Korea. Due to threats to water, wildlife and the community it is irresponsible to develop the Wallarah 2 coal project and we urge the NSW government to reject the proposal
880.	General	CFMEU	SIG4	The Project has been rigorously environmentally assessed in accordance with the EP&A Act, its 'objects', including the principles of ESD, and by processes and in the manner required by the DGRs. This assessment has concluded that the Project should be approved under the EP&A Act.
881.	General Ecology	CFMEU	SIG4	There are environmental costs which have been identified and which are capable of being acceptably managed by operational controls, land acquisition and management plans that would be established and adopted as approved by the Director-General of Planning & Infrastructure and appropriate other Government agencies and authorities. Ecological and long term costs have been minimised and will be offset by management strategies to maintain and improve vegetation and ecological values in the long term.
882.	General	CFMEU	SIG4	The Project mine plan appropriately represents a material reduction in scale and impact from the maximum resource extraction mine plan and justifiably sacrifices a material proportion of the remaining in-situ coal reserve. The Project as proposed meets environmental and social requirements and still results in a mine plan and development for which there is a demonstrated need and from which there are material economic, environmental and social benefits.
883.	Economic Social	CFMEU	SIG4	The Project will maximise the economic and social value from the remaining coal resource by a mine plan that will appropriately address the environmental and socio-economic constraints and the objects of the EP&A Act, including the principles of ESD.
884.	General	CFMEU	SIG4	There is no basis for the rejection of the granting of the consent being sought by the Proponent. The Construction, Forestry, Mining & Energy Union (CFMEU) and its Members strongly support the approval being granted in the form sought
885.	Economic	Economists at Large	SIG5	Economists at Large have reviewed Appendix W Economic Impact Assessment of the Wallarah 2 coal project, written by Gillespie Economics. We are concerned that the assessment overstates the economic case for the project and that there is a major lack of transparency around key calculations. The results from this appendix are used heavily in the project justification section of the environmental impact statement. Without confidence in these results it is impossible for decision makers to make an informed assessment of this project.
886.	Economic	Economists at Large	SIG5	The economic assessment by Gillespie Economics does not contain sufficiently transparent analysis to provide confidence in a number of assumptions.
887.	Economic	Economists at Large	SIG5	The most important results from the economic appendix for Australian and NSW decision makers to consider are the net present benefits to Australia, estimated by Gillespie Economics at $346m. This consists of present value royalties to NSW of $207m and commonwealth taxes of $139m.
888.	Economic	Economists at Large	SIG5	Royalties There is no discussion in the economic assessment of what royalty rate has been applied in this calculation. NSW coal royalty rates vary depending on the type of mining and the depth of operations see (NSW DII 2008). This is particularly concerning given the NSW Auditor General's finding that:

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				DII cannot assure the people of NSW that all royalties owed are being paid in full. This is because it does not have sufficiently robust systems and processes to identify what is owed and to make sure it is paid. (NSW Auditor General 2010) p2
889.	Economic	Economists at Large	SIG5	Commonwealth taxes Gillespie Economics' estimate of $139m in tax revenue to the commonwealth is not explained. It seems to be based on applying a tax rate of 30% to revenues less royalties. While a corporate tax rate of 30% is theoretically faced by companies, mining companies receive a wide range of rebates, tax exemptions and depreciation allowances, see (Grudnoff 2012). The effective tax rate they face is, therefore, much lower. (Richardson & Denniss 2011) estimate the effective corporate tax rate faced by mining companies in Australia at 13.9%, while (Markle & Shackelford 2009) estimated this rate at 17%. Using these findings, commonwealth taxes could be as low as $64m, meaning the economic assessment could overstate this value by $75m.
890.	Economic	Economists at Large	SIG5	For a thorough understanding of the royalty and tax implications of the project, details on several key financial aspects of the project are required. These are inadequately provided in the economic assessment and the EIS main volume.
891.	Economic	Economists at Large	SIG5	Production Neither the economic appendix, nor the main body of the EIS contains even an indicative production schedule. Without this information and explanation of the assumptions behind the forecast, it is difficult to assess the project's sensitivity to other factors, particularly in early years of production. All readers are told is the project hopes to produce "run of mine" coal at a level of 5 million tonnes per year. No indication is given as to what quantity of actual saleable coal will be produced. These numbers are clearly important to calculating royalty and tax revenue and to understanding the viability of the project.
892.	Economic	Economists at Large	SIG5	Price Gillespie Economics' assessment is based on a Newcastle benchmark thermal coal price of $AUD99/tonne. This is in line with analysts' expectations such as (CBA 2013), of a $USD90/t price and an exchange rate of 0.88. Unfortunately there is no discussion of the specifications of the coal and how that might change through the life of the project. Table 14.1 of Appendix C Geology report of the EIS suggests ash content higher than the Newcastle benchmark, which may result in a discount, although calorific values may improve the price received. As royalties are based on marketable value, this is an important consideration for decision makers.
893.	Economic	Economists at Large	SIG5	Costs There is very little information in the economic assessment about capital, mining, processing and transport costs. On page 11 Gillespie Economics state: *The annual operating costs of the project include those associated with mining, environmental management and monitoring, ROM coal processing, water treatment, administration and coal rail transport. Average annual operating costs of the Project (excluding royalties) are estimated at $192m.* This seems unrealistically low. Assuming that the project produced 4mtpa of saleable coal, this implies cash costs to free on board in Newcastle of $48/t. This would make it one of the cheapest mines in Australia, as most NSW coal mines have cash costs per tonne of between $55-80/t. While this consideration would not affect state royalties, it would affect commonwealth tax payments, which are based on income rather than production volume.
894.	Economic Social	Economists at Large	SIG5	Social value of employment The values claimed as social value of employment are misleading. We have argued this in submissions on the Boggabri Coal Project, Warkworth Coal Project, Maules Creek Coal Project, Coborra project and others. The proponents of the Maules Creek Coal Project commissioned Professor Jeff Bennett of the Australian National University to review the economic assessment of that project, also by Gillespie Economics, which also included a "social value of employment". In relation to the inclusion of this value, Professor Bennett said: *[The] EIA's inclusion of benefits associated with employment [is contentious]. The argument advanced is that people outside of the mine workforce enjoy benefits associated with people having jobs in the mine. The values of this 'existence benefit' of work estimated for the case of a mine in the southern coal field are 'transferred' to the current case. A number of points argue against this approach. First, there is a conceptual issue. In a fully employed economy, it is doubtful that people employed in the new mine would be drawn from the ranks of the unemployed. So people outside the mine are unlikely to hold any existence benefits for the jobs provided by the mine in that case. Second, there is an estimation issue concerning the use of a benefit estimate transferred from another context. The conditions in the southern coalfield – the context of the source of the benefit estimate are very different from the proposed mine context….. [The] inclusion of the employment benefit as a component of the EIA is not recommended. Their inclusion would overstate the extent of proposal benefits. (Bennett 2011)*

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				These are the words of one of Australia's most senior academic economists and the lead author of one of the papers Gillespie Economics cite to justify their inclusion of this value. Professor Bennett is not alone in his criticisms of Gillespie Economics' use of a social value of employment. Other prominent academics have criticised its inclusion in the Warkworth case, University of Queensland's Prof John Quiggin and The Australia Institute's Dr Richard Denniss (Campbell et al. 2012) as well as leading private sector consultants (Deloitte Access Economics 2012).
895.	Economic	Economists at Large	SIG5	Water, noise, dust and traffic Considerable debate exists over the potential impacts of the project on water supplies, air quality, amenity and local traffic. Gillespie Economics ignore these debates in their cost benefit analysis, assuming that there will be no impacts. By ignoring these external costs, the value of the project is overstated, particularly to local residents who will bear the costs associated with any change.
896.	Economic	Economists at Large	SIG5	Input-output modelling in Economic Impact Assessment The use of input-output modelling in section 3 of the socio-economic assessment creates a misleading impression of the impacts of the project. These results are prominently stated in the executive summary, which gives them more weight than the cost benefit analysis: During the construction phase, the Project will contribute to the NSW economy through construction workforce expenditure and equipment purchases. In this phase, the Project will provide the following contributions to the NSW economy: • $1,156 million in direct and indirect output or business turnover; • $514 million in direct and indirect value added; • $368 million in direct and indirect household income; and • 1,697 direct and indirect jobs at the peak of construction. These are certainly overestimates. Input-output modelling has fallen from favour with economists for many reasons, the main ones being explained by the Australian Bureau of Statistics (ABS 2011): ***Lack of supply–side constraints****: The most significant limitation of [input-output modelling] is the implicit assumption that the economy has no supply–side constraints. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.* **Fixed prices**: Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. Prices are assumed to be unaffected by policy and any crowding out effects are not captured.
897.	Economic	Economists at Large	SIG5	Emphasis on input-output model results is not favoured by NSW Treasury: *Model based economic impact assessment [such as IO analysis] is not a substitute for a thorough economic analysis of a policy. The appropriate method for analysing policy alternatives is benefit cost analysis (BCA). (NSW Treasury 2009, p4)*
898.	Economic	Economists at Large	SIG5	Decision makers need to understand that the results of input-output modelling are certain to overstate the case for the project and make use of assumptions that may bear little relation to the reality on the ground. This was the strong finding of Preston CJ in the recent Warkworth decision in the NSW Land and Environment Court: *There is another, more fundamental issue with the IO analysis. The IO analysis only looks to economic impacts, not environmental or social impacts, and then only to economic impacts measured by reference to goods and services with a market value, not those without a market value. It provides, therefore, some information but only on one set of matters relevant to be considered by the approval authority in determining the project application. The IO analysis is not a substitute for the decision- making process that the approval authority must undertake in determining the project application, and the conclusions the IO analysis reaches cannot be substituted for the fact finding, weighting and balancing of all of the relevant environmental, social and economic matters required to be considered by the approval authority. The conclusions the IO analysis reaches on the economic benefits of approving the Project, evaluated for their reliability and given appropriate weight, need to be balanced against all other environmental, social and economic benefits and costs. (Preston 2013) para 463*
899.	Economic	Economists at Large	SIG5	Conclusion The economic assessment of the Wallarah 2 Project is not suitable for decision making in its current form. It fails to clearly demonstrate the economic benefits of the project to Australia, much less NSW and the local community. Justification of all assumptions, especially relating to royalties and taxes, is

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				crucial if the public is to have any faith in this assessment. Methodological flaws such as inclusion or reference to social benefits of employment and misleading use of input-output modelling need to be revised before the assessment can inform decision making around this project.
900.	Greenhouse Gas	Climate Future	SIG6	*Climate Futu*re on behalf of the wider Central Coast Community objects to the above development proposal (Wallarah 2 Coal Project) on the grounds that the impact on the Central Coast Community and on the wider State and Global population from changes to climate resulting from the mine is unacceptable.
901.	Greenhouse Gas	Climate Future	SIG6	These impacts include: 1) Increased global average temperatures – unacceptable 2) Increased acidity of the ocean – unacceptable 3) Direct economic cost – unacceptable 4) Increased human suffering – unacceptable 5) Decreased rainfall – unacceptable 6) More intense drought – unacceptable 7) Increased storm intensity – unacceptable 8) Increased flooding / storm surge – unacceptable 9) Loss of biodiversity – unacceptable 10) Decreased water supply – unacceptable 11) Decreased food supply – unacceptable 12) Loss of coastal land / property – unacceptable 13) Decreased human health – unacceptable 14) Increased human disease – unacceptable 15) Decreased fish and other ocean resources – unacceptable 16) Political unrest – unacceptable 17) Destabilization of human society – unacceptable
902.	Greenhouse Gas	Climate Future	SIG6	The EIS and the Statement of Commitments does not adequately address the impact of the mine on global warming or on ocean acidification.
903.	Greenhouse Gas	Climate Future	SIG6	We consider there is overwhelming evidence to support the following contentions that form the basis of our submission: a) Green house gases have been significantly increased in the atmosphere by human activities. In this case the green house gas under consideration is CO_2 which has increased approximately 40% as a result of human burning of fossil fuels, mostly in the last 30 years. b) The scientific evidence is incontrovertible that increased CO_2 in our atmosphere is causing increased global average temperatures which will continue to rise into the future. c) There is sufficient scientific evidence that the increase currently threatens to be more than 2 degrees (average global temperature rise) and that under current policies 3 to 6 degrees is likely. d) The results of such a rise represent a catastrophe for the human race and must be avoided. A short list of the impacts under a warming global temperature include all the objections listed above. It would appear to be madness to continue to increase our burning of fossil fuels under these conditions but that is exactly what is proposed under the Wallarah 2 Coal Mine project. In this case we are actually to expand the use of fossil fuels by opening up a new resource.
904.	Greenhouse Gas	Climate Future	SIG6	Recent reports by Price Waterhouse Coopers, the International Energy Agency and the World Bank (among many others) indicate that we are taking insufficient action to reduce emissions. A report issued in May 2013 (Unburnable Carbon) indicates that to have an 80% chance of remaining below the 2 degree threshold agreed by countries at the Copenhagen 2009 UN conference, total fossil carbon burned by 2050 must be less than 900 Gt. Current recognized global assets of fossil carbon amount to more than 2,500 Gt. This effectively means we must leave most of the currently 'banked' fossil fuel assets in the ground.
905.	Economics	Climate Future	SIG6	In this submission we intend to focus on the economic costs of the mine but it should be borne in mind by the approver of this mine that the social, human and environmental impacts of our current path towards more and more combustion of fossil fuels are too huge to quantify.

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				Just taking one example, how do we value the cost to a thousand generations into the future of the loss of land to sea level rise. A rise of more than 5 metres (likely in the longer term of hundreds of years if we continue on our current path) would result in the loss of all the major river deltas of the globe:- Lower Egypt, Amazon delta, Bangladesh, Yellow River delta, and many more. Such losses would displace hundreds of millions of people from the most productive agricultural lands of this planet. We do not believe this could be evaluated purely on an economic basis.
906.	Economics	Climate Future	SIG6	***Economic impacts*** The economic impact of climate change has been estimated by many economists. A reasonable range of estimates is from $20 to $150 per tonne. The value depends on the discount rate and the actual effort to reduce emissions that is undertaken.
907.	Economics	Climate Future	SIG6	The Wallarah 2 mine intends to mine 150.9 million tonnes of coal which results in emit 369 million tonnes of CO2-e green house gas emissions. This value does not appear to include transport outside Australia. All but 2.5% of the 369 MtCO2-e comes from burning the coal (equivalent to 100.64 MtC). Adopting a value of $40 /t for social cost of carbon gives a total of:- $4.03 billion Over 38 years this is $100 million per year.
908.	Economics	Climate Future	SIG6	If the social cost of carbon were to be in the upper range of assessments ($150/tC) the total cost of this mine relating to climate change would be:- $15.1 billion To put this into perspective:- this single mine, not large when considered in the context of coal mines in Australia, could cause climate change costs equivalent to the entire military budget of a mid-sized developed country (e.g., Israel's military budget is $15 billion).
909.	Economics	Climate Future	SIG6	The decision to allow this mine will unleash costs of billions of dollars onto future generations. This must be taken into consideration in the economic assessment of this mine. If this mine is allowed to go ahead on the basis that lots of other mines are being allowed and we should continue with business as usual, then the likely costs per tonne of carbon will go up as the likely trend in temperature increase into the next century and beyond will also go up. The costs associated with a rise of 4 degrees will be increased enormously over the costs of a 2 degree rise due to the disruption of society and collapse of nations.
910.	Economics	Climate Future	SIG6	As the recent statements by the Chief Economist of the International Energy Agency, Fatih Birol (to the UN climate talks conference of parties in Bonn, June 2013) – Two-thirds of all proven reserves of oil, gas and coal will have to be left undeveloped if the world is to achieve the goal of limiting global warming at two degrees Celsius:- "*We cannot afford to burn all the fossil fuels we have. If we did that, it* [average global surface temperature] *would go higher than four degrees."* *"Globally, the direction we are on is not the right one. If it continues, the increase would be as high as 5.3 degrees — and that would have devastating effects on all of us."*
911.	General	Climate Future	SIG6	We believe it is better to leave this coal un-developed rather than expose future generations to huge costs for adapting to the impacts of climate change. It is highly likely that the State Government will to have to buy the mine back in 10 years time when we finally realize the madness of allowing it to start in the first place.
912.	General	Climate Future	SIG6	***Conclusion*** In summary, this proposed coal mine is not in the local community, the State's or the wider global public interest. The Environmental Impact Assessment (EIS) does not provide sufficient justification for it to be approved considering the huge costs both economic and in human terms from the impacts of climate change.
Public Submissions				
913.	General	David Harris	P1	I believe these concerns remain with the new Environmental Impact Statement and that the company Wyong Areas Coal Joint Ventures (WACJV) has failed to convincingly address many issues of concern raised in their previous application.
914.	Groundwater	David Harris	P1	I regards to those studies I draw your attention specifically to the following analysis; *Wyong Water Study* and the *Wyong Water Study: International Peer Review* which was commissioned in 2010. The PAC report states that they were disappointed that the brief for the study did not call for a more comprehensive assessment of the groundwater situation, including independent modelling. This is a major deficiency in the data in my opinion.
915.	Groundwater	David Harris	P1	In their *Wyong Water Study* report, SKM stated that: In the context of groundwater levels, "*Additional groundwater monitoring within the coal seam needs to be obtained prior to any inseam development of*

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				the proposed mine… In terms of the ability of the available data to provide a control for changes due to natural variability, this information is required once the impacting activity occurs. Therefore, if regular monitoring of the current network of available groundwater bores is re-established prior to any inseam development, then this control information would be considered adequate… Regular groundwater level monitoring of these bores for a minimum of 2 years prior to any inseam development (to establish patterns of fluctuation across different climatic events) to the proposed impact, is essential to identify impacts subsequent to the mining activity."
916.	Groundwater	David Harris	P1	In the context of groundwater quality, *"If regular groundwater quality monitoring of the current and proposed bore network is re-established prior to any inseam development, then this groundwater quality control information would be considered adequate… The primary data insufficiency relates to the information available to identify the impacts of the proposed change. It is recommended that regular groundwater quality monitoring of the current monitoring network (and the proposed coal seam formation bores recommended in Section 10.2) is required. Regular groundwater quality monitoring of these bores for a minimum of 2 years prior to any inseam development, is essential for the impacts on groundwater quality to be observed."*
917.	Surface Water Groundwater	David Harris	P1	In their *Wyong Water Study: International Peer Review* of SKM's report, Aqualinc recommended that: *"All groundwater level, groundwater chemistry, stream flow, stream chemistry and climate sites that are used to determine baseline conditions should have at least two years of relevant data prior to the commencement of mining activity that is likely to affect surface water or groundwater flows or quality."*
918.	Surface Water Groundwater	David Harris	P1	NSW Office of Water reviewed SKM's Wyong Water Study and Aqualinc's review, and stated that: *"The assertion made within the SKM study and Aqualinc peer review that two years of baseline data is adequate to capture groundwater fluctuations and provide statistically significant correlation is questionable… In terms of assessing sensitivity of surface-ground water connectivity and groundwater base flow contributions to Jilliby Jilliby Creek and tributaries, and maintaining flow into the Wyong River, this should have been examined more closely."*
919.	Groundwater	David Harris	P1	The Commission accepted that, "ideally", two years of groundwater monitoring should be available before the commencement of "inseam mine development".
920.	General	David Harris	P1	The previous Government rejected the application for Wallarah 2 on grounds of unsustainability (ESD principles) and the Government's application of the Precautionary Principle. Nothing in the new application changes that concept as essentially it is a reworking of the previous application. The current NSW Government's "Aquifer Interference Policy" as intended should nullify the application at hand.
921.	Subsidence	David Harris	P1	The current application again raises serious issues in regards to subsidence including; A total of 245 houses (Appendix H, Page 130) will be impacted by subsidence from a conservative one metre to 1.6 metres throughout the mine area. A total of 755 Rural Building Structures will be impacted (Appendix H, leading up to 179) and 420 Farm Dams suffering subsidence to some degree (Appendix H, leading up to 187). As can be seen the projected damage inside the mining lease area would be catastrophic. The hinterlands of the valleys are to be subsided 2.6 metres; Little Jilliby Jilliby Creek at the southern end is predicted to fall 2 metres; the main artery into the Jilliby/Dooralong Valley, Jilliby Road is destined to be subsided 1.75 metres in places, remembering that these valleys flood on a regular basis leaving residents isolated from all directions.
922.	Ecology Surface Water	David Harris	P1	The green riparian corridors in the Yarramalong and Dooralong valleys (including the Jilliby Conservation Area) could be subjected to environmental degradation, destroying the habitats, ecosystems, biodiversity and ecological integrity of these valleys. Some thirty-three (33) threatened species of NSW wildlife and nineteen (19) avifauna species of national environmental significance (protected under the Australian International Migratory Bird Treaty- CAMBA and JAMBA Agreements - with China and Japan, under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, would be threatened by the proposed longwall coal mine. The migratory waders feed in the Tuggerah Lakes Barrier Estuary and are dependent upon the fresh water discharge from Wyong River and Jilliby Jilliby Creek flowing into this estuary, which is also subjected to ocean tidal inflows. The interception of polluted coal seam waters, arising from subsidence in the valleys, would cause these estuarine areas to become heavily polluted and destroy aquatic organisms - a major food resource of the national and international migratory waders. This whole issue remains clouded in, and predicated upon, significant subsidence impact modelling to develop enhanced empirical models for the hydrogeological character of the overburden strata above the coal seams in both valleys.
923.	Surface Water Ecology Subsidence	David Harris	P1	The interception of polluted coal seam waters, arising from subsidence in the valleys, would cause these estuarine areas to become heavily polluted and destroy aquatic organisms - a major food resource of the national and international migratory waders. This whole issue remains clouded in, and predicated upon, significant subsidence impact modelling to develop enhanced empirical models for the hydrogeological character of the overburden strata above the coal seams in both valleys.

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924.	General	David Harris	P1	You will receive many more detailed submissions with more technical information than I can provide. I do note that previously the NSW Office of Water, DECCW and NSW Health Submissions all raised considerable concerns that are still relevant to the new application for this mining project. I ask that the application be rejected.
925.	General	David Holland	P2	Many existing urban areas have the potential to be affected by impacts from the proposed development as well as a high level of potential for impacts on future urban and large lot developments planned in relatively close proximity to the site.
926.	Air Quality Noise	David Holland	P2	Some assertions related to noise and air particulates as potential impacts to the surrounding environments are as follows: The Coal Loader as part of the Wallarah 2 Coal project is far too close to residential areas. One example is Blue Haven, which is situated less than 3 Kilometres from the proposed coal loader and head works facility.
927.	Air Quality	David Holland	P2	There is an overall hazard for airborne particulates in the form of coal dust pollution with thepotential to cause health issues in the general population living, working and transiting the proximity of the proposed facility.
928.	Noise	David Holland	P2	The western end of Blue Haven is less than 1 kilometre from the proposed rail spur junction with the main northern line. This proximity of the Coal Loader's rail spur junction is too close to residences in the Western end of Blue Haven. Its proximity will cause interference with the ambiance of the locality by heightening noise levels.
929.	Air Quality Health	David Holland	P2	The details of the concerns related to the impacts of the coal loader are as follows: **1. The proximity of the coal stockpiles and any open-air movement of coal would tend to create emissions of coal dust.** Even if this coal dust can be controlled most of the time, there is likely to be emissions from the site from beside stockpiles and as the material is loaded onto and transported by the coal trains. This coal dust has a potential to cause breathing problems, especially with the young and the elderly. It has the potential to cause underlying respiratory complaints not detected until latter in life. It has the potential to cause carcinogenic reactions in future life plus a range of other affects as described below.
930.	Land Values Economic	David Holland	P2	a. Due to a coal loader being so close to the suburban areas, I believe that the property market of the area will be affected. Whether coal loader impacts are a perceived degradation of the living environment or an actual degradation, the same result of an affected property market will occur. That is that the coal stockpile facility and coal loader in the area will have a negative influence on house and land prices. This will mean that prices will tend to fall below a level that otherwise would have existed without the building of the coal loader facility. This will mean that all those owners potentially affected by the coal loader's proximity will have a devalued capital asset. As a consequence, borrowing against that asset will be at a lower value to what otherwise would have been expected without the presence of the proposed coal loader. Blue Haven will not be affected alone, with the township of Wyee and the proposed town centre at Warnervale within the proximity of the loader facility impacts will be more widespread. In addition new developments planned west of the freeway will be affected by these price distortions.
931.	Air Quality Social	David Holland	P2	b. The urban interfaces around the proposed facility are set to expand. Blue Haven may have finished expanding to the west but with Wyee Station just over 3 kilometres from the proposed facility, and Warnervale's proposed town centre only 1500 meters to the south of the facility, the potential for coal dust impacts are as real in Wyee and Warnervale as they are in Blue Haven. Wyee is set to expand its residential areas around the station, while Warnervale is expected to be the hub of very many new housing estates. Even with a light southerly or northerly wind, coal dust would be expected in these areas as well.
932.	Social	David Holland	P2	c. With the likely development of Bushell's Ridge industrial area to the north, the opportunity of having the railway so close to the suburban areas of Blue Haven, and with the expected population growth for the locality stretching from Warnervale to Gwandalan, a real possibility exists of having a bus and train interchange at Blue Haven not far from the proposed development. With the potential for airborne particulates to be in the area, greater numbers of people could be affected with health issues caused by inhalation of coal dust. In time it would be expected to see more bicycle use for commuting to railway stations like this proposed one and the proposed new railway station at Warnervale. These developments would widen the potential impacts of coal dust on the population. (See interchange proposal at: Blue Haven Rail and Bus Interchange Proposal)
933.	Air Quality Surface Water	David Holland	P2	d. Currently many residents of Blue Haven have installed rainwater tanks. With the potential of particulates of coal dust landing on rooves, it is expected that tanks will tend to fill up with this fine coal dust necessitating more clean-outs of these tanks and causing new risks to the health of the cleaners. Not only would Blue Haven be affected, but also all the new subdivisions at Wyee, Warnervale and any proposed urban

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				development areas close by, where rainwater storage units are compulsory for new homes.
934.	Air Quality	David Holland	P2	e. Over the last year or so, many residents have installed solar panels on the roof hoping to save power and reduce electricity power costs. With fine coal dust falling on the panels it is expected that the available sunlight to these panels will be reduced unless cleaned regularly. In addition the savings otherwise made to residents would be far less, squandering their small effort to reducing carbon emissions, and reduce their power bills.
935.	Air Quality	David Holland	P2	f. With the existing and proposed urban areas situated in relatively close proximity to the stock piling facility and the potential for prevailing winds to carry the finer particles of the coal dust several kilometres, it is likely that all out door surfaces will be affected by the dust. This will include washing hung out to dry. As a response to coal dust on washed clothing, it is expected that householders will react by installing electric clothes dryers, thus artificially increasing the amount of electricity used and the cost of the household power bill.
936.	Air Quality Ecology	David Holland	P2	g. There are concerns about the unknown impacts of coal dust on the natural environment. It would be expect that after rain, much of the dust will wash off the leaves of vegetation, however some will tend to build up and persist on the leaves. The impacts of the fine dust have on insects and other larger fauna in the local areas of bushland adjacent to the proposed facility would be unknown without extensive studies. However, under longer dry spells it would be expected that coal dust coatings on leaves would adversely impact on bushland flora species. In a wet spell, rainwater would wash the fine coal dust into the creek system, causing unseen damage to the benthic biota in Wallarah and Spring Creeks.
937.	General	David Holland	P2	These are all hypothetical if the proponents guarantee that there will be no dust emissions from the site. How can this be done with coal moving constantly on the site? Wetting the top layers of coal will tend to dampen the coal dust in the stock pile until the sun dries it out again, but the loading process as mentioned above should generate large amounts of coal dust. In addition the transportation of the coal has an additional potential to produce dust emissions. Thus the adjacent bushland and creeks must suffer from this potential impact in some way and all the other impacts itemised above are open to occur. Below is a web address that shows an NBN television article on a recent study in the Hunter Valley on coal dust emissions related to coal loaders and coal being transported by rail. http://www.nbnnews.com.au/index.php/2013/03/08/dust-data-sparks-fears-over- fourth-coal-loader/ Below is a paper from the Hunter Community Environment Centre (HCEC) making some serious points about the potential problems with coal dust in the environment. http://www.hcec.org.au/20130417/global--coal--study--highlights--serious--health--risks--hunter
938.	Noise	David Holland	P2	**2. Noise emissions related to the operation of the coal loader facility.** When considering the rail spur's proximity to the lower parts of Blue Haven and other urban areas close to the proposed development, the noise generated by the rail trucks crossing the points as the coal train enters the main northern line will have a negative impact on residences in local streets. I believe that this impact will be felt throughout the night as well as the daytime.
939.	Noise	David Holland	P2	a. Noise from the locomotives shunting between the rail line and the rail spur, where trucks are banging against each other as they couple, will impact Blue Haven residents. Currently as the rail line is about 500 meters from houses, freight trains can be heard on many occasions. With the operations of the coal facility and the proposed rail spur trains, residents would expect to hear bangs rather than a sound of a train slowly rising in volume and then fading away again as is the case with trains on the main line currently. Residents would expect these bangs will not only affect residents sleep patterns day or night but arouse many of the neighbourhood dogs, thus causing a great deal of anxiety for both dogs and owners.
940.	Noise	David Holland	P2	b. Although the noise generated by the loading of each rail truck as the coal falls into the bottom of the truck is probably too far from Blue Haven residents to hear, unless under extraordinary wind conditions, it is likely that the urban and semi rural areas of Warnervale will be disturbed by this noise. This noise would be happening almost constantly. With the right wind conditions the noise would be exacerbated and again continue to bother the neighbourhood dogs in any suburb within a range of the loading facility.
941.	Air Quality Noise	David Holland	P2	All of the above will affect the current ambiance of the neighbourhoods around the proposed plant. We recognise that the land is zoned industrial, but many industrial sites in Wyong Shire do not have an intensity of open--air activity that will produce noise to this level both day and night.
942.	General	David Holland	P2	**3. Risk factors related to the Toohey's Road site and coal loader site.** It is my contention that the risks related to the impacts associated with the development are too high for urban areas. It is my contention that if the development were not proceeded with, the level of any additional risk would be zero. This would be an acceptable risk level.

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				The potential impacts related to just the issues mentioned above present a level of risk to the people living in surrounding urban areas that would not be present if the development did not go ahead.
943.	Land Values Economic Health Air Quality Surface Water	David Holland	P2	**a. The level of risk related to additional financial costs due to potential externalities to the site could be considerable**. Following is a list of the potential financial impacts that residences may have to consider. a. Loss of capital value to a property b. Additional cost related to laundry. ie. New dryer, extra power costs, buying new clothes more frequently. c. Health costs – ie. More medication for children and others. More medical practitioner and specialist expenses. d. Expenses related to cleaning house external walls and rooves. e. Loss of water quality related to rainwater tanks. ie. The expense related to cleaning tanks. Additional risks related to workers cleaning the tanks causing increased cost associated with cleaning due to more expensive equipment needed due to potential health dangers of handling coal dust fine particles. f. Loss of sunlight shining on solar panels on rooves thereby reducing returns on the investment in the panels.
944.	Air Quality Health	David Holland	P2	**b. Risk and how it relates to coal dust in urban areas** The proponent will attempt to control the dust from the development so that it is below the standard set by the EPA. It seems that the most dangerous size of particle material from coal dust is between PM 10 or 10 micrometres in diameter down to PM 2.5 or 2.5 micrometres in diameter. Particles below this size are often produced from the burning of material including hydrocarbons. For instance diesel fuels and flare emissions. However, it seems that the majority of these PM 10 to PM 2.5 diameter particles likely to be produced by the facility are the coal dust produced by the stockpiling and transportation of coal. Recently a study was done in the Hunter Valley Coal fields of NSW that related to the measurement of particle material close to coal transport facilities. Over the 7 days monitoring period, readings exceeded the preferred standard set by the EPA for the whole time of the monitoring. There are academic papers that indicate that some of these particles can penetrate human tissue particularly through the lung wall. It is also asserted by some experts that such particles of coal can cause free radicals in the human body. If these particles are small enough to penetrate the tissue and organs of a human body, what damage could be had if these particles of coal dust are in fact a potential cause of the production of free radicles in the human body? What risk of cancer would someone run who was in constant contact with coal dust within a coal dust affected area?
945.	Air Quality Health	David Holland	P2	**c. What level of coal Dust emissions will cause cancer?** Since we measure the development of cancer as a risk factor to the concentration of a pollutant, it is hard to quantify whom the coal dust will affect. The only result we can perhaps glean from a study of a population in an affected area is the number of cancers formed in a sample of the population. Through this we would get an approximate risk factor. When standards are established, I would contend that it is based on a loose correlation between cancer in the community and the level a pollutant of a particular type. This same conundrum was realised when assessing the level of lead and arsenic in an orchid being studies by me as a student. The fact that we found arsenic and lead in the orchid from pest control sprays at or below the EPA guidelines did not mean that there was no risk to the workmen in the orchid. Similarly, risk is apparent in the proximity of the coal loader from the health affects of coal dust inhalation or imbibition, cannot be quantified. Perhaps this pollutant in the environment will not affect many people. Maybe many will not show symptoms of effects for some years and the correlation between the coal dust and other environmental pollutants may be blurred. But rest assure that if a pollutant is introduced such as coal dust or arsenic into an environment, risk of health issues will be apparent. As mentioned before, if the coal loader is not developed no risk from the development will be there to the population of the towns of northern Wyong.
946.	Social	David Holland	P2	**4. The proximity of urban areas closer to the site than Wyong Township.** In the introduction to the Environmental Impact Statement (EIS) for the Wallarah 2 project it states that Wyong is the closest town to the development with a distance of about 5 kilometres. This may be true to the closest part of the mine proposal, but the coal loader facility has

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				several towns closer to it than the Wyong Township. Below is a list of townships and suburban areas closer to the proposed development than the small township of Wyong. **Town Centres** (A township by definition has a shopping centre) Lakehaven Charmhaven Kanwal Warnervale (Proposed New Centre) Wadalba Wadalba East (Proposed Town Centre) Gorokan Wyee Watanobbi San Remo **Suburban Areas** Blue Haven Woongarrah Hamlyn Terrace Warnervale Halloran (Industrial Area) Bushell's Ridge (Proposed Industrial Area) Jillaby Rural estates Bruce Crescent Rural estates Doyalson
947.	General	David Holland	P2	I thank you for the opportunity to present a submission on this project and expect the Commonwealth EPBC Act 1999 will be consulted and support the disapproval of the proposed development on environmental grounds. I also hope that the Director General of the Department of Planning, responsible for good planning outcomes in NSW will disapprove of the proposed development due to the risk of impacts related to the development of the coal loader operations and its proximity to existing and proposed urban areas and public infrastructure.
948.	Subsidence	Mark Moffett	P3	I am a property owner of 34 acres located at 45 Boyds lane, Wyong creek, NSW, 2259. The recently released Wallarah 2 EIS indicates that I will be directly affected as a result of vertical subsidence (75cm) + horizontal subsidence (15cm) to our dwelling that we have recently completed at a cost of over $1 million.
949.	Economic	Mark Moffett	P3	Furthermore, I have needed to expend a $20,000 to date to adhere to Mine subsidence board requirements and I believe it is unfair and unreasonable to enforce extra costs (without compensation) onto land owners for a mine that should not proceed.
950.	General	Mark Moffett	P3	The proposed mine impacts the following Key Areas that I believe deem the proposal unsuitable. The Wallarah 2 coalmine should be rejected due to the following reason/submissions:-
951.	Air Quality Health	Mark Moffett	P3	**Coal Dust** The EIS indicates that there is a risk of illness leading ultimately leading to death as a result of air borne coal dust originating from the coal mine + transport. As one of the fastest growing (population) regions within Australia, North Central coast are expected to attract 100,000 residents to new developments at Warnervale + Wyee. This development area exists within a short distance to the proposed Bushells Wallarah 2 main plant.
952.	Air Quality Health	Mark Moffett	P3	It is current practice for schools and residents around Tighes Hill (Newcastle) to measure coal dust effects on the current student population due to significant increases in student illness as a result of airborne coal dust. COAL DUST Does carry! The risk of such on established areas such as Lake

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				haven, Blue Haven, Charmhaven, Bushells Ridge are significant. **The Impacts are too great to permit a coal mine.**
953.	Air Quality Ecology	Mark Moffett	P3	I refer to previous coal dust studies contained below:- *Wetlands Ecology and Management* *October 2005, Volume 13, Issue 5, pp 509-515* ***Coal Dust Pollution Effects on Wetland Tree Species in Richards Bay, South Africa*** The impact of coal dust on natural vegetation is excessive as it reduces photosynthesis and much of the coal dust on the underside of leaves etc cannot be blown/washed off. Much of the land surrounding Wallarah 2 facilities is either marked for residential/commercial development or sensitive vegetation including but not limited to wetlands, rainforest pockets and Euclaypt forestation. I believe that the risk of unrepairable damage to the natural vegetation are significant. **The Impacts are too great to permit a coal mine.**
954.	Historical Heritage	Mark Moffett	P3	**Historical Protection + Significance** The Proposed Coal Mine EIS has indicated that the belowmentioned Heritage listed dwellings will Subside by approx 75cm. There are also a further 7 x Heritage Listed structures/dwellings in the immediate Wyong Creek vicinity that will attract horizontal subsidence. The belowmentioned structures are currently used / maintained by descendants of the original pioneering families and are currently used and admired by the local community. Heritage significance also applies to the construction techniques used at the time of construction. Cedar used in the construction of these buildings originated from our Yarramalong Valley ('aboriginal name' for Cedar) and damage to these buildings cannot be rectified without impacting the true heritage significance of these structures. I have included below details of the heritage properties effected. ***STATEMENT OF SIGNIFICANCE:*** *Lot 129 DP 755271 Boyds Lane, WYONG CREEK* ***STATEMENT OF SIGNIFICANCE*** *WYONG CREEK COMMUNITY HALL* *Lot 1 DP 945671 Yarramalong Road, WYONG CREEK* **The Impacts are too great to permit a coal mine**.
955.	Ecology Surface Water Groundwater	Mark Moffett	P3	**Endangered Flora/Fauna** Animals and plants will be impacted by the Coalmine. There are a number of international waders, recorded under the Australian Government agreements with China and Japan, whose fragile habitat is entirely dependent upon the health of the water catchment river systems, and thirty-three (33) endangered or threatened species of flora and fauna within the Wyong / Jilliby catchment valleys. Longwall coal mining not only poses a threat to the water supply, both surface and subsurface waters, but it also poses a threat to the habitat of the various endangered and threatened species of flora and fauna. A report on Jilliby Jilliby Creek, prepared in 2004 by River Care, in association with Hunter-Central Rivers Catchment Management Authority, National Heritage Trust and the Department of Infrastructure, Planning and Natural Resources, declared this water system as one of the most pristine in New South Wales. This report also condemns the damage that will be caused by the impact of longwall coal mining. **The Impacts are too great to permit a coal mine**.
956.	Surface Water Subsidence	Mark Moffett	P3	**Water Catchment** The water catchment area of Dooralong and Yarramalong Valleys in which the coal mine is proposed to travel under account for 50% of the water for the entire Central Coast region surrounding major hubs of The entrance, Gosford and Wyong and also being one of the largest population growth areas of Australia. The river systems are fed 2/3 by underground aquifers. I own a property that borders the Wyong Creek Catchment river and I have personally encountered platypus, fish, eels, birds, wombats , kangaroos and echidnas surviving in and around the fresh water. The maps displayed to me at Kores premises (Wyong) indicate that the coal mine travels within 18 metres from the vertical line of the Wyong Creek ...some 550 metres below surface. The map contradicts any other maps circulated and distributed as marketing material. The EIS clearly states that there will be significant loss of surface water from Wyong Creek as a result of mine subsidence. These valleys (Dooralong

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				and Yarramalong) not only provide habitats to our native emblems and animals but also the most valued asset- Drinking WATER to our most valuable ASSET – HUMAN LIFE. **The Impacts are too great to permit a coal mine**.
957.	General	Ken Scales	P4	My name is Ken Scales and I live with my wife in the last part of Blue Haven subdivided and sold by Landcom which is closest to the proposed coal mine. During the purchase of my land I made inquiries about mining through the Mine Subsidence Board as advised by my Solicitor. I was told that mining south of the general line of Roper Road would not be an issue and Landcom assured me that this was a pristine area for living. No one mentioned that we would be getting the added bonus of a huge Coal Loader just up the road.
958.	Air Quality Health	Ken Scales	P4	I prepared and submitted written submissions to both previous inquiries inquiry into mining in this area and also spoke at both inquiries. I am lodging this submission as an individual with a severe dust allergy who does not want to relocate because of a proposal which I consider immoral to say the least
959.	Health	Ken Scales	P4	Firstly the environmental impact statement located in volume 1-main report page 13 assesses the health risk resulting in death at 1 in 100,000. The health assessment in Appendix M at page 7 contains a chart showing increased mortality and serious illness that will result from increased coal dust generated by the mine.
960.	Air Quality Health Social	Ken Scales	P4	I am sure that the good people from Kores will assure us that not enough coal and crystalline silica dust will reach Blue Haven to kill us or our neighbours. Unfortunately for me that will not work and because I have suffered from severe hay fever generated by dust for most of my life. I could not take the risk and would be forced to relocate. The maps in the previous EIS clearly show the effects of dust. Figure 18 shows dust reaching the Western end of Blue haven where I live. It would also affect the Blue Haven Primary School and the three nearby child minding centers. Young children and older people such as myself with existing respiratory issues are the ones at greatest risk from the dust. I believe these maps have been omitted from the new EIS to make dust deposition in critical locations much more obscure. I have attached the section from the previous EIS which shows these maps as figures 1 to 18 at the end of the document. The dust data is identical in both EIS documents except that the latest one omits the maps.
961.	Air Quality Health Traffic and Transport	Ken Scales	P4	Last but not least the EIS does not adequately address volumes transport and storage of fine Crystalline Silica Dust Particles generated by blasting to get access to coal. I was informed by a local mine engineer who lives in the valleys that this mine will generate a significant volume of Crystalline Silica Dust Particles. This seems to be substantiated by various sections of the EIS. The EIS states that these particles can cause tuberculosis, bronchitis, emphysema, chronic obstructive pulmonary disease, renal disease, silicosis and lung cancer. I believe that by putting all this data out in the EIS, the consultants Pae Holmes have made sure there they have no case to answer if it all goes wrong. The data is there but any conclusions are obscure and there is no risk management strategy to make an informed decision as what the real effects will be. Pontius Pilate was alive and well when he prepared this report.
962.	Air Quality Health	Ken Scales	P4	There was a time when low levels of asbestos dust were considered to be acceptable and within government guidelines. As a child I played on heaps of broken asbestos sheeting donated by James Hardie as land fill behind the local scout hall. Later on I cut up fibro sheets with a handsaw. Maybe in time the safe dust from the mine at the predicted safe levels will cost the community as much as the asbestos only in this case it will be the NSW taxpayers who will pay.
963.	Air Quality Health	Ken Scales	P4	The real bottom line is that the dust from this mine will kill people and make others very sick. Yes it is only a few but how many dead people are too many. What about a small child who dies from the dust? Would the person who signs this off like to visit the children's hospital and explain to a parent why their child has a lung disease caused by crystalline silica or coal dust. The EIS actually acknowledges that there are no actual levels of crystalline silica or coal dust which can be guaranteed to be totally safe (See page 11 Executive Summary & pages 6 to 9 Appendix M Health Risk Summary)
964.	Subsidence	Ken Scales	P4	**SUBSIDENCE** The main purpose of an Environmental Impact Statement is to assess the effects of a project and assess what can be done to mitigate any negative impacts. In the event of any major subsidence damage to property the mitigation strategy is clearly stated in Section 6.2 at the top of page 68 which states **"In the event that any impacts do occur the Mine Subsidence Board will rectify them".** This is not an acceptable mitigation strategy under the risk assessment practices I studied during my working career. This strategy has not worked in the past with subsidence events such as those at Chain Valley Bay. Again it is the taxpayer who gets the bill. (See page 68 Subsidence Modelling Study Appendix G)

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965.	Subsidence	Ken Scales	P4	**DAMAGE TO POWERLINES** The mitigation for major damage to the Transmission Lines and their supporting towers is even better than the subsidence strategy. This matter is covered on page 106 of the report which states that based on the experience at other NSW longwall mines that impacts to powerlines as a result of subsidence are uncommon and damage is generally of a minor nature. The mitigating strategy is to **"discuss this with Transgrid"** so that the towers are not undermined. This does not appear possible with the length of the panels and the huge area that will be subsided. At Jilliby road three of the Towers are almost together and could be displaced in a single subsidence event with quite devastating consequences to the Sydney Electricity supply grid. There is no remedial action proposed if this did happen. We just have to hope the talks with Transgrid work out for the best. (See Page 106 Impacts Management & Mitigation Volume 1 No 7)
966.	Surface Water	Ken Scales	P4	**FLOODING** The flood assessment indicates that a total of 75.4 hectares of land and 27 dwellings will be impacted in some way by flooding that will increase as a result of subsidence caused by the mine. The EIS does have a clear strategy to deal with these outcomes. It list some measures such as raising houses, constructing levies, and moving or relocating houses to higher ground within the existing property boundaries. It states that for potentially impacted houses that are unable to be protected raise or moved properties may need to be purchased or owners otherwise compensated. It does not mention who will actually look after these matters just goes on with a lot of motherhood statements about determining mitigation options prior to commencing mining. Unfortunately there is no legal compulsion for the mining company to do anything once the EIS is approved. Anything relating to flooding is virtually impossible to prove in court. There is no legal protection for residents against these events other than to get out of town before it happens and watch the unfortunate purchaser telling their story on a Current Affair. Environmental Impact Statements are designed to stop these events happening by not approving projects such as this one. (See page ii Volume 3 No K Flood Impact Assessment)
967.	Surface Water	Ken Scales	P4	**FLUSHING OF TUGGERAH LAKE** The reduction in water flowing from the Wyong River into Tuggerah Lake will reduce the flushing ability of the lake. Tuggerah Lake is only partially tidal and the eco systems within the lake are dependent on regular flushing from Wyong River generated by heavy rain. This is recognized in the EIS however there does not seem to be any mitigating strategy to address the effects of reduced water flows from the Wyong River and consequential reduced flushing of Tuggerah Lake. Any reduction in this would cause damage to the eco systems of the lake and irreparable damage to marine creatures and bird species that live in and on the Tuggerah Lake. All current Strategies to keep the lake healthy are based on the principle that the whole eco system is delicately balanced and any major change such as a breakwater to increase the inflow of sea water would cause destroy the balance. I am sure any major reduction in river flushing would have the same effect. However the breakwater may become necessary if too much water is lost because of the mine. (See pages 4 & 5 Aquatic Ecology Impact Assessment Volume 5 No P)
968.	Surface Water	Ken Scales	P4	**INCREASE IN WATER CHARGES** The damage to the water supply will be well covered by others. However I would point out the a reduction in supply will cause a huge rise in cost over the long term much like electricity and have political ramifications for decades. This will have little effect on me because I have 5 water tanks and pay little in water charges. However I do care about my community or I would not have fought against this proposal.
969.	Surface Water	Ken Scales	P4	**WATER QUALITY** No matter how it is argued there is a significant risk that the mine could compromise the quality of the water going into Mardi Dam. This happened with the Cataract River where the cracks in the bed resulted in large amounts of sediment entering the water flows and reducing the quality of the water. Cataract Dam is a small part of a very large water catchment system and consequently this sediment has not caused significant problems for the Sydney water supply. Mardi Dam on the other hand is a relatively small dam but forms a major component of the Central Coast Water Supply System. Any serious degradation of the water flowing into Mardi Dam would have serious consequences for the entire Central Coast water supply system.
970.	Air Quality	Ken Scales	P4	**DUST ALONG THE RAIL CORRIDOR** At the last enquiries the issue of dust disposition along the rail corridor was raised. Kores answer to this was that it was not their problem. The social responsibility for potential harm to the community again is a matter for an EIS not something to be dismissed by motherhood statements. This matter should be examined in conjunction with the Senate Hearing into dust issues in Newcastle and along the rail corridor where we are sending this coal.

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971.	Air Quality Health Traffic and Transport	Ken Scales	P4	**DUST AND THE F3** The effect on passing traffic on the F3 Freeway which is very close to the mine loading and stockpile area does not get a specific mention. Dust will actually be sucked into the ventilation units of passing motor vehicles. This will include Crystalline Silica Dust Particles which are only slightly less deadly than Asbestos. This will concentrate it and blow it directly onto passengers. The negative health effects of this material are well covered in the EIS. Even worse a police highway patrol vehicle parked on the side of the road to perform speed checks with the air conditioner running in hot weather will ingest a much higher volume of dust than any other vehicle. I believe both the tens of thousands of motorists who drive along this road every day and in particular the Police Officers who put their lives on the line on a daily basis deserve better treatment than this. I believe the EIS should include a strategy for the closing and cleanup of the F3 if sufficient amounts of this material had accumulated and were found to constitute a health hazard along this part of the freeway and surrounding area. The maps in the file attached from the previous EIS shown as figures 14 to 18 at the end of this document clearly show dust disposition on the F3 during construction and mine operation
972.	Social Economic Tourism	Ken Scales	P4	**FINANCIAL BENEFITS AND EMPLOYMENT** The EIS lists large numbers of jobs and income for NSW that will be generated by the project. There are several points that need to be made here. Firstly the will be a lot of jobs created that are not listed in the EIS, but they will all be paid for by the NSW taxpayers, not Kores. Just to list a few there will be positions in health due to dust, construction jobs to repair damage caused by subsidence and flooding, possibly a breakwater for Tuggerah Lake to allow seawater to replace the river water lost to the mine, additional rail infrastructure, additional road and rail maintenance just to name a few. Secondly I would not like to own a business that is run like this mine. For the current owners of the coal, the NSW taxpayers, there is a bounty of $7.00 a ton or slightly more. For the citizens of South Korea they get coal worth around $170 a ton less the cost of mining and transport. There are taxes on employees and some other offsets for NSW taxpayers but nothing that substantial. The coal was acquired by the NSW Government in 1981 to provide cheap power for NSW not South Korea. Lastly restoration of fish stocks in the Tuggerah Lakes and some minor redevelopment of existing tourist infrastructure could make the area a fishing mecca. This would provide as many long term jobs as this project. We do not need to destroy the environment to just make money.
973.	Traffic and Transport	Ken Scales	P4	**TRANSPORT ISSUES** The rail study indicates the mine will be using the best available technology to transport the coal. It mentions the use of locos with AC traction motors. I would also expect that new coal hoppers with ECP braking will also be built and used for this operation. This might make us believe that there will be no effect on other operations on the main Northern line between the mine and Newcastle. The rail study points out the following: • The most suitable option for transporting the coal to Newcastle will require the provision of new 1700 meter southbound and northbound loops at Awaba. I would expect this would be funded from the public purse • The project will impact on level crossings at St James Road Adamstown and Clyde Street Islington. There are already significant traffic issues with these crossings and this will only make things worse. • Despite a lot of confusing data in the EIS the general rules with coal trains are a top speed of 65kph loaded, 80kph empty, and 15kph when entering loops or any type of track crossing. Fast intermodal and passenger trains can travel up to 115kph on this line if speed boards permit. • Even with the best of intentions and the latest equipment a heavy coal train starting on an uphill grade and crossing to the other side of the line to run north uphill will have a significant effect on the north bound fast container and passenger trains between the mine and Newcastle • As a general rule a heavy coal train travelling north from the mine to Newcastle would on average take nearly double the time of a fast intermodal train because of a lower top speed and much slower acceleration and deceleration when starting and stopping. Anyone deciding the fate of this EIS should be aware that nothing can stop Kores from transporting the coal by road to Newcastle or Wollongong if they so desire. This has already happened in NSW with wheat and petrol and there is no legal recourse to stop it happening. It is simply up to the operator. Coal is already being carried by rail from Newcastle to Wollongong for blending. Together with coal travelling from the western line to Wollongong this has a negative impact on the ability of the Sydney train network to carry passengers and consequential effects with increased traffic gridlock. Kores also have the right at any time to ship the coal by rail to Wollongong if they so desire. Although the rail loop points north, trains can be easily sent south to Wollongong by using additional shunting locomotives to turn them, as they leave the loop.

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				There are no mitigating strategies for any impacts caused by the rail transport for this project. However my reading of the rail study indicates that transporting the coal by rail is not feasible without major improvements to existing rail infrastructure. I believe the real risk is that the coal could be moved by road or even sent to Wollongong if it becomes necessary.
974.	Risk Assessment Surface Water Subsidence Health Ecology Air Quality	Ken Scales	P4	**SUMMARY** The EIS should not be approved for the following reasons; 1. It does not adequately satisfy current industry risk management guidelines for • Damage caused by subsidence • Flooding caused by subsidence • Damage to Electricity Supply caused by subsidence • Health issues caused by dust to nearby homes • Health issues caused by dust to passing traffic • Health issues caused by dust along the rail line • Damage to Eco systems in Tuggerah Lake caused by a reduction in water flow into the lake
975.	Land Values Social Surface Water Economic Health	Ken Scales	P4	2. It does not address the social impacts of • Property loss and damage from subsidence • Property loss and damage from flooding • Increased water charges and restrictions • Negative effects on residents health from dust
976.	Traffic and Transport	Ken Scales	P4	3. It does not have a satisfactory transport strategy. The rail study gives some options. It does not contain a satisfactory transport plan that would fit within current operating timetables using existing infrastructure. There are no available legal controls that would stop Kores transporting the coal by road.
977.	Economic	Ken Scales	P4	4. Objectively the financial gains for NSW citizens are not really what they seem. The real benefit from this project is cheap power or steel for South Korea. Unlike locally owned companies there is not the same flow of money back to shareholders which then further stimulates our economy. Some of the real benefits of the mining boom are now being lost because we do not have the same income return through local shareholders that we had when all money from mining was returned to our economy.
978.	Economic	Ken Scales	P4	5. Kores cannot sue the government if the EIS is rejected. The main Statute which governs mining in NSW is the Mining Act 1992 No29. Section 127 of this Act protects the government from any legal action to seek compensation if the mine is refused. However if the EIS is approved other legal avenues for compensation become available.
979.	General	Ken Scales	P4	The mine was rejected by Tony Kelly the last time on the precautionary principle for reasons such as those above. Some of the issues in the last EIS have been addressed but there are still no satisfactory solutions to most of the issues that resulted in it being rejected last time.
980.	Rehabilitation	Ken Scales	P4	Most remedial action will be paid for by all NSW taxpayers where ever anything goes wrong. It seems that risk management strategies for adverse outcomes are based on the Harrison Ford principle in the movie Raiders of the Lost Arc. As he chased a truck on a white horse he was asked, “what are you going to do”? He replied much like Kores have in the EIS, “I am making this up as I go along”.
981.	Air Quality	Ken Scales	P4	The omission of some of the Maps from the last EIS which contained virtually the same data on dust is an act of deceit. This should throw some doubt on the integrity of the latest EIS.
982.	General	Ken Scales	P4	There are significant risks to all mining revenue in NSW if this were to generate legal action by landowners in the valleys. The legal precedents would apply to nearly all underground mining outside Newcastle and Gloucester. A decision in the High Court of Australia on Constitutional grounds cannot be fixed by some new dodgy legislation under NSW Statutes.
983.	General	Ken Scales	P4	The whole concept is morally wrong and simply ruins the lives of those affected by a project that should never be approved. A lot of negative outcomes cannot be fixed. If this EIS is approved then our society is in deep trouble. I formally request that the Wallarah 2 mine proposal be refused for the reasons set out above.
984.	General	Form Letter 1	P5	The original application by Wyong Areas Joint Coal Venture in 2010 was rejected by the previous NSW Government in March 2011 on grounds of unsustainability (ESD principles) and the Government's application of the Precautionary Principle. Nothing in the new application changes that concept

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				as essentially it is a reworking of the previous application. The current NSW Government's "Aquifer Interference Policy" as intended should nullify the application at hand.
985.	General	Form Letter 1	P5	The Wyong Water Catchment was protected under a proclaimed NSW Statute in 1950 (Gazette No. 153 of the LGA 1919, 1950).
986.	General	Form Letter 1	P5	Some 300,000 people in the Wyong and Gosford Local Government Area rely upon this major water catchment for their potable water. The recently completed Mardi-Mangrove pipeline also relies upon the sustainability of the water catchment district to transfer water from this system to the Mangrove Dam for water banking.
987.	Groundwater	Form Letter 1	P5	In 1999 groundwater consultants, ERM Mitchell McCotter, found that transient pathways for water to travel downwards to the coal strata was evident and so bulk water would not be impeded on its downward path.
988.	Groundwater	Form Letter 1	P5	Kores claim that there will be no effect upon the water supply due to impervious layers between the surface and the mine seam. Professor Phillip Pells, Senior Lecturer at the University of NSW, dismisses these claims. Kores do admit to a loss of water rated at 2ml per day per square metre of the mine surface area. This extrapolates over the whole mine area to approximately 8 megalitres per day or 3000 megalitres each year once mining is complete. The professional uncertainties characterised within the Kores submission paint a very tentative picture for protection of the coast's natural potable water supply.
989.	Subsidence	Form Letter 1	P5	The Peer Review by Professor Bruce Hepplewhite (page 258, Appendix H) questions many of the terms used and assumptions made during the geological modelling upon which subsidence and water loss are based.
990.	Subsidence	Form Letter 1	P5	Some 46 panels are to be mined, including in the Hue Hue Subsidence Area where 150 houses (Appendix H Map on page 240) mostly of modern brick design exist on subdivided acres and will be subjected to subsidence up to one metre but may well suffer further subsidence due to the existence of Awaba Tuff strata below the mine on which the remaining pillars are supported. Much discussion within the application refers to the uncertain nature and caution needed re the soft bedded Awaba Tuff leading to a scenario of adaptive management as mining begins to proceed. This type of experimental mining should only be carried out in an outback remote location and not under modern homes within the expanding outer suburbs of Wyong. The Department of Infrastructure and Planning should be alarmed by this and immediately inform the unsuspecting owners of the properties in the Hue Hue Subsidence District.
991.	Subsidence	Form Letter 1	P5	A total of 245 houses (Appendix H, Page 130) will be impacted by subsidence from a conservative one metre to 1.6 metres throughout the mine area. A total of 755 Rural Building Structures will be impacted (Appendix H, leading up to 179) and 420 Farm Dams suffering subsidence to some degree (Appendix H, leading up to 187). As can be seen the projected damage inside the mining lease area would be catastrophic. The hinterland of the valleys are to be subsided 2.6 metres; Little Jilliby Jilliby Creek at the southern end is predicted to fall 2 metres; the main artery into the Jilliby/Dooralong Valley, Jilliby Road is destined to be subsided 1.75 metres in places, remembering that these valleys flood on a regular basis leaving residents isolated from all directions.
992.	Air Quality Health	Form Letter 1	P5	Dust and noise from stockpiling and rail movements will impact on the established suburbs of Blue Haven, Wyee and all along the rail corridor from Morisset through Cardiff and southern suburbs to the port of Newcastle. The proponent fails to adequately address these ramifications. New burgeoning suburbs being created in northern Wyong shire will be impacted by the mining proposal. It is placed amid these developments and should not be considered based on known high rates of asthma and bronchitis as voiced by the medical profession for decades.
993.	Ecology	Form Letter 1	P5	Nineteen species of avian migratory waders in the area are protected under the Federal EPBC Act with binding agreements with China (CAMBA), Japan (JAMBA) and South Korea itself (ROKAMBA). The proposal directly affects these agreements. There are also flora species listed as threatened under the Act and local fauna species listed as endangered under the Act with the proposed mining area.
994.	Greenhouse Gas	Form Letter 1	P5	The Director-General's Requirements are extensive and in most areas Kores have failed to address these adequately. The proposal should be rejected outright as the long term damage to the coast's water, biodiversity, infrastructure, amenity and health is unacceptable. The addition of the result of burning this resource within the next ten years has not been evaluated upon damage to the earth's climate and will be wholly condemned as the trend to reject fossil fuels gains momentum.
995.	General	Form Letter 3	P6	The Wyong Water Catchment was protected under a proclaimed NSW Statute in 1950 (Gazette no 153 of the LGA 1919, 1950). The now extinguished Part 3a of the EPA Act overrode this Statute so effectively the original protective measure should now be in place.
996.	Subsidence	Form Letter	P6	The Peer Review by Professor Bruce Hepplewhite (page 258, Appendix H) questions many of the terms used and assumptions made during the

No.	Aspect	Stakeholder	ID	Issue
		3		geological modelling upon which subsidence and water loss are based. For instance (page 258, Appendix H) indicates… "Page 73.- a similar issue of semantics occurs when discussing changes to stream alignment. MSEC states that there will be no significant changes, but what is regarded as significant? Can this be quantified at all?" …and.. again.. "Page 74..(part),In discussion of valley floor closure and upsidence, it is noted that such behaviour is expected to occur in a number of valleys, but will be masked by overlying alluvium. It is noted that small zones of increased permeability might develop in the top few metres of the rock head beneath the alluvium, but due to the saturated overlying alluvium, these increased permeability zones will not result in any impact on surface water levels. This conclusion may be correct, but is it not possible that some conditions may exist due to localised geological changes, and changing climatic conditions such that the alluvium is not always saturated and some loss of water level in the streams may occur? "….
997.	Subsidence	Form Letter 3	P6	A total of 245 houses (Append .H Page 130) will be impacted by subsidence from a conservative one metre to 1.6 metres throughout the mine area. A total of 715 Rural Building Structures will be impacted {Append. H >page 179) and 420 Farm Dams suffering subsidence to some degree (Append.H >page 187). As can be seen the projected damage inside the mining lease area would be catastrophic. The hinterland of the valleys are to be subsided 2.6 metres; Little Jilliby Jilliby Creek at the southern end is predicted to fall 2 metres; the main artery into the Jilliby/Dooralong Valley, ARON Road is destined to be subsided 135 metres in places, remembering that these valleys flood on a regular basis leaving residents isolated from all directions.
998.	Surface Water	Form Letter 4	P7	The proposed mine will be directly beneath our Central Coast's major water catchment area and puts at risk our drinking water forever.
999.	Air Quality Noise Health	Form Letter 4	P7	The coal loading facility will be adjacent to the growing suburbs north of Wyong which is where we live. Dust and noise from stockpiling and rail movements will impact on the established suburbs of Blue Haven, San Remo, Wyee and all along the rail corridor from Morisset through Cardiff and southern suburbs to the port of Newcastle. The proponent of the Wallarah 2 Coat Project, South Korean owned mining company Kores, admit in their Environmental Impact Statement there will be death from coal dust exposure. This admission alone should be sufficient reason to deny the application
1000.	General	Form Letter 5	P8	At first I was sceptical of how Wallarah 2 Coal Project could go ahead without harming the environment of the Central Coast and especially the water supply. However, after researching all about the project I am confident that it will not cause harm to the Central Coast. It will take place in a relatively small area and Wallarah 2 has affirmed their commitment to the water supply. It is also important to note that transport of coal with not take place on roads, but underground and by rail. The amount of jobs created by the project (over 1000) as well as the revenue created will far outweigh the negatives — which from my research are very little. I have lived on the Central Coast my whole life and support this project. It's important that the region develop and keep moving.
1001.	Surface Water	Form Letter 6	P9	<u>Ground and surface water impacts</u> The proposal is a significant risk to the security of our drinking water catchment. 53% of the water catchment area supplying Central Coast residents is threatened by this mine application. The site water management is inadequate because almost all management plans are merely observational. Some monitoring plans are not due to be created until two years into the operational life of the mine.
1002.	Health	Form Letter 6	P9	<u>Dust and noise</u> The EIS fails to adequately address dust and noise impacts. The project should be refused based on the health risks associated with air pollution from mining, stockpiling and transporting coal. The Wallarah 2 Coal Project application has already been refused once, based on the proponent's failure to adequately address issues of water quality, ecological, subsidence and heritage impacts. The proponent has not made any substantial changes to their previously rejected proposal and it remains to be against the public interest.
1003.	Ecology	Form Letter 6	P9	<u>Threatened Species</u> The current EIS lists 37 recorded threatened and migratory fauna species and six vulnerable or endangered flora species within the project site. Many of these species are protected under state and federal legislation as well as international agreements. The key threats to these species include land clearing, change in habitat due to subsidence and alteration of water flow, wetlands and floodplains. All of these threats are possible effects of this project.

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1004.	Ecology	Form Letter 6	P9	Climate Change The proposal is a substantial contribution to total carbon emissions and is in conflict with state and federal programs to reduce our contribution to global climate change.
1005.	General	Form Letter 7	P10	Kores Ltd in its proposal has failed to adequately address the issues of water quality, land subsidence, and air quality. The proposal should be rejected again.
1006.	Surface Water	Form Letter 7	P10	I strongly believe it's quite simple really, that whenever there is a threat to water supply, a mine should not even be considered. This mine is in a water catchment area for the Central Coast, therefore Wallarah 2 Coal Project should be rejected.
1007.	Health	Form Letter 7	P10	Air quality will be compromised with the dust created from the mining, stockpiling and transporting of coal. The long term impact on the health of exposed residents and the already stretched health dollar is immeasurable.
1008.	Ecology	Form Letter 7	P10	There is also the threat to local flora and fauna (many already endangered) due to habitat destruction and changes in water flow and land subsidence.
1009.	General	Form Letter 8	P11	I would like to submit my support for the proposed mining development in Wyong - Wallarah 2 Coal Project. I am a member of the Central Coast Poultry Club and have had an opportunity to hear an overview of the Project and what it seeks to offer the Central Coast. I particularly believe that the Project will benefit local jobs and create new business for our region, which should be considered a priority for the Central Coast. The mining operation will open up new doors for our young people in terms of training opportunities and will also stimulate our local economy. Upon viewing environmental impact assessments provided by Wallarah 2, I can see no reason why the project shouldn't go ahead. The mine will not negatively impact our waterways and will have very little effect on the surrounding environment.
1010.	General	Form Letter 9	P12	I am a member of the Central Coast Poultry Club. I am writing to you in support of the Wallarah 2 Coal Project. I have lived on the Coast for the majority of my life and have started a family here. Over the past 10 years I have noticed a dramatic decrease in the employment of young people. I believe there is a vast lack of opportunity for younger people in the local community. It is my opinion that the operation of an underground coal mine would significantly benefit present and future job opportunities for the younger generation. I would like to see greater opportunities for my own children and I think this would go some way to addressing the issue.
1011.	General	Form Letter 10	P13	As a Central Coast resident, I support Wallarah 2 Coal Project as I believe the Central Coast needs to support initiatives that will provide jobs to future generations. Projects and developments continue to be denied because older generations oppose them. It has been assured that the project will not harm the environment, damage the water supply or allow coal to be transported via roads. It WILL provide jobs and revenue! So many people leave the Coast because there are not enough opportunities for employment, leaving the Coast desperate for development and renewal. Give future generations a chance and support investment into our region.
1012.	General	Form Letter 11	P14	I'm writing to highlight my support for the Wallarah 2 Coal Project. I have had an opportunity to find out about the Project through information sessions and believe that it will provide a number of benefits to the local community, including job creation and a boost to the local economy. As a person who lives in the Wyong Shire, I can see no problems with the proposed mining development, particularly due to its remote location. I understand that all of the mining operations will be occurring deep underground, with very little impact to the surface land. I believe that our community will benefit significantly if the Project goes ahead, not only economically but also through the creation of vocational training opportunities as shown through the Project's association with Central Coast Group Training and Hunter TAFE.
Crown Land NSW				
1013.	General	Crown Land	RA19	Crown Lands advise that the surface constructions for the Project at Tooheys Road appear to affect Crown public road at the Tooheys Road/F3 intersection. Should this be the case then acquisition of the affected Crown land will be required.
Forestry Corporation NSW				
1014.	Forestry	Forestry Corporation	RA20	Forests NSW became Forestry Corporation of NSW (FCNSW) in January 2013 following implementation of the *Forestry Act 2012*. Future correspondence should be made direct to FCNSW. In the meantime in relation to this referral, FCNSW advises:

No.	Aspect	Stakeholder	ID	Issue
1015.	Forestry	Forestry Corporation	RA20	(i) the then Forests NSW was consulted in the preparation of the GHD review and FCNSW is satisfied with the Forestry Assessment undertaken
1016.	Forestry	Forestry Corporation	RA20	(ii) FCNSW would require that subsidence monitoring be undertaken over the life of the mine to ascertain the effects on the Wyong State Forest, similar to requirements placed on other mining ventures underlying State forest (refer Appendix A-Subsidence).
1017.	Forestry	Forestry Corporation	RA20	(iii) the following corrections to the submitted documentation should be noted: (a) change in reference to Forestry NSW to Forestry Corporation of NSW.References to the Minister for Forests remain the same (b) the western ventilation shaft is proposed for location within Wyong State forest. The text asserts it is already there. The land is owned by the State of the *Forestry Act 2012* (refer section 2.5). (c) Wyong State forest is located in the Central Forest ManagemenRegion (refer section 3.2 Appendix Z). (d) reference to an Occupation Permit should be to a Forest Permit as granted under section 60 of the *Forestry Act 2012* (refer Appendix Z section 4.3 last line, section 5.4, and section 7, last line).
NSW Office of Water				
1018.	Groundwater	NOW	RA1	The NSW Office of Water advises the following key issues: (i) continuous and uncontrolled reduction of base flow in the Wyong River during low flow periods is likely to reduce extraction opportunities available to the Gosford-Wyong Water Authority. Reduction in the number of opportunities to extract water during low river flow periods will impact on the public water supply system. The same scenario will apply to all other downstream water users and the environment. The Office of Water requests that the proponent undertake a detailed risk analysis that examines the potential impact to the Gosford-Wyong Water Authority.
1019.	Groundwater	NOW	RA1	(ii) the proponent should also develop a response and mitigation strategy in the event that vertical leakage, hence the impact on surface water and shallow groundwater, is found to be greater than predicted.
1020.	Surface Water	NOW	RA1	(iii) subsidence of creek beds and alluvial systems is likely to modify the geomorphic features of the streams and the hydrogeological regime of the area. The Office of Water recommends the proponent undertake a full fluvial geomorphic assessment which specifically details the risk of bed and bank erosion, change in slope or plan form for individuallongwall panels and the cumulative risk as a result of subsidence over the life of the mine.
1021.	Groundwater	NOW	RA1	(iv) in order to better understand the impact to the hard rock aquifers, the Office of Water requests the proponent undertake an assessment against the minimal impact considerations of the NSW Aquifer Interference Policy. It is recommended that the proponent present this information in the same table format as in Appendix B, below.
1022.	Surface Water	NOW	RA1	(v) it is not clear if the proponent has estimated the maximum annual water take from each water source. The proponent should undertake this assessment, and should be required to obtain licensed entitlement sufficient to account forthe predicted maximum annual take of water, prior to commencing activities
1023.	Surface Water Groundwater	NOW	RA1	In addition, Attachment B includes: • detailed comments on the groundwater assessment,

No.	Aspect	Stakeholder	ID	Issue
				• an assessment of potential impacts on surface water systems and water users, • a summary of licences and approvals required under the *Water Management Act 2000* and the *Water Act 1912*, and • recommended conditions should the application be approved.
1024.	Groundwater	NOW	RA1	**Comment by NSW Office of Water (NOW)** **PART A: Potential Groundwater Related Environmental Impacts** **A1. Geology/Hydrogeology** Main stratigraphical units of interest include in a top-down progression, the Hawkesbury Sandstone, the Terrigal Formation, the Patonga Claystone, the Tuggerah Formation, the Munmorah Conglomerate and the Dooralong Shale. The Wallarah/Great North seam underlies the Dooralong Shale.
1025.	Groundwater	NOW	RA1	**Comment by NSW Office of Water (NOW)** **PART A: Potential Groundwater Related Environmental Impacts** Rates of groundwater flow through the subsurface strata are governed by the prevailing piezometric surface and the hydraulic properties of strata. The velocities of flow within the hard rock system are calculated to be very low and in the range from 1.0E-7 to 1.0E-4 *m/day (0.036* to 36 mm/year) based on the hydraulic conductivities used in numerical modelling of these groundwater systems. The reduction in leakage induced by depressurisation after 38 years of ining is calculated to be less than 2 millilitres/day/per square metre of land surface. This rate is very low compared to a potential steady state rate of rainfall recharge calculated to be as high as 130 millilitres/day per square metre (assuming 4% infiltration).
1026.	Groundwater	NOW	RA1	**Comment by NSW Office of Water (NOW)** **PART A: Potential Groundwater Related Environmental Impacts** **A1. Geology/Hydrogeology** Groundwater quality within the hard rock strata is brackish to saline (limited measurement) with an indicative total dissolved solids (TDS) range of 1800 to *7500 mg/L* while pH values range from 6.3 to 7.6.
1027.	Groundwater	NOW	RA1	**A2. Surface Water Bodies** The project is located within the Tuggerah Lakes Basin, which has a catchment area of approximately 700km^2. Surface drainage comprises of creeks which ultimately drain into the Wyong River. Most of the Project extraction area lies within the Jilliby Jilliby Creek catchment. The Tooheys Road site (the project's coal loading facilities) is located within the Wallarah Creek catchment.
1028.	Surface Water	NOW	RA1	**A2. Surface Water Bodies** The Jilliby Jilliby Creek Water Source (2003) and the Central Coast Unregulated Water Sources (2009) apply to the project. No groundwater sharing plan is applicable to the project.
1029.	Groundwater	NOW	RA1	**A3. Groundwater Dependant Ecosystems (GDE's)** GDE's have been identified along surface drainage channels within project boundary. The GDE's that have been identified include Paperbark, Coachwood, Blackbutt and other species that rely on shallow water table. The possibility of subsidence does have the potential to alter the level of the water. Predicted high rainfall recharge events will counter the alteration of the water table, and may result in only minimal impact on the GDE's.
1030.	Groundwater	NOW	RA1	**A4. Groundwater Users** There are 12 registered bores and wells located within the extraction area. There are an additional 49 bores registered within 5km of the extraction area.
1031.	Groundwater	NOW	RA1	**A5. Geotechnical and Mining Effects** The predicted impacts include: • Depressurisation in the subsurface strata, leading to reduced baseflow and surface water reliability (of significant importance due to water supply requirements from the Wyong River catchment for use by the Central Coast population) • Cracking of hard rock strata in elevated areas may initiate localised redirection of surface flows in some drainages leading to water-rock interactions and possibilities of iron staining downstream.

No.	Aspect	Stakeholder	ID	Issue
				• Potential for hydraulic connections to exist or be induced by mining in the substrata • Subsidence and depressurisation effects on local groundwater users.
1032.	Surface Water Groundwater	NOW	RA1	**A6. Groundwater Modelling:** **(i) Predicated Groundwater Volumes**: *"On completion* of *the* 38 *year simulation period, specific zone budgets were extracted from the groundwater model in order to provide estimates* of *mine water influx ... A total water make* of *about 26,500 ML is predicted over the mine life.* **(ii) Water Balance** A water balance model has been presented for the project area and reflects changes in the water management system over the life of the project. Groundwater inflows used in the calculation of the water balance were sourced by the model creators. **(iii) Conceptual Model, Parameters, Model Calibration and Performance** The model comprises 14 model layers representing the various rock strata layers and subdivision of some of the geological layers with associated anisotropic permeability, representing a total area of about 575 sq. km. There are 105,768 cells per layer with and are a minimum 50 x 50 metre, with a 50 metre thickness except within the Waliarah/Great North coal seam. The model confidence level classification is of a class 2 model with aspect of class 3. The table below lists the layers used and their associated hydraulic conductivities. • Parameters used in the model included hydraulic conductivity, compressive (elastic) storage and specific yield. Hydraulic conductivity was assigned from 3 boreholes, from which an adopted matrix of known hydraulic conductivity values was associated with bore stratigraphy. • The calibration of the model was dependant on the measurements and assignment of formation hydraulic properties as determined by packer and core tests, and upon the steady state hydrostatic piezometric surfaces. • Steady state calibration was conducted using head level elevations derived from a majority of alluvial monitoring wells. . • Transient calibration involved groundwater system reaction simulation using water table response I response to rainfall recharge based on measurements from the Wyee rainfall gauge and five piezometers at Honeysuckle Park which have been data logged since 2010. It has only been possible to calibrate the alluvial water table variability using the rainfall information.Sensitivity analyses on the vertical conductivity of the constrained zone indicate that horizontal conductivity can be increased without affecting the vertical conductivity. *"Basically the horizontalconductivity is relatively insensitive when compared to the verlical conductivity in controlling verlicalleakage through the constrained zone".* **(iv) Issues identified** **Conceptualization of Vertical Hydraulic Conductivity** The earlier review of the Wallarah 2 Coal from NOW stated that "The conceptual model on which the numeric groundwater model has been based assumes there is limited vertical hydraulic connection through the Patonga Claystone and the overlying surface water resources both prior and post mining .. . In summary, there is the potential for this hydraulic connection to exist, or be induced by mining, and the impacts of the scenario should be assessed ... There has not been a sensitivity analysis undertaken on the predictions of the numeric groundwater model, in particular a leaky aquitard scenario to consider potential impacts of hydraulic connection ... ". In response, the applicant has conducted a vertical hydraulic conductivity sensitivity analysis, for the constrained zone, which was considered as a suitable alternative. Kalf and Associates (KA) agree that *"The results indicate that the bulk vertical permeability is derived of the same order of magnitude* as *that adopted for the regional model.*
1033.	Groundwater	NOW	RA1	As reported by NOW, vertical connectivity is important given the reliance of surface water by the Gosford-Wyong Water Authority as a source of water supply. Further, the model indicates potential risk to the local water supplies. • *Leakage from alluvial sources has been associated within the model in terms of loss ofbaseflow from the alluvial and hard rock groundwater systems to the local creek catchments" .* • *"The rate of leakage from the alluvial lands will be governed almost entirely by the hydraulic conductivity of constrained zone which is comprised of Patonga Claystone and Tuggerah Formation"*

No.	Aspect	Stakeholder	ID	Issue
1034.	Geology	NOW	RA1	Regarding the geological evidence in the area, the applicant has suggested reported lineaments through the project area are hypothetical and were unsupported by evidence as to the location and the extent in which faulting occurs around the project area. Faulting reports conducted by the applicant were reliant on drill core evidence and a geological survey. • *"The Wyong Areas Coal Joint Venture (WACJV) geology team found, with almost* 20 *years* of *underground experience in the South Newcastle Coalfield, that water make from these features* i.e.: local faulting), *was manageable and that traditional bord and pillar operations commonly negotiated 4-5m faults at depths of 150m beneath Lake Macquarie without experiencing significant inflows. This was also the case where the Boomerang Creek Tunnel intersected two major faults. While inflows were initially exposed, this rate dropped* to *only severallitres per minute within a few hours.* • *Despite the intensity of the WACJV exploration program, no evidence supporting these features* ~.e.; the major lineaments), *has emerged.* • *Results suggest that the 'Coastal Lineament" may have been misinterpreted from remote sensing data* as a *structure, when in fact it approximately corresponds with the west side of the massive conglomerate channel ...* ".
1035.	Surface Water Groundwater	NOW	RA1	The above evidence notwithstanding, the potential impacts on surface water requires ongoing monitoring and assessment with mitigation option developed by the proponent.
1036.	Groundwater	NOW	RA1	**Water Monitoring and Management Plan** A water management plan is yet to be developed to address monitoring and trigger levels. A current issue with gathering groundwater data involves gaining land access for monitoring use by council and landholders. Access is currently being sought and as such the monitoring program cannot be modified until access is granted. There remains a concentration of monitoring data to areas of limited spatial coverage due to land access issues.
1037.	Groundwater	NOW	RA1	For consistency with the NSW Aquifer Interference Policy, the proponent needs to demonstrate that the background monitoring for evaluating before and after impact can be achieved. The current concentration of monitoring data to areas of limited spatial coverage, with no groundwater monitoring information west of honeysuckle Park, and in the catchments of the Little Jilliby Jilliby Creek, Myrtle Creek, and within the Jilliby SCA and the Wyong State Forest.
1038.	Groundwater	NOW	RA1	**Model Uncertainty** In assessing the proponent's groundwater model, Kalf and Associates have reviewed the model in conjunction with the *2012 Australian Groundwater Modelling Guidelines,* as required by the NSW Aquifer Interference Policy. The review shows that an uncertainty analysis has not taken place. This is particularly important in relation to the possible risks to surface water impacts. Permeability values used in the model are based on packer tests and the examination of drillcore logs. Whilst no evidence of significant faulting can be found, similar geological reports indicate the presence of two lineaments intersecting or proximately adjacent to the project site.
1039.	Groundwater	NOW	RA1	**AIP Requirement** Described the water source (s) the activity will take water from? **Proponent response** Listed surface water sharing plans: *Jilliby Jilliby Creek Water Source 2003 Central Coast Unregulated Water Source 2009* Hunter/Central Coast, and is within a 10km *(Wyong River)* **NOW Comment** No mention of groundwater sources. Overlies Sydney Basin – Lower Hunter/Central Coast, and is within a 10km proximity of the *Hunter Unregulated and Alluvial 2009 WSP.*
1040.	Groundwater	NOW	RA1	**AIP Requirement** Predicted the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity? **Proponent response** The Groundwater Model predicts a cumulative seepage of 26,500 ML over 28 years. **Water Allocations:** Predicted average annual take is estimated to be around 660 MLlyear (Coal measures: 638.75 MUyr, Alluvial: 7.3 MUyr, Shallow Hardrock: 14.6 MUyr). For surface water: 270 MLlyr for Jilliby Jilliby Creek and 30 MLlyr for the Wyong River.

No.	Aspect	Stakeholder	ID	Issue
				NOW Comment Daily influx ranges from 0 ML/day in the first year, to 2.5 ML/day in the 19th year. Applicable groundwater source is Sydney Basin -Central Coast once the North Coast Fractured and Porous Rock WSP commences.
1041.	Groundwater	NOW	RA1	**NOW Comment** Predicted the total amount of water that will be taken from each connected groundwater or surface water source after the closure of the activity? **Proponent response** Groundwater to infill mining void after the closure of the mine. **AIP Requirement** No mention of volume entering the voids post mining.
1042.	Groundwater	NOW	RA1	**AIP Requirement** Made these predictions in accordance with Section 3.2.3 of the AIP? (refer to Table 3, below) **Proponent response** Yes **NOW Comment** Yes, however it is not clear if the adjunct modelling used to quantify water table impacts in the alluvium were subject to the independent peer review.
1043.	Groundwater	NOW	RA1	**AIP Requirement** Described how and in what proportions this take will be assigned to the affected aquifers and connected surface water sources? **Proponent response** Yes (see above point 2) **NOW Comment** Yes
1044.	Groundwater	NOW	RA1	**AIP Requirement** Described how any licence exemptions might apply? **Proponent response** No **NOW Comment** No
1045.	Groundwater	NOW	RA1	**AIP Requirement** Described the characteristics of the water requirements? **Proponent response** Loss of pressure within the strata will induce seepage into the mine working . **NOW Comment** Likely variable due to rainfall and fracture storage. At times unavoidable due to nature of the workings.
1046.	Groundwater	NOW	RA1	**AIP Requirement** Determined if there are sufficient water entitlements and water allocations that are able to be obtained for the activity? **Proponent response** Since no WSPs are in place with respect to groundwater, no water access licences will be required in respect to the Water Management Act. Water licences will be required under Part 5 of the Water Act in respect to any groundwater take for the project. **NOW Comment** This is currently correct. Once a WSP commences there will be unassigned water in water source. Surface water entitlement would be obtained by a dealing under the WSP rules. This is currently correct. Once a WSP commences there will be unassigned water in water source. Surface water entitlement would be obtained by a dealing under the WSP rules.
1047.	Groundwater	NOW	RA1	**AIP Requirement**

No.	Aspect	Stakeholder	ID	Issue
				Considered the rules of the relevant water sharing plan and if it can meet these rules? **Proponent response** Only surface water plans applicable. **NOW Comment** This has been sufficiently addressed. Yes, however the implications of receiving entitlement once a WSP commences has not been considered.
1048.	Groundwater	NOW	RA1	**AIP Requirement** Determined how it will obtain the required water? **Proponent response** Yes **NOW Comment** Yes, however the implications of receiving entitlement once a WSP commences has not been considered.
1049.	Groundwater	NOW	RA1	**AIP Requirement** Considered the effect that activation of existing entitlement may have on future available water determinations? **Proponent response** Not addressed. **NOW Comment** Not addressed, however issued entitlement is lower than the long term average annual extraction limit so impact is unlikely.
1050.	Flooding	NOW	RA1	**AIP Requirement** Considered actions required both during and post-closure to minimize the risk of inflows to a mine void as a result of flooding? **Proponent response** Not addressed. **NOW Comment** Not applicable
1051.	Groundwater	NOW	RA1	**AIP Requirement** Developed a strategy to account for any water taken beyond the life of the operation of the project? Will uncertainty in the predicted inflows have a significant impact on the environment or other authorized water users? Items 14-16 must be addressed if so. **Proponent response** The mine will act as a groundwater sink for 500 years. **NOW Comment** Unlikely that take would be greater than that during the mine life and would therefore be covered by any entitlement held. The proponent may be required to retire entitlement to account for the ongoing take. Yes, hence 14-16 must be addressed.
1052.	Groundwater	NOW	RA1	**AIP Requirement** Considered any potential for causing or enhancing hydraulic connections, and quantified the risk? **Proponent response** Refer to discussion in Section 4.1 above. **NOW Comment** Refer to discussion in 'conceptualisation of vertical hydraulic conductivity' above.
1053.	Groundwater	NOW	RA1	**AIP Requirement** Quantified any other uncertainties in the groundwater or surface water impact modelling conducted for the activity?

No.	Aspect	Stakeholder	ID	Issue
				Proponent response Not addressed **NOW Comment** No uncertainties are provided with the model. Limited monitoring and water level information. Predictive accuracy of the model is therefore difficult to assess.
1054.	Groundwater	NOW	RA1	**AIP Requirement** Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the project, and how these requirements will be accounted for? **Proponent response** Development of a comprehensive groundwater monitoring program will include measurement of rates of groundwater seepage and monitoring of groundwater quality as part of the mine water management system. Production of annual reviews. **NOW Comment** A monitoring plan to address this has been provided and will be satisfactory if implemented as described.
1055.	Groundwater	NOW	RA1	**Determining water predictions in accordance with Section 3.2.3** **AIP Requirement** For the Gateway process: Is the estimate based on a simple modelling platform, using suitable baseline' data that is fit- for-purpose? **Proponent response** **NOW Comment** (N/A)
1056.	Groundwater	NOW	RA1	**AIP Requirement** For SSD or mining or CSG production, is the estimate based on a complex modelling platform that is: Calibrated against suitable baseline data, and in the case of a reliable water source, over at least two years? • Consistent with the Australian Modelling Guidelines? • Independently reviewed, robust and reliable, and deemed fit-forpurpose? **Proponent response** Calibration of the model focussed on alluvial systems and the water table response to rainfall. • Limited measurements of water rest levels. • Dependant on the measurements and assignment of formation hydraulic properties as determined by packer and core tests. Independently reviewed by Kalf and. Associates (KA) **NOW Comment** • Very limited spatial coverage of bore network. 2 years of water measurement readings from one area of the project site, therefore limited and incomplete baseline information. Given that the risk of causing more than minimal harm to surface water is generally low, this is considered acceptable, provided monitoring and mitigation measures are in place. • Considered consistent with Australian Groundwater Modelling Guidelines. • The peer review recommends that it is suitable for public exhibition. • It is unclear if the adjunct modeling undertaken to predict the impact on water tables in the alluvium was subject to the peer review.
1057.	Groundwater	NOW	RA1	**AIP Requirement** In all other processes, estimated based on a desk-top analysis that is: • Developed using the available baseline data that has beencollected at an appropriate frequency and scale; and • Fit-for-purpose? **Proponent response**

No.	Aspect	Stakeholder	ID	Issue
				NOW Comment (N/A)
1058.	Groundwater	NOW	RA1	**Other requirements to be reported on under Section** 3.2.3. **AIP Requirement** Establishment of baseline groundwater conditions? **Proponent response** Addressed **NOW Comment** • Use of existing water quality data (from 1996 - 2004, 2006 - recent). • Groundwater levels from specific alluvial monitoring bores.
1059.	Groundwater	NOW	RA1	**AIP Requirement** A strategy for complying with any water access rules? **Proponent response** If the project is granted development consent, by theaccess rules? operation of section 89J of the require water use approvals under section 89 of theEP&A Act, it will not Water Management Act, water management approvals under section 90 of the Water Management Act, or a controlled activity approval (except for an aquifer interference approval) under section 91 of the Water Management Act. **NOW Comment** Acknowledges licensing requirements. Unlikely to be relevant given take is incidental.
1060.	Groundwater	NOW	RA1	**AIP Requirement** Potential water level, quality or pressure drawdown impacts on nearby basic landholder rights water users? **Proponent response** Yes. Potential impacts include: • Reduction in regional hard rock pressures. • Leakage of groundwater from shallow alluvial sediments to deeper systems. • Change in shallow aquifer storage induced by subsidence. • loss of groundwater yield at existing bore locations • change in groundwater quality. **NOW Comment** Refer to table addressing the minimal impact considerations.
1061.	Groundwater	NOW	RA1	**AIP Requirement** Potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems? **Proponent response** For the project, the most significant aspect of subsidence with the potential to impact on GDE's is considered to be the temporary change in water table. The water table is expected to fall by up to 1.3 metres. **NOW Comment** Refer to table addressing the minimal impact considerations.
1062.	Groundwater	NOW	RA1	**AIP Requirement** Potential for increased saline or contaminated water inflows to aquifers and highly connected river systems? **Proponent response** There may be localised changes in salinity where groundwater mixes with fragmented materials in the goaf. **NOW Comment** This is considered satisfactory.
1063.	Groundwater	NOW	RA1	**AIP Requirement**

No.	Aspect	Stakeholder	ID	Issue	
				Potential to cause or enhance hydraulic connection between aquifers? **Proponent response** There is potential for groundwater exchange between strata via fractures and micro cracks which introduce secondary permeability if they are connected. **NOW Comment** See discussion in above.	
1064.	Surface Water	NOW	RA1	**AIP Requirement** Potential for river bank instability, or high wall instability or failure to occur? **Proponent response** Potential for the associated river valleys to be affected by subsidence. **NOW Comment** Most issues relate to subsidence of the alluvial water source causing issues with river baseflow. Changes to creek/river beds as a result of subsidence are given, however, subsidence issues relating to river banks are not available.	
1065.	General	NOW	RA1	**AIP Requirement** Details of the method for disposing of extracted activities (for CSG activities)? **Proponent response** N/A **NOW Comment** N/A	
1066.	Groundwater	NOW	RA1	**Aquifer:** Alluvial **Category:** Less productive **Level 1 Minimal Impact Consideration** - **Water Table** Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site;listed in the schedule of the relevant water sharing plan. **OR** A maximum of a 2 m water table decline cumulatively at any water supply work unless make good provisions apply.	**Assessment** **Level 1 -Acceptable** There are no high priority groundwater dependant ecosystems or high priority culturally significant site identified in the WSP for Jilliby Jilliby Creek or the WSP for Central Coast Water Supply. Although it should be noted that forthcoming mapping of high value GDEs indicate that they will exist within the area of impact. Maximum drawdown in the water table is predicted to be 1.4 m. Maintained by the assumption that the flow conditions in the Creek remain unchanged.
1067.	Groundwater	NOW	RA1	**Water pressure** A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the base of the water source to a maximum of a 2 m decline, at any water supply work.	N/A
1068.	Groundwater	NOW	RA1	**Water quality** Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. No increase of more than 1 % per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. No mining activity to be below the natural ground surface within 200 m lateraly from the top of high bank or 1 00 m vertically beneath (or the three dimensional extent of the aluvial water source -whichever is the	**Level 1 -Acceptable** No long term change in water quality, including salinity, is predicted since subsided areas will essentially reflect unsubsided conditions with respect to aquifer material properties, rainfall recharge and surface drainage systems when mining is complete. While there is no direct mining activity within these prescribed limits, consequential subsidence has direct impact on the alluvial groundwater systems. However, these impacts are not likely to affect the long term viability of the water source.

No.	Aspect	Stakeholder	ID	Issue	
				lesser dimensional extent of the aluvial water source -whichever is the lesser dimensional extent of the aluvial water source -whichever is the lesser distance) of a highly connected surface water source that is defined as a distance) of a highly connected surface water source that is defined as a "reliable water supply" .	
1069.	Groundwater	NOW	RA1	The groundwater model and assessment presented by the proponent show no specific information regarding minimal impact considerations to the water sources underlying the local alluvial system, and hence no assessment can be made.	
1070.	Groundwater	NOW	RA1	**Aquifer Porous rock or fractured rock** **Category I Less productive** **Level 1 Minimal Impact Consideration** Water Table Less than or equal to a 10% cumulative variation in the water table, allowing for typical Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (c) high priority groundwater dependent ecosystem; or (d) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. OR A maximum of a 2 m water table decline cumulatively at any water supply work. **Water pressure** A cumulative pressure head decline of not more than a 2m decline, at any water supply work. **Water quality** Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	**Assessment** Not available. No assessment has been made. Not available. No assessment has been made. Not available. No assessment has been made.
1071.	Groundwater	NOW	RA1	**PART B:** Potential impacts on surface water systems and water users. The EIS identifies potential impacts on surface water (4.1 Appendix J). One of the key issues of concern is loss of surface water from the Gosford-Wyong Water Supply Scheme through enhancement of hydraulic connectivity between surface waters and underground aquifers.	
1072.	Groundwater	NOW	RA1	The EIS predicts a maximum subsidence of 2.6 metres on creek beds. The EIS further predicts that subsidence within the water supply catchment areas has the potential to affect the yield of surface water through altered drainage patterns and efficiency and changes to groundwater recharge due to subsidence of creek beds and aquifers. Base flows contribute to 14% - 28% of the flow in the Wyong River.	
1073.	Groundwater	NOW	RA1	The licences and approvals held by the Gosford-Wyong Water Authority from the Wyong River Water Source are subject to conditions related to stream flows. Continuous and uncontrolled reduction of base flow in the Wyong River during low flow periods will reduce extraction opportunities available to the water authority. The same scenario will apply to all other downstream users and the environment.	
1074.	General	NOW	RA1	If the proponent needs to undertake a dealing under s71 of the *Water Management Act 2000* in order to take water, then Office of Water is required to consider the Access Licence Dealing Principles (ALDP) in the determination of such application.	
1075.	Groundwater	NOW	RA1	**PART C:** **Licence requirements** ***Water Act 1912*** • All groundwater sources in the area are currently managed under the *Water Act 1912.*	

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				• No exemptions for licences under the *Water Act* 1912 apply as a result of approval under the *Environmental Planning and Assessment Act 1979.* • licences required for all bores under Part 5 (s.112) of the *Water Act* 1912 (definition of a bore is provided under s.105). • Monitoring bores may require licensing under Part 5 of the *Water Act* 1912 unless the bores meet the criteria for exempt monitoring bores as defined in the *Water Management (General) Regulation 2011.* Flood control works will require licensing under Part 8 of the *Water Act 1912.* Application forms for licences and approvals are available on the Office of Water website at www.water.nsw.gov.au.
1076.	Surface Water	NOW	RA1	***Water Management Act 2000*** **(WMA)** • Water Access Licences are required to take water from any water source managed under the WMA. • Exemptions for access licences are provided in Clause 18 and the Schedule 5 of the *Water Management (General) Regulation 2011.* • Section 54 of the WMA provides details on harvestable rights. • Requirements for access licence dealings are provided in the following documents: - Section 71 of WMA - Access Licence Dealing Principles www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+433+2004+cd+0+N - Part 12 of the Water Sharing Plan www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+347+2009+cd+0+N Application forms for access licence and access licence dealings are available on the Office of Water's website at www.water.nsw.gov.au.
1077.	Surface Water	NOW	RA1	**PART D:** **NSW Office of Water Recommended Conditions of Approval.** 1. Should the application be approved, the NSW Office of water recommends the following 2. The proponent is required to estimate the volumes of water taken from both the surface water covered by the *Water Sharing Plan for the Central Coast Unregulated Water Sources 2009* and the *Water Sharing Plan for the Jilliby Jilliby Creek Water Source 2003* and obtain sufficient licensed entitlement to account for take from all water sources managed under the *Water Management Act 2000* prior to commencement of activities. (Note: Actual allocation may vary from time to time due to changes in available water determination.)
1078.	Groundwater	NOW	RA1	3. The proponent is required to obtain all necessary licences and approvals under the *Water Act 1912.*
1079.	Groundwater	NOW	RA1	4. The proponent is required to hold or retire sufficient licensed entitlement to cover the perpetual take of water flowing into the final void (and out of the evaporative sink) at the cessation of mining.
1080.	Groundwater	NOW	RA1	5. The proponent must report on the groundwater monitoring and evaluation program as outlined in the EIS every two years after the commencement of the project. The report is to include records of groundwater take against licences, groundwater hydrographs, assessment of groundwater impacts, including a comparison against predicted impacts, and details of the response to any such impacts.
1081.	Groundwater	NOW	RA1	6. The proponent must provide the report identified in condition 4 & 5 to the NSW Office of Water when requested, and include it in the annual environmental monitoring report.
1082.	Surface Water Groundwater	NOW	RA1	7. The Site Water Management Plan should include: • a methodology to estimate the annual volume of surface water and alluvial groundwater intercepted by the operation; • a groundwater monitoring and contingency plan; • review and validation of model predictions using groundwater monitoring data; and • strategies to manage water in the post mining landscape to minimise harm to water sources or their dependent ecosystems.
1083.	Surface Water	NOW	RA1	8. The proponent must undertake a full fluvial geomorphic assessment which specifically details the risk of bed and bank erosion, change in slope or plan form for individual longwall panels and the cumulative risk as a result of subsidence over the life of the mine.
Public Submissions				
1084.	Air quality Health	Elza Eddy	P15	I wish to object to this application as I live directly in front of this mine and have lived here for just on 25 years. The idea of a mine west of Blue Haven is not welcome one only has to listen to the Newcastle news & read of the poor air quality they live in plus all the coal dust over their homes reading the Morriset paper showing as the paper described it a Cyclone of coal dust We at Blue Haven do NOT WANT OR NEED THIS I have already lost my beloved husband to CANCER another thing that is also attributed to some cancers I am elderly who is going to clean my home of all this coal dust I will not believe that there will be none also what about the water I drink straight from the tap how will that be Please don't go ahead with this idea just leave

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				our beautiful area ALONE
1085.	General	Alexia Martinez	P16	I am concerned about the future of my family ; that of my friends', neighbours' and fellow residents of the Central Coast ; and that of the place I chose to live in.
1086.	Subsidence	Alexia Martinez	P16	- This project, if it goes ahead, will affect me: I live in a mine subsidence area, straight up from the proposed underground mining operations. That means that the ground beneath my feet/house, or that the hills next to which I live, or that the creek that flows through my land and neighbourhood can collapse.
1087.	Surface water	Alexia Martinez	P16	It will affect us all on the Central Coast: the proposed mining operation would drill under the Coast's main water catchment of Wyong River, Jilliby Creek, some of their tributaries and several natural ponds and wetlands.
1088.	Ecology Surface water	Alexia Martinez	P16	- It will affect our natural landscape, ecological balance and heritage: the proposed underground mining operation will drill under wetlands, rivers, farm land, state forests, and conservation areas.
1089.	Surface water Subsidence Groundwater Flooding Air Quality	Alexia Martinez	P16	Longwall mining operations pose known serious risks which will leave a permanent imprint on the area: 1. Contamination of water catchment by methane, ethane, and other gases released into the aquifers, streams, bogs, ponds and rivers. 2. Collapse of rivers, rivulets, ponds and wetlands leading to drying out (the water bleeds through underground cracks created by drilling/mining) 3. Shortage of water supply for the Coast's residents 4. Flooding in low lying areas 5. Dust
1090.	Surface water	Alexia Martinez	P16	Again, this is not just affecting me and my land, but our water catchment for our generation and the next. The Central Coast is growing and is priding itself of its natural beauty - It is paramount to protect these assets and our water supply.
1091.	General	Alexia Martinez	P16	I personally object to this project based on the risks listed above. If these risks were only to be impacting my tiny little life, I wouldn't step onto my soap box. BUT, these risks would affect my child's generation, and that of her children.
1092.	Health	Alexia Martinez	P16	I also generally object any project associated with the unethical raping of land resources that will cause trauma, ill-health and pollution. Water is more valuable than coal.
1093.	Groundwater	Karen Fisher	P17	I am very concerned about the impact this mine will have on the local environment. Despite the EIS claiming there will be minimal impact, it is clear that the mine poses significant risk to the water table and will cause major damage to the local environment.
1094.	Various	Karen Fisher	P17	This mine is not welcome in the local community and should not be approved. The benefits in terms of jobs and export income will be temporary, but the damage to the environment and to the local community will be permanent. A foreign company will reap the benefits of raping our land, and we are the ones who will have to live with destroyed landscapes, land subsidence, polluted water and loss of animal habitat.
1095.	Surface water	Name withheld	P18	I object the proposal to mine under the dooralong valley As no one can possibly guarantee that there will be no impact to drinking water supplied to 350,000+ people on the Central Coast this mining proposal and any future mine applications must be rejected I will not accept a computer model advising everything should be fine.
1096.	General	Corrina Roberts	P19	This is something that Barry O'Farrell promised would NOT happen to our drinking water catchment. Our drinking water will end up contaminated with ethane, methane & other gases not to mention damage it could cause to building structures. If this goes ahead it will only prove how dishonest your government is & that you don't understand what the word promise means.
1097.	Surface water	Warren Simmons	P20	I am a resident of Yarramalong Valley, but am not directly affected by the subsidence, water, land values or any other issue. I am not anti coal. My opposition to the mine is based on sound historic observations, technical data and common sense. This area is a declared water catchment for a very good reason. It provides drinking water for the whole of the central coast. We, as land owners, have very strict guidelines regarding the activities we are able to carry out in the valley for good reason. Without getting into highly technical arguments which have been presented by the Australian Coal Alliance and others, my argument is based on saving the water quality, and relies on common sense and anti-corruption.
1098.	General	Warren Simmons	P20	The State Government Scientific Committee on Long Wall Coal Mining report is a credible document, which leaves little to the imagination, and is supported by the arguments raised by all the opponents to this mine. I should not need to burden you again with all that info, but trust it will be properly considered.
1099.	General	Warren	P20	The community on the Central Coast was subjected to a Labour Party reshuffle where Ian McDonald became the Minister for Natural Resources and

No.	Aspect	Stakeholder	ID	Issue
		Simmons		also Minister for the Central Coast. This effectively shut down the community voice. We knew at the time this was a setup in favour of the proposal, and thank God, ICAC became involved and stopped this little group of alleged crooks.
1100.	General	Warren Simmons	P20	The promise by the O'Farrell Government was well received, but has also been broken, so the opinion of the general community on the coast is that we do not trust the system. We have seen reports that Nick DiGirolamo, a Liberal party fundraiser lobbied the Premier and Chris Hartcher in favour of the mine, and now we have a broken promise.
1101.	Economics	Warren Simmons	P20	We have also seen reports of huge sums of money being given to local organisations and schools, specifically : • CCGT, which is associated with the Mayor Eaton (Director) and Councillor Best (GM) sitting on Wyong Council, • Wyong Public ($70K), Wyee ($10K) and other schools, which are State owned and operated, under the current Government. • Community groups like the Central Coast Poultry Club, who say their "Gift" from the mining company is estimated to be worth $700,000.
1102.	General	Warren Simmons	P20	The only way this mine could now proceed in good faith is by an independent Judiciary, being a panel of three or more Judges, hearing submissions, both technical, social and economical, under oath, by the professional engineers on both sides, experts and the community. This process would have the threat of Contempt, resulting in Jail time for any person who lies to the panel.
1103.	General	Warren Simmons	P20	Given the corruption and bribery we have seen so far, the community does not trust the process, and the mine should not proceed under the current process. My questions are : • "What assurances are now in place to ensure that the people taking part in the process are honest, impartial and above corruption and intimidation?" • "Is there a mechanism in place where any corrupt or unethical behaviour would be seen and dealt with as contempt of court, resulting in a jail term ?" • "Is there an Ethics guideline, which must be adopted by the panel and other participants?"
1104.	General	Warren Simmons	P20	This is the second time that this application has been submitted. Nothing has changed. The community totally resents the pressure and stress put on it by the proponent and the Government after already winning the argument, and obtaining a promise from the Premier himself, after he had given it full consideration and had a complete understanding of the situation. Given the data before us, there is no logical reason for this mine to proceed and only a corrupt, irrational and negligent system would allow it. This process is heavily manipulated and deliberately wastes the communities time and effort. Personally, I am disgusted.
1105.	Air quality health	Warren Simmons	P20	I wish to raise several Points for consideration re the Now Submitted Statements these are 1 The Statements cover Air Quality however I feel they don't adequately cover the about the content of the Air Bourne Pollutants that will be discharged from the operations there within the proclaimed Mining Zones. I.e. what's actually in the air and content of the dust, asbestos, etc.? What are the levels prior to commencement of operations there v's proposed content once operations commence, also Levels that are will Exist when Mining has been fully completed. The mining will draw much air from the surrounding areas to ventilate the mine shafts and workings and at the same time discharge much air from the mine shafts and workings via exhaust stacks. It is my view that the levels that existed prior to commencement of mining of the whole area should be maintained and not exceeded during or after mining the site has fully completed, and to ensure the area restored to its prior conditions or better condition than that existed prior to the commencement of mining operations. Known Fact Singleton has one of the highest respiratory health issues in the world. Also contaminant dust settles into water tanks via those that are not town water connected which is most of Jilliby. How are they going to report, prevent and remediate this? Why not have a remediation surety account for claimants. E.g. like James Hardy does for its asbestosis victims. Perhaps $100 million initially and CPI increases thereafter. The money managed by an independent body appointed/chaired from the concerned affected citizens.
1106.	Air quality	Warren Simmons	P20	3 The Statements does not seem to cover or mention Smells Odor's and or Fumes. This is of extreme concern to me and many Friends regarding the recent highlighted problems that have been noted in the media. Those emitting from the development at Rutherford in the Hunter Valley which has been for many years caused many concerns and complaints from local residents in that area and also the Development in Queensland more recently in the Media and it seems nothing much can be done once the consent for mining is approved we most certainly don't want the potential for the same or similar to happen in our area or the chances of it to happen. If the Wallarah 2 Project get the Approval to go ahead

No.	Aspect	Stakeholder	ID	Issue
				Fumes and odours: Affecting all peoples lifestyle amenity. How will this be judged and remediated if affected
1107.	Surface water	Warren Simmons	P20	4 The Statements Cover Water Quality however they fail to cover area of (T.B.C.) Total Bacteria Counts contained within the Existing Steams also (T.D.S.) Total Dissolved Solids contained within the Existing Steams Water Flows again prior to commencement of Proposed Operations V's Level that will exist during Operations and Levels that will exist and remain after operations are completed in the proposed areas. Again list the content of the bacteria that exist prior to and the estimated content during operations also list estimated levels once operations have been completed and areas restored to their former condition that existed prior to the commencement of Mining Operations.
1108.	Surface water	Warren Simmons	P20	5 The Statements Cover High Levels of Discharged Water from mining operations and associated water treatment for that water. What are the estimated (T.B.C.) Total Bacteria Count Levels also (T.D.S.) Total Dissolved Solids contained within that excess Water extracted to allow the mining operations and the Whole Project to get the go ahead. And what to what Levels will the Water be treated to in terms of Total Bacteria levels and Water Quality will it be of Drinking Water Standards i.e. Potable Water Quality if not why not.
1109.	Social Economic	Amanda Austin	P21	This project will bring to the Wyong and Central Coast regions many opportunities for employment and business. Coal mining can exist in our local areas alongside residential and small business as proven by the many existing mines located around the bottom end of Lake Macquarie.
1110.	Social	Brigit Graefner	P22	May I remind you that you made some promises before the election? To walk away from them now will have devastating consequences for you as a politician – who could/would ever trust you again? FYI I sent you this letter from the Nature Conservation Council:
1111.	Economics	Chris Davies	P23	We support the Wallarah 2 Coal Project Development Application due to the economic benefits of the project to local and regional employment and to the NSW and Australian Economy. We are a small business who depends on a strong mining industry and the flow on benefits from such a project is crutial to small business survival in the mining sector.
1112.	Social Economic Surface Water	Grace Robinson	P24	I support the Wallarah 2 Coal Project because it is committed to providing lasting benefits to the local community, without threatening residential areas or the Central Coast water supply. Mining is proposed for only a small section of the Western area of the existing exploration tenements, with no plans to mine the eastern areas beneath Tuggerah Lake. Great job opportunity for the local Wyong and surrounding areas. I fully support this project.
1113.	Support Economic Employment	Jay Barry	P25	Please accept this submission in support of the proposed Wallarah 2 Coal Project. I am fully informed with regard to the extensive environmental assessments undertaken to support this EIS and I am also aware of the significant economic and employment opportunties this project offers to the Central Coast community.
1114.	Support Economic Employment	Julie-Anne Barry	P26	Please accept this submission in support of the Wallarah 2 Coal Project. I believe this project offers significant employment and economic stimulus opportunities to Wyong and the greater regional area which are very much needed. Lake Macqaurie Resident
1115.	Support Economic	Lindsay Auston	P27	I have witnessed first hard the coal mining operations in the local area, and strongly beleive that coal mining operations conducted with correct controls pose no risk to the health of people or risk to the environment . Coal mining makes a positive contribution to both the local area economy and the state Gov coffers.
1116.	Support Economic	Patrick Walters	P28	Honestly don't we think our country is going backwards at a fast enough pace. With the ridiculous carbon tax, now the downturn in coal, jobs that are being lost. We can't afford not to have the Wallarah 2 and any other mining project go ahead.
1117.	Support Economic Employment	Steve Mason	P29	We at Mcorp are totally supportive of the proposed underground mine at Wyong for the following reasons: • Employment generated will be of huge benefit to our regional area that is in urgent need for local opportunities for particulary our youth. • Trickle through demand for associated manufacturing & service industries creating activity & demand & economic benefits to our local area. • Training & skills development for our local people with possibilities for innovation and continued industry development. • Increased revenues on local / state & federal levels. • We urge that an early & favourable decision be achieved with this project. I am available for further input relating to this submission.
1118.	Support Economic Employment	Tony Twomey	P30	Growing up on the land in a rural community I have firsthand experience as to what such a project like Wallarah brings to the local community and economics for the region as a hole. With this experience I wholly support the approval of and the ongoing production of Wallarah 2 Coal Project.

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1119.	Support	Tony Sager	P31	I support this project wholeheartedly. This is all positive for community.
1120.	Support	Victoria Oszko	P32	Lycopodium Rail recently attended the MESCCA industry briefing held at Newcastle on 17 April 2013 with respect to the Wallarah 2 Coal Project. Lycopodium is very impressed with the thorough research the Wallarah project team has undertaken in relation to the Project impacts and appreciate the efforts Wallarah 2 have taken to minimize, as far as reasonably practical, environmental impacts.
1121.	Support Economic	Victoria Oszko	P32	Businesses, such as Lycopodium Rail, rely on the continued operation of the coal mining industry in NSW and also new projects such as this project. Projects such as the Wallarah 2 Project, support both local employment opportunities and opportunities beyond its immediate service providers. Thses projects are critical for growth of the economy. Not only will the Wallarah 2 Coal Project support the local economy by boosting employment both during construction and its operational phase but it will also support state and federal economies by contribution of taxes and royalties.
1122.	Support Economics Employment	Name withheld	P33	I am for the project. It will provide significant jobs for the region. Provided the workings to not undermine any dwellings I do not see that it will have a great impact on the local area. Working in the mining industry I have been able to visit the Mandalong Colliery at Morriset many times, and I am always surprised at how well hidden the mine is.
1123.	Support Economics Employment	Name withheld	P33	The development of the Wallarah 2 project is important to the local mining community as there are some established mines that are either coming to the end of there life cycle or struggling to compete against the bigger collieries in the Hunter Valley and the Gunnedah region if Wallarah 2 does not get approval it will continue to hurt the mining industry, its suppliers and the local buisnesses as the men that work in the industry will have to either relent to fly in fly out mining or move their families to an area where the industry is still strong once the remaining mines close down.
1124.	Support	Name withheld	P33	Coalmines are well aware of their responsibilities to the enviroment and the subsidence issues, the mines are able to develop and design there mines to minimise the effect of these issues.The people that do not agree with the approval have no understanding of the way that mining is undertaken and thus are scared of the very unlikely issues that some people are declaring to gaining disapproval of this project.
1125.	Support	Name withheld	P33	I have lived around the lake macqaurie area for 43 years and know of people that do not realise that the local mines are very close to the places that they live I have 27 years in the mining industry as production worker and undermanager. Education of the mining procedure is the key to lesson the fears of people opposing this project.
1126.	Support Employment	Name withheld	P34	I think it is long overdue. I moved away due to lack of jobs in my field for that area.
1127.	Support	Barrie Toepfer	P35	I am a 3rd generation resident in this area. I have worked closely in and around various coal mines in the local area since leaving school. It is my opinion that with the introduction of improved techniques in underground mining and the focus on best practice within the industry, there is little effect on the landscape and surrounding environment. The coal mining industry in general places great emphasis on quality care and research, resulting in minimal community and public impact.
1128.	Support Employment	Barrie Toepfer	P35	On a personal level, as a father and grandfather, the coal mining industry can provide not only long term employment, but that within a high income scale. This is a great asset to local community otherwise struggling with record level unemployment figures. Finally, the positioning of the site and the efforts focused on the design and implementaion will prove to have minimal visual impact and low level noise emissions. I strongly support the application.
1129.	Support	Bruce Meikle	P36	We need to make use of our resources while we can, provided we minimise any impact on the environment and community
1130.	Support	Chris Velovski	P37	We at EDC Consultants support this submission and wish Wallarah 2 Coal Project all the best in the submissions and furture success.
1131.	Support Employment	Clinton Charles	P38	Coal mining is integral to our Nation's continued survival and, as a contractor, we are able to employ local people for the ancilliary services to support this venture. I wholey support this project for the benefit of our local workforce and the local community.
1132.	Support Economic Employment	Deborah Burrows	P39	I think this will give the region an economic boost & provide much needed jobs
1133.	Support	Keith	P40	The reasons I support this project are:

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		Bartlett		1. It is probably one of the most highly explored and, as a result, best understood coal projects ever in NSW 2. The exploration program undertaken for this project was specifically designed to gather as much high quality systematic data as possible on all aspects of the geology and resource
1134.	Support	Keith Bartlett	P40	3. Industry experts with many years of experience and many with world class reputations have been engaged to design and assess the proposal 4. Techniques employed to assess the rock mass behaviour above and around the proposed mining area to determine impacts on groundwater, flooding, structures, sensitive environmental aewas and heritage sites have been described by experts in the field as leading edge
1135.	Support	Keith Bartlett	P40	5. Because of the high quality and quantity of scientific data gathered for the project and the wealth of experience held by those assessing that data stakeholders can have a very high degree of confidence in the predictions made 6. Concerns expressed by stakeholders have been examined and addresse during the design and assessment process 7. Some claims by opponents of the project could best be described as ill informed, unsubstantiated and misleading and are obviously made by persons with no qualifications or experience in the areas they choose to comment on
1136.	Support	Keith Bartlett	P40	8. More than one expert panel and several peer reviews have supported the claims by the project that the Central Coast water supply, the item of most concern to local residents, will not be compromised by the project 9. Impacts from subsidence, flooding, noise, dust and transport have been shown to be either well within design standards and readily addressed by ongoing management plans 10. There are very few and only minor environmental impacts 11. The coal resource planned to be mined by the projects is one of the last high quality, readily accessible coal resources in NSW
1137.	Support Employment	Keith Bartlett	P40	12. The central coast needs investment in jobs to reduce the high unemployment in the areas and this project will provide many direct, highly paid, high skilled positions and even more in support roles 13. If this project does not proceed, coal mining on the central coast will probably cease within the next 10 years resulting in the loss of many positions and skills to the area
1138.	Support	Keith Bartlett	P40	I believe that if this project is thoroughly assessed on its merits it will be found that its positive features far outweigh any negative impacts (all of which would be addressed by the normal operational management plans and incremental approval processes that all coal mines must comply with). The project should recerive the full support of planning & infrastructure, the state government and the local community
1139.	Support Economic Employment	Leigh Smith	P41	This project will add value to the local and further reaching community and provide jobs and stability.
1140.	Support Employment Economic Education	Michael Jones	P42	I'm in FAVOUR of the Wallarah 2 Coal Project for the following reasons; 2. Increased employment opportunities for the Central Coast as a whole. 3. Provide job security and a secure long term future for hundreds of Central Coast workers both young and old. 4. Provide jobs for future generations to come. 6. Provide school leavers on the Central Coast with a future in Coal Mining at years 11 and 12 with courses in Mine Engineering, Environmential studies and Workplace Safety.
1141.	Support Employment	Michael Jones	P42	1. Increased infastructure projects for the Wyong region.
1142.	Support Economic	Michael Jones	P42	5. Increased tourism for the region due to greater infrastructure in roads, cycleways, parks, sporting complexes and the building industries such as hotels and resorts.
1143.	Support Education	Michael Jones	P42	7. The W2CP will also benefit all TAFE colleges and Univerities on the Central Coast with Diploma and Degree courses in Mining, Engineering, Environment and Safety.
1144.	Support Economic	Steve Williams	P43	Projects like this provide essential employment and income opportunities to a whole tranche of small businesses like mine, that support the mining industry. The current economic climate has made it very difficult for these companies to continue to trade. This project would provide the lifeline for such companies. I would endorse this project, subject to the findings of the application process.
1145.	Support	Tim Leeson	P44	Australia leads the world in development of safe, economical and profitable mineral extraction, this is an industry that must be encouraged.

No.	Aspect	Stakeholder	ID	Issue
				I beleive the underground coal industry is important economically, and with the planned environmental controls this mine poses no risk to the area I live in. .
1146.	Support Economic Employment	Name Withheld	P45	I have lived in Wyong and Lake Macquarie for 24 yrs and my kids were born here, I have 2 sons doing engineering at university. I sincerely hope this goes ahead, kids need to work and I will be grateful if my boys can work here and not have to move away. If the people who have designed this are Australian engineers, scientists and geologists and have answered the environmental questions asked of them then the priority should be what the locals can get out of the project not what nationality the owners are. As our leaders, are you focusing on our kids and their future?. for there are a large number of unemployed youth in Wyong who need a start in life. Their circumstances will shape tomorrow's community. Jobs make a difference and mining has been positive here. Kids getting skills and apprenticeships and underemployed tradesmen moving into mining jobs around the Lake means we are lucky to live in a happy, secure community that has improved in prosperity, surrounded by a beautiful and healthy environment, as Lake Mac is. If this is to be an underground mine with the same type of parameters as others nearby then this mine will provide few problems and more of these benefits. The Wyong Council and State Gov should be grabbing this, making it work for us, ensuring it delivers local employment and another source of community funding. As Government, you should be able to see through the nonsense of open cut mining photos and other distortions of reality and consider what we need. Come on, don't muck around any longer, we want this.
1147.	Support Economic Employment	Name withheld	P46	I have resided in the local area my entire life. I am a 3rd generation resident. I have had a close working relationship with the local mining industry, which has provided long term, stable employment for my family members and close friends. The benefits far outweigh any negative aspects to this proposal. With modern mining techniques and an emphasis focused heavily on environmental impact, there is little to no impact on the environment and its community. The Wallarah 2 project would inject new life into an otherwise stale local economy, providing not only much needed employment, but a dramatic increase in clientelle for local business. I strongly submit the application for the Wallarah 2 project
1148.	Support Employment	Name withheld	P47	Approval of this underground mine would be great for the Wyong Shire and local areas offerring employment including apprenticeships for a community with a very high unemployment rate.
1149.	Support Employment Economic	Anna Mason	P48	I am in support of the Wallarah 2 Coal Project. Here is a great opportunity for local employment and growth in nearby communities. Our company supports the submission for the Wallarah 2 Coal Project. We encourage that consideration be made for huge benefits such a project can bring to the people of the local communities.
1150.	Support	Bruce McCutcheon	P49	This project would bring many great opportunities to our local community.
1151.	Support Economic	Brendan Rutherford	P50	Australian industry and every link in the domestic supply chain that represents need this project to be approved and more like it in view of the current economic environment. The proponent has worked assidiously to engage with the local and greater geographical community about the scope and timing of their requirements. This proponent has been particularly specific about the negligible environmental impact of this project and when compared to others that have already been approved, it's difficult for me to fathom why there is continual delay.
1152.	Support Economic Employment	Form Letter	P51	As a supplier of goods and services to the underground coal mining industry, our business relies directly upon the continued operation of existing coal mines and the development of new projects such as the Wallarah 2 Coal Project. During a presentation by Wallarah 2 at the MESCA briefing held at Newcastle Panthers on the 17 April 2013, the significance of this project to the regional and nsw economies in terms of employment and economic stimulus became clearly evident. Correspondingly, the approval of this project inspires confidence and impetus for continued and expanded employment opportunities with our own business space.
1153.	Support Economic employment	Kim Anderson	P52	As part of the mining Industry I believe the Wallarah 2 Coal Project will bring much needed employment oportunities and an economic benifit to the area.
1154.	Support Economic Social	Peter Blanch	P53	I support this project & would like to see it proceed. Jobs will be created, taxes & royalties will be paid, apprentices will be trained & the mine will support local businesses.
1155.	Support	Robert	P54	I believe this will be a great outcome for the region, I am confident that all impact studies and statements will suceed

No.	Aspect	Stakeholder	ID	Issue
		Burrows		
1156.	Support Social	Rodney Whitaker	P55	With the decentralizing of the populous from Sydney it is an excellent opportunity for added employment to the Central Coast region. With a very sound environmental plan and the added attraction of Underground extraction methods it will be a project that is very sustainable for the next generation of our children in relation to the jobs market.
1157.	Support Social economic	Todd Levien	P56	I was at the MESCA breifing regarding the Wallarah 2 Coal Project. Pan Process Pty Ltd is a specialised company that deals with Bulk Material Handling and Processing Electrical Site commissioning. We have seen alot of projects put on hold lately. There has been a huge slow down of mining projects that is our companies life blood. Please consider the economic benefits that a project will bring to this region when you consider this approval.
1158.	Support Social economic	Shane Crutcher	P57	I support for the Wallarah 2 coal project to proceed as it offers improved job opportunities for the local residents. Central Coast area is lacking big business idusttries, and yet its population is growing faster than its economy can sustain. Hence high unemployment rate is rising. I bellieve that the Wallarah 2 coal project can significantly help boost the local economy, improve local infrastructures, and will stimulate the growth of other small local businesses. Furthermore, the project has also higlighted detailed plans on maintaining a low impact to the local environment during mining. Therefore I also believe that the benefits this project brings to the community outwieghs any environmental impact issues.
1159.	General	Name withheld	P58	I beleive that this project is not in the best interests of the community on the central coast, and the potential negative enviromental effects are not managable.
1160.	Support Social	Name withheld	P59	The approval of this project would have an enormous positive effect on the Wyong Shire and local areas with job opportunities for both skilled and unskilled workers including apprenticeships. The whole community will benefit
1161.	Support Social	Name withheld	P60	I support the project and believe it is good for the local community and jobs in NSW
1162.	Support Social economic	Andrew Brook	P61	We look forward to the jobs and services that will be required to fulfill this project. In a NSW market that is looking very ordinary, this is one shining light of hope for all service providers to the NSW Coal Industry
1163.	Economic	Craig Evans	P62	As a regular visitor to the area I strongly object to the proposal on safety, financial and process concerns
1164.	Support Economic	Duncan Hardie	P63	The project has been fully thought thru - is an excellent resource project, with existing infrastructure that can be utilised, as with the existing workforce. This gives the project a huge advantage over similar projects being considered in Australia and the rest of the world. Both NSW and Australia need this type of employment generating projects, and particular ones that provide new inflows of overseas money and tax/royalties for the state and federal governments.
1165.	Greenhouse Gas	Esther-Marie Berry	P64	This region of the Central Coast has begun and will continue to have a rapid population expansion. The environmental and health impacts of mining does NOT belong amongst such growth. Approval should not be given to another mining operation that will contribute to carbon emissions and GLOBAL WARMING.
1166.	General	Greg Burge	P65	I strongly object to the establishment of an underground coal mine in this area. The effect on the people and environment will be not be outweighed by any potential earnings the state may make from allowing this to go ahead.
1167.	Support	John Edwards	P66	I am familiar with this project and believe it to be technically sound. It offers significant socio-economic benefits to the Shire and should not be judged on the grounds of political expediency.
1168.	Groundwater	Leslie Moore	P67	I have the following objections to the proposal: 1) That the water aquifer will be contaminated and exhausted due to mining activities. My household supply is from a bore to the aquifer and I enjoy my water. Water not coal!
1169.	politics	Leslie Moore	P67	2) That the State Premier has not honoured an election promise to revoke the mining licence. I am disappointed with State and Federal politicians not honouring election promises. I voted for the current Liberal state party for the election promise of 'No coal mining on the Central Coast.
1170.	Ecology	Leslie Moore	P67	3) That habitat for flora and fauna will be destroyed particularly that for migratory bird species.
1171.	Subsidence	Leslie Moore	P67	4) That land subsidence is a result of long wall. This includes the Northern railway and the F3. Will the damage be paid for by the mining company?
1172.	Air quality	Leslie	P67	5) That the proposed Warnervale shopping centre will be a neighbour of the mine head. Dust and noise pollution will impact on adults and children.

No.	Aspect	Stakeholder	ID	Issue
	Noise	Moore		
1173.	Economic	Leslie Moore	P67	6) That a foreign company is proposing the development. This means that once again Australia will come second financially.
1174.	General	Leslie Moore	P67	7) That rehabilitation of the mine tunnels is expensive and is unlikely to be carried out leaving a lasting legacy to our children. In my opinion Kores and the State government have failed to address any of these and other issues. No coal!!
1175.	Politics	Pamela Rabinau	P68	Before Mr Barry O'Farrell was Premier he promised there would not be any coal mines near water catchment areas and I would like him to keep that promise. The Wallarah Coal Project should not go ahead.
1176.	Support Social	Scott Bradford	P69	I believe that there has been a significant amount of investigation and planning into the viability of this proposed operating mine. I also believe it would provide great employment opportunities for the people of the Central coast and surrounding areas including flow on to local businesses.
1177.	Surface water Ecology Health/social	Mary Goodwin	P70	My concern, if coal mining is to proceed, is that the water catchment area on the NSW Central Coast will be affected regardless of the reassurances we have received from the "experts". Surely such mining will be damaging to flora and fauna, not to mention the thousands of families living in the area.(My daughter and her family being one of those families). So yes, I strongly object to such mining going ahead. I hope this current NSW government will do the right thing and put the health of our AUSTRALIAN Central Coast residents above the greed of a FOREIGN mining company.
1178.	Support Economic Social	Name withheld	P71	The project should proceed to provide much needed stimulus and job creation at a time when job security and tenure is diminishing in NSW.
1179.	Support	Name withheld	P72	I would like to submit my support for the proposed Wallarah 2 Coal Project mining development. I was recently given the opportunity to tour the Wallarah 2 headquarters, where I was able to learn more about the proposed mining development and the impact it will have on our region. Following this, I am confident that the risks associated with such a project are far outweighed by the significant benefits it will bring to our region.
1180.	Support Economic	Name withheld	P72	Having lived and worked on the Central Coast for my entire life, I am very familiar with Wyong Shire and surrounding areas. I believe that the Project will bring a major boost to the local economy and hopefully breathe new life into the region.
1181.	Support Social	Name withheld	P72	On top of this, the Project will create a number of new employment opportunities for local residents and drive new skills to the area.
1182.	Support Social	Name withheld	P72	In addition, I am aware of the range of community programs and initiatives that Wallarah 2 supports and was particularly warmed to hear that the Project has offered to provide a free storage facility for Community Advocates - a local charity which provides essential clothing and products to vulnerable people on the Central Coast.
1183.	Support Economic Social	Name withheld	P72	I support growth for the Central Coast and believe that the Wallarah 2 Coal Project will achieve just that - growth for our economy, growth in employment and growth for the community.
1184.	Surface water Greenhouse Gas	Thomas Colley	P73	The Wallarah 2 proposed coal mine is intended to operate for 25 years and provide coal, a key source of carbon pollution, whilst it simultaneously threatens to pollute a valuable drinking water catchment. Alternative projects for renewable energy should be target for investment now, not dangerous projects like this one. I completely object to the proposed coal mine.
1185.	Previous EIS Surface water	Thomas Colley	P73	This venture was proposed and rejected for good reason under the previous NSW government. At that time, it was noted that the proponent failed to adequately address issues of water quality, ecological, subsidence and heritage impacts. The current proposal is not significantly better. The proposal seriously threatens the quality of water in the Jilliby Jilliby Creek catchment, and in Tuggerah Lakes basin.
1186.	Monitoring	Thomas Colley	P73	The monitoring requirements are insufficient to provide adequate protection, and cannot hope to contain the damage associated with this type of operation.
1187.	Aboriginal heritage	Thomas Colley	P73	The threats to protected species and Aboriginal Heritage are also sufficient to void this proposal. Please don't allow this project to proceed.
1188.	Health	Name withheld	P74	What are the people in Government thinking of; selling off our precious resources, bad enough to an Aussie company but an overseas one is disgusting. We would not be allowed to even consider doing something like that in Korea. How long must the people of the Central Coast fight this underhanded use of the pristine land and waterways that help to make this area one of the landmarks for overseas visitors to include in their itinerary.

No.	Aspect	Stakeholder	ID	Issue
				Our family moved up here from Sydney to have a cleaner healthier lifestyle for their children the future of this country what will this sell off to to that dream.
1189.	Support Social	Name withheld	P75	I believe that the project will provide much needed employment and from the information I have gleaned it does not appear that it will have an adverse impact on the environment.
1190.	Surface water Air quality Noise Health	Name withheld	P76	I oppose the wallarah 2 coal project on behalf of myself and my family. With a new subdivision approval for Wyee of more than 750 homes, it is not appropriate to mine in the proposed area and have a facility so close to this subdivision. It would directly affect quality of life in regard to water pollution, air quality and noise pollution. Mining subsidence has proven to have a negative affect on the Lake Macquarie district in the past. This is about our childrens future and the negative environmental impacts this project will introduce.
1191.	Health	Name withheld	P76	Please consider the latest research regarding lead poisoning of children in Mt Isa due to Xstrata mining emissions, which causes irreversible brain damage in children. Mining close to communities do not mix, health is more important than jobs
1192.	Support Social Economic	Ben Belfield	P77	With the current state of economy we need more investment in our community. This project has enormous potential for jobs both directly and indirectly. The entire community will benefit from this development.
1193.	Subsidence Surface water Ecology Health	Dylan Andrijic	P78	I am only 12 years old and would like to live a long time and have children in the future but I am concerned about what you're proposed mining will do to our beautiful valley. I am scared that we will lose our home, our river, our wildlife and most of all I am terrified that your submission includes possible death from mining and coal dust. Please please please don't wreck our valley that we live in.
1194.	Surface water	Graham Sturt	P79	This submission to the NSW Government should be rejected. This development would, as a minimum, 1. seriously prejudice the reliability of water supplies to my home/farm, our Valleys & The Central Coast
1195.	Subsidence	Graham Sturt	P79	2. cause unacceptable land subsidence
1196.	Health	Graham Sturt	P79	3. cause unacceptable health risks. All major State & Federal political parties have agreed this development should not go ahead .
1197.	General	Heather Ingram	P80	I wish to make objection to the proposed Wallarah 2 Coal Mine Project - Application No. SSD 4974 - for the following reasons: 1. The original application by Wyong Areas Joint Coal Venture (Kores Pty Ltd) in 2010 was rejected by the then State Labor Government on the grounds of unsustainability (ESD principles) and the application of the Precautionary Principle. This application is not any different in its basic proposals as the previous application and therefore the current Government's Acquifers Interference Policy should nullify this application.
1198.	Surface water Air quality Noise	Heather Ingram	P80	2. As this Government is intent on markedly increasing the Central Coast's population over the next twenty or thirty years, the plans for a new coal mine would have a severe impact regarding water supply, air quality and noise pollution on the surrounding suburbs of Blue Haven, Wyong and Warnervale/Wadalba, including the rail corridor to Newcastle.
1199.	Ecology	Heather Ingram	P80	3. The proposed mine will have an adverse impact on the migratory avian habitat, which is covered by international agreements to protect such environments with other countries.
1200.	General	Heather Ingram	P80	I do not believe that the Premier's explanation at a recent Cabinet meeting on the Central Coast that (not verbatim) "I only said I would stop the mine if I were certain an area's water supply would be adversely affected" is not good enough now, when prior to the 2011 State election the Premier and all the Coalition candidates swore that a coal mine would never be permitted under their government. Where is the mandate for the Government to override this community's known objections to this mine?
1201.	General	Jim Thomson	P81	The Wheat and the Chaff The director-general, Planning and Infrastructure. Mr Sam Haddad, in a Media release dated 24 April, 2013, stated that "the Department had required the applicant to thoroughly address a range of key issues, such as the potential impacts of the mine on water resources, biodiversity, heritage, air quality, noise and traffic and transport." The prospective miner, Kores, and its associates, has provided an extensive (and expensive) response in six bound volumes plus a collection of appendices. While some of the material presented is in line with one or other of the director-general's requirements much of it appears to make certain significant information presented difficult to find among the verbiage, especially for those who, while they have strong views about what is at risk, have

No.	Aspect	Stakeholder	ID	Issue
				limited time to plough through the wealth of irrelevant material provided.
1202.	General	Jim Thomson	P81	For example, in the section dealing with the proposed mine's potential impact upon water resources, rather than looking at the impact of a mine in operation, extensive coverage is given to the environmental history of those whose land would be undermined by longwall mining, any contaminants such as chemicals or asbestos sheeting which may exist at present and what inquiries of a Government department may reveal - or usually not reveal - about present owners. All of this is completely irrelevant to the question of what contaminating activities an operating mine may present. It serves, however, to give the appearance of responding to the director-general's requirement more directly than is, in fact the case. Representatives of the mining company have consistently asserted that the impact of the proposed mine in the areas of concern to the director-general, will be quite minimal.
1203.	Surface water General	Jim Thomson	P81	1. Water Resources (i)The Government's Scientific Committee, supported by excellent research, described longwall mining as "a key threatening process". (ii) The Wyong Water Catchment has been gazetted for protection under local government ordinances; both Gosford and Wyong Councils strongly oppose mining in the catchment. (iii) The business community, particularly the Wyong Chamber of Commerce, concerned about the adverse impact of a coal dump and loader upon the long planned Wyong Employment Zone, (WEZ), strongly opposed it; the significant number of citizens concerned about global warming opposed it. (iv) Evidence within the E.I.S. This evidence tends to be hidden in the verbiage of massive documentation referred to above, much of it not particularly relevant to the issues raised by Mr Haddab.
1204.	Subsidence	Jim Thomson	P81	We note, however: (a) In the Hue Hue Subsidence Area, some 150 houses, most of brick or brick veneer construction on small acreages, will be subject to subsidence estimated at one metre but recognizing that this may well increase due to the existence of Awaba Tuff strata.
1205.	Subsidence Geology Management Surface water	Jim Thomson	P81	(b) This exists below the mine on which the remaining pillars are supported. The E.I.S. is uncertain about the nature and caution needed in dealing with soft bedded Awaba Tuff and adaptive management is proposed as mining proceeds. The procedure proposed might well be appropriate in some outback, remote situation. It is in no way appropriate in what is, in effect, a small suburb of Wyong. "Adaptive management" with its suggestion of "playing by ear" , making changes and hoping for the best, is not good enough when what is at stake is the drinking water of half of the Central Coast.
1206.	Subsidence	Jim Thomson	P81	(c) Subsidence ranging from 1 metre to 1.6 metres is stated in Appendix H to affect 245 houses and 715 rural building structures. 420 farm dams will be impacted.
1207.	Subsidence	Jim Thomson	P81	(d) Subsidence will occur along 5.2 km length of Dooralong flood plain (including part of Jilliby Jilliby Creek, little Jilliby Jilliby Creek and minor tributaries) - Appendix K, Flood Impact Assessment p.(i)
1208.	Subsidence	Jim Thomson	P81	(e) The hinterland of the valleys face subsidence of 2.6m . Little Jilliby Jilliby Creek at the southern end is projected to subside 2m.
1209.	Subsidence Economic	Jim Thomson	P81	(f) The main roads from the Dooralong Valley into Wyong, Jilliby Road and Dicksons Road are projected to fall 1.75 m. in places. In times of significant rain it is difficult to get through under existing circumstance. The projected fall in such times would leave residents completely isolated. The alternative route proposed, through the forest to Mandalong is itself subject to being cut off in one low-lying section. I note that no provision has been suggested to compensate Wyong Shire Council for the substantial damage to infrastructure such as roads, which the proposed mining will inevitably cause.
1210.	Surface water Flooding Groundwater	Jim Thomson	P81	(g) The Northern Geoscience Report. The Northern Geoscience Report was prepared for the Australian Gas Alliance in 1995 by hydrologist and hydrogeologist, Tim Jones. Mr Jones was shocked that mining in the water catchment should even be considered. He stated: January 2005 - 18 – 0105102967 The Wyong Shire pumps from the Wyong River at Woodburys Bridge Pumping Station to the Mardi Dam. The river contributes approximately 50% of the central coast drinking water supplies. The Gosford-Wyong Councils Water Supply Report states for the year 2001, the serviced population of 285,000 drinking water demand was 34,300 ML/a, with peak demands averaging 254 ML/d (Wyong Shire, 2004). Both the Jilliby Creek and Wyong River flow continually with sharp flow responses following heavy rainfall events. The Department of Infrastructure, Planning & Natural Resources (2004) has stream gauging stations on Jilliby Creek at Wyong River (station 21101), and the Wyong serviced population of 285,000 drinking water demand was 34,300 ML/a, with peak demands averaging 254 ML/d (Wyong Shire, 2004). Data from the stream flow (HITS)

No.	Aspect	Stakeholder	ID	Issue
				database was assessed in this study. Daily average recorded stream flows for both stations is presented in Figures 8 and 9 and Appendix A. The average daily flow for Jilliby Creek for the period 1 January 2000 to 1 January 2005 is 34.15 ML/day with an average annual flow recorded as 12,481 ML/year. The average daily flow for the same period in the Wyong River is 46.0 ML/day with an average annual flow recorded as 17,045 ML/year. The combined average annual flow over a five-year period from the study area is recorded as 29,526 ML. Both the Jilliby Creek and Wyong River trend line show a significant decline in average daily stream flow over the five-year period. The reasons for this are estimated to be a combination of evaporation losses, evapotranspiration, periods of low rainfall and groundwater abstractions The total average annual flow for the Wyong River at the pumping station to Mardi Dam is reported at 94,080 ML (Wyong Shire, 2004). An assessment of stream flow from the study area reveals that the Jilliby Creek and the upper reaches of the Wyong River contribute approximately 32% of the surface flow recorded downstream at the pumping station. Asignificant portion of downstream flow in the Wyong River, calculated at 64,554 ML per annum, derives from groundwater discharge into the river system between the gauges and the pumping station. The high number of springs, wetlands and variability in water quality confirms this assumption.
1211.	Surface water Flooding	Jim Thomson	P81	What we have here are not woolly assumptions based upon a model lacking adequate baseline material but hard, empirical data based upon visiting the site, examining the way measurements were taken by stream gauging stations and available in the records of the Department of Infrastructure, Planning and Natural Resources. These proved that the surface water available to be pumped into the Mardi storage reservoir contributed only 32% of the water which was, in fact harvested. The remaining two-thirds of the water harvested could only have come by means of discharge from the shallow aquifer underlying the junction of Jilliby Creek and Wyong River. Despite claims by Kores of impervious layers preventing the potable water aquifer simply seeping down to the mining area with its surrounding contamination, the Geoscience Report identified numerous transmission routes. More recent statements by the highly regarded Professor Phillip Pells, denied the existence of impervious layers between aquifer and mine - a denial supporting the 1999 statement by groundwater consultants, ERM Mitchell McCotter, that transient pathways allowing water to travel downwards to the coal strata were evident. Clearly the aquifer identified in the Geoscience Report as vitally significant for providing town water to approximately half of the water ratepayers on the Central Coast is very much at risk from the proposed mining.
1212.	Groundwater Surface water	Jim Thomson	P81	The Cataract River example What happened to the Cataract River further illustrates this risk. It is not necessary to mine under a water source to damage it. In the Cataract River example, after the river water had disappeared because of mining and been replaced by methane vents, able to be lit by a flame, BHP Billiton consulted its mathematical model and decided that ceasing mining operations a certain distance from the river would mean no subsidence problems. It didn't. After further consultation with its model, stopping mining a somewhat further distance back was decreed to safeguard the river. It didn't. What is demonstrating again by this example is that any model is only as good as the information fed into it. (Indeed the Finding 11 tells us that "cessation of flow " of the Cataract River had been recorded "on over 20 occasions between June, 1999 and October, 2002." Clearly the model being used was not working well, yet the second Wallarah 2 E.I.S. very much relies upon models whose input validity can well be questioned.)
1213.	Surface water Groundwater	Jim Thomson	P81	Issues raised in the Final Report of the Cataract River Taskforce, 1998. These issues relate to what happened to the Cataract River and were published together with an attachment, Attachment A. Section 4.2 of the `Final Report of the Cataract River Taskforce 1998: `Longwall mining has impacted on the surface water flows in the Cataract River. In addition gases have been released that have had an impact on vegetation in some limited areas. These impacts were not predicted and a review of the technical literature has not found records of similar developments involving longwall mining at 430 to 515 m depth. Similarities between the disastrously impacted Cataract River and the still-to-be impacted section of the Wyong Catchment Area are noted: The Wallarah No 2 proposal and the Cataract River mining have similarities with the proposed mining depths and geological basin. Differences include wider longwall panels up to 250m and much thicker coal seams for Wallarah No 2 averaging 6m. In essence this means a greater degree of fracturing both expressed at the surface and immediately above the mined areas. ... This cracking only needs to come in contact with any overlying aquifer, areas of existing bedding plane separation or any of the natural fractures or joints within the Triassic Sandstones to provide a potential conduit for water transmission. Additional subsidence cracking expressed at the surface would further exacerbate this potential. (p.5)
1214.	Surface water Groundwater	Jim Thomson	P81	... In 2001, water in the Cataract River was still highly coloured, flammable gas was still being released and flow losses of about 50% (3 - 3.5 ML/day) still occurring." (DLWC 2001).

No.	Aspect	Stakeholder	ID	Issue
				Attachment A concludes with a technical examination of the contribution of groundwater as baseflow . Two figures are provided, one relating to data at one particular stream gauge over a 33 year period, the second to what happens if the existing groundwater flow is changed as a result of mining: Figure 2 presents the results of the hybase program showing the break up of stream flow into a baseflow component and quick flow (run-off) component. It may be a little difficult to visualise, being plotted on a semi-logarithmic scale, but the results indicate that the total baseflow contribution represents around 18% of the total volume of stream flow, however most importantly that for 95% of the time over this 33 year period, the majority of the flow in the river at this point is derived from baseflow. Thus the implications of modifying the groundwater flow either in quality or quantity are tremendous. " The implications of modifying the groundwater flow either in quality or quantity are tremendous". Indeed so.
1215.	Surface water Groundwater	Jim Thomson	P81	What can we learn from Attachment A ? Given the similarities reported in Attachment A, about the area mined and affecting the Cataract River, and the area proposed for mining in the Wyong Water Catchment, there is no reason to expect that what was reported about the Cataract River at the turn of the century should not mirror what may, in future, be reported about the results of Wallarah 2 mining if its application to mine is approved.
1216.	General	Jim Thomson	P81	Introductory statement of Office of Water to Kores' earlier EIS This brief report has been prepared to accompany Office Of Water's environmental assessment requirements for the Wallarah No 2 Coal Project. The proposal could result in a significant alteration of the groundwater environment and cause a major change
1217.	Ecology	Jim Thomson	P81	2. Biodiversity In looking at biodiversity, It is necessary to take into accounts Australia's binding agreements with China (CAMBA), Japan (JAMBA), and, indeed, South Korea itself (ROKAMBA). There are 19 species of avian migratory waders protected under these agreements and under Australia's own EPBC Act. At the level of biodiversity, these acts cannot be ignored.
1218.	Health Air quality Monitoring	Jim Thomson	P81	3. Air Quality For thousands of residents in the northern part of Wyong Shire, in suburbs such as San Remo, Blue Haven, Warnervale, Woongarrah and Hamlyn Terrace, health concerns ranked highly - not just their own health but, more importantly, their children's health. This they see as the effect of coal dust, and especially the small and deadly PM 2.5 particles, blowing from a coal dump and loader, as well as the open carriages of coal trains, to cause asthma and other respiratory diseases. In this part of Wyong Shire, health threats from coal dust particles blown from a major coal dump and train loader are extremely worrying. It is significant too, that in the ABC's 4 Corners programme on air pollution resulting from mining in the Hunter Valley, it was stated that "Only 4 out of 14 dust monitoring stations are capable of measuring the level of PM 2.5 particles." Suitable monitoring stations could have been included in the mine plan. I have seen no evidence that they have been.
1219.	Health Air quality	Jim Thomson	P81	Under the heading, Mines, dust and health, a leading article in The Newcastle Herald of May 24, 2010, we read, "It (a report by Government health authorities) declares that mines and power stations are important sources of air pollution and that the number and scale of these sources have increased dramatically in the Hunter in recent years. It confirms a strong association between high levels of particulate exposure and some forms of illness including respiratory and cardiovascular disease." There should be no need to emphasize that in the area reasonably close to the site of the proposed coal loader and dump, and to the northern suburbs of Wyong, there are already three power stations with associated coal dumps so there is no need to add another, larger and closer source of health risks.
1220.	Economic Surface water	Jim Thomson	P81	There is a need to recognize the need to reconcile the economic development resulting from mining, with the planned economic development described in CCPS. In particular the conflict between clean light industries within the Wyong Employment Zone (WEZ) and the proposed major coal dump and loader in Tooheys Road, a dirty, There are several, including: There could not possibly be a less suitable site in which to conduct mining, and, unless money is considered to be a more important criterion than the impact upon people and the environment, there is no need to mine in (as the attachment proved) a highly sensitive water catchment.
1221.	Surface water health	Jim Thomson	P81	Conclusion (i) The likely consequences of mining as Kores proposes have, to a considerable extent, been demonstrated to fail in the ways shown during mining which affected Cataract River. (ii) The impact upon the ever-growing community of the Central Coast would be much greater than the impact upon the community centred around Cataract River. (iii)It is possible that, despite the evidence within Attachment A and above, it will be decided to adopt the Russian Roulette option. (iv) Should then, permission to mine be granted, it will not be possible to say that no warning was given if things do go disastrously awry.

No.	Aspect	Stakeholder	ID	Issue
1222.	Surface water General	Lois Katz	P82	Clean water is a basic requirement of life. The proposed Wallarah 2 Coal Project puts into jeopardy the drinking water of the 300,000 people who live within the Wyong and Gosford area and 53% of the water catchment area supplying these residents. Tragically the O'Farrell government has decided to completely ignore its election promise that "The next Liberal-National government will ensure that mining cannot occur ... in any water catchment area ... no ifs, no buts, a guarantee." Mr O'Farrell said this whilst campaigning because he knew that water catchments are of vital interest to people. But, once in office, all good sense has been put aside, and he plans to ignore his promise and the need for a safe water supply.
1223.	Surface water	Lois Katz	P82	This is a sad and recurring theme in the NSW State Government. Below are reasons that I believe explain why this project should be rejected outright. The recently completed $80 million Mardi-Mangrove pipeline was funded by the Federal Government specifically to transfer water from this system to the Mangrove Dam on the escarpment during flood rains. The valleys above this mine regularly flood as recognised in the proponent's submission.
1224.	Air quality Health	Lois Katz	P82	AIR QUALITY AND DUST Dust and noise from stockpiling and rail movements will impact on the established suburbs of Blue Haven, Wyee and all along the rail corridor from Morisset through Cardiff and southern suburbs to the port of Newcastle. The EIS fails to adequately address these impacts. The project should be refused based on the health risks associated with air pollution from mining, stockpiling and transporting coal. Short-term exposure to particulate matter pollution can lead to diminished lung function, damage and inflammation of lung tissue, increased mortality rates in children and young adults, aggravation of asthma symptoms, heightened risk of cardiac arrhythmias, heart attacks and other cardiovascular issues.
1225.	Ecology	Lois Katz	P82	THREATENED SPECIES The current EIS lists 37 recorded threatened and migratory fauna species and six vulnerable or endangered flora species within the project site. Many of these species are protected under state and federal legislation as well as international agreements. The key threats to these species include land clearing, change in habitat due to subsidence and alteration of water flow, wetlands and floodplains. All of these threats are possible effects of this project.
1226.	Greenhouse Gas	Lois Katz	P82	CLIMATE CHANGE Five million tonnes of export grade thermal coal per annum represents a substantial contribution to NSW total carbon emissions and is in conflict with state and federal programs to reduce our contribution to global climate change.
1227.	Greenhouse Gas	Lois Katz	P82	The argument for continued coal-fired electricity in comparison to the long-term investment in renewable energy sources has not been adequately investigated. The government should perform a cost benefit comparison of investing the equivalent amount in renewable energy sources.
1228.	Support	Ross Campbell	P83	I have been involved with the coal industry for almost 40 years, and write in support of the Wallarah 2 project. I should declare that I worked on this project as a Mining Engineer for a short period in 2002, but am not currently employed on that project or by its owners. However, this is not to say I am disinterested in the outcomes of the planning process. For my own benefit and in my own time, I have attended a Council meeting and community forum held at Wyong Council Chambers.
1229.	Support	Ross Campbell	P83	I find the anti-coal anti-development stance of not only the "professional" action groups but the local council at the time totally lacking in any factual knowledge of the coal industry, its proven positive environmental record or its importance not only to the state but to the local community. The ludicrous comments of the previous mayor, (I believe he has been replaced), as to the additional rail traffic would prevent local people getting to work were laughable. As well, to authorise ridiculous spending on "friendly" anti development consultants was an insult to the local community and a misuse of funds in my opinion. The facts are that the central coast inclusive of Wyong has severe unemployment and that the few rail movements of coal per day would present no net impact on the passenger services. This is not to say that development should occur at any cost and any impression that is what I am advocating is incorrect.
1230.	Support	Ross Campbell	P83	My career has seen the coal industry being at the forefront of environmental protection. The industry uses the best engineers to determine the environmental impact of their operation and modifies its plans to suit the conditions. It is very easy for the uninformed protest movement to throw up red herrings in order to delay and stymie objective debate. I know the efforts that have been undertaken on the project to protect the local environment, and the owners should be congratulated instead of demonised.
1231.	Support	Ross Campbell	P83	The fact is that the quantity of coal located near our power stations, is limited. There are already plans to source coal from more remote sources instead of utilising the local resource. Local resources that if mined would deliver local employment and support local businesses. A mine producing 5M tonne per annum would contribute at least $250M to the local community and governments at all levels.
1232.	Support	Ross Campbell	P83	To willingly reject the project on ideological grounds would be a travesty. Let the engineers come up with the solutions, that is what they are paid to do. As I stated earlier, I have worked in about 10 underground mines and have never seen a more environmentally and safety aware industry. The

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				environmental degradation that the professional activists perceive has never happened.
1233.	Support	Ross Campbell	P83	With manufacturing retreating, Australia needs to pursue those projects that we can do successfully and compete on the world stage. We can no longer afford irrational lobbyists whose ultimate objective is to send us back to the stone age. I support the Wallarah 2 project.
1234.	Health	Tammy Dial	P84	My child has Cystic Fibrosis and the dust from the mines is a concern for me.
1235.	Agriculture Ecology Air quality Greenhouse Gas	Shirley Hotchkiss	P85	I object to the submission because of the negative effects on agrarian amenity (the growing of food), the natural environment (flora and fauna), our supplies of clean air and water, the built environment (homes and infrastructure such as bridges, schools), and I object to the reason for this exploitation for non-renewable energy, when we have the technology to implement and utilise renewable energy.
1236.	General	Name withheld	P86	I OBJECT MOST STRONGLY. Please do not allow this mining to go ahead. It will devastate our community. I have personally witnessed the effects of mining subsidence, often years after the 'miners' have gone. Broken homes, broken hearts and broken promises.
1237.	Surface water	Name withheld	P87	We have lived at this address for 24 years and have seen the difficulties faced due to shortage of water. As this proposal would without any doubt impact on our water supply and the population relying on that water is increasing, I am TOTALLY opposed to any government body signing off on the risk involved in any mining in the area. I believe the proof has been shown many times stronger for risk than not. PLEASE don't do this to our valley and it's delicate water supply as has been done in so many other areas that are now devastated by underground damage.
1238.	Surface water	Name withheld	P87	I can't believe that our council and state government would spend our money on what appears to be a successful project, pumping river water into our mountain dam and then risking losing all or even a part of that river supply. The risk of contamination has also been shown to be a real possibility in other areas. I would like to believe my family and the people moving to this region will be able to continue to live with the safety and confidence we have enjoyed in this beautiful area.
1239.	Subsidence Geology Surface water	Name withheld	P88	I along with my family are frightened that your mining is going to desecrate our lives by means of subsidence, damage to the environment , possible earth quake issue like the Newcastle one many years ago , let alone our own fear that your coal dust in one of the reports says loss of life quite possible and you actually give ratios geeese that is reassuring . I strongly object to mining in our area that also has a water catchment fed river that we may loose due to subsidence and that would affect 300,000 or so people if we were to loose that !
1240.	General	Name withheld	P89	Under no circumstances should this extraction of coal be allowed to proceed! It has the potential to destroy an entire community for the benefit of WHO? Would the Korean Government / Local Government permit Central Coast Residents/ Companies to mine in similar circumstances in South Korea? It is worth remembering; "The damage will be remembered long after the price has been forgotten" and people in a position to do something and who don't will be attributed the blame and responsibility for many years to come
1241.	General	Name withheld	P90	I strongly object to mining in our beautiful valley ,you big greedy companies do not seem to get the point of what quality of life means DO YOU! You come into our worlds and lie and scam your way through to try and make out that what you want to do is safe and wonderful and that no damage will be left behind ! Will you people wake up to your self's and understand that what you want to do is dangerous and life threatening to us and the environment , you only have to see by your past results and now you want to F#$K our area up as well !! I am not going to say please don't mine here because you have caused more problems with your lies than one can imagine instead I am going to be rude like you and say Take your greed and your lies and smoking mirrors and put them where the sun don't Shine you Arrogant A Holes !!
1242.	Surface water	Andrew Thomson	P91	The Idea of putting the Central Coast Water Catchment as more risk to depletion and pollution is deplorable.
1243.	Subsidence Economic	Andrew Thomson	P91	I have family and property interests in the area and ask who will compensate fully for subsidence to properties?
1244.	Greenhouse Gas	Andrew Thomson	P91	Coal mining contributes to pressures on Global Warming that should be avoided. The Exports will contribute to Foreign wealth and people as far as Newcastle will suffer the overheads of coal dust pollution

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	Air quality Economic			
1245.	support	Christopher Ellis	P92	It is evident from the comprehensive environmental, social and economic studies completed that the Wallarah 2 Coal Project (the project) has, throughout the development of the EIS, been designed and refined to create a financially justifiable project, while meeting the requirements and objectives of the Environmental Planning and Assessment Act and the principles of ecologically sustainable development.
1246.	Support Employment Economic	Christopher Ellis	P92	Specifically, it is noted the Project will; • avoid, mitigate, or manage all of the environmental, social and health risks of the project, including those of vital importance to the local and regional area; • provide significant employment opportunities both during construction (up to 450 direct jobs) and operation (up to 300 direct and 500 indirect jobs); and • have substantial positive impacts for the local, regional, state and national economies.
1247.	Support Economic Social	Christopher Ellis	P92	In consideration of the above, while recognising the project will require substantial and complex management and mitigation measures to address the risks identified, it is clear that the project, if approved, will provide significant benefits to the local communities, businesses, people of NSW and the Australian economy.
1248.	Support Economic Social	Form Letter 12	P93	As a supplier of goods and services to the underground mining industry, our business relies directly upon the continued operation of existing coal mines and the development of new projects such as Wallarah 2 Coal Project. During a recent presentation by the project at the Mining Energy and Services Council of Australia (MESCA) briefing held at Newcastle panthers in April 2013, the significance of this project to the Regional and NSW economies in terms of employment and economic stimulus became clearly evident. The approval of this project would inspire confidence and impetus for continued and expanded employment opportunities within our business market.
1249.	Geology Groundwater	Doug Williamson	P94	The EIS refers to 'aquicludes' and 'constrained zones', any examination of geology dictionaries provides definitions for no such terms. The consultants who wrote this report created quasi-scientific terms to give their hypotheses legitimacy and as such, all their conclusions should be treated with scepticism.
1250.	Economic	Doug Williamson	P94	The Wallarah 2 coal mine will contribute little, if anything to either the state or local economies. Indeed 'South Korea … has plans to introduce a price on carbon… which will apply to coal consumption' (Cubby 2013), meaning that this proposal at best, is merely a short term one and as such, definitely not worth the permanent damage it will do to the CC region.
1251.	Ecology	Dennis Bately	P95	I object to this mine proposal on the Central coast. I am concerned for the well being of the environment, the migatory birds whose habitat will be adversely affected as well as all the other wildlife.
1252.	Surface water	Dennis Bately	P95	The other huge concern is the damage to the water , this is a water catchment area for the central coast. Mining of this nature has already destroyed over 30 rivers in this country.
1253.	Groundwater	Dennis Bately	P95	To even contemplate mining in a water catchment is ludicrous. The risks are too high; you cannot fix the problem once you have damaged the aquifers as we have already seen. Let hope common sense prevails and not mine in water catchments.
1254.	General	Hugh Mansfield	P96	To whom it SHOULD concern, I am furious that the Wallarah 2 Coal Mine is being considered once again. This project was put to rest a couple of years ago, much to the relief of the environment and residents in the area, yet somehow it is now being considered again?! Exactly what has changed in terms of the impact this mine will have since last time the plan was looked at? I can answer that one for you, absolutely nothing!
1255.	Surface water	Hugh Mansfield	P96	Water quality WILL still be affected, and its not just humans and our drinking water, but all of the other ecosystems and species that rely on this water.
1256.	Air quality	Hugh Mansfield	P96	Airborne coal dust, yep it's still going to be a problem as well. Kores even admits this in their EIS, does that not concern you enough to reject this plan?
1257.	Subsidence	Hugh Mansfield	P96	Subsidence caused by the mining is still going to happen as well, and is estimated to be up to 2 metres in some cases! How happy would you be to see your house or any part of your property sinking 2 metres into the ground? Pretty sure I could answer that one as well.
1258.	General	Hugh Mansfield	P96	This plan must be put to rest, once and for all. We trusted you to look after the interests and future of the residents on the Central Coast, not to look after a Korean Coal Mining company and theirs.

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1259.	Health Air quality Surface water	Jean Bately	P97	I object to the Wallarah coal mine proposal even though I do not reside on the central coast. I am concerned for the health and well being of both my daughter and grandchildren that live on the coast. The dust risks are too high and to compromise the water catchment is an irreversiable problem that mining will create. Mining in a water catchment is dangerous, once the damage is done hundreds of thousands of peoples drinking water is lost forever.
1260.	Surface water Greenhouse Gas	Michael Lynch	P98	I object to the proposed mining lease being granted because it not only affects water security, but also will add to CO2 emissions. The report said yesterday 60% of fossil fuels should stay in the ground. Alternative sources of energy need to be used.
1261.	Support Social Economic	Tim Maddison	P99	Maddison Safety is a 100% Australian owned and operated company. We have serviced the Mining Industry nationally for over 25 years. Our company employs over 30 local people who work in various roles such as manufacturing, warehousing, admin, sales and marketing. Approval for new projects such as Wallarah 2 is vital for our company to continue providing future employment and development for future years.
1262.	Support Social	David Auston	P100	I think the project should go ahead so as we have more employment for the younger people.
1263.	Subsidence Surface water Air quality	Name withheld	P101	My home is just a few hundred metres from the Buttonderry Site of this proposed Coal Mine which, if approved, will extract coal from beneath my home and cause the land to subside. Most of the homes in my area are not connected to the town water supply or sewerage system. We rely on the rainwater collected on our roofs and stored in tanks of substantial capacity for all our requirements. All liquid waste is treated by on-site Aerated Waste Water Treatment plants. Air pollution and dust from the proposed mine will contaminate the air I breath, my drinking water, damage my roof and degrade the efficiency of my solar PV panels and solar hot water unit. Subsidence may cause damage to the house, tanks, pipes and Treatment Plant.
1264.	Hazards	Name withheld	P101	Also the intention of storing detonators, explosives, 55,000 litres of fuel, 15,000 litres of Hydrochloric Acid plus hydraulic oil and chemicals so close to so many residents is of great concern. (See Appendix AB, Preliminary Hazard Analysis).
1265.	Subsidence	Name withheld	P101	Some years ago at Chain Valley Bay (Lake Macquarie) there was serious land subsidence due to coal mining which damaged houses, flooded residential land and bushland causing many mature trees to die. A similar disaster could easily happen in Jilliby and Dooralong Valley on a far greater scale.
1266.	General	Name withheld	P101	If the committee members have not visited the Jilliby/Dooralong area I would urge them to do so and see what we could lose if this mine is approved.
1267.	General	Name withheld	P102	I am deeply concerned to learn that the Wallarah 2 Coal Mine project is back on the agenda. After having avoided the potentially catastrophic consequences of such a plan a couple of years ago, thanks to the intelligence and forward-thinking of a previous State government, I find it incredibly upsetting that once again, we need to spend so much time and effort convincing this State government of the dire outcomes that such a plan is likely to produce. To be specific, I am extremely concerned about the following impacts:
1268.	Air quality	Name withheld	P102	1) AIRBORNE COAL DUST PARTICLES: the effect this will have on the respiratory systems of residents in the area is of grave concern. Kores admits in their EIS that deaths will result. How is this acceptable?
1269.	Subsidence	Name withheld	P102	2) SUBSIDENCE: some estimates put this at up to 2 metres in certain areas. How is it ok to have ordinary Australians' assets put at risk like this?
1270.	Surface water	Name withheld	P102	3) WATER QUALITY: the proposed mine will be situated beneath the Central Coast's major water catchment area. According to an expert in this area, Professor Philip Pells, this would have catastrophic implications for the quality and quantity of our drinking water as well as broader biodiversity issues for our waterways.
1271.	General	Name withheld	P102	Please do not allow this to go ahead. Why should we suffer so that a foreign company can tear apart our beautiful surrounds in order to further pollute the world? You have been elected because we trust you to make intelligent decisions that protect the public from the greedy interests of groups such as Kores. I urge you to make the right decision for the residents of the Central Coast and NSW - and that means shutting down this proposal once and for all.
1272.	General	Name withheld	P103	I object to this, on the basis that not enough research has been done into the long-term effects of this. Especially when such a large water catchment is in close proximity. This kind of short-sighted development may ruin the land for future generations.
1273.	Ecology	Name withheld	P103	My property overlooks a permanent natural billabong which covers approximately 2 hectares, and is fed by Jilliby Jilliby Creek. This is not on my property, but is on privately owned land at 32 Dicksons Road. The billabong and surrounding trees are used as a roosting area and nesting habitat for over 200 birds year-round, including egrets, ibis, swans and ducks, and occasionally spoonbills.

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1274.	Subsidence Surface water Ecology	Name withheld	P103	The proposed Wallarah 2 coal mine extends directly beneath this body of water. I am seriously concerned that subsidence caused by the mine will result in the disappearance of this surface water, and consequently the loss of this special habitat.
1275.	Geology	Name withheld	P103	Additionally, the earthquake in Newcastle in 1989 has clearly identified that this is an earthquake prone area. I am fearful that the occurrence of an earthquake in this area after it has been considerably destabilized by underground longwall mining could have catastrophic effects on the local landscape.
1276.	Surface water Subsidence Groundwater	Name withheld	P104	Dear Sirs, I am writing to protest about the proposed coal mining. My concerns are pollution of our drinking water (we cannot get any town water) both for myself and my animals, and the possible subsidence of land when the water tables are tampered with. I would not like to get sick and also would not like my house to sink.
1277.	Surface water	Alexia Gratelle	P106	I write to object to the Wallarah 2 Coal Project for the following reasons: 1. Water Catchment Wyong Water Catchment is protected under a proclaimed NSW Statute in 1950. The water systems of the Dooralong and Yarramalong Valleys account for 50% of the water catchment for the entire Central Coast. Therefore I do not promote any mining operation in this area.
1278.	General	Alexia Gratelle	P106	2. "No ifs - no buts - a guarantee" The Liberal Party prior to the 2011 State Election promised in writing three times that if elected they would not allow the Wallarah 2 mine to proceed. They promised to introduce legislation into the Parliament to protect the water catchment area from coal mining. Barry O'Farrell stood up at a public rally in front of the electronic media and said, "the next Liberal/National Party Government will not allow mining to occur here... no ifs, no buts, a guarantee". The Liberal Party ran an election campaign on the Central Coast on the back on the anti coal campaign, reinforcing their absolute promise.
1279.	Subsidence	Alexia Gratelle	P106	3. Collateral damage of a broken promise Aware of the facts that Wallarah 2 had been refused based on unsustainability, and that Barry O'Farrell promised that no mining would occur under the Central Coast's water catchment, I went about purchasing a farm and land. I believed what the politician I had backed promised. We knew our property sat in a mine subsidence district but we acquired it on the basis of Mr. O'Farrell's promise to legislate and based on the government's common sense to reject the first application to Wallarah 2. What is new to us now is that we are predicted to sustain 2250mm of subsidence, a 25% probability to sustain a R1 or R2 impact, a 10% probability to sustain a R3 or R4 impact. I would never bet against those odds. I request that Mr. O'Farrell's promise is honoured.
1280.	Subsidence Surface water Stakeholder engagement	Alexia Gratelle	P106	4. Subsidence * The extent of predicted subsidence is staggering (over 1000mm on average, 2000- 2250m for our farm - 245 homes, 420 dams, 755 farm structures) - this item of subsidence alone brings too many risks for the local community and the local environment. Too many remediation strategies will need to be devised at the emotional cost and the monetary cost of the local community and tax payers. * The study area is crisscrossed with rivulets, dams, ponds, bogs, wetland and rivers, most are tributaries to the Jilliby Jilliby Creek and Wyong Creek. The risk to incur any subsidence underneath these water resources is far greater than what the Central Coast can take, and the predicted water loss is far greater than the recharge capacity or the JJC river flow. The Central Coast is in constant need for clean and nutritive drinking water. Risking pollution by gases or shortages due to seepage is not a risk I want my community to bear. * The alluvial valleys are fertile because of ground and surface water storages. Many businesses and farms like ours depend on these natural passive water storages. Risking loosing or damaging these water resources because of this Project is not a risk that I want to take for the sustainability of my farm operations and that of my colleagues. I already have climate change to worry about and I invest a lot in building dams to store any precious water that fall on our roofs. I don't want to see those natural passive water storages nor our man-made water resources drain any single drop of water to mining. * KORES spokesperson indicated in a recent interview with ABC Central Coast that remediation options will be discussed with each land owners two years before the panels go in. TWO YEARS? I don't accept such little time frame - this is nowhere near a guarantee to safeguard my assets, my farm operations, my future and that of my child's, and our safety. * The press release announcing the new EIS is grossly understating the extent of the project: "the mining area is predominantly situated underneath Wyong State Forest". This statement is untrue as only between a fifth to a quarter of the study area is made of the Wyong State Forest. Over three quarters of the study area are made of the State Conservation Area, farmland, expanding suburbs, rivers and streams.
1281.	Flooding	Alexia	P106	5. Flooding

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		Gratelle		Subsidence impact on flooding is of great concern to me. Figure 34 of "Impacts, Management and Mitigation" shows that the beginning of Beaven Lane and a large portion of Jilliby Road will flood, henceforth preventing access to us, other residents north of this area and to any medical or emergency teams. I am personally affected with a life-long illness that requires un-schedulable emergency hospitalisation. The fast route that is Jilliby road being cut off by flood caused by mine subsidence would require that I or any emergency medical team take the longer route through unsealed Durren Road. I cannot promote the Project for this reason.
1282.	Subsidence	Alexia Gratelle	P106	6. 330 kV Transmission Lines I am greatly concerned with Wallarah 2's opinion that Transgrid should reinforce the footings of the tension towers (especially those on our land and adjacent to it which span is of over 1km) as means to avoid coal sterilisation. The work required to replace those towers with other subsidence-proof tower (should they exist) as suggested by Wallarah 2 on page 100 of Appendix H will have enormous negative collateral impacts which are not assessed in the EIA. I cannot therefore promote this Project for these reasons as Wallarah 2 is not amiable to coal sterilisation, and is privileging profit over common-sense.
1283.	Ecology	Alexia Gratelle	P106	7. Bush Fires The valleys are naturally wet. All the time. The forested hills are naturally wet too. Remnants of rainforest or rainforest regrowth are strong, healthy and thriving with life (fauna & flora) because they are wet. All the time. Our floodplains are wet. All the time. This humidity is possible thanks to a healthy recharge area from the forested hills down to the aquifers, ground storage and surface water storage. This humidity is a major damper to bush fires as confirmed to me by the SCA Park Management representative. This protects assets both public and private, this protects wildlife and this sustains the natural features of our coastal hinterland (pastures, farmland, estuary, etc). The EIS does not take into account the amount of work and resources the rural fire brigades will need to undertake when bush fires become more prevalent. I am not saying mining will cause bush fires. It will however gradually rob the ground of its natural moisture. And with climate change becoming more apparent every season, we need to increase our chances to protect our land and our assets. Thus I cannot promote this Project as it will undermine our land and our community's bush fire safety.
1284.	General Economic	Alexia Gratelle	P106	8. Touristic destination & economic value for the Central Coast The scenic beauty of the Central Coast's forested backdrop is a major tourist attraction. Its pristine valleys, its rainforests, its wetlands and estuary are the pride of Central Coast residents and businesses. Both Wyong and Gosford Council are strongly promoting environmental protection of this natural backdrop along with the Tuggerah lakes and the beaches. Risking undermining their health and integrity as well as their related economic output because of subsidence, or pollution downstream or bad publicity is madness for the resiliency of the Coast and its touristic and economic vantage points. I cannot promote this project for this reason.
1285.	Surface water	Alexia Gratelle	P106	9. Drought damper For the same reasons as outlined in my point number7, I cannot promote this Project which will rob our land of its water. The ground water is drought proofing our pastures, our farm operations, our economic farm output, our economic tourist output, etc.
1286.	Social	Alexia Gratelle	P106	10. Solidarity and integrity of our community We are sustainable local employers. We are also parents of children to whom we are promoting the Central Coast as a place to live, work, play and raise their own family. We participate in the local economy. We contribute to our local community. Wallarah 2 however has not shown any of that so far, and I don't suspect it ever will. Instead, it's buying out our community with community grants here or there. It's dividing our community. Our community will see nothing of Wallarah 2's wealth made over our coal reserves. Our community will be left patching scars left by the mining operations. Wallarah 2's claim to create 1000 jobs over the length of the Project - that is 35 jobs a year! Woa! Big deal (not) for the Central Coast! I cannot support such project which will not sustainably our community.
1287.	Ecology Groundwater	Alexia Gratelle	P106	11. Destruction of native ecosystems In 1999 groundwater consultants, ERM Mitchell McCotter, found that transient pathways for water to travel downwards to the coal strata was evident and so bulk water would not be impeded on its downward path. Furthermore, the Peer Review by Professor Bruce Hepplewhite (page 258, Appendix H) questions many of the terms used and assumptions made during the geological modelling upon which subsidence and water loss are based. The EIS offers no guarantee that our landscape will not face a bleak outlook once panels go in. The native ecosystems that depend on those landscapes are to invaluable to risk slow death by subsidence or drying out.
1288.	General	Alexia Gratelle	P106	12. Quarry Our property is backed by a disused quarry. I scoured the EIA to find impact assessments related to this particular item. I found nothing. This is worrying and it gives me no guarantee that the EIA is comprehensive in its study. Should the quarry be mentioned in the EIA, I am still worried as I

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				couldn't find it. This is once again showing that the EIA was not written for the intention of the public but mostly to satisfy a regulatory requirement. Once again, the community is not at the heart of Wallarah 2 Project proponents. So how will subsidence impact the the area since there is a quarry sufficiently large to be seen on satellite pictures and a 330kV tension line nearby?
1289.	Hazards	Alexia Gratelle	P106	13. Safety I am greatly concerned about the behaviour of subsidence especially when they are predicted to reach 2.2 meters or more. Despite the fact that we sit on a proposed panel that is predicted to subside by 2.25m, we also do extensive bush hiking in the SCA and State Forest. We also walk our paddocks every day. We drive our cars and tractors through roads that are predicted to subside. We cross bridges that sit over subsidence area. Are we at risk of falling in a big hole on day? Will my living room disappear by 2.25m? The EIA doesn't address the predicted behaviour of subsidence of our specific geological landscape. I cannot support such Project that fails to address legitimate community concerns well before they were raised. Such a lack of common sense from the Wallarah 2 Project proponents is symptomatic of its lack of community concerns.
1290.	Air quality	Alexia Gratelle	P106	14. Pollution by dust, noise and emissions I am concerned about the pollution that would enter our lungs from the Western ventilation shaft, and the Buttonderry stockpiles. The EIS has not addressed the issue of crystalline silica appropriately other than by quoting past studies done in other parts of the world. This is not good enough in my views.
1291.	Stakeholder engagement Greenhouse Gas	Alexia Gratelle	P106	15. Some last concerns: The EIA is an incredibly indigestible and convoluted piece of document. I was made aware of it on the last week of May when I received a hand-delivered (there was not postal stamps) letter from Wallarah 2 dated "May 2013". This letter informed me that the EIS was on public display until Friday 21 June and that I was not to worry about subsidence as the Mine Subsidence Board will take care of everything. Why did I not receive it earlier? I am one of those time-poor over-worked mortgage-paying families that haven't time to read the papers, watch TV or log on to the Wallarah 2 website and read their newsletter. So this letter certainly did not encourage me to read the bulky EIA and it was very good at giving me a false sense of security. I decided to have a go at reviewing the EIS despite all odds and got a CD Rom copy from the library (the documents are too heavy to download from the internet and I didn't know I could get a free hardcopy from the Council Chambers) and I set myself up to read them. You'll excuse me if I cannot quote any data related to CO2 and methane release into the atmosphere as I haven't yet gotten to that part - if there is indeed a mention of this topic in the EIS. But common sense prevails and I suspect that if you take coal away from its natural underground storage and if you are to burn it to produce electricity (or bombs?), you are certainly releasing it into the atmosphere. So the Project is against any Climate Change mitigation strategies and lacks crucial amount of common sense.
1292.	Surface water Air quality	Kimberley Bushnell	P107	I wish to strongly object to the proposal made to construct a coal mine beneath the water catchment valleys of Wyong. My reasons for this objection are briefly due to: <u>Air Quality</u> An aritcle in a Australian Mining Publication in November 2010 quoted the findings of a senior public health officer for the Central Coast Region, to the NSW Planning Dept, 'that air pollution had been underestimated by by Wallarah Coal and would produce increased respiratory systems and morbidity among residents.' The article further stated 'that air quality data from the Minors EIS was inadequate and pollution levels projected would cause harm.' It quoted 'that the coal dust would spread well beyond the boundaries of the proposed mine.'
1293.	Surface water Groundwater	Kimberley Bushnell	P107	<u>Water Quality</u> These valleys which will be adversely affected (Dooralong and Yarramalong) account for approximately 68% of the water catchment for the entire Central Coast of NSW. The community can see that this proposal has the potential to destroy the catchment river systems and the underground aquifers. The river systems are two-thirds fed by these aquifers and to compromise their integrity is unacceptable.
1294.	Ecology	Kimberley Bushnell	P107	<u>Ecological Balance</u> This proposal has the potential to disrupt the ecological balance of bird, animal, aquatic and plant life, and endanger the estaurine habitat of endangered international migratory birds that are protected. Also, the proposal will compromise the beautification of our State Forest.
1295.	General Visual	Kimberley Bushnell	P107	<u>Conclusion</u> I am aware that governing agencies are looking for reassurance from Wallarah Coal that they will bear responsibility to remedy any adversity this coal mine will cause, however it is very hard to unscramble an egg and as the saying goes, an ounce of prevention is worth a pound of cure. On a personal note, I have recently undetaken much travel within Australia and the increase in mining activity I have seen within this county is concerning. It is very unappealing to the eye and devastating for the health and wellbeing of communities.
1296.	Air quality Noise	Lyn Axford	P108	The coal loading facility will be adjacent to the growing suburbs north of Wyong which is where we live. Dust and noise from stockpiling and rail movements will impact on the established suburbs of Blue Haven, San Remo, Wyee and all along the rail corridor from Morisset through Cardiff and

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	Health			southern suburbs to the port of Newcastle. The proponent of the Wallarah 2 Coat Project, South Korean owned mining company Kores, admit in their Environmental Impact Statement there will be death from coal dust exposure. This admission alone should be sufficient reason to deny the application.
1297.	Surface water	Megan Hitchens	P109	The Wyong Water Catchment was protected under a proclaimed NSW Statute in 1950 (Gazette No. 153 of the LGA 1919, 1950). This statute still stands. About 300,000 people in the Wyong and Gosford Local Government Area rely upon this major water catchment for their potable water. The recently completed Mardi to Mangrove pipeline also relies upon the sustainability of the water catchment district to transfer water from this system to the Mangrove Dam for water banking, with the aim of alleviating shortages in times of drought. The catchment is vital to the Central Coast.
1298.	Subsidence	Megan Hitchens	P109	There are approximately 46 panels to be mined, including in the Hue Hue Subsidence Area where 150 houses (Appendix H Map on page 240), mostly of modern brick design, exist on subdivided acres and will be subjected to subsidence up to one metre. Many may well suffer further subsidence due to the existence of Awaba Tuff strata below the mine on which the remaining pillars are supported. There is much discussion within the application referring to the uncertain nature and the caution needed regarding the soft-bedded Awaba Tuff, and need for a scenario of adaptive management as mining begins to proceed. This type of experimental mining should only be carried out in a remote location of no environmental signifigance, NOT under modern homes within the expanding outer suburbs of Wyong. The Department of Infrastructure and Planning should be alarmed by this and immediately inform the owners of the properties in the Hue Hue Subsidence District.
1299.	Subsidence	Megan Hitchens	P109	A total of 245 houses (Appendix H, page 130) will be impacted by subsidence from a conservative one meter to 1.6 meters throughout the mine area. A total of 755 Rural Building Structures will be impacted (Appendix H, leading up to 179) and 420 Farm Dams suffering subsidence to some degree (Appendix H, leading up to 187). As can be seen, the projected damage inside the mining lease area would be catastrophic. The hinterland of the valleys are to be subsided 2.6 metres; Little Jilliby Jilliby Creek at the southern end is predicted to fall 2 metres. Professor Pell writes in his own report on the impact of subsidence on the creeks and water ways in the mining area. Creeks will have areas where part of the bed has tilted in an opposite direction to the surrounding bed, interrupting the flow of water and causing ponding. There will also be cracks causing draining. He predicts that the damage and resultant water loss will exceed local rainfall, causing the affected waterways to be dry for about 200 days in each year.
1300.	subsidence	Megan Hitchens	P109	The main artery into the Jilliby/Dooralong Valley, Jilliby Road, is predicted to subside 1.75 metres in places. It needs to be remembered that these valleys flood on a regular basis, leaving residents isolated from all directions. The main access into the valleys needs to be protected and maintained, with particular reference to the access of rescue vehicles. Further to this, it should be remembered that it is the Mine Subsidence Board that will be left with the ensuing mess, not the mining company. This unnecessary burden on the people of New South Wales and particularly on the residents in the Hue Hue Subsidence District can easily be avoided by refusing approval.
1301.	Air quality Noise Health	Megan Hitchens	P109	Dust and noise from stockpiling and rail movements will impact on the established suburbs of Blue Haven, Wyee and all along the rail corridor from Morisset through Cardiff and sourthern suburbs to the port of Newcastle. Kores fails to adequately address the ramifications of this. New suburbs being created in northern Wyong Shire will be impacted by the mining proposal. The stockpile and loader are placed in these developments and should not be considered based on known local high rates of asthma and bronchitis as voiced by the medical profession for decades. Further, Dr. Peter Lewis, Area Director Public Health, NSCC Public Health Unit, criticises the Wallarah 2 EIS for lack of quantification in modelling, poor presentation of data, and an absence of time series plots in the presentation of PM10 data. He also highlights the complete absence of assessment of increase in respiratory symptoms associated with increasing particulate pollution, and the almost non-existent acknowledgement of population growth in the affected areas. The EIS does admit that there will be an increase in deaths and hospitalisation due to the dust from the mining project, but if it fails to acknowledge population growth in the area, then this admission of harm can only be underestimated. Again, the EIS downplays the harm Wallarah 2 will cause, but even if only one person dies as a result of this mine, that is one too many. And how do you explain to the family of that person that the death is only "minimal" and "within the scope of the mining project"?

No.	Aspect	Stakeholder	ID	Issue
1302.	Ecology Surface water	Megan Hitchens	P109	Kores has publicly stated that "the majority of the mine is under State Forest". This is not true. About 20% is under State Forest, 25% under the Jilliby Conservation Area and the remainder under rural residential properties. However, even if it were true, State Forest belongs to the people of the State, not to a mining company. As to conservation, the area proposed to be mined contains habitat for nineteen species of avian migratory waders which are protected under not one but three BINDING International agreements: CAMBA (with China), JAMBA (with Japan) and ROKAMBA (with South Korea). The proposal directly affects these agreements and should it proceed places us, Australia, in breach. Drainage channels caused by subsidence and natural drainage flow lines will lead to contamination of the Wyong River and the estuarine areas of Tuggerah Lakes, destroying aquatic organisms, thereby damaging the feeding habitat of these migratory waders. Discharge of any kind into the water systems, be it deliberate or caused by subsidence, is unacceptable. This includes Porters Creek Wetlands, which the EIS repeatedly, and erroneously, refers to as "Porters Creek Swamp". Porters Creek Wetlands is the most pristine wetlands on the Central Coast and next to residential areas. It is also an integral part of the Tuggerah Lakes system. Kores and Wallarah 2 seem incapable of correctly referring to the areas within their proposal. What faith can we possibly have that they will not damage what they cannot or will not correctly identify. Yet again they show their contempt for the community.
1303.	Ecology	Megan Hitchens	P109	There are also within the proposed mining area flora species listed as threatened and local fauna species listed as endangered under the Threatened Species Conservation Act 1995, a total of thirty three in all. The fate of these species and their habitat is not adequately addressed in the EIS.
1304.	Greenhouse Gas	Megan Hitchens	P109	There is no real assessment within the EIS of the damage to Earth of the burning of the coal to be mined. 97.1% of scientists agree that dangerous levels of climate change are being driven by human activity, with a large contribution from the burning of fossil fuels. There has been a further call to ensure that 80% of Australia's fossil fuels remain in the ground to play our part in avoiding catastrophic climate change. The damage to the earth's climate caused by the burning of coal from Wallarah 2 has not been evaluated or even adequately acknowledged within the EIS.
1305.	Health Air quality Surface water	Peter & Tanya O'Neill	P110	We are residents of Jilliby and welcome the opportunity to comment on the proposed Wallarah 2 Coal Mine proposal. The proposed mining site will directly affect us and many, many other people in a variety of negative ways and should not be allowed to proceed. The health and well being of people, animals and the environment should come before money - no price can be put on health and once people are sick and the environment is dying, there will be no going back. It is an absolute disgrace that this proposal should even be considered, especially as it was previously unanimously rejected by politicians prior to the last State election due to its unacceptable impacts. Health impacts will be severe and completely unacceptable. We should not be forced to breathe in coal dust nor drink it. The entire area relies on tank water and anything in the air will settle on our rooves, wash into our water tanks and then be ingested by us. We don't suffer from asthma or chronic lung disease and don't wish to have it induced due to mining. We also don't want our peaceful area to be subjected to the noise and huge increases in traffic (trucks in particular) that will be generated.
1306.	Subsidence	Peter & Tanya O'Neill	P110	Subsidence will be a major problem. Roads, properties, dwellings and land in general will all be affected. We do not wish to drive along sunken roads and have our house and land sink, crack and become worthless and uninhabitable. This is our home. Trying to fix these problems, apart from being prohibitively costly, will be impossible due to the cause being under the ground and beyond our control.
1307.	Ecology	Peter & Tanya O'Neill	P110	Apart from these major impacts upon us personally, there will also be the impact on the beautiful environment both flora and fauna. Threatened and endangered species living here will also be subjected to the same health issues as the human population and have their habitat taken away and forever detrimentally altered.
1308.	Surface water	Peter & Tanya O'Neill	P110	The broader community will have their water supply affected also, with a huge percentage of the water catchment area being directly in the proposed mining area, as well as the largely unknown impacts on the area's groundwater.
1309.	Ecology	Peter & Tanya O'Neill	P110	Everything about this proposal is in conflict with human and environmental health and sustainability. It is in conflict with government policies and Australia's stance on being a world leader regarding these issues. Let our Governments show that we all stand for the important things in life and that the health and wellbeing of our fellow human beings, our communites, our fauna, our environment and our way of life are of the upmost importance and will not be compromised. This proposal should not be allowed to proceed.
1310.	General	Philippe Gratelle	P111	I strongly object to the Wallarah 2 Coal Project for the following reasons: Science: Approval to this project was previously denied due to over 40 items relating to unacceptable damage or disturbance. The new EIS is essentially a revamped version of the previous one and doesn't address these issues (excessive subsidence, increasing flooding, water catchment reduction, air pollution...). I object to be submitted to stress and anguish whilst this project has no ground to be re-submitted.

No.	Aspect	Stakeholder	ID	Issue
1311.	General	Philippe Gratelle	P111	Broken promise: Aware of the fact that my property was in a mine subsidence area, I acquired it on the basis of Mr B. O'Farrell's promise to ban mining in the Yarramalong and Duralong valleys if elected as premier.
1312.	General	Philippe Gratelle	P111	Process: The process is designed in such a way that people concerned do not get an easy, user-friendly and timely access to information which will significantly and adversely affect their lives.
1313.	General	Philippe Gratelle	P111	* The EIS is an extremely large and complex document which was put in exhibition for less than two months. That puts extreme pressure on working families like us to review the EIS.
1314.	Stakeholder engagement subsidence	Philippe Gratelle	P111	* In the last week of May, I, received a letter dated "May 2013" from Wallarah 2 - the letter was not posted - no stamps - but delivered to my mailbox. My neighbours received the same generic letter on the same day. It announced the new release of the EIS (which happened a month prior to the day we received that letter!!!), and it broadly informed us that we should not worry about subsidence as the Mine Subsidence Board will compensate us. It's only upon digging into Appendix G (figure 5.6) and Appendix H (table D.01) that I learnt that I was in a 2.2m subsidence zone. A Kores spokesperson on ABC local radio (Gosford 17/6/13) said "people shouldn't be concerned, as this is a very long project, subsidence will only appear in over 10 years' time..." This is akin to saying: "you have a terminal illness, but do not be worried; you'll only die in 10 years' time...". The spokesperson went on: "in any case, once the project is underway we will come 2 years ahead of time to discuss the specifics with each resident concerned" I need to know NOW what remediation strategies will be offered for my assets, the water resources, the natural landscape, etc. Failing that, I can only but object this project.
1315.	Stakeholder engagement	Philippe Gratelle	P111	* Why wasn't I (and the other 244 property owners in the Study Area) not contacted before that date and personally informed about subsidence specific to each case? This only left us less than three weeks to meet the submission deadline. Unacceptable. For all the reasons stated above, I find this process dishonest.
1316.	Stakeholder engagement Ecology	Philippe Gratelle	P111	Misleading information: Misleading information was published in the Press Release: "the mining area is predominantly situated underneath Wyong State Forest". This is purposely worded to lull people into thinking "Well, that mining project is OK then, it will not affect our lives directly as it lays mostly under bushland" This statement is untrue as only less than a quarter of the study area lays in the Wyong State Forest. Over three quarters of the study area are made of the State Conservation Area, farmland, expanding suburbs, rivers and streams
1317.	Subsidence	Philippe Gratelle	P111	Livelihood: My property is marked as one to sustain one of the highest levels of subsidence (2.2m). I am told that remediation by the subsidence board is a lengthy process and also that it covers only houses. Left out are: infrastructure such as dams, sheds, fencing, land... I acquired my property both as a residence and as an agricultural concern. What will happen to the income derived from that activity after a 2.2 metre subsidence destroys my fences and sheds, takes away my dams and who will pay to restore this infrastructure to its former state?
1318.	Subsidence	Philippe Gratelle	P111	Safety: A point of great concern to my family. How can we predict with certainty when and where a subsidence of this magnitude will occur? Will we be crushed under our house, fall into a sinkhole or will the two 330kV Transgrid high-voltage lines crisscrossing our property fall on us (The towers are only tension towers).
1319.	Agriculture	Philippe Gratelle	P111	Greater good: we have started working with the Catchment Management Authority and NSW Environment & Heritage Department (Land for Wildlife scheme) to establish a framework for our agricultural activity that will preserve water quality on Myrtle Creek, control weed infestation and maintain wildlife on the edge of the State Conservation Area. Longwall mining operations have too many cases-gone-bad scenario that permanently damaged and altered the natural processes on stream and rivulets. The government is taking great pride in protecting these natural assets and mining under them is in complete contradiction with those strategies. The only justification for sacrificing pristine environments and valuable water catchments such as the ones found in the Yarramalong and Dooralong valleys would be, as a last resort, to address a pressing need of energy resources for Australia itself, definitely not to be squandered as export to a foreign power.
1320.	Stakeholder engagement	Wayne McCauley	P112	In the limited time frame that I have had to review the EIS (all 3,572 pages) since becoming aware of its publication for public comment I offer the following comments in support of my request that it be rejected. While the document supposedly went on public exhibition on 26 April 2013 I did not become aware of its exhibition until around 5 May 2013. I have been regularly reviewing both the Wallarah 2 website and the Major Projects section of the Department of Planning website and I am certain that I looked at the Wallarah 2 website at this time (5 May) and there was no reference in the planning section of the website to the fact that the EIS was on public exhibition (in fact this section of the website still fails to state in the planning stages that it is on public exhibition).

No.	Aspect	Stakeholder	ID	Issue
1321.	General	Wayne McCauley	P112	Due to the size of this EIS I have not been able to thoroughly review each and every section to the extent that I would have liked but am sure that the points that I raise below are representative of the general failings of this EIS to fully and comprehensively meet the requirements of the DGR's. I trust that there will be other respondents that address areas that I am unable to cover due to lack of time or knowledge on particular issues. Perhaps my understanding of the English language is lacking compared with the supposed experts that have prepared this EIS and reviewed it but I can find no specific mention in the PAC report on the previous EIS that it "was recommended for approval by the Planning Assessment Commission expert panel" as stated in the Executive Summary Introduction and Section 1.2 Previous Application. In fact the PAC report states: "The Commission wishes to express its disappointment at the level of information provided in the EA. ...... In summary, the Commission recommends that: 1. If the proposal is approved, ...", (highlighting added) and goes on to define a further 39 detailed recommendations on issues that need to be addressed. While it is accepted that the PAC does not reject the proposal they do not "Recommend" it either. This is one of many examples of the Proponent taking liberties with the facts and needs to be given thorough consideration in the assessment of this EIS.
1322.	General	Wayne McCauley	P112	The Proponent in the Executive Summary section Existing Environment Regional Setting page iii states that "The F3 Freeway and Main Northern Railway Line run generally north – south, adjacent to the eastern extent of the Project Boundary ..." I would suggest that the F3 Freeway runs through the Project Boundary as clearly documented on Figure 2.
1323.	Subsidence	Wayne McCauley	P112	The Proponent in the Executive Summary section Catchment page iv states "The Project Extraction Area ... represents about 5% of the total catchment area of the Scheme." (the scheme being the Central Coast Water Supply) implying that potential effected area is small compared with the total catchment but fails to mention the area of the catchment upstream of the Project Extraction Area which is more important in consideration of the water catchment area. If the Project Extraction Area significantly affects the water supply by interrupting flow to the Mardi pump station on the Wyong River then any supply from the upper catchment is also significantly effected. I would also suggest that it is not the Project Extraction Area that needs to be considered but the Project Area effected by subsidence arguably defined by the Proponent as the Subsidence Impact Limit although I would suggest that this should extend out to zero subsidence and not the 20mm nominated by the Proponent.
1324.	General	Wayne McCauley	P112	EIS Main Report The detail in Figure 5 on Page 11 and Figure 7 on Page 16 shows a highlighted area as being owned by the Proponent when in fact it is not (refer to the highlighted area extending over Jilliby Jilliby Creek from Land ID 1 onto Land ID 278 & 279). The highlighting is either incorrect or the diagram showing the location of the Jilliby Jilliby Creek is incorrect. As the owner of one of these parcels of land I know my boundary extends to the creek. This issue is repeated again in Figure 36 on page 158, Figure 45 on page 199, Figure 46 on page 204 and in Figure 1 of Appendix P. The table following Figure 7 also notes that certain lots/parcels of land have no residence and again this is incorrect (refer to lots identified as 260, 283 and 284 on Jilliby Road – while ID 260 is used for a number of land parcels in the valley the lot on Jilliby Road adjacent to 283 and 284 and these lots as depicted in the figure do actually have residences on them). Again another example of the Proponent failing to correctly document the facts, if it cannot get these clear and straight forward details correct what confidence should we have on the more difficult and theoretical matters.
1325.	Stakeholder engagement	Wayne McCauley	P112	The Proponent regularly states that it provides ongoing and thorough community consultation and the distribution of information and Newsletters. As I pointed out in my submission on the previous EIS, all the Newsletters have not physically been delivered to my address and since then of the 4 Newsletters issued only one has physically been delivered. As I stated in my submission on the previous EIS as an owner and resident of land direct above the proposed long wall mine I fail to see how community consultation is effective if I am not receiving these documents. No doubt the Proponent will respond that it places advertisements in the local newspapers but again it needs to be known that the local newspaper is not delivered to the majority of residents of the Valleys and thus any communication in the local newspaper is not effective.
1326.	General	Wayne McCauley	P112	Section 2.6.2 provides details of average rainfall for the Central Coast and details rainfall from Peats Ridge, I question why the rainfall data from the recording station on Jilliby Creek (BOM Station ID 061380) is not used for the rainfall data.
1327.	General	Wayne McCauley	P112	Section 3.1 states that "Development consent is sought for a period of 28 years ..." and "A further planning approval will be required to enable continuation mining beyond Year 28.", if mining is envisaged to go beyond 28 years why is this not clearly documented and included within this EIS and development application.

No.	Aspect	Stakeholder	ID	Issue
1328.	Subsidence	Wayne McCauley	P112	Section 3.2.1 states that "The headings are either permanent tunnels for access and services throughout the mine life or temporary tunnels for access to the longwall panel. The permanent headings do not result in any surface subsidence." How is subsidence above these headings prevented when the diagrams show similar widths for the headings to the longwall panels. Where is the subsidence above the temporary headings documented as the detailed description of subsidence only appears to cover the actual longwall panels. As the longwall panel is mined what stops the goaf from extending into the heading. The Subsidence Predictions and Impact Assessment appendix states that the subsidence effects extend out at an angle of 26.5 degrees from the edge of the longwall panel so how does the area above the heading not experience any surface subsidence
1329.	Subsidence	Wayne McCauley	P112	Section 3.2.2 Page 36 states that "Panel widths can be varied along the length of a panel ..." please clarify how this can occur when the mine layouts and schematics (eg Figure 16) show rectangular longwall panels formed by parallel roadways, these roadways being formed first for each longwall panel and the panel being mined from the far end back to the main heading viz the parallel edges of the panel are formed before the longwall panel is mined. It is also noted that none of the analysis presented in Appendix G appears to consider anything other than a parallel rectangular panel of a specified width.
1330.	Mine plan	Wayne McCauley	P112	In Section 3.3.3 (and also in Appendix D) there is a comment that approval is sought for other plans which are not detailed and it is specifically requested that any detail not clearly spelt out in this EIS not be approved. If the Proponent has other plans why does it not present them in detail in the EIS so that they can be examined and commented upon. Section 3.3 states that "actual equipment utilised for the Project may vary" it is specifically requested that any equipment not equivalent to that in Table 7 (in terms of environmental impacts – noise, vibration emissions etc) not be allowed to be used without full consideration of any impacts on the details in this EIS and consultation of all stakeholders.
1331.	General Traffic and transport	Wayne McCauley	P112	Section 3.4.4 contains a somewhat hidden additional and significant source of environmental risk, it states that "To assist in reducing the regional transport of coal by road, the Project may also potentially facilitate the receipt, stockpiling and rail transport of coal from other mines in the vicinity within the coal handling approval limits sought in this Development Application. The gaining of any required approvals associated with the transportation of coal to the Tooheys Road Site from other coal producers or for any additional required infrastructure at the site is not part of this application and would be the responsibility of the proponent seeking to utilise this facility.". It is noted that this fact was more clearly spelt out in the referral to the Australian Government (Document ref 111013 Wallarah Background Document – Attachment B to the referral dated 16 May 2012 available on the DPI website under this DA). This proposal would significantly increase the effects of coal dust, noise and traffic impacts around the Tooheys Road site which have not been documented in this EIS. I would suggest that at no previous point in time has this proposal been made known to the community even though the Proponent is at pains to point out its open transparent communication with the community.
1332.	General Greenhouse Gas Air Quality Surface Water	Wayne McCauley	P112	Section 3.4.5 states that gas will be flared initially as indicated on Figure 19 – Figure 19 does not provide any information in relation to gas flaring. Another example of failure to ensure correct documentation by the Proponent. Please clarify the proposal for underground boreholes to capture gas in the pre-mining period – are these drilled from above ground or completely underground with no disturbance to above ground areas. I note that the Proponent has taken a step back from its previously advised intention to utilise the gas from the mine for power generation to now only stating that "commercial opportunities may become available for gas management and utilisation". Section 3.9.4 states that the salts in the brine are returned to the original location from which they came namely the coal seams but does not clearly state that it is done so in a much more concentrated manner in a much smaller area, thus if any leaching from the water table occurs into this area the saline water will be highly concentrated. This section states that 2 of the 5 headings will be used for brine/salt storage but the detail shown on Figure 18 shows only one area for underground water storage.
1333.	General	Wayne McCauley	P112	Figure 18 shows a 38 year time frame for mining yet the main comments in the EIS are for a 28 year project life of the mine, what is the intention, why is the Proponent stating one thing in one section and something different elsewhere, if it can't be consistent on this what is to be believed. Section 3.11 states that the clean excavated waste rock will be used for site works yet section 3.12 states that it will be stockpiled and trucked offsite, again why is the proponent stating one thing in one section and something different elsewhere, if it can't be consistent on this what is to be believed.
1334.	General	Wayne McCauley	P112	I note that Figure 23 incorrectly nominates the north end of Dickson Road as Buangi Road, again a failure on the part of the Proponent to get easily discernible factual details correct.
1335.	Legal and Regulatory Subsidence	Wayne McCauley	P112	Section 3.13 lists under Option 1 that the "Do Nothing" alternative "is not considered to meet the Objects of the EP&A Act". I would point out that the Act has more than the sole Object of encouraging the proper development of natural resources viz coal mining but also the proper management and conservation of agricultural land, natural areas, forests, water and villages.

No.	Aspect	Stakeholder	ID	Issue
				Section 4.1.10 state that "The Project will have no impact on the existing or proposed use of land above the Extraction Area" I would contend that it is not possible to make such a Guarantee ("will have no impact") and the EIS specifically states that subsistence effects will occur. The section goes on to state that "The Project has been designed to minimise as far as practical its impact on water, ..." in relation to SEPP Clause 14 a) requirements which specifically states "that impacts ... are avoided or minimised to the greatest extent practicable", I would contend that it has not been designed to minimise impacts to the greatest extent possible as it is clearly stated in Section 3.13.2 Option 2 that this option "would generally result in a lower level of surface subsidence above the Extraction Area" and thus impact on water resources and other land use but this option has been rejected by the Proponent.
1336.	General	Wayne McCauley	P112	Section 4.7 Table 14 notes that the Minister has delegated his approval functions for most SSD to the PAC. I fail to see the point of this note when there is nothing in either the DGR issued on 12 January 2012 or supplementary DGR's issued on 11 July 2012 to state this is the case for this EIS. Has this application been delegated or not.
1337.	Stakeholder engagement	Wayne McCauley	P112	Section 5.3.3 discusses Newsletters and their distribution of approx. 5200 Newsletter, how does this relate to the number of households in the direct impact area. We have only received 1 newsletter in the letter box during the period since the rejection of the previous EIS.
1338.	General Subsidence Geology	Wayne McCauley	P112	Figure 27 shows the coal seam as being parallel to the ground surface how representative of actual geology and the proposed mining is this, the figure shows the ground surface as horizontal which is not the case - what difference will arise in subsidence due to this difference in the ground surface not being even. I would suggest that further description of the detail in this figure is required to clearly describe what is occurring and that it is an "ideal/theoretical" depiction. Data in Appendix H clearly shows that the coal seam is not level and varies in depth between 320m to 500m AHD and that the surface topography varies in height by up to 150m.
1339.	Subsidence	Wayne McCauley	P112	Figure 28 fails to show culverts under Dickson Road at my and one of my neighbours properties but shows a similar culvert at another neighbours property. These culverts were either reinstalled or added when the road was covered with asphalt and thus should be readily known.
1340.	General Geology	Wayne McCauley	P112	Section 7.1.2 discusses the computer simulation models and the validation of them by undertaking comparison to actual subsidence in the Hunter Valley and Southern Coalfields when earlier in the discussion it is stated that neither the Hunter Valley nor Southern Coalfields have similar geology and therefore predictions by ACA and others using information from these areas is not realistic. If the Proponent uses this argument to debunk the predictions of others how can it use the same geological data to validate it's model. It is stated that SCT determined that a 65m pillar with cut throughs at 100m intervals is approximately equal to the strength of a 55m continuous pillar, on what basis is this approximation determined if the geology of the proposed Project is not equivalent to any other known mine site. Please provide the basis of the geological factors used to calibrate the FLAC model with the "standard" IPM model – if the validation is based on assumption which are incorrect how can further "fudge factors" be considered to be any more correct.
1341.	Geology	Wayne McCauley	P112	Section 7.1.3 Table 25 - What is the basis of applying a factor of 15 to obtain tensile and compressive strains from the hogging and sagging curvatures. The reference to this value used in the Southern Coalfields is considered unreliable when the Proponent regularly states that the Southern Coalfield geology cannot be compared to the geology of the Project area.
1342.	Subsidence Surface water	Wayne McCauley	P112	Page 104 states that there is predicted to be maximum subsidence of 175mm in the Wyong River and also 150mm upsidence and then goes on to state this is a net subsidence of 25mm and that this is negligible. I would contend that if one section of the river subsides 175mm and the adjacent section upsides 150mm this results in a change in level of 325mm which could not be considered negligible and will have an impact on the river flow, and all this in an area that is not directly above the proposed longwall mining so the effect on creeks directly above the longwall mining are likely to be extreme and significantly effect creek flow.
1343.	Subsidence Flooding Traffic and transport	Wayne McCauley	P112	Page 105 states that there is predicted to be a change in cross gradient of sealed roads of 0.9% and states that this is less than normal cross fall for drainage and therefore will have no impact, I would contend that if the predicted change leads to formation of ponding on sealed roads this is likely to result in increased accidents due to aquaplaning and loss of traction and is therefore a significant issue and risk to public safety.
1344.	General	Wayne McCauley	P112	Page 107 makes no mention of proposed fibre-optic cable for the NBN – why has this not been considered.
1345.	Subsidence	Wayne McCauley	P112	Page 108 states that the maximum change in freeboard for farm dams is 500mm, the sensitivity analysis on page 109/110 then goes on to state that the maximum change in freeboard height after doubling the subsidence effects is still only 500mm. I contend that this is in error and that a change in freeboard will occur if the subsidence effects are doubled.

No.	Aspect	Stakeholder	ID	Issue
1346.	General	Wayne McCauley	P112	Page 110 I would suggest that Quarterly reporting of predicted versus measured actual subsidence needs to occur for the entire time of mining and not just the first 5 years as the geology of the extraction area is stated as being different in the nominated 3 areas.
1347.	General	Wayne McCauley	P112	Table 33 on page 118 again lists a mining period in excess of the previously stated 28 years (38+ years is stated) why the discrepancy in mining period to that requested in this development application.
1348.	General Groundwater	Wayne McCauley	P112	Clause 7.2.4 page 123 states that "If faulting is present, mine planning will be revisited to develop appropriate management and minimisation measures" does this also include the complete cessation of mining. Clause 7.2.4 refers to the lack of adequate data due to the inability to access more bores etc, the previous PAC report, the Strategic Inquiry and other documents reviewing the previous EIS all referred to the lack of data and that additional data was required to properly assess the EIS – what actions has the proponent taken to obtain access to the other bore sites or properties to obtain more data, no detail is provided in this EIS of any attempt to obtain data and any refusals thereof. A number of the previous documents all stated that a number of years of baseline data was required prior to commencing mining and putting in place additional data recording at some time in the future does not appear to address this issue.
1349.	Groundwater Subsidence General	Wayne McCauley	P112	Page 123 Mitigation measures - Any damage to private bores should result in replacing the water supply to compensate for the water losses whether or not the damage exceeds the predicted levels or not.
1350.	Groundwater Surface Water	Wayne McCauley	P112	Page 126 Proposed Water Management System – How does the predicted peak in groundwater runoff of 2.5ML/day correlate with the actual runoff experienced during the June 2007 long weekend rainfall and flooding, Why is the brine treatment plant only to be operational for 14 years and not the entire time period of the mining operations. How does the 100 year ARI 72 hour storm event compare to the June 2007 long weekend rainfall.
1351.	Surface water	Wayne McCauley	P112	Clause 7.3.3 page 133 states that subsidence effects will impact on surface water and result in a loss of 300ML/year whereas the Proponent has regularly stated that there will be no effects on surface water.
1352.	Surface water	Wayne McCauley	P112	Page 132 the water treatment plant should treat water to the same if not better than Wallarah Creek water quality and not just "similar".
1353.	General	Wayne McCauley	P112	Table 42 on page 141 refers to various dwellings by number but nowhere in the EIS is this number related to an actual property address or location, hardly an example of effective communication. Similarly Table 44 on page 143 refers to various road low points by number but the actual location of these is not readily identified and it is only by searching through the Flood Impact Assessment Appendix K that one is able to find where the low points are, the table should reference where the identification can be found at the very least if not providing the actual detail.
1354.	General	Wayne McCauley	P112	Page 146 – How representative of the Project area are the data from Cooranbong, Norah Head and Williamtown, why was no actual data for the Project Area recorded and used. If project location data was collected for a number of years and shown to be equivalent to that for these other locations then there could be no argument, as previously noted many reports have stated that more project location specific data needed to be collected, why has this not been done by the Proponent.
1355.	Air quality	Wayne McCauley	P112	Clause 7.5.2 Page 147 - A statement is made that "compliance with the air quality criteria during the operational period will ensure that the criteria are complied with during the construction period." I contend that compliance in the construction period is predicated on the measures that are put in place during the construction period and has nothing to do with compliance during the operational period, I would accept that it should be easier to comply during the construction period based on the nominated 35% lower emission level but it does not necessarily follow that if the Proponent achieves compliance in the operational period that it would have necessarily achieved it during the construction period. Yet another distortion by the Proponent in order to present a better view of it's proposal
1356.	Air quality	Wayne McCauley	P112	A similar statement is made again in Clause 7.5.3 on page 148, I again contend that compliance during operational phase has no bearing on the construction phase and these types of statements should be a basis for the rejection of the EIS and mining proposal. Monitoring of air quality and dust emissions needs to occur during the construction period and methods need to be put in place to eliminate or minimise dust generating activities during the construction period.
1357.	Air quality	Wayne McCauley	P112	Page 148 Coal Haulage - I would contend that any studies of dust from coal trains in central Queensland has little if any relevance to coal haulage in the NSW Central Coast as the coal in central Queensland is significantly different to that which will be mined under this proposal – Queensland coal is considered to be "sticky" and therefore is likely to have far less dust than that which will be mined here.

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1358.	Greenhouse Gas	Wayne McCauley	P112	Page 150 Section 7.6.4 I would contend that the Energy and Greenhouse Strategy should be prior to commencement of extraction and not within two years after commencement.
1359.	Air quality	Wayne McCauley	P112	Page 155 Section 7.7.3 concludes that "The increase in risk of daily mortality ... is estimated to be approximately 1 in 100,000." I would contend that any increase in mortality is unacceptable and should be the basis for rejection of the development application.
1360.	Rail Noise	Wayne McCauley	P112	Page 161 Section 7.8.3 Project Operational Noise – I would contend that loading of coal trains will not occur with locomotives and wagons stationary on the rail loop as stated as the train has to move past the loading bins to load the train and thus the train is moving and the noise levels generated will not be constant as is the case of a stationary train with the locomotives engines idling but will increase and decrease as the engines are powered up (it is noted that the Proponent states that the train will be loaded on an upgrade and thus the locomotives will have to throttle up as the load increases). Also there is the likelihood of wheel rail noise as the train negotiates the curves in the loop, while the size of the curve radius of the loop will assist in minimising wheel squeal it will not eliminate it. There will also be a variable noise generated by the loading of the wagons as the coal loading chute is opened and closed to account for the gaps between the wagon hoppers.
1361.	Ecology Stakeholder engagement	Wayne McCauley	P112	Page 166 Field Surveys - notes that "Permission to access private property was sought through surveys and direct interviews with landowners. Despite these endeavours, WACJV was unable to obtain access to private properties above the Subsidence Impact Limit.". It would be more appropriate to provide details of these endeavours then just make the statement – as an owner and occupier of a property above the mine extraction area I am not aware of any approach to either myself or my neighbours.
1362.	Ecology	Wayne McCauley	P112	Page 169 states that the threatened "fauna" species are shown in figure 40 when in fact it is the "flora" species in this figure.
1363.	Ecology	Wayne McCauley	P112	Page 187 Section 7.11.4 states that if perceptible impacts are observed during site monitoring activities then if it is determined to be mining related that the relevant government authorities will be notified, I would suggest that if any impacts are observed that they should be notified to the relevant government authority even if they are not mining related – this is just good corporate citizenship and I would suggest that the Proponent would want to demonstrate this.
1364.	Traffic and transport	Wayne McCauley	P112	Page 190 Section 7.12.2 states that traffic data (AADT) for key roads for the period up to 2004 was utilised, I would suggest that between 2004 and 2012 significant increases in traffic have occurred in the area due to the significant population increase due to increased housing in the Blue Haven – Warnervale area.
1365.	Traffic and transport	Wayne McCauley	P112	Page 193 Section 7.12.4 – Traffic management activities need to be put in place for the Western Ventilation Shaft site during construction to ensure that traffic flows are minimised or construction traffic is not to occur within school arrival and departure times due to the narrow Jilliby Road for safety reasons. Mention is made of improvements to road intersection including for access to the Western Ventilation Shaft site with details contained in Appendix Q, however no road improvements to the Jilliby Road / Little Jilliby Road intersection can be found in Appendix Q.
1366.	Noise	Wayne McCauley	P112	Page 250 Section 7.26.2 The LAmax requirements of the EPA licences issued to ARTC and RailCorp are 87dBA at 15 m from the locomotive measured in accordance with AS3722 and not 85dBA at 100 m as stated. It is noted that the licences have a goal of 80dBA LAmax and 60dBA LAeq 24hr at 1m from the façade of nearest effected residential property.
1367.	Risk assessment	Wayne McCauley	P112	Section 6 / Appendix F Who were the participants in the risk assessment, what is there experience in undertaking risk assessments, what is their relevant experience in the industry areas in which they are offering opinions on risks, when was it conducted, where is this documented.
1368.	Stakeholder engagement	Wayne McCauley	P112	What is the engagement with stakeholders mentioned in the report, where is this documented.
1369.	Risk assessment	Wayne McCauley	P112	Why are there a number of risks/issues that have not been evaluated in the Preliminary Risk Assessment but are done so now. The whole point of the Risk Assessment standard and the guidelines published by Australian Standards is to communicate with "All" stakeholders to establish the context and identify the risks at the start of the process.
1370.	Risk assessment	Wayne McCauley	P112	I would suggest that the consequences for "Unplanned movement of land resulting in significant environmental effects" by definition needs to be higher than "3" based on the definitions in the Consequence Scale.
1371.	Risk assessment	Wayne McCauley	P112	I would suggest that it is rare that the control measures will impact on the consequence and thus the "Groundwater inflow into underground workings" consequence should not lessen from "3" to "5". What methods have been implemented to supposedly reduce the consequence, while the likelihood may

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				be reduced by diverting water around the operations if water does infiltrate the underground workings how is the consequence reduced.
1372.	Risk assessment	Wayne McCauley	P112	I would suggest that the Descriptions in the Likelihood table do not correlate with the Indicative Frequency, eg "The event might occur once in your career" and "Once every ten years" are somewhat at odds – whose career only lasts 10 years.
1373.	Risk assessment	Wayne McCauley	P112	The risk assessment should include a monitoring and review section as well as detailing who is responsible for implementing each of the risk treatments.
1374.	Risk assessment	Wayne McCauley	P112	I would suggest that there are considerable more risks involved in this project that should be included in the Risk Assessment – where are the risks related to the physical activities of underground mining, where are the risks of loading of coal trains, where are the risks of the construction activities in building the mine, etc. The Preliminary Hazard Analysis (Appendix AB) does not cover these risks. On the basis of the above comments I believe the risk assessment is flawed and can not be relied upon.
1375.	General	Wayne McCauley	P112	Appendix G Section 1.1 states "The Project team .... was determined from the outset to formulate a mine plan that avoided and did not cause impact on these important resources." I would suggest that the Project Team have failed to meet this requirement as there are clearly impacts on the "important resources" ie subsidence will occur, thus by the project team's own words and evidence they have failed to meet their own requirements and avoided impact and thus should not proceed with the project.
1376.	General	Wayne McCauley	P112	Section 3.6 is headed The Forest Case yet the text in the first paragraph states "this case is called the Valley case", how many other errors are in the EIS.
1377.	Subsidence	Wayne McCauley	P112	Appendix H Subsidence Predictions and Impact Assessment Table 1.2 states that particular requirements of the DGR's are addressed in the "Subsidence Prediction Report" and the "Subsidence Impact Report" there are no such identifiable reports contained in the Proponent's EIS. If the Proponent cannot correctly identify where the DGR's are addressed what should we believe.
1378.	Subsidence Groundwater	Wayne McCauley	P112	Section 2.2 states that "minor springs or seeps may occur ... as described in the Wallarah 2 Hydromorphology Study Report (IEC 2012)", no such report is included in the list of Appendices in the EIS.
1379.	Subsidence	Wayne McCauley	P112	Section 2.14.2 states that "There are no swamps or wetlands that have been identified in the Study Area" yet Figure 39 of the EIS shows what is labelled Swamp Mahogany Swamp Forest between Dickson Road and Jilliby Jilliby Creek, in the Buttonderry site and in the Tooheys Road site, if they are swamp forests then surely there must be swamps.
1380.	Subsidence	Wayne McCauley	P112	Section 2.5.2 Table 2.3 States that Little Jilliby Road is "Not directly mined beneath" however the headings for the longwall panels are mined beneath Little Jilliby Road, there is no mention of mining beneath Watagan Forest Drive.
1381.	Subsidence flooding	Wayne McCauley	P112	Section 2.5.3 and Drawing MSEC 515-12 fail to note the existence of 3 drainage culverts under Dickson Road east of the one culvert on Dickson Road shown on the drawing. These 3 culverts have caused flooding in the past and I believe that definitely one of them is lower than the culvert shown on the drawing and thus is more likely to be of significance in the flood studies. It is considered that knowledge of these culverts would not be difficult to obtain and thus why they are not shown or known is unexplainable and another failure of the Proponent to correctly identify easily known factual information.
1382.	Subsidence	Wayne McCauley	P112	Section 3.1 makes detailed mention of the fact that subsidence cannot be reliably predicted for "non-conventional subsidence" where by definition the coal seam is not level and the topography is not flat which in my opinion is the situation in the Project Area and is confirmed by Drawing MSEC515-03, thus there can be no guarantee as proposed by the Proponent that the subsidence levels are accurate or that there will be no impact on the water supply.
1383.	Subsidence	Wayne McCauley	P112	Section 5.23.4 lists an "Aviary" being "Highland Park Aviary" whereas Drawing MSEC515-19 lists "Highland Park Apiary", I understand the business to be "Highland Park Apiary", again another example of the Proponent not getting easily identifiable factual data correct or consistency within their own documentation.
1384.	Subsidence	Wayne McCauley	P112	Tables in Appendix D identify various houses, farm buildings and farm dams by number but there is nowhere any correlation between the number and the actual location to allow confirmation of the correctness of the data stated.
1385.	Subsidence	Wayne McCauley	P112	Drawing MSEC515-14 incorrectly marks the location of Jilliby Public School and Jilliby Cemetery, another example of the Proponent getting easily discernible factual data incorrect, what other easily discernible factual data has the Proponent got wrong.
1386.	Subsidence	Wayne	P112	Appendix G – Peer Review

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		McCauley		I note that Mr Hebblewhite's review is dated 10 July 2012 and is in relation to Rev 3 of the Subsidence Predictions and Impact Assessment (SPIA) and a March 2012 Draft Report on Subsidence Modelling Study whereas the SPIA document in the EIS is Rev B (note there are 3 revisions between the SPIA report provide to Mr Hebblewhite and the one in the EIS – there is no record of what amendments have been made between the various revisions so it is unclear how Mr Hebblewhite's comments have been addressed). I subsequently note that Mr Hebblewhite has updated his review on 5 October 2012 but still in relation to Rev 3 of the SPIA report even though Rev 4 was issued before this update it does not appear to have been reviewed). There is no revision record documented between the March 2012 Draft Report and the report in the EIS.
1387.	Subsidence	Wayne McCauley	P112	Page 257 Comment in relation to Page 64 - On what basis does the Proponent and the Peer Reviewer conclude that fracturing will occur only up to 200m above the mining horizon surely this should be related to a geological formation/structure and not simply a dimension as this statement implies. I would contend that the dimension above the mining horizon will be variable depending upon the geology of the overburden
1388.	Subsidence	Wayne McCauley	P112	Page 260 Comment in relation to Page 4 – It is heartening to see the Peer Reviewer concur that it is inappropriate to state that the geology in the Project area is different to the other coalfields and then use data from the other coalfields to calibrate/validate the model.
1389.	Subsidence	Wayne McCauley	P112	Page 260 Comment in relation to Page 12 – It is heartening to see the Peer Reviewer to put forward a view similar to the one I made in my submission on the previous EIS that "... it is never possible to fully define the overburden geological and geotechnical domain ..." and thus I contend that there can be no guarantee on the subsidence levels and effects as the Proponent regularly appears to do.
1390.	Subsidence	Wayne McCauley	P112	Page 260 Comment on Page 15 – Again it is heartening to see the Peer Reviewer comment on the fact that the pillars may not all yield as predicted and that analysis should be undertaken to cover this scenario – I see no evidence to support that this has been done.
1391.	Subsidence	Wayne McCauley	P112	Page 264 Section 6 Summary Conclusions 5th dot point – Again it is heartening to see the Peer Reviewer state "... it is important to recognise that there are difficulties in subsidence predictions especially where extensive databases of past practices do not exist or are not directly relevant. As a result the predictions made are not without a level of uncertainty ..." I suggest that this supports my contention that the Proponent cannot provide a guarantee on the level of subsidence, its effects or the impact on the water supply as it continually appears to do. There is a level of risk involved and in my opinion in relation to any possible effects on the water supply this is totally unacceptable and thus grounds for rejection of this development.
1392.	Flooding	Wayne McCauley	P112	Appendix K Flood Impact Assessment I would like some clarification on the statement in the executive summary that "This report is based on .... and utilises highly accurate topographic data for existing and post subsidence conditions." How can the "post-subsidence conditions" be highly accurate when they are not known as they have not occurred yet and are merely predictions based on certain assumptions which have still to be proven. The report goes on to state that it uses the upper bound (maximum) subsidence predictions so again how can the "post-subsidence conditions" be highly accurate if they are merely predictions.
1393.	Flooding	Wayne McCauley	P112	I find it somewhat strange that the executive summary states that "Only one additional flood event (March 2007) had occurred since the previous report..." when a simple review will confirm that a significant flood event occurred over the June long weekend in 2007 and additional flood events have occurred since then including most recently in Jan and Feb 2013 (2 floods from Jilliby Jilliby Creek). The Aquatic Ecology Impact Assessment report also mentions flood events prior to the Autumn 2011 sampling (2 flood events) and prior to the Spring 2011 sampling. It is interesting to note that in this document a 42 year project life is nominated when it has been generally stated that the mining project is for 28 years, why this glaring discrepancy in time frame – what time frame is intended, if the Proponent states varied time frames which do we trust.
1394.	Rail	Wayne McCauley	P112	Appendix N Section 3.1 7th dot point states "A rail loop that would be able to hold three (3) of the anticipated 3,400 tonne capacity trains." while Section 3.5 states "The rail loop would be designed to permit continuous controlled train loading and parking for two (2) additional trains." Which of these statements is correct as the second implies that a total length of the loop is at least the length of 4 trains, 2 trains parked and a third train in the process of loading and thus the loop could handle 4 parked trains 2 outbound from the loader and 2 inbound to the loader while the former implies a balloon loop length equivalent of 3 trains only. Train length will ultimately be dependent upon the type of wagon utilised with mention in the train path analysis of using either 100 tonne gross and 120 tonne gross wagons. Section 4.5 mentions that rail noise was measured "north of Wyong" – where exactly was it measured as track gradient will have an impact on noise emissions from the various trains.
1395.	Ecology	Wayne McCauley	P112	Appendix O Table G1 – Other fauna species also seen in the area include: Regent Bowerbird – Sericulus chrysocephalus (in fact it has been seen coming from the

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				Jilliby Jilliby Creek boundary of the land owned by the Proponent in Jilliby Road so the studies could not be considered to have been complete); Sacred Ibis – Threskiornis aethiopica. Mention is made of feral cats, dogs, rabbits, pigs, foxes and goats but not of the feral deer (red & fallow) that are in the area, no mention is made of the various livestock in the area (horses, cattle,sheep, goats, alpacas etc) which could be seen from public roads;
1396.	Aquatic Ecology	Wayne McCauley	P112	Appendix P Aquatic Ecology Impact Assessment – Mentions that surveys were conducted in Autumn 2011 and lists the dates as 27/6/11 to 01/07/11, perhaps my memory is fading but I always understood that Autumn finished on 31 May and Winter started on 1 June.
1397.	Visual	Wayne McCauley	P112	Appendix U Visual Impact Assessment - I find it difficult to believe that the 32m tall by 24m x 13.5m tower building for the winder motor at the Buttonderry site (as shown on Drawing WAL-300-SK-0030 Rev D in Appendix E) will not be visible from Hue Hue Road / Sparks Road or from the houses or the properties around the Sandra Street /Amberwood Close or Buttonderry Way / The Knoll areas as stated in this Appendix. It is noted that the Proponent states that the high voltage transmission towers in the Project area are approximately 30m high in Section 2.5.8 of Appendix H and thus the tower building will be taller than the transmission towers and be of a solid construction and not the lattice construction of the transmission towers and thus more readily visible and difficult to obscure behind trees. I am not aware of many trees in the Project area that are over 30m tall and even so they would take a long period of time to reach this height and provide any screening of the building. I can see no detailed plans for much of the infrastructure in the Tooheys Road site such as the coal loader or the crusher and thus how the visual impact from the height of these structure has been determined and consideration of its accuracy. It is assumed that Appendix E is supposed to provide all the detailed plans of the infrastructure in accordance with the DGR on Plans & Documents but obviously doesn't include this detail.
1398.	Geology	Wayne McCauley	P112	Under the Key Points – Subsidence of the DGR's is a requirement for "accurate predictions of potential subsidence effects and impacts of the development, including a robust sensitivity analysis of these predictions" while the Proponent will no doubt argue this requirement has been met I would contend that the predictions are and can not be "accurate" due to the lack of detailed evidence and experience in mining in the particular geology of the Project Area (as noted by the Proponent itself). I would also contend that a "robust sensitivity analysis" has not been undertaken and in the very least has not been clearly documented, as noted above the Proponent has stated that doubling the subsidence effects resulted in no change to the freeboard of dam – hardly a robust analysis or an accurate one.
1399.	General	Wayne McCauley	P112	Item 11 of the Supplement to the DGR's issued on 11 July 2012 required that the Proponent provide details of any proceeding under a Commonwealth, State or Territory law against it, I can find no detail in the EIS where this requirement has been addressed and documented.
1400.	Geology	Wayne McCauley	P112	Regularly throughout the EIS there are references to the fact that the geology of the mine area is different to the geology of the Southern coalfields and the Hunter coalfields and thus that the experiences seen of subsidence and river loss of flow cannot be used in the mine area however there is also consistent use by the Proponent of data from the Southern coalfields and Newcastle/Hunter coalfields to supposedly validate and calibrate the computer simulations and also utilise experience from these other coalfields to make predictions of the subsidence and effects of the mining. I fail to see how it can beargued in the negative that data and experience from the other coalfields can be used by the opponent to the mine and then go and use the data and experience from the other coalfields as a means of validation, there needs to some level of consistency by the Proponent.
1401.	General	Wayne McCauley	P112	As documented above there are many examples of the Proponent getting factual data incorrect, what effect has this had on the supposedly "accurate" predictions of subsidence and the effects thereof, I believe that these are grounds for a rejection of the development application.
1402.	Health	Wayne McCauley	P112	I note that in the local radio news (ABC Radio – Wallarah Two dismisses mine concerns as scaremongering - Thurs 6 June 7:16am AEST) in recent days it is reported "A spokesman (for the Proponent) says the independent EIS actually concludes the mine will not cause any adverse health effects" however the EIS clearly states in the Health Risk Section of the Executive Summary on page xi that "The increase in risk of daily mortality on the worst day in the life of the Project is expect to be approximately 1 in 100,000 ..." thus there is a risk to health and therefore adverse health effects, I would further suggest that the EIS can not be considered as "independent" and this is a further example of the Proponent distorting the facts.
1403.	General	Wayne McCauley	P112	In conclusion I believe that the risks posed by this proposed mine are too great and that the development application should be rejected as it fails to address all the DGR's adequately and conclusively. The subsidence level and effects cannot be reliably predicted due to the limited understanding of consequences of mining under geology that is significantly different to that in other coalfields. There is insufficient historical data of water flows, dust and airborne pollution which has been mentioned in the previous PAC report as well as the Strategic Inquiry as a necessity for review, however the Proponent has failed to fully address this issue prior to resubmission of this EIS. Unfortunately I fear that the mine will be approved, despite the many shortcomings in the EIS, due to the value of the mighty dollar that flows to various levels of government and thus repeat my request from my previous

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				response to the previous application that a substantial monetary security (cash and not bank guarantees) be put up front by the Proponent to cover the potential risks due to subsidence, I consider that the value should be in the hundreds of millions of dollars and not just the pittance paid in the mine subsidence levies.
1404.	General	Name withheld	P113	I am a land owner and resident of the Dooralong Valley & I would like to express my objection to the proposal for the Wallarah 2 Coal Project, Application Number SSD-4974. I would also request that my name be withheld from the list of submitters to protect my privacy.
1405.	Surface water subsidence	Name withheld	P113	I have multiple concerns in regard to the proposal and feel that if it did go ahead that it would: * negatively impact the ground and surface water within the catchment area that will in turn affect the water supply of 300,000 residents of Wyong & Gosford that rely on the Mardi-Mangrove pipeline, as well as damage to the delicate ecosystems of the waterways,
1406.	Ecology	Name withheld	P113	* negatively impact the flora & fauna (including the 37 threatened migratory fauna species and 6 endangered flora species within the project site),
1407.	Greenhouse Gas	Name withheld	P113	* conflict with State & Federal programs to reduce total carbon emissions and global climate change,
1408.	Air quality	Name withheld	P113	* increase air pollution from the increased dust and noise generated from stockpiling and increased rail movements. (This is of particular concern as I have an asthmatic child and the Environmental Impact Study failed to adequately address these issues.),
1409.	Subsidence	Name withheld	P113	* cause major subsidence and movement to structures on my property which will undoubtedly decrease the value of my substantial investment in the area.
1410.	General	Name withheld	P113	I am also concerned that this application has already been refused once on the grounds that the proponent, Kores Ltd, failed to adequately address the issues listed above, and I question why this proposal is being considered yet again without any substantial changes to the original proposal.
1411.	Ecology	Name withheld	P114	Within the extraction zone there is 525.8 ha of Coachwood - crab apple rainforest. As there is so little rainforest left in Australia this section of rainforest would be irreplaceable and difficult to offset. There would be quite a few animal species affected also - for example the Little Eagle and Freetail bats that studies show are evident in the rainforest. A lot more species would move through it but due to access these haven't been noted. This is a significant area of warm temperate rainforest of the North Coast and northern Sydney Basin to be affected and should be left insitu.
1412.	Health	Name withheld	P115	I am writing to submit my objection to the proposed Wallarah 2 Coal Project Application No. SSD-4974. The basis of my objection includes the following: 1) Health concerns as a result of the coal project including increased in respiratory problems including asthma and the long term effects that the fine airborne particles of coal dust may have on this and generations to come. These concerns are highlighted by the proposers own admission that there could be deaths resulting.
1413.	Surface water	Name withheld	P115	2) Concerns over the impact on our region's water supply and catchment areas as a result of the coal proposal.
1414.	Subsidence	Name withheld	P115	3) The negative impact on local homes that will result from the project. It is anticipated that mine subsidence of 1 to 2m could result impacting many local homes.
1415.	General	Name withheld	P115	I believe the long term damage to the Central Coast's water, infrastructure and health that would result from this proposal being approved cannot be ignored.
1416.	Previous EIS	Name withheld	P115	The original proposal back in 2010 was rejected by the previous NSW Government in March 2011 on grounds of unsustainability (ESD principles) and the Government's application of the Precautionary Principle.
1417.	Previous EIS	Name withheld	P115	Nothing in the new application changes that concept as essentially it is a reworking of the previous application. The same problems still exist and the devastating effect that this could have on our local environment and way of life should not be underestimated.
1418.	Support Social	Garry Manwarring	P116	As a director of Mynetrades, I am in full support of the above project, and for the following reasons believe Wallarah will support local community: • Local employment for the Wyong and surrounding shires. With the down turn in the resources sector, this project will provide much needed employment opportunity
1419.	Support Economic	Garry Manwarring	P116	• Local business support: small business has a lot to gain from this project in many ways
1420.	Support	Garry	P116	• Income injected into the local community

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	Economic	Manwarring		
1421.	Support Social	Garry Manwarring	P116	• training and development for new candidates into the mining sector
1422.	Surface water Subsidence Land value	Paul Borg	P117	We are formally writing to address our objections to the above proposal for coal mining in our area. Our property lies in Wyong LGA catchment area and the proposal will reduce the water provided to service our community. Furthermore, there are no guarantees that our land will not be subjected to subsidence and at serious possible risk of decreasing land value and use.
1423.	General	Paul Borg	P117	We object to the proposal and do so with full confidence that this project would cause long term damage to the Central Coast's water, infrastructure, amenities and health.
1424.	Surface water	Sharon Salmi	P118	I am writing to object to the Wallarah 2 Coal mine for the following reasons: 1. Threat to the water supply. Longwall coal mining has a history of ruining aquifers and the central coast relies on the Yarramalong and Dooralong Valleys for their water supply. In recent years our central coast water supply was reduced to almost 10% capacity. We have recovered for now but in this land of droughts we cannot afford to take our water supply for granted. We can live without coal royalties but we can't live without water.
1425.	Surface water Flooding Greenhouse Gas	Sharon Salmi	P118	2. Wallarah Creek are in danger of being polluted as they run through the mine site and then into Budgewoi Lake, Taking away the riparian vegetation from the catchment areas of these creeks will cause erosion and siltation of the creeks and Lake. The proposed coal stockpile will be located in the creek catchment. The stockpile would have to be constantly washed and turned over to prevent combustion and reduce dust. What happens to this filthy water? What happens when it rains? If the dirty water is kept in holding dams any flooding will cause it to overflow into creeks and downstream to the lake. In 2007 the central coast suffered major flooding, including Spring and Wallarah creeks. Climate change will ensure this kind of major flooding will occur more often.
1426.	Greenhouse Gas	Sharon Salmi	P118	3. On the subject of climate change, the coal from this proposed mine will produce hundreds of millions of tonnes of green house gases when burnt and contribute to global warming.
1427.	Ecology	Sharon Salmi	P118	4. Threatened species. The following species which occur at Bushells Ridge are listed as vulnerable (high risk of extinction in the wild in the medium term future) under the Environment Protection and Biodiversity Conservation Act: Tetratheca juncea, Angophora inopina, Cryptostylis hunteriana, Wallum Froglet, Large Footed Myotis, Little Bent Wing Bat, Black Bittern, Squirrel Glider, Glossy Black Cockatoo, Eastern Bent Wing Bat, Eastern Freetail Bat, Greater Broad Nosed Bat, Masked Owl. The following species which occur at Bushells Ridge are listed as endangered (very high risk of extinction in the wild in the near future) under the EPBC Act: Genoplesium insignis, Acacia bynoeana, Eucalyptus parramattensis subspecies parramattensis. The Endangered Ecological Communities River Flat Eucalypt Forest and Swamp Sclerophyll Forest occur at Bushells Ridge as well as a 7G (locally critical) wetland.
1428.	Health	Sharon Salmi	P118	5. The central coast already has a high incidence of respiratory illness without daily doses of coal dust. Blue Haven School and two child care centres are located within 3 klms of the proposed mine site and there would be many more in surrounding suburbs.
1429.	Noise	Sharon Salmi	P118	6. Noise. Blue Haven residents can hear noisy goods trains at night quite clearly. I have been told that the kilometres long coal trains will have to work in with passenger trains. I take this to mean that they will be running at night and machinery to load the trains will need to be running too. If they are anything like the coal loading machinery at Newcastle they are too filthy and noisy to be allowed to run near housing.
1430.	General	Sharon Salmi	P118	7. The proposed mine site is located too close to the Wyong Employment Zone. Clean industries, including food and beverage producers, will not want to be located close to such a dirty industry.
1431.	General	Sharon Salmi	P118	8. Aboriginal land. The proposed mine rail loop will have to be built over Darkinjung land. Personal communcation with a member of the land council has informed me that they will be allowing this to happen. Unfortunately there are greedy people who make these decisions but don't necessarily represent the wishes of the whole community.
1432.	General	Sharon Salmi	P118	I hope the good of the environment and the health of the people of the central coast will be put before dollars. I was at the meeting when Barry O'Farrell assured us that his government would not allow this mine to go ahead, yet here I am again having to explain the obvious to politicians. If you allow this to go ahead you are contributing to the loss of threatened species, the worsening of climate change, water and air pollution, and you should be ashamed of yourselves. If you have children or grandchildren then think about what kind of world you would like for them and whether you can hold your head up high and say you did your best to protect it.
1433.	General	Sharon	P118	I find it amusing that there is a provision that I must disclose any political donations or gifts. I would sincerely love to find out about Kores political

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		Salmi		donations or gifts. Is there somewhere I can find this information?
1434.	Subsidence	Thais Gratelle	P119	Wallarah 2 was rejected due to "unresolved concerns" regarding water impacts, important subsidence, ecological and heritage impacts. According to the Department of Planning the "project was not considered consistent with the principles of ecologically sustainable development." Meanwhile, the assessment commission said the mine posed no significant issues for the Central Coast water supply PROVIDED there were no major unidentified geological faults. However, the Peer Review by Professor Bruce Hepplewhite (page 258, Appendix H) QUESTIONS many of the terms used and assumptions made during the geological modelling upon which subsidence and water loss are based. So the EIS offers no guarantee that our landscape (geology, water resources, etc) will not face a bleak outlook once panels go in. The plans for Wallarah 2 are the same as those that were rejected once already. The risks are the same.The unsustainability of this project is the same. I therefore strongly object to this project.
1435.	Subsidence	Bradley Moffett	P120	Too much subsidence for populated areas
1436.	Surface water Air quality	Lisa Moffett	P121	Too many risks - drinking water loss, deaths from coal dust, over populated area with a growing percentage of young families....Too many risks
1437.	Support General	Name withheld	P122	I am and have been the owner of a residential property on Ruttleys Road Wyee Point (a location within the potential impact area associated with the proposal) for approximately 15 years and prior to that time was a very regular visitor to Wyong Shire. Over this period I have made a number of observations regarding the status of the area and changes that have occurred, particularly in terms of residential development and the ever increasing trend for the area to be a residential base for people who then travel elsewhere for employment due to the failure for employment opportunities to keep pace with residential growth.
1438.	Support Social	Name withheld	P122	For as long as I have been a visitor/ property owner in the Wyong LGA and from the literature, it has been and continues to be apparent that the area is relatively economically and socially disadvantaged when compared to the majority of LGAs within the State and exhibit unemployment at level significantly higher than the State average, issues specifically identified within the Department's Central Coast Regional Strategy (2011). The recent placement of the Mannering Colliery on care and maintenance and the decision by LMCC and the State Government to ban open cut mining in the Lake Macquarie LGA has only exacerbated this situation.
1439.	Support Social	Name withheld	P122	In that same strategy document, a growth target for the LGA of some 50% has been identified for the Wyong LGA for the next 20 years. However, without the development of significant new employment opportunities, including industries such as mining which not only employ large numbers of people during both construction and operational phases but also have significant flow-on benefits by way of enhanced existing and new local businesses, it is difficult to see the requisite employment opportunities developing and any meaningful change in the existing social and economic situation occurring.
1440.	Support	Name withheld	P122	I have read the Wallarah 2 Coal Project EIS in its entirety, looking at its content both from the perspective of a new development as well as the treatment of matters identified as the basis for its prior rejection, noting in particular that WACJV has designed the project to minimize impacts on all aspects of the environment through things such as longwall dimension variation, positioning to avoid significant features and orientation, and infrastructure placement.
1441.	Support Monitoring Social Economic	Name withheld	P122	As with ALL new developments, be they residential, commercial or industrial, there will inevitably be some impacts. However, even as a potentially affected person, I am of the opinion that the assessment is scientifically sound; the identified residual impacts can be readily managed through the adoption of the nominated mitigation and management measures, as well as through an adaptive management regime based on monitoring which reflects the nature of underground mining; are personally acceptable as well as within acceptable levels, and would satisfy reasonable community expectations. As a consequence, and in light of the obvious benefits in terms of the local social and economic environment; the future of the Shire as a dynamic area with a diverse economy and a place where people can both live and work, and the benefits to the State as a whole, it is my opinion that the impacts are justifiable and that the proposal should be supported at all levels and approved.
1442.	Groundwater Traffic & transport	David Grover	P123	The multi-facetted impact of mining for coal on this scale (5 million tonnes per year) is overwhelming. The long term consequences upon the water table, roads and infrastructure's impact on the landscape, pollution (in even the most carefully controlled situations) are all sufficient to disqualify this proposal. It has already been rejected once by the State Government due to unacceptable impacts on water, ecosystems and heritage sites. These objections should be supplemented by the consequences of coal burning globally and its polluting impact. There is a point in time when we must place longer term outcomes above the more immediate ones. We know now that the importance of securing arable land and quality water supplies for

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				the future and pursuing alternatives to fossil fuel burning are of the highest importance.
1443.	Subsidence Surface water General	Name withheld	P124	I object very strongly to the Wallarah 2 coal mine proposal . My family home, where my family still lives, is directly above the proposed coal mine and I am very concerned for the subsidence to the home, sheds, fences, paddocks and driveways, as well as the increased risk of flooding. Kores/Wallarah 2 cannot guarantee that there will be no damage to home, property and the water catchment area, so unless they are able to do exactly that, then this mine should not go ahead. Furthermore, there should be NO MINES in any water catchment area or near urban areas, and there should be legislation put in place to protect those areas forever. Mr O'Farrell should keep his promise of "no mines, guaranteed".
1444.	General	Greg Piper MP	P125	I wish to make a submission on the Wallarah 2 longwall coal mine proposed for an area north-west of Wyong. The area to be undermined and the surface facility at Buttonderry fall within the lectorate of Lake Macquarie. The proposal is therefore of significant interest and concern to my constituents. Having represented the State electorate of Lake Macquarie since 2007, I am aware of the background of this project and the previous rejection of an almost identical proposal by the then State Government in 2011. I have received briefings on this proposal from proponents for the mine, including management of the joint venture company and from constituents opposed, and have carefully considered all arguments.
1445.	Social	Greg Piper MP	P125	With an estimated 1,000 jobs expected to be created over the lifespan of the mine, I recognise that the proposal offers a significant employment opportunity for the Central Coast, along with the associated economic benefits that job creation brings.
1446.	Greenhouse Gas	Greg Piper MP	P125	I also realise that as a society we still rely heavily on coal as an energy source, and despite my view that we should be moving to develop alternative clean technologies, I accept the reality that we will remain highly dependent on fossil fuel for some time to come.
1447.	Surface water	Greg Piper MP	P125	However, I cannot support this proposed mine because of the threat it poses to the significant water catchment in the area to be mined, as well as other adverse impacts it will or may have, on the local community and environment
1448.	Surface water Groundwater	Greg Piper MP	P125	My primary concern with this proposal has been the risk that groundwater and surface water in this important catchment area could be adversely affected by mining activities. Regardless of ssurances from the company that this risk has been addressed and is minimal, I am not convinced that they can guarantee the integrity of these watercourses will not be compromised
1449.	Surface water Groundwater	Greg Piper MP	P125	In a quote to Australian Mining magazine on April 17 last year, Wallarah 2 General Manager Kerry Heywood sought to dispel concerns about the mine's impact on water by saying the following: "Even if there is an impact, it is only likely to be between five and 14 per cent. A minimal amount." I find this admission most disturbing. When we are talking about the quality of a water catchment that provides more than 50 per cent of the drinking water for the Central Coast, I do not regard an 'impact' of between five and 14 per cent to be inconsequential. I am also troubled by the use of the word 'likely', which does not suggest the company has confidence in its own modelling
1450.	Subsidence Surface water General	Greg Piper MP	P125	In a statement to a public inquiry in 2007 into the first Wallarah 2 proposal, I made clear my concerns in this regard, telling the inquiry there was no certainty the mine would not deliver the disastrous impacts on water systems in the surrounding area that have resulted from other longwall operations. I pointed to the example within my electorate of Diega Creek, near Wakefield, which suffered a complete loss of flow after it was undermined, damage that was attributed to subsidence.
1451.	Surface water Groundwater	Greg Piper MP	P125	Just one crack in the Dooralong and Yarramalong valley floors could result in a reduction of the catchment-sourced water supply for the Central Coast.
1452.	Subsidence	Greg Piper MP	P125	The mining company has admitted there will be subsidence from the mine. The Environmental Impact Statement identifies 245 homes at risk, and the potential damage to those properties is another matter of concern.
1453.	Air quality Health	Greg Piper MP	P125	Another issue that has been raised by residents who live near the sites of the proposed surface facilities is the potential dust fallout from coal stockpiles. The health risks associated with air pollution from mining and coal transportation is a significant and growing matter of concern in the Hunter Valley and neighbouring mining districts and I do not believe new mining operations should be considered in proximity to residential areas while these issues remain unresolved.
1454.	Ecology	Greg Piper	P125	Constituents have also raised with me concerns that noise impacts from the mining operations have not been adequately addressed and that the habitat

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		MP		of threatened species will be destroyed or significantly disrupted.
1455.	Economic	Greg Piper MP	P125	As has been my argument in the past, I am not convinced that the economic benefits of the mine are justified by the potential environmental and social problems it poses. In considering the use of caution with mining in such a context, I do note that the coal to be won would be destined for the export market and while there would be local economic benefit, the significant benefit would be to a foreign company.
1456.	General	Greg Piper MP	P125	That in itself is not a bad thing, however I do believe that it is a factor in determining what level of risk a community should be asked to accept when weighing risks against the benefits. It remains my strong view that in determining this application the consent authority should err on the side of caution and reject this proposal.
1457.	Subidence	Maree Beveridge	P126	I write with strong objections to the proposed Wallarah 2 coal mine, planned for underneath my family home, one of the 245 homes directly affected according to the Wallarah 2 EIS.
1458.	General	Maree Beveridge	P126	I could write a lot about what is in the EIS submitted by Wallarah 2 however it is clear to me the local residents do not want the mine here, the local council and others in town do not want the mine here, that health and medical and environmentally experienced people have raised valid objections - and have done so for some years with the various mine and gas proposals - and it all seems to be falling on deaf ears.
1459.	General	Maree Beveridge	P126	I am very concerned that the panel assessing the submissions will be full of mining folk or those which may be inclined to favour a coal mine in this region and not be truly independent. It bothers me that two mining applications have been "okayed" in the past prior to a Labor Minister putting a stop to the first Wallarah mine at the last minute prior to the last State election - regardless of the reports, reviews, multiple submissions and objections.
1460.	Subsidence	Maree Beveridge	P126	I do not understand why this mine would be really that much different to other mines before it. At public meetings I have attended in recent years, there have been residents of other regions affected by mining, speaking about their homes and livelihoods which have been damaged by mining and who are still waiting on compensation, years later, some more than two decades. It appears that the residents concerned have had to prove it was the mine which damaged their homes, instead of the mining company ensuring things were fixed promptly. If this mine were to go ahead, what guarantees would Kores/Wallarah 2 provide to ensure that did not happen in this instance? Would local residents have to wait the full length of the mining lease (40 or so years) before the compensation process could begin, and then would it be up to those residents to prove it was the mine which caused the damage?
1461.	Surface water	Maree Beveridge	P126	I would prefer Jilliby Jilliby and Little Jilliby Jilliby creeks to remain as creeks and not dried up creek beds with a couple of ponds here and there as has been advised by the mining company. Native animals drink from and take safe harbour in the areas close to the creeks and would be affected by water loss and/or contamination.
1462.	Subsidence Stakeholder engagement	Maree Beveridge	P126	I have been told to my face in the Kores/Wallarah office in Tuggerah, by a company geologist in the presence of at least six other Kores employers and employees, that there will be subsidence and that I should be grateful it won't be "spiked" or "peaked" subsidence but a type of undulating subsidence. That wasn't a very satisfactory response to my questions, nor a satisfactory and appropriate attitude to take with a concerned local resident.
1463.	Subsidence	Maree Beveridge	P126	I would like to, in turn, look each and every mining employee at every level of the business in the eye and ask them how they and their families would feel and respond should a similar mine be proposed for underneath or beside their own homes. I suspect if they were to speak truthfully, they would give a very different response to the glossy, positive words they are trying to convince us with.
1464.	Subsidence Flooding	Maree Beveridge	P126	What would our valleys be like in a flood situation after the mine had been through?
1465.	Geology	Maree Beveridge	P126	How would our valleys be impacted if an earthquake should occur like it did in nearby Newcastle some years ago? With damage to the earth underneath our feet due to mine subsidence, the resulting additional damage could be catastrophic to homes, human beings and the natural environment. What allowance has Wallarah 2 made for this possibility?
1466.	Subsidence	Maree Beveridge	P126	It is clear there will be subsidence, damage and health and environmental issues however the coal company cannot guarantee our water and the natural environment will be safe and I propose for that reason alone, the mine should not go ahead.
1467.	General	Maree Beveridge	P126	However, it seems we should even be sceptical of guarantees after NSW Premier Mr Barry O'Farrell promised no mining in water catchment areas with his "no ifs, no buts, a guarantee" at a meeting in a local park myself and many others attended, just prior to being elected.
1468.	General	Maree Beveridge	P126	I would like to see this mine proposal rejected and legislation put in place immediately to stop any mining company, now and forever, being able to mine in our precious and fragile water catchment regions (any and all of them) and urban areas.
1469.	General	Maree Beveridge	P126	I object very strongly to this proposed coal mine.

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1470.	General	Maree Beveridge	P126	The community here, and the people of the Central Coast, have been working for many years to have it stopped for a multitude of reasons and we believed it had been, by the State Labor Government just prior to the election which they subsequently lost. Prior to that election, Mr Barry O'Farrell promised to not allow the mine to go ahead (and signed a paper stating so) if his party won, but it seems he has changed his mind. This is an outrageous move to make after such a public promise.
1471.	General	Maree Beveridge	P126	The environmental impacts of this mine are too great to consider going ahead with such a plan. My family and I live directly over the proposed mine area and it will also run under the nearby creek, which feeds into Wyong River and helps to provide water for many, many people on the Central Coast.
1472.	Subsidence Surface water Flooding	Maree Beveridge	P126	To risk the creeks drying up, the roads, our homes, driveways and paddocks to sink and dip with the subsidence that Wallarah 2 company representatives told me directly would occur (up to 2 metres at least, or more), is too great.
1473.	Social	Maree Beveridge	P126	The community doesn't want the mine, Wyong Council does not want to see it here, and local businesses are against it.
1474.	Greenhouse Gas Economic	Maree Beveridge	P126	It's time to look to renewable energies and other means of providing energy needs, and phase out coal. The coal mined in this proposed plan would not be for our country either, it would be destined for Korea. The number of people they expect to employ is not that great and the annual revenue to the State Government would eventually run out, leaving a scarred landscape and scarred community.
1475.	Economic Ecology	Maree Beveridge	P126	Other communities in Australia have suffered similar "developments" and are damaged and still awaiting compensation many years later. Compensation to home and land owners and farmers is one thing but spare a thought for the birds and animals which drink from the local waters and find food and safety in the forests around, as their homes will be damaged as well.
1476.	Noise Air Quality	Maree Beveridge	P126	I haven't even begun to address the issues pertaining to residents further north of here who would have to contend with noise and coal dust.
1477.	General	Maree Beveridge	P126	The Wallarah 2 coal company cannot guarantee that there will be no damage to the people, land and environment and until or unless they can, then all plans for a mine in this fragile water catchment area should immediately be scrapped.
1478.	General	Maree Beveridge	P126	In fact, I believe there should be NO mining in or near a water catchment area, and NO mining in or near a residential or semi rural area AT ALL, anywhere in Australia, and call on the State Government to disapprove this mine application.
1479.	Surface water	Michael Conroy	P127	I object to the proposal for coal mining under the catchment of the Wyong River and its tributaries. My principal objection is because this catchment provides water which is then pumped into the Gosford-Wyong Water Supply System.
1480.	Groundwater	Michael Conroy	P127	The earlier study by Professor Pell has shown that the underground mine will interfere with the aquifers and result in diversion of the groundwater that feeds into the Wyong River and its tributaries. It is understood that Professor Pell has estimated that the coal mine will divert about 8 Ml of water per day from the water catchment.
1481.	Surface water	Michael Conroy	P127	The Gosford-Wyong Water Authority reports on its web site that it pumped 10,200 Ml through the Mardi-Mangrove Pipeline between the start of 2013 and 16 June, approx. 170 days. This is equivalent to about 60 Ml per day being pumped from the Wyong River catchment.
1482.	Surface water	Michael Conroy	P127	The proposed Kores mine, therefore, could cause the loss of 8 Ml or 13% of the water currently being collected for the Gosford-Wyong Water System. The Federal Government and the two Councils have invested $120 million of taxpayers' funds in this Mardi-Mangrove Pipeline to ensure security of water supply for the Central Coast.
1483.	Surface water Economic	Michael Conroy	P127	It would be a grossly irresponsible decision to approve a private development that causes the loss of 13% of the water currently collected in the Wyong River drinking water catchment and, consequently, reduces the viability of public infrastructure that cost $120 million. Gosford and Wyong Councils have borrowed $40 million to fund their share of the pipeline, so the ratepayers of the Central Coast will be paying additional water charges for many years to

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				pay for the pipeline.
1484.	General	Michael Conroy	P127	Furthermore, prior to construction of the Mardi-Mangrove Pipeline, the NSW Government placed a cap on new residential development on the Central Coast because of the lack of a secure water supply. If the viability of the pipeline is undermined by the Kores proposal, the NSW Government decision to proceed with the development proposed in the North Wyong Structure Plan will be severely at risk. The Government, therefore, needs to take into consideration the potential loss of housing opportunities for up to 50,000 people as a result of the proposed coal mine.
1485.	Surface water	Peter Cooke	P128	I wish to object to the Wallarah 2 Coal Mine Proposal because I believe that the damage that can potentially result from this type of mining cannot be properly evaluated without human error and any mistakes made in the EIS will lead to devastating damage to this pristine region and will be both permanent and irreversible.
1486.	General	Wilderness Society	SIG 7	The Wilderness Society objects to the Wallarah 2 proposal as it is the same project that was rejected in 2011 because of its unacceptable risks to water resources and risks to wildlife. The state government in early 2011 rejected Wallarah coal mine because of: * uncertainty around subsidence; * unacceptable impacts on surface water quality; * uncertainty around ecological impacts; and * uncertainty around heritage impacts.
1487.	General	Wilderness Society	SIG 7	Then Planning Minister Tony Kelly in March 2011 concluded that the project was "not consistent with the principles of ecological sustainable development, including the precautionary principle, and as a consequence is not in the public interest".
1488.	General	Wilderness Society	SIG 7	Nothing in the new application changes that concept as essentially it is a reworking of the previous application. We firmly believe that water catchments must be afforded the highest level of protection from pollution. Wyong Water Catchment was protected under a proclaimed NSW Statute in 1950 (Gazette no 153 of the LGA 1919, 1950). The now extinguished Part 3a of the EPA Act overrode this Statute, so effectively the original protective measure should now be in place.
1489.	Flooding Surface water	Wilderness Society	SIG 7	The valleys above this mine regularly flood as agreed in the proponent's submission posing a huge risk to water quality and ultimately public and environmental health. Some 300,000 people in the Wyong and Gosford LGA's rely upon the 53% of their potable water emanating from these critical valleys.
1490.	Groundwater	Wilderness Society	SIG 7	Kores claim that there will be no effect upon the water supply due to impervious layers between the surface and the mine seam. However, this is not possible there is no such thing as an `aquiclude' rather `aquitards that whilst slow down the flow of water between layers do not stop it. There is a serious lack of data about the hydrogeology of the region.
1491.	Groundwater	Wilderness Society	SIG 7	In addition, Phillip Pells, Senior Lecturer at the University of NSW dismisses these claims. Kores do admit to a so-called tiny loss of water rated at 2ml per day per square metre. This extrapolates over the whole mine area some 8 megalitres per day or 3000 megalitres each year once mining is complete. The professional uncertainties characterised within the Kores submission paint a very tentative picture for protection of the coast's natural potable water supply.
1492.	Ecology	Wilderness Society	SIG 7	The Wilderness Society is particularly concerned about the impacts from the mine and risks to water and air quality, noise and blasting on the 19 species of avian migratory waders in the area are protected under the Federal EPBC Act with binding agreements with China,(CAMBA) Japan(JAMBA) and Korea itself(ROKAMBA). The proposal directly affects these agreements.
1493.	Surface water	Wilderness Society	SIG 7	In addition to risks to the water catchment the project is likely to: * cause a reduction of baseflow into local streams
1494.	Subsidence	Wilderness Society	SIG 7	* cause subsidence resulting in potential damage to houses
1495.	Air quality	Wilderness Society	SIG 7	* high levels of air-pollution in local towns of Blue-Haven and Wyee and also Newcastle
1496.	Greenhouse Gas	Wilderness Society	SIG 7	* contribute unacceptable levels of GHG emissions both the fugitive methane emissions from the open-cut as well as the burning of the coal at a coal fire powered station
1497.	General	Vanessa Vallack	P129	When do we stop?. Do we stop?. What do we really want?. More jobs, more money, a stronger economy?. Or do we hold on to what we have before we totally destroy it? I know it is an old quote but sometimes the simple things in life are often the best. We have enough holes underneath us already; not to

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				mention the one that we will all end up in......so let us enjoy what we have; some of us need it. Humans are always discussing the effects of the wild pig upon our land, the kangaroos, the wild horses, the rabbits etc. My argument is and always will be the animal that is destroying our land the most is ourselves. With the negatives there are always positives, i.e. employment, improved economy etc......but if we don't start putting our foot down we will have nothing left to put our feet upon.
1498.	General	Name withheld	P130	I am most disturbed that this mine has been refused in the past and Mr O'Farrell is going back on his promise, made prior to being elected, to not have any mines in a water catchment region. At the time he was talking to a large group of local valley residents and it was a public meeting directly related to the Wallarah 2 coal mine proposal. Mr O'Farrell said "no ifs, no buts, a guarantee", so he should honour his promise.
1499.	General	Name withheld	P130	At the same time, legislation should be introduced to permanently protect each and every water catchment region and to ensure mining of any type is not approved close to urban regions.
1500.	General	Name withheld	P131	I am a resident of Sydney, but I have family members who have moved to the Central Coast. We all remember the last drought when water supplies were running low and there were contingency plans for 'mini'desalination plants on every beach.
1501.	Surface Water Groundwater	Name withheld	P131	A multi-million dollar pipeline was built from Mardi to top-up the Mangrove Dam. Now we hear that this long-wall coal operation threatens to undermine the water catchment areas of the Dooralong and Yarramalong valleys from which this top-up water was to come. It has been reported that 79 million litres of groundwater a day would leach into the mine –more than the area's annual rainfall.
1502.	General	Name withheld	P131	For this threat to the catchment, and hence to the water supply for the residents of the Central Coast, this proposal should be rejected. As it was by the previous government.
1503.	General	Name withheld	P131	This proposal is not significantly different from that which was submitted previously and still does not address the issues that caused it to be rejected at that time.
1504.	Noise Air Quality	Name withheld	P131	There are a number of immediate effects that are reasons for rejection, both locally and further afield. Locally, the suburbs of Blue Haven and Wyee would be affected by noise and dust from the stockpiling and loading of the coal trains. Further afield, the coal trains would leave a trail of coal dust pollution through the southern suburbs of Newcastle. Just when the residents of Newcastle thought they could breath easier after the cancellation of the fourth coal terminal.
1505.	Ecology Greenhouse Gas	Name withheld	P131	Then there are the indirect and longer term effects, including loss of biodiversity and contribution to climate change
1506.	Greenhouse Gas	Name withheld	P132	I object to Wallarah2 coal mine for many reasons.Primarily because coal mining must cease. The concentration of greenhouse gases in the atmosphere and the resultant global warming is already at a dangerous level. Burning fossil fuels has to be arrested. This proposal already failed to gain clear approval on environmental grounds it makes absolutely no sense to now approve it.
1507.	Surface water Subsidence	Name withheld	P132	Increased risk to the Central Coast water supply should not be taken. Subsidence impact on the forest and endangered ecosystems should not be risked.
1508.	Ecology	Name withheld	P132	The owl records within the project area reflect the high conservation value of this habitat. Biodiversity of the Central Coast needs increased protection not greater threats and further loss of habitat.
1509.	Support	Name withheld	P133	I wish to state my support for the proposed Wallarah 2 Coal Project, with particular interest to see it be approved so that there will be the potential for significant new jobs in the Wyong area and Central Coast generally. As a regular visitor to the Central Coast I appreciate that it is important that adequate environmental protection is undertaken to maintain the qualities of the area. I have looked at the very large environmental impact report by Kores and consider to be very thorough indeed. It is very clear that they have taken a lot of care in the mine plan and project generally. I am aware that the mine has already been carefully assessed and recommended to be approved, as often noted by the Mayor Eaton. The people who prepared the document are clearly among the best in the field in Australia. I have some familiarity with mining and coal mining areas, and am very confident that a modern, well planned, deep underground coal mine that is proposed will have minimal impacts. I have seen and heard the grossly exaggerated claims by some in the local area and I consider that such alarmism is unwarranted. there are many people like me in the community that are tired of rantings of uninformed people who really have their own agenda and who are just opposed to coal mining without understanding that nearly all our electricity comes from coal. I only chose to make a submission after hearing a ranting Alan Jones on the radio today about this project and it is clear that he is very biased and

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				doesn't know anything about the real way that coal mining now looks after the environment and what has been done on this project to protect houses and the water catchment.
1510.	General Air quality Surface water	Rae Davenport	P134	I have just read a model submission against the mining of coal under my house at Jilliby. It is a scholarly document which expresses for me the dismay I feel. I am not able to produce the facts and figures therein. Ordinary people can only rely on the politicians who govern us. All I know is that Barry O'Farrell promised us at a public meeting before he was given a mandate that he would stop coal mining in our valley. All I know is that coal mining in a rapidly expanding highly populated area is an obscenity. He is condemning the people of the central coast to live with water and air pollution, to say nothing of huge coal trucks and mining paraphernalia clogging our already insufficient roads. Good government planning would surely keep heavy industry out of water catchment areas. What are you thinking of? This is a dormitory area for Sydney. Don't let our workers live with coal dust. You can dig for coal elsewhere. We have more than enough coal in a world that is changing. Do not spoil what we have left.
1511.	Groundwater	Name withheld	P135	I wish to object to the Wallarah 2 Coal Project. The first is the risk of losing water from bores and from the catchment areas. There is the risk that the water will seep into the ground and also that the water may be contaminated by the mining process.
1512.	Economics	Name withheld	P135	Also, economically I do not think that it is a worthwhile exercise. I have been told by KORES that the project will yield 1.56 billion over 40 years for the royalities and lease directly attributable to the mine. I know that does not include other monies including taxes paid by workers and the company. However, 1.56billion works out at only 40 million dollars a year so it does not seem that the environmental and health risks posed to the population make this venture at all viable. This money if need could be easily made by subdividing the land or by other means.
1513.	Air quality	Name withheld	P135	The other issues include coal dust. This is not just a old issue. There will be coal dust concerns for both the workers which will be addressed by OH&S I'm sure, but also by the people living nearby where the coal is transported and stock piled.
1514.	Rail Noise	Name withheld	P135	Also additional noise by the transportation of coal which will happen on a large scale.
1515.	Visual	Name withheld	P135	When I first arrived in the Central Coast I always felt that the Jilliby area was one of the prettiest part of the Coast. There is no economic value that can be put on asthetics and beauty but they put value into people's lives, make it more uplifting and beautiful. People love to live near beauty and this proposed coal mine will devalue the entire area by an uncalculated amount merely by the presence of the coal industry being there but then by subsidence issues which will affect stability of houses and dams that may be affected as well.
1516.	Visual	Name withheld	P135	Coal mining does not belong on the Central Coast, we are a growing area why should we have coal in the a beautiful part of our community which provides many people with pleasure but also could potentially be in the future a place where many more people could live without the worry of subsidence issues which will be a worry and concern for generations to come.
1517.	General	Brian & Carole Donaldson	P136	We are writing as concerned residents for the future of the Wyong water catchment which supplies water to over 300,000 residents on the Central Coast and the permanent damage which will be done to the environment if this mine goes ahead.
1518.	Subsidence Ecology Flooding	Brian & Carole Donaldson	P136	We are looking at subsidence of no known figure and the damage it will cause to the flood plains which is a critical point in the long wall mining process. The migratory birds that feed here would loose their feeding grounds and they come in their thousand at different times. These birds are protected by the Federal EPBC Acts. The impact of subsidence on the flood plains along Jilliby Road would also cause heavy flooding and cut off the road access to the valley which is already a problem in heavy rainy periods.
1519.	Groundwater	Brian & Carole Donaldson	P136	The original Kores application was rejected by the previous Government on the grounds of unsustainability. Nothing new changes that concept it is just a rework of the previous application. Kores paint a very tentative picture for protection of the coast's potable water supply and Professor Pells of NSW University dismisses their claims that there will be NO EFFECT upon the water supply due to impervious layers between the surface and the mine seam. How can anyone believe these lies just to extrapolate coal for 28 years and ruin these beautiful valleys and leave a desert of devestation and isery.
1520.	Subsidence	Brian & Carole Donaldson	P136	The properties along the Hue Hue Rd. Will be seriously impacted by subsidence at an approximate of 1.75 metres and the dust and noise from the stockpiling and rail movements on the established suburbs of Blue Haven, Wyee and all along the rail corridor will impact on peoples health.
1521.	Greenhouse Gas	Brian & Carole Donaldson	P136	Kores has failed to address adequately all the issues surrounding this application. The proposal should be rejected outright as the long term damage and effects to the coast's water, infrastructure, amenity and health is catastrophic. The burning of this resource over 30 years has not been evaluated upon the damage to the earth's climate and should be condemned. In conscience this mining proposal should be and is totally abhorent.

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1522.	Subsidence Economic	Brian & Carole Donaldson	P136	As land holders on the Jilliby flood plains we know only too well the impact that mining subsidence would create here it would be an environmental disaster. Personally we would be affected and our livelihood taken away and our property devalued considerably. The impact of mining is just too horrible to contemplate.
1523.	Groundwater Air quality Health	Brian & Carole Donaldson	P136	The mere fact that the aquifers would be destroyed in the process of long wall mining affecting the water supply to the Central Coast, subsidence on a huge scale, coal dust and health issues for young families in new sub divisions and what this will leave behind should be taken into very serious consideration.
1524.	Support Social Economic	Jean Gaggin & Louise Gaggin	P137	As a Central Coast resident, I support Wallarah 2 Coal Project as I believe the Central Coast needs to support initiatives that will provide jobs to future generations. Projects and developments continue to be denied because older generations oppose them. It has been assured that the project will not harm the environment, damage the water supply or allow coal to be transported via roads. It WILL provide jobs and revenue! So many people leave the Coast because there are not enough opportunities for employment, leaving the Coast desperate for development and renewal. Give future generations a chance and support investment into our region.
1525.	General	Robert Holland	P138	To make my point! This is the first time I have made any written summation to any project. As most people say I SHOULD WRITE TO THE RELEVANT BODY BUT NEVER DO! Also I do not have any affiliations with the local coal alliance people!
1526.	General Greenhouse Gas Economic	Robert Holland	P138	Firstly I'm opposed to a coal mine next to my house! With all the information about global warming, and the horrible carbon tax that has increased all household expenses, why on earth do we need another coal mine? Why to accommodate another greedy country, with endless bucket of $. Why not leave it in the ground. Tell them to live within their means. After all they don't give a flying razoo about our country or what the people what. They would tear out your heart if there was a $ in it for them.
1527.	Air quality Noise	Robert Holland	P138	I suppose that whoever looks at this will dismiss it as I do not have a fist full of degees after my name. This EIS expert panel to manage noise & dust emissions are stringently managed. I would bet $ that none of them live near this mine. Also that if I was a large country with a bottomless pit of $ and I wanted a report to say that there was life on mars, I could give them a cheque with 6 *0 they would write it in favour of their benefactor.
1528.	Air quality Surface water	Robert Holland	P138	As for the dust! How can they assure me that no dust will come my way? We live within approximately 1KM of loader and only 200M from mine head. We are reliant wholly and solely on rain water for our house. Any particulates per trillion that even remotely come near my house and catchment being my roof is offensive! The way I have seen them reduce particulate dust is by spraying; there is no way they can guarantee no dust. If this project goes ahead as the mine progresses through as it nears the end they will do less and less maintenance. All the bad reports and fines that are imposed will mean squat. Once this mine is in place there will be no stopping it.
1529.	General	Robert Holland	P138	The Chikarovski Inquiry should be stoned for suggesting that more coal mining is better for the environment! Another large cheque. A short story, on a visit to Richmond vale rail & mining museum, an elderly retired miner told me that the difference between their mining, is some 800 to 900M underground, and when told him where I lived he told me the coal seam is quite close to the surface. Is this why they want it here?
1530.	Traffic and Transport	Robert Holland	P138	This leads to mine subsidence. When we built our home some 20 years ago we couldn't build above single story due to existing mine subsidence. We already have some cracking both inside gyprock and outside brick work from subsidence. If you look at the F3 between Morisset & Tuggerah both north/south bound the RTA has over the years done quite extensive work including pinning and crack filling with some substance that breaks apart as crack gets wider. Not to mention replacing or repouring large section of concrete. As a bike rider when you get caught in crack it makes the bike unstable. So your newsletter dated number 21 may 2013 map legend yellow line (subsidence impact limit) may be incorrect. I would suggest your experts need to open their eyes or go back to school to re learn their trade.
1531.	Social	Robert Holland	P138	As for local employment yes there will be some probably basic labouring jobs but most would not come from Central Coast as most the companies that supply to mining industry aren't local and source most equipment from overseas. There was a company that serviced mining equipment but it closed years back. On the F3 quite frequently you see mining equipment going south used & coming back new or refurbished.
1532.	General	Robert Holland	P138	As for having politicians support our side. Some years back where we live was changed from an electorate that doesn't have any new coal mines to Lake Macquarie electorate that has lots and lots of coal mines, they would say what all the fuss. To the point that at last election at the school we have been voting at for 20 years we had to vote out of area or absentee. I make a joke to my wife that's why we had change so they could get at more coal, some joke it turns out. So money talks and what the local people want don't count for squat?
1533.	Economic	Robert	P138	Benefits of W2CP- I can't see any! Oh, that's right Wyong Shire Council see lots of $ benefits & to hell with the people they are supposed to serve. State

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	Politics	Holland		& Federal government see billions of tax $ benefits: If they balance the books why don't they end the stupid carbon tax & send the boat people back and bill the country they came from that would stop them and save from what heard recently 1 billion a year, tax payer dollars.
1534.	General	Robert Holland	P138	We built on our property which we own. We don't want to see our area disfigured like up towards Muswellbrook where I did some non mining related work. As you drive through the piteous country side you notice the scars from the dirty Grote conveyor belt, snaking across the landscape. Rusty dirty silos, terraforming the country, building unnatural hills or mount am n as they move spoil around.
1535.	General	Robert Holland	P138	The only direct impacts of the project will occur on suitably zoned land owned by W2CP. Suppose that why council recently re zoned most of the land in this area. Of interest to my propity was that my property is now zoned transitional! It all makes sense now as why do it in first place. To accommodate W2CP. Spouse that why my property is zone transitional now, if it does become infected council will zone it industrial and force me out of the home we built.
1536.	Economic	Robert Holland	P138	A friend told me that every train that leaves for the coal loader is $1 million dollars profit for the company. Tell big companies to shove it.
1537.	General	Robert Holland	P138	A few items to consider 1:- Which is better to look at from your house, cows grazing in the paddocks, trees, grass, native wild life OR Unsightly dirty grubby building site with towers, heavy machinery, noise, extra traffic, if you don't get what trying to say go for drive through your local industrial area. I KNOW WHAT I WOULD LIKE, THAT'S RIGHT I HAVE CURRENTLY
1538.	Economic	Robert Holland	P138	2:- North of sparks Rd the sizable farms where re-zoned to industrial. This company then paid the people to vacate houses and farms or the council probably put their rates up so much they would go broke. Forcing them out! The houses were demolished. So now instead of neat tidy houses/farms we have overgrown paddocks, a haven for people to dump rubbish as has happened. Resulting in council to clean it up that costing $ that could been better used elsewhere. Does the Project Manager Kerry Barry even care, no they pay him probably mega $ not to care and probably he doesn't live anywhere near W2CP.
1539.	Ecology	Robert Holland	P138	3:- Where I grew up north of Parramatta i spent lots of time roaming the hills and creeks of the area. As more & more houses were built, there was a decline in creek water quality, loss of wild life and degradation of surrounding areas. There were platypus believe it or not! There is a very nice creek running across the road from mine head site toward the freeway. Having ferns, small shrubs almost like rain forest. Looks like nice place on hot day with a good book. If they build the mine head across the road! I don't care what sort of environmental or water cleaning or monitoring say or provide will prevent damaging that fragile environment. After all man is the biggest plague on the planet. Tiger kills to eat, man consumes everything.
1540.	Ecology Economic	Robert Holland	P138	I don't need a degree or doctorate to say this project is a bad idea. You only have to look at other mines in this area to see the unhealthy landscape in that area. It should have been refuted before it even started, as bad. Except council & government try to tell us, it is good for us but these un-Australian types don't care are caught up in the mega greed and don't care about the people that it affects. So long as they get more $.
1541.	General	Robert Holland	P138	From reading this I sincerely hope that you look at my intent as you think I'm no word smith you what summation on this stupid mine. I also hope it get read by somebody that count & can stop this mine. As I started saying this is my first time writing summation. I spent some considerable time thinking getting angry at people who can't see this is bad greed. Not to mention most of a Saturday writing this instead of spending it with my family.
1542.	General	Robert Holland	P138	Spouse will get the obligatory letter saying thank you for your summation and will be considered and probably not looked at or considered as it actually affects my home and family. It time like this wish could get, like other countries that when election goes against them they take matters into own hands.
1543.	Surface water Ecology subsidence	Sandy Langsford	P139	I am writing in opposition to the Korres Wallarah 2 coal project. I have a lovely property at Jilliby which may be heavily impacted by the effect of mining beneath. We have a pristine lake that is home to a multitude of water bird life. If the mine goes ahead there is potential for us to loose this lake due to subsidence and in essence will loose all the beautiful bird habitat that relies on this environment. Birds fly in from everywhere.
1544.	Subsidence Economics	Sandy Langsford	P139	Not only the lake will be effected, I am very scared that our riding/agistment business will also be effected by land subsidence. We have put a lot of effort into making it a safe environment for kids and adult to come and enjoy the benefits of horse riding. Any sort of land subsidence will cause a safety issue and will make it hazardous to ride horses on our land, fences will be effected which will render them unsafe to contain our valuable horses.
1545.	Surface water Health	Machala Family	P140	There are many reasons to object to the Wallarah 2 Coal Project in Wyong Shire. A clean and reliable water supply is essential to living a healthy lifestyle. The Wyong Shire has had severe water restrictions in recent years until the completion of the over $70 million pipeline, Federally funded, to take water from Wyong creek to Mangrove Storage Dam at Mangrove Mountain. The planned mine would be under the pipeline and adjacent to our aquifer underground water supply. Our water supply is not safe. The mining process will

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				need a water supply, 24hours a day, 7days a week for 28 years. Do we have enough water? What will happen to the toxic mining waste water? Will it be taken to Korea with the coal?
1546.	Air quality	Machala Family	P140	The rapidly growing population of Wyong Shire, over 160,000 encouraged to live here by NSW government needs clean water and clean air to breathe. The 28 year constant coal stockpile and transport of coal by rail to Newcastle will affect everyone's health. Coal dust, 2.5 micron particles will travel great distances from the coal stockpile and from coal trains. Particles will cause skin irritation and accumulate in lungs and bloodstreams of the population. Suburbs are less than 5km from the coal stockpile, as is the new Warnervale Town approved for construction by NSW government in 2013.
1547.	Ecology	Machala Family	P140	We have lived in Wyong Shire for 20 years and our family home is 4.5 km from the coal stockpile site. We moved from Sydney for a cleaner lifestyle, people want to retain this. Will people be compensated for loss of health, lifestyle and land values, by the Korean Government or NSW Government?
1548.	General	Machala Family	P140	In conclusion it is our considered opinion that Long wall Coal Mining is too dangerous for people, for water catchment functioning, for wild life and for the health of generations to come in our fast growing community, which we would like to be sustainable. We ask the Department of Planning and Infrastructure NSW to heed the wishes of our community and stop the Longwall Coal Mining Application in Wyong Shire now.
1549.	General	Paul Phillips	P141	The Wallarah 2 coal mine should be rejected as surface and groundwater issues are fundamental issues that CAN NOT be left for later resolution or adaptive management.
1550.	General	Paul Phillips	P141	This project was already rejected on the grounds of the precautionary principle, surface and groundwater issues, subsidence and coal dust issues. Nothing has changed.
1551.	Flooding	Paul Phillips	P141	The EIS states on page 143 that when 2 low points on jilliby road defined as d50 & d70 become flooded due to mining operations 198 properties will be cut off for 28 hours. What about those needing urgent medical attention or elderly people trapped in their homes or simply just people like me that need to get to work and cant afford to have a day off while the water subsides.
1552.	Flooding	Paul Phillips	P141	The EIS states on page 143 that a section of Jilliby Road that is defined as d50 currently experiences zero hours of flooding. Table 44 clearly shows that after mining this same section of road will become flooded for 31 hours. Is this acceptable that an entire community will be cut off for this length of time?
1553.	Flooding	Paul Phillips	P141	The EIS states on page 144 "due to the magnitude of flooding in the dooralong valley, flood modification structures will be neither practical nor effective " This is scary that Kores admits mine related flooding will be so catastrophic in the Dooralong valley that they will be unable to control it. They plan to develop community readiness programs and have emergency evacuation procedures in place. This is an unacceptable risk to human and stock life in the valley.
1554.	Flooding	Paul Phillips	P141	The EIS states on page 145 that due to the magnitude of mining relating flooding the only options available are to raise the piers of homes to keep the floor above the flood waters, re build your house on a higher part of your property, build flood levees around your house or if you are lucky enough to be in one of the "high hazard areas" where property modification options are impractical they will offer some compensation.
1555.	Flooding	Paul Phillips	P141	The EIS states on page 145 that mining induced subsidence will drop road levels on Jilliby Road 2.3 metres. The solution by Kores is to raise 880metres of Jilliby Road to keep it above mining induced flood levels. While this is a ridiculous idea it says nothing of the fact that the surrounding land and paddocks are privately owned and what they are going to do to ensure these privately owned paddocks remain flood free for the enjoyment of their owners.
1556.	Stakeholder engagement	Paul Phillips	P141	All of these excerpts taken from the EIS contradict their feel good newsletters that state the only impacts are on land suitably zoned or land owned by Kores.
1557.	General	Paul Phillips	P141	I STRONGLY OPPOSE THE WALLARAH 2 COAL PROJECT The EIS is based on out of date information. My home appears as vacant land in the report although I have resided in the valley for several years. What other critical assumptions in the report are made on old information? The map labeled "figure 34" shows that due to the subsidence from mining operations in my immediate area of the valley my property will be the subject of flooding once mining is in operation.
1558.	Subsidence Groundwater Air quality	Paul Phillips	P141	The executive summary states ; - There will be subsidence up to 2.6 metres in the study area (see table 23) - There will be a lowering of the aquifers - There will be water seepage of 2,600,000 litres per day - There will be odours from the ventilation shaft and the buttonederry site

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				- There will be 33 dwellings from 245 residences adversely impacted by flooding during mining operations (including mine) - There is a risk of adverse impacts on air quality due to fugitive coal emissions from trains - There will be vibration levels felt at private receivers due to the project
1559.	General	Paul Phillips	P141	These are not irrational accusations from environmentalists or greenies but facts from Wallarah's own report on the impacts of mining in the water catchment of 350,000 people. Every assumption taken from the EIS is based on mathematical computer modeling and NOT real life examples. Real life examples of the negative impacts of long wall mining can be found by searching the words "long wall mining disasters"
1560.	Groundwater	Ray Rauscher	P142	I am a resident of Wyong Shire for over 34 years (recently reside in E Gosford) and consider the Wallarah 2 proposal unacceptible from an environmental impact view, including: above ground mining infrastructure too close to urban areas (i.e. Blue Haven and Warnervale); and, possible damage to water tables in Wyong Valleys.
1561.	Surface water	Roger Thomson	P143	I wish to object in the strongest possible terms to the above Project. Many words have been said and written about the pros and cons, but it all boils down to one thing:- There is no-one, no-one from Kores, not any person in the world who can state with absolute certainty, that the water catchment will not be permanently damaged by the mining. Water is life. The risk is too great.
1562.	Surface water	Chris & Lydia Downes	P144	Our Objection to the Wallarah 2 mining proposal throughout the Dooralong and Yarramalong valleys is based on the following. 1. First and foremost is the potential devastating impact on the water catchment area and its environs and the loss of this natural resource for over three hundred thousand residents of the central coast.
1563.	Subsidence	Chris & Lydia Downes	P144	2. The proposed mine will create extensive subsidence throughout the planned area to be mined with adverse effects on private residences.
1564.	Health	Chris & Lydia Downes	P144	3. Health issues, including asthma, bronchitis and other lung related diseases are a result of airborn coal dust.
1565.	Ecology	Chris & Lydia Downes	P144	5. Damage or loss of the bio diversity of the catchment area due to the changing nature of this area following mining, subsidence and loss of the water catchment area.
1566.	Greenhouse Gas	Chris & Lydia Downes	P144	6. On a larger scale what effect does coal mining, or come to that any mining, have on the issue of Global Warming?
1567.	Subsidence	Michelle Campbell	P145	My reasons are: Living at Jilliby my home will be above the coal seam. 1 have just got my home the way I want it, I don't want to see cracks from mine subsidence in my walls or in the ground my house sits on. I don't want to have to take anyone to court and have to prove that any damage to my home was from mine subsidence — (I don't need that stress).
1568.	Surface water	Michelle Campbell	P145	My Family moved to the Central Coast for the Clean Air and Healthier Lifestyle. The water we use to drink is gathered from the rain that falls on the unpolluted roof of my house.
1569.	Ecology	Michelle Campbell	P145	At the end of my property is Jilliby Creek where we have a lot of Fauna that enjoy a drink from the creek or live in the creek, or close to the Creek. Some of these creatures are Wombats, Echidna, Goanna, Wallaby and on occasion Deer.
1570.	Health	Michelle Campbell	P145	Please consider the Health and wellbeing of the people in our shire, yes we understand that there will be a few local jobs created, but this is no compensation for the stress of when the mine subsidence happens what happens to us. When the unhealthy get sicker from coal dust what happens to them.
1571.	General	Michelle Campbell	P145	There is a lot more to consider that just the few cents per ton the Government will receive for the lease, let's not forget this is Australian Land, Australian Coal, why are we giving this Overseas Company the rights to any of this. Would you like this threat under your home, would you like it to happen to your Kids, Grandchildren, Family etc
1572.	Surface water	Alan & Judith Hayes	P146	The Dooralong and Yarramalong Valleys is the largest drinking water resource for the entire Central Coast population, more than 300,000 people, and account for approximately 53% of the drinking water supply, which is drawn from the streams and aquifers. The various streams, creeks and rivers within the water catchment are primarily fed from the underground aquifers, providing approximately 68% of the water to these streams. We are concerned that

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				after fully reading the Wallarah 2 EIS that the proposed mine will have an unacceptable impact on the drinking water catchment.
1573.	Surface water	Alan & Judith Hayes	P146	A report on Jilliby Jilliby Creek, prepared in 2004 by River Care, in association with Hunter-Central Rivers Catchment Management Authority, National Heritage Trust and the Department of Infrastructure, Planning and Natural Resources, declared this water system as one of the most pristine in New South Wales. This report also raises concern of the potential damage that may be caused by longwall coal mining directly beneath the creek system and within the catchment area.
1574.	Subsidence Ecology Air quality Health	Alan & Judith Hayes	P146	We are concerned that coal extraction from beneath the water catchment valleys will have enormous environmental, health, economic and social impacts on the Central Coast. In particular the problem of ground subsidence impacting on the water supply and the habitat of many endangered species of fauna of national significance, flora and fauna that are listed as threatened and endangered and the impact, airborne coal dust particles emanating from the coal loading facility and rail transport will have on human health.
1575.	Air quality Health	Alan & Judith Hayes	P146	We are also concerned about the problems associated with coal dust (respiratory and skin disease) being transported on the wind. In particular mortality from fine airborne coal dust emissions as clearly in the Wallarah 2 Executive Summary (page xi) and Appendix M, pages 6 - 17 of the Health Assessment Risks.
1576.	Ecology	Alan & Judith Hayes	P146	There are a number of international waders, recorded under the Australian Government agreements with China, Japan and South Korea, whose fragile habitat is entirely dependent upon the health of the water catchment river systems, and thirty-three (33) State endangered or threatened species of flora and fauna within the catchment valleys. Concern is raised at the threat posed to the habitat of the various endangered and threatened species of flora and fauna.
1577.	General	Alan & Judith Hayes	P146	We are also concerned that Kores' Environmental Impact Statement (2013) of the Wallarah 2 Coal Project is only are submission of their previous submission, dealing with some of the matters in a different way but still providing the same conclusions as previously.
1578.	Stakeholder Engagement	Alan & Judith Hayes	P146	Wallarah 2 have not obtained a social licence (acceptance from the community) and have failed to adequately address community concerns or consult with them. In particular there has been a total failure by the proponent to engage in a one-on-one discussion programme with landowners within the mine footprint. Distributed newsletters have done no more than promote Wallarah 2 propaganda, lulling landowners into a false sense of security that there will be no impact upon there properties.
1579.	General	Alan & Judith Hayes	P146	The previous Minister for Planning Tony Kelly rejected the Wallarah 2 mine proposal because of too many uncertainties. He confirmed in a letter on the 21st March 2011, "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."
1580.	General	Andreas Dalman	P147	It concerns me greatly that another submission has been made for the Wallarah 2 coal project given it is essentially the same in content to a previous submission which was rejected by the previous government.
1581.	Surface water	Andreas Dalman	P147	The development of such a coal project poses serious impacts to ground and surface water in the catchment which would directly affect the residents of the Wyong and Gosford area. Site water management plans are inadequate since most are merely observational. Some monitoring plans are not due to be created until two years into the operational life of the mine.
1582.	Air quality	Andreas Dalman	P147	Air quality will be degraded by mining dust impacting the established suburbs of Blue Haven, Wyee and all along the rail corridor from Morrisset through Cardiff and southern suburbs to the port of Newcastle. Noise pollution will also increase to these areas. Exposure to particulate matter is detrimental to human and animal health and will increase the likelihood of health issues in populations affected.
1583.	General	Andreas Dalman	P147	The Wallarah 2 Coal Project application has already been refused once based on the proponent's failure to adequately address issues of water quality, ecological, subsistence and heritage impacts. No substantial changes have been made in this current proposal and therefore the project is still against the public best interest. Premier O'Farrell promised during his election campaign "The next Liberal-National government will ensure that mining cannot occur ... in any water catchment area ... no ifs, no buts, a guarantee." It is time his government make good on this promise by rejecting this proposed coal project once and for all.
1584.	Ecology	Andreas Dalman	P147	There are currently 37 recorded threatened and migratory fauna species and six vulnerable or endangered flora species within the project site. Many are protected under state and federal legislation as well as international agreements. Land clearing and change in habitat due to alterations to subsistence and water quality and flow affecting wetlands and floodplains pose clear threats to these vulnerable species and would be likely direct results of this project going ahead.

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1585.	Greenhouse Gas	Andreas Dalman	P147	Five million tonnes of export grade thermal coal per annum represents a substantial contribution to NSW total carbon emissions and is in direct conflict with state and federal programs to reduce our contribution to climate change. The government should conduct a cost benefit comparison investing the equivalent amount in renewable energy sources which in the longer term will likely be more economically AND environmentally sustainable.
1586.	Greenhouse Gas General	Duncan Bourne	P148	It is folly to consider starting a new coalmine when we know that it's effect on human induced climate change will be dramatic. On top of that is the large scale impact on the water catchment area affecting rural communites and the considerable ecological damage. This mine would result in the extraction of up to 5 million tonnes of polluting coal each year for 28 years, undermining several waterways north of Wyong. This project has already been refused once, by the previous government, due to unacceptable impacts on water, ecosystems and heritage sites. This project should be rejected once and for all. "The next Liberal-National government will ensure that mining cannot occur ... in any water catchment area ... no ifs, no buts, a guarantee." Then Opposition Leader Barry O'Farrell, 2009
1587.	General	Helen Borland	P149	Where can I find out what has changed since the previous application which was quite rightly rejected by the previous Government? Why are schemes like this never properly 'advertised' to the public? I am overseas and only return on 21 June and wish I'd taken the time to contact you before I left, not that I have any expectations that this will even be read.
1588.	Aboriginal Heritage	Form Letter 14	P150	The Wallarah 2 Coal Project site is located wholly within the Tuggerah Lakes Basin, the extraction area lies in the Jilliby Jilliby Creek catchment. The mine and rail link will impact on Crown land, land owned by the Darkinjung Aboriginal Land Council, protected species habitat and historical and Aboriginal cultural heritage sites.
1589.	General	Form Letter 14	P150	This project application has already been refused once. In March 2011, the previous NSW Government refused the Wallarah 2 Coal Project application on the basis that the proponent failed to adequately address issues of water quality, ecological, subsidence and heritage impacts. The proponent, Kores Ltd, has not made any substantial changes to their proposal and it remains to be against the public interest. It should therefore be once again rejected.
1590.	Surface water	Form Letter 14	P150	Further the water supply of approximately 150,000 people reside who within the Wyong and Gosford area is threatened by this mine application.
1591.	Rail Air quality Noise	Form Letter 14	P150	Dust and noise from stockpiling and rail movements associated with the mine will impact on the established suburbs of Blue Haven, Wyee and all along the rail corridor from Morisset through Cardiff and southern suburbs to the port of Newcastle. The EIS fails to adequately address these impacts. The project should be refused based on the health risks associated with air pollution from mining, stockpiling and transporting coal.
1592.	Health Air quality	Form Letter 14	P150	Short-term exposure to particulate matter pollution can lead to diminished lung function, damage and inflammation of lung tissue, increased mortality rates in children and young adults, aggravation of asthma symptoms, heightened risk of cardiac arrhythmias, heart attacks and other cardiovascular issues.
1593.	Ecology	Form Letter 14	P150	The current EIS lists 37 recorded threatened and migratory fauna species and six vulnerable or endangered flora species within the project site. Many of these species are protected under state and federal legislation as well as international agreements. The key threats to these species include land clearing, change in habitat due to subsidence and alteration of water flow, wetlands and floodplains. All of these threats are possible effects of this project.
1594.	Greenhouse Gas	Form Letter 14	P150	Five million tonnes of export grade thermal coal per annum represents a substantial contribution to NSW total carbon emissions and is in conflict with state and federal programs to reduce our contribution to global climate change.
1595.	Greenhouse Gas	Form Letter 14	P150	The argument for continued coal-fired electricity in comparison to the long-term investment in renewable energy sources has not been adequately investigated. The government should perform a cost benefit comparison of investing the equivalent amount in renewable energy sources.
1596.	General	Form Letter 14	P150	The Wallarah 2 Coal Project application has already been refused once, based on the proponent's failure to adequately address issues of water quality, ecological, subsidence and heritage impacts. The proponent has not made any substantial changes to their proposal and it remains to be against the public interest. It should therefore be rejected once and for all.
1597.	Greenhouse Gas	Peter Carroll	P151	Any proposal to mine coal at this stage of the climate cycle is sheer madness. It is clear from the vast majority of scientists specialising in the relevant fields that the world is warming and our climate is changing and that a high proportion of the change is attributable to anthropogenic causes. A key aspect is the mining and burning of coal.
1598.	Greenhouse	Name	P153	The project will contribute to global climate change and not enough has been done to investigate and invest in renewable energy sources.

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	Gas	withheld		
1599.	General	Adrian Watkins	P154	Premier Barry O'Farrell promised no coal mines in water catchments. The proposed Wallarah 2 coal mine would reinforce the public's strong impression that politicians are liars leading to a further undermining, so to speak, of confidence in our institutions. Not good for society.
1600.	Greenhouse Gas	Brett Hedger	P155	Australia needs to lead the way in turning its back on coal and creating a clean and renewable future, there is no place for coal mines in Australia, this type of project is dangerous, foolhardy and has massive risk to Australia and the rest of the planet - please do not go ahead with this coal mine, leave it in the ground and use the funds to build a solar thermal plant or a bunch of wind turbines, it really is that easy - for the sake of my community and yours don't proceed with this crazy coal project.
1601.	Surface water	Brian Wilson	P156	We have just spent $120 million on a pipeline that could be jepordised itself or the river or dam it takes water from and possibly the dam it takes water to.
1602.	Subsidence	Brian Wilson	P156	The many new residential houses in the northern Wyong shire could also be damaged by mine subsidence.
1603.	General	Ifeanna Tooth	P157	I regularly use this area for tourism and recreation and these will be degraded by the vegetation clearing, mining works and transport of coal.
1604.	Subsidence Groundwater Surface water	John Belwood	P158	We have briefly reviewed the available EIS although I assume you will understand that due to its size, we have not been able to fully absorb all the detail. Our main concern with the proposed project is the potential impact of subsidence on storm water flows in the area. We have looked at the sections relating to Surface Water Impact Assessment. and Subsidence Predictions and Impact Assessments but I have not seen any information dealing with impact on storm water surface water flows through the low lying areas bounded by Parkridge Drive, Crestwood Road and Sandra Street.
1605.	Flooding	John Belwood	P158	Currently there is an easement between properties on the north side of Parkridge Drive and the south side of Crestwood Road which carries the main storm water flow/run-off from the elevation to west of the housing development, and eventually discharges this water into lower lying areas to the east of Hue Hue Road. In the present circumstances, during in periods of heavy rainfall, it is common to have water backing up and pooling along this channel. At the northern end of our property, depths of ~ 500 mm are seen typically 2 to 3 times/year due to insufficient flow capacity through this channel and into the area receiving this discharge. According to the predicted subsidence contour map, it is expected that existing fall gradients will be decreased by ~ 1000 mm west to east across a distance of ~ 1km through this easement/channel.
1606.	Flooding	John Belwood	P158	Accepting also the prediction that absolute 100 yr flood levels will still not affect this area after subsidence, nevertheless we are concerned that the reduced flow capacity during periods of heavy rainfall resulting in the increased back up of storm water, may potentially threaten property and structures on our housing development. From our experience living in this area over 15 yrs, we would anticipate properties towards the northern end of Brookfield Close to be most vulnerable to decreased flow capacity along this channel.
1607.	Surface water	Jane Smith	P159	The Central Coast has experience drought with water levels dropping to dangerous levels. This highlights the importance of protecting our drinking water catchments above all else.
1608.	Health Economic	Cheryl Graves	P160	I am a resident of Wyong Shire and this mine will effect my health and financial status. I work in Real Estate and already clients do not want to buy in the area based on the proposal alone. If the proposal is approved, our property values will suffer, and a lot of residents need the values of their properties for their retirement. I do not agree with taking away our quality of life, quality of ground water, quality of fresh air, just to satisfy other country's need for fuel and the federal Government's need for money. Tax dollars from coal in this area will only mean more tax dollars being spent to bring us water, tax dollars being spent on Medicare funded health care for all the subsequent health issues and tax dollars being spent on supporting us in retirement when our properties values decline to the point of no longer being a viable source money. How can anyone feel that is an acceptable trade off?
1609.	General Economic	Ian Brown	P161	It would also appear from my reading of the Kores submission and data based there on that at best the "experts" are only guesstimating what will be the effects if the mine goes ahead. Who is to say the effects will not be many times worse that estimated. It is human nature to guess on the conservative side. Kores only wants our coal and they obviously do not care of the consequences such as destroying our homes, property and environmkent. As a resident we will receive nothing but grief and a land value far less that it should be.
1610.	Agriculture Economic Air quality Ecology Subsidence	Ian Brown	P161	I make a living off the land in our valley at present as a beekeeper. My work, which I have spent many years building up, will be at risk. As you would appreciate, bees need flowering flora to get the necter to make honey, what will be the result when the water table is interferred with and land starts to drop. Flora only flowers when conditions are right for them which is tricky enough with our present climate conditions. Add other indefinte variables such as water table, sub surface soil changes to name just a few and my honey business will be finished. Will Kores pay me a compensatory salary for my loss of business AND a compensatory amount for the devaluation of my house and property? I doubt it.

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1611.	Air quality Agriculture Ecology	Ian Brown	P161	I am also concerned about the effect the mine dust and noise will have on my bee population. Bees are very sensitive creatures and collect pollen. Pollen as you would know comes from within the flower head and any coal dust in the air would settle in the flower head and would coat the pollen. Pollen is used in the hive to breed baby bees. What mutant breeds will be produced when fed coal dust as part of their diet. Whilst I am on the subject of coal dust, also from the depths of the flower the nectar is gathered for the honey, what effect will coal flavoured nectar have on the bees, they use the nectar / honey as a food source within the hive, or the general public, that's if I am permitted to market my coal flavoured honey.
1612.	Groundwater Ecology	Bateau Bay Progress Association	P162	We would also like to point out that a mine at Newnes Plateau, near Lithgow caused a significant impact on the endangered Temperate highland peat swamps. We understand that mining activities resulted in the loss of ecosystem function and the formation of a large slump hole. As a result, the swamps were unable to serve their important hydrological role of acting as water filters and releasing water slowly to downstream watercourses. Other devastating impacts have occurred at other mine sites in NSW. Comparable devastation is entirely probable on the Central Coast.
1613.	Management	Rhonda Audsley	P163	There is inadequate water site management plans and no guarantee that these plans will be affective or implemented.
1614.	Ecology Surface water Subsidence Air quality	Community Environment Network	P164	For many years the community of the Central Coast has faced the prospect of a large coal mine extracting coal reserves from under the main water catchment for both Wyong and Gosford. From the outset CEN has opposed this concept based on obvious criteria regarding loss of biodiversity, ecological communities, precious potable water resources with subsidence to the water catchment areas and impacts to our population's health and well-being from coal dust and fines.
1615.	General	Community Environment Network	P164	As far back as 1950, the Wyong Water Catchment District, was protected under State Legislature as being a precious resource not to be interfered with. Despite this foresight being shown by our elected representatives at that time, we have had to continually go into battle against the mining industry since the early 1980's.
1616.	Groundwater	Community Environment Network	P164	Consultants to the former lease holders BHP Billiton, ERM Mitchell McCotter, found in their submission that pathways for water to travel down from the surface of the valleys to the mine seam was evident. Later independent consultants, Tim Jones and again Ray Evans, both qualified water specialists, independently concluded that there was no barrier against water percolating from the surface to the mine seam. In the previous application by Kores, Professor Philip Pells, Senior Lecturer at the University of NSW for graduates entering the mining industry, proved once again in a lengthy and detailed presentation and written submission to the Planning and Assessment Commission that the same conclusion that others had come to was true. Surely no more needs to be said regarding the likelihood of severe loss of water in the valley system if mining is approved.
1617.	Air quality	Community Environment Network	P164	Air Quality in the northern areas of Wyong has been a prominent media theme for many years, and even some doctors have gone public on the fact that respiratory diseases are prevalent in the population. Dr Peter Lewis, Area Health Director, Northem Sydney and Central Coast, in his submission before the PAC in 2010 states that... "A major concern is the level of increased particulate pollution experienced well beyond the boundaries of the land owned by the proponents This concern exists because any increased exposure to particulate pollution is associated with increased adverse health outcomes, EVEN IF the levels are BELOW the current guidelines. The predicted bug/cm increase in PM10 will produce increased respiratory problems and morbidity among residents".
1618.	Subsidence	Community Environment Network	P164	The fact that the hills surrounding the valley system are destined, according to the EIS, to subside 2.6 metres means dramatic change to streams and tributaries and the tree communities and their soil support systems. Enough weight of importance to this effect is not evident in the EIS and so the damage to the natural environment generally is given scant recognition.
1619.	Surface water Groundwater	Susan & Richard Bell	P165	We saw how attractive and healthy the Cataract River was before long wall coal mining was undertaken hundreds of metres below it, and how the subsequent cracking of the rocks in and around the river have drastically reduced its flow and resulted in considerable unsightly pollution. No one in their right mind would want this result for the waterways in the Central Coast area. Our water supplies and a healthy ecosystem around the rivers must be preserved at all costs. Once the rivers are damaged, like the Cataract River, remediation is almost impossible. The damage there seems permanent and irreparable. A previous government rightly rejected this proposed mine and we believe that the only environmentally responsible action is to once again reject this proposal completely.
1620.	Ecology Groundwater	Carolyn & Brett Huntley	P166	As a long time resident of Dooralong I am dismayed that Kores may eventually destroy the ecosystem existing in this valley. Just because they have bought one property and based much of their argument for mining on the data they have retrieved from this property, [Honeysuckle Park] does not mean they have conducted thorough and non biased conclusions regarding the long term affects on the water table, aquifers, wildlife and ecology of this area. We have platypus, echnidnas, wombats, wallabies, etc., all relying on these tributaries which eventually flow into Jilliby Jilliby Creek. This wildlife will all

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				be at risk. Who will guarantee their safety?
1621.	Economic Ecology General Greenhouse Gas	Karen Higgins	P168	I purchased property in Jilliby just over 2 years ago, having assurance that coal mining activity would not proceed in this area, as promised by Barry O'Farrell in one of his Election promises. I am very concerned about the impact any mining will have on the environment (air, water, land, wildlife, infrastructure, humans, etc.) that would affect, not only my property and family, but many others in this area. Additionally, looking at the bigger picture, I believe the detrimental impact on the world environment that mining and burning coal has is irresponsible for the future of our world and all of mankind. Please note my strong objection to any mining activity.
1622.	Air quality Health Ecology Subsidence Economic	Therese Wilkins	P169	I am a resident of Tuggerawong and have been such since May 1990. I have seen many changes take place on the Central Coast over the last 23 years. I do not believe that a coal project wihcih will create coal dust emission which will impact on people and their breathing, the quality of drinking water and water in general use, also water tables, the environment both flora and fauna and the actual land resulting in subsidence is a worthwhile project for the benefit of the people of the Central Coast. Immediate money should not outweigh the hazardous and long term effects of mining.not only on the immediate community but that of communities in the years to come.
1623.	Groundwater Surface water Agriculture	Therese Wilkins	P169	I object to the proposal for the following reasons: Ground and surface water impacts. The water will be affected both surface and loss of water will result as it will be unuseable and this will restrict the overall water levels which have only just increased to an extent where restrictions are not needed. Also those with dams and tank water run the risk of the water catchments on their properties becoming fouled and therefore unuseable. What do they do then for their crops, cattle and daily lives< As the deposits build up on the soil and leech below the water table becomes contaminated and then we have a huge problem which then impaccts on the flora and fauna..
1624.	Management	Therese Wilkins	P169	What plans are in place now to ensure that the water problem will be kept at minimum levels and therefore the company can be proactive and management is in place as operations start. I dont think so and so the damage is done.. They leave take the coal and Australian soil is corrupted forever and lives, fauna and flora lost forever because of a so called profit margin.
1625.	Noise Air quality Management	Therese Wilkins	P169	Dust and noise. People do not need to be subjected to noise and dust - those with any sort of lung or asthma associated run high risk of permanent damage and noise is going to impound on peoples lives and ability to rest this is not tenable. Once again profit margins before people. What controls are in place now to stop noise and dust emissions ...
1626.	Air quality Noise Economics Health	Therese Wilkins	P169	The Wallarah 2 Coal Project application has already been refused once, why then would you suggest that the dangers have lessened or did someone offer to up the price. People on the Central Coast are entitled to a healthy lifestyle, clean water and free from pollution and noise. They have paid to live here and do not need to be endangered...
1627.	General	Therese Wilkins	P169	The proponent has not made any substantial changes to their previously rejected proposal and it remains to be against the public interest.
1628.	Ecology	Therese Wilkins	P169	Threatened Species. Mines means that flora and fauna will die and in some instances cannot be replaced as the land that is so badly impinged on that it cannot recover. So money will replace endangered species I dont think so once they are gone they are gone... Think before you act.
1629.	Greenhouse Gas	Therese Wilkins	P169	Climate Change. Yes all the talk about climate change and carbon emissions and can we believe that there are people who would for money risk the future of all by place a mining project in and around where we live and subject us to all the contaminants that come with it and also emissions that will not only endanger our lives but those of future generations. Sanity would suggest that the coal stay in the ground and the company goes elsewhere ....
1630.	Surface water Groundwater Ecology	Beverley & Alastair Sloan	P170	We are the owner of DP755271 Lot 236, located at 400 Little Jilliby Road. We reside above the LW6SW 7SW and 8 SW shafts. I have read the submission by Wallarah (Kores) and I am seriously concerned about the impact on my property. We are worried about the proposed coal mine and the long term effects on the water supply to the central coast, the impact of the mine on the flora and fauna of the area and the potential subsidence on our land. We are surrounded by the Wyong State Forest. Importantly, we are at the beginning of tributaries that form the Little Jilliby Jilliby Creek. The proposed development by KORES et al will impact my livelihood in this valley in the following ways:
1631.	Groundwater	Beverley & Alastair Sloan	P170	In the review of this proposed coal mine, the panel from the Chikarovski era found that: “On the weight of evidence presented to it, longwall mining is likely to cause subsidence-related impacts within the water supply catchments associated with Wyong River and Jilliby Jilliby Creek.”
1632.	Agriculture	Beverley &	P170	As a landowner in the proposed area of mining, this causes great concern to me. Over the past several years I have invested considerable time and

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		Alastair Sloan		expense improving the pastures and crop carrying capability of my property. This has included working with the CMA to protect our waterways in recognition to the fact that the catchment area is important to the Central Coast. It worries me that the water supply could be jeopardized by coal mining.
1633.	Surface water Subsidence Agriculture	Beverley & Alastair Sloan	P170	As our property lies within the Little Jilliby Catchment area we will be directly and unfavourable affected by the proposed mining in the area. In fact, some of the tributaries to the water catchment start on our property. The river system around the property can be seen by the submission map 18 and the potential longwall shafts. This farm is used to raise livestock and crops and a deterioration of the water supply, as evidenced by other similar mining projects that have been undertaken and evidenced in prior studies would inhibit our ability to continue our livelihood. This is not acceptable.
1634.	General	Beverley & Alastair Sloan	P170	On my property I have a myriad of assets that will be affected by the potential subsidence of land and the loss of water. A picture of just some of the assets can be seen below.
1635.	Agriculture Surface water	Beverley & Alastair Sloan	P170	The subsidence would negatively affect: • I have cattle requiring the water flow. This property is not serviced by town water. We rely on the rainfall runoff through the creeks. A reduction in surface water would not allow us to continue farming the land. A contamination of the water supply, notorious from the brackish output of mining would be just as bad. I am incredulous that in other mines the dilution of mine water using town water is considered treatment.
1636.	Agriculture	Beverley & Alastair Sloan	P170	• I have dams that provide irrigation for the crops including wine and forage and animal consumption. This also includes the water for the house.
1637.	Agriculture Subsidence	Beverley & Alastair Sloan	P170	• I have fencing throughout the property that the report states this is at risk from the subsidence. This fencing has been put in at my expense over the past 3-5 years.
1638.	Subsidence Health	Beverley & Alastair Sloan	P170	• I have bridges that would be affected. There are two on the property and three more that we travel on to access the lot within 2 km of the farm. Subsidence here would put my family and employees at risk when using the bridges. Some of these bridges (3) have been replaced within the past year.
1639.	Subsidence	Beverley & Alastair Sloan	P170	• I have a house that is up on stilt/support poles. You can see that in the picture above. The height at some corners is a full storey. Naturally any subsidence in this area will directly impact the safety of me and my family. I would hold those granting the authorization of this activity below the property as directly responsibility for any consequences from this activity since there is prior knowledge of the known dangers and risks. If the risks cannot be mitigated the economic consequence should not be the overriding deciding factor.
1640.	Subsidence	Beverley & Alastair Sloan	P170	• I have tennis court which the report discusses can be affected. A lopsided court is useless.
1641.	Subsidence	Beverley & Alastair Sloan	P170	• I have an in-ground swimming pool that again the report says there are risks. This worries me. A crack here would render the pool damaged and useless.
1642.	Subsidence	Beverley & Alastair Sloan	P170	We have two water tanks residing on the hill above the house. They would each hold approximately 25,000 litres. One is made from concrete and stores the household water. A subsidence here would mean we would have to leave the property as the government has not seen fit to attach the farm to town supply.
1643.	Subsidence	Beverley & Alastair Sloan	P170	The maximum predicted total conventional subsidence tilt and curvature under our property is predicted by the report to be 2550 mm / 12 mm / 0.19, almost the maximum for the overall mine site. The report goes on to note that the maximum predictions do not include valley related upsidence and closure movements. We live in the valley. This study and or results should have been included to show our risks to you.
1644.	Subsidence Flooding	Beverley & Alastair Sloan	P170	The report notes that longwall mining can result in increased levels of flooding or scouring of the stream banks if the mining increases tilt. We already face flooding in periods of high rain. I am worried that increased flooding would cut us off from the town. We already see several instances a year where the water can reach 1-2 metres above the road (which is in turn 2 metres above the normal creek water surface level) at our front gate.

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1645.	Subsidence Flooding	Beverley & Alastair Sloan	P170	I will not be the only one affected. A total of 245 houses (Append.H Page 130) will be impacted by subsidence from a conservative one metre to 1.6 metres throughout the mine area. A total of 755 Rural Building Structures will be impacted (Append. H >page 179) and 420 Farm Dams suffering subsidence to some degree (Append.H>page 187). As can be seen the projected damage inside the mining lease area would be catastrophic. The hinterland of the valleys are to be subsided 2.6 metres; Little Jilliby Jilliby Creek at the southern end is predicted to fall 2 metres; the main artery into the Jilliby/Dooralong Valley, Jilliby Road is destined to be subsided 1.75 metres in places, remembering that these valleys flood on a regular basis leaving residents isolated from all directions.
1646.	Subsidence Flooding	Beverley & Alastair Sloan	P170	It is galling that the report dismisses surface cracking to such an extent. Despite noting that compressive buckling in the bedrock and dilation of the uppermost bedrock could occur from valley related movements, the report goes on to say that these cracks would be filled with water in times of heavy rain and then gaps filled by alluvial deposits. What rubbish.
1647.	Subsidence Surface water	Beverley & Alastair Sloan	P170	The original report asserted: "the nature of the geology, geomorphology and depth of the coal seams make it unlikely that underground mining will result in a loss of surface water." This comment gives me little comfort. In trying to determine the history of coal mining and the potential effects on my property, I have seen the following examples. Just within the Hunter Valley, there are examples of damage to creek systems in the Hunter Valley associated with subsidence from longwall mining. Affected creeks include Eui Creek, Wambo Creek, Bowmans Creek, Fishery Creek and Black Creek. The damage caused from sediment, instability and even the complete loss of flow gives concern that the farming of the Wyong area and the safety of our water source could be compromised.
1648.	Surface water	Beverley & Alastair Sloan	P170	How has the new report found differently in the face of such damming evidence and scientific fact? The proof of the loss of surface water supply is available to all on the internet as pictures of before and after effects and resultant total loss or brackish water seepage can be seen all over Australia.
1649.	Groundwater	Beverley & Alastair Sloan	P170	Kores claim that there will be no effect upon the water supply due to impervious layers between the surface and the mine seam. Professor Phillip Pells, Senior Lecturer at the University of NSW dismisses these claims. Kores do admit to a so-called tiny loss of water rated at 2ml per day per square metre. This extrapolates over the whole mine area some 8 megalitres per day or 3000 megalitres each year once mining is complete. The professional uncertainties characterised within the Kores submission paint a very tentative picture for protection of the coast's natural potable water supply.
1650.	Groundwater Subsidence Surface water	Beverley & Alastair Sloan	P170	I have recently read the paper "Impacts of longwall coal mining on the environment in New South Wales" by the Total Environment Centre. Disputes abound, and yet we are contemplating another location for a mine. The economics of the projects cannot be assessed solely through the potential economics but also through the social and environmental impacts for generations to come. The table below attests to the concerns that I have to the effect that mining may have on our Valley.
1651.	Ecology Greenhouse Gas	Carolyn Donnolly	P171	Please accept my submission on the abovementioned proposal. I am using the template below because I agree with its contents. I have briefly looked at the documents on display and I believe that the long term ecological impacts from this proposal far outweigh the short term financial benefits to NSW. Rather than having the significant impacts on our flora and fauna, our communities and on our climate that this proposal would clearly have, we should be investing in renewable sources of energy. We are one of the few countries in the world in a position to make that choice. Please have the foresight to see that the impacts of this proposal are far too great to allow it to go ahead. Have the strength to reject this damaging proposal (as did past governments).
1652.	Surface water	Our Land our water our future	P172	Not only do I object to the proposal for Wallarah 2 Coal Project Application No. SSD-4974. I would go even further to consider this proposal "complete Insanity". I fail to comprehend how any community representatives could allow such a proposal? If any of these representatives were truly protecting the best long-term interests of the Central Coast Community, this submission should have been stopped long ago? I can only conclude that the government representatives elected to protect the best interests of the Central Coast Community, are in great need of correct objective information from dedicated professionals whom specialize in ground and surface water studies and whom have the information available on Climate Change. The $80 million Mardi-Mangrove pipeline designed to transfer water from this system to the Mangrove Dam on the escarpment during flood rains, was built to provide the Central Coast Community with water at times of great shortage. The Wallarah 2 Coal Project proposal risks the long-term integrity of this pipeline and again further risks the water supply for thousands of Central Coast residents.

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1653.	Geology Groundwater	Richard Farrell	P173	The kores eis seems to imply that an ironstone layer protects surface water from mixing with the poorer quality of water at the level where coal will be extracted. My understanding is that the ironstone is not the one complete layer but a layer of loose ironstone that will permit surface and lower levels of water to mix.
1654.	Geology Groundwater	Richard Farrell	P173	Can you please clarify for me: 1. Is the ironstone layer impervious to water that is unbroken layer and if it is, how can it be prevented from cracking once mining and subsidence occurs
1655.	Groundwater	Richard Farrell	P173	2. How can water quality and the water level be restored once it is impacted by mining and subsidence?
1656.	Air quality Health	Kevin & Susan Wynn	P174	The conclusions in the leaked version of the Australian Rail Track Corporation's (ARTC) `Particulate Emissions from Coal Trains' report dated 24 May contradict those in the released version of 31 May and indicate coal trains are much more polluting than the government claims. The ATRC's leaked report clearly shows that uncovered coal trains pollute the air and put resident's health at risk particularly lung disease and more severe asthma and according to Wallarah 2's own information will increase morbidity and cause deaths.
1657.	Air quality health	Bronte Talbot	P175	The mining company will build a gigantic coal loader right next door to the largest urban growth area on the Central Coast. This will be 2.4km from the proposed Warnervale town center, 2.9km from Blue Haven and close to Wyong Hospital and Lake Haven Shopping Centre. (australiancoalalliance.com/coaldust.htm). This will have a major impact on surrounding houses, communities and schools full of children including "Lakes Grammar, An Anglican School" which I attend in Warnervale. My school and Mackillip Catholic College at Warnervale are right near the railway station, which will be affected majorly with coal dust. This is a major health concern for the young children attending these schools and living nearby.
1658.	Surface water subsidence	Bronte Talbot	P175	The South Korean Government wants to mine under our valleys. These valleys supply 50% of the water catchment for the entire Central Coast of NSW. The weir and the pump pool for the Mardi Dam are located within the horizontal subsidence zone of the proposed coal mine project. The mining under the valleys may contaminate the Wyong River and the Dooralong creeks which all run into the Tuggerah Lake. This water is pumped up into the Mardi Dam and supplies the Central Coast with Water. Do we want the South Koreans to take our coal and ruin our landscape and water catchments in return for money and compensation? Without water, how do we survive? We need to stop these plans for mining as it is going to have a major impact on our natural environment as well as our health.
1659.	General	Sandra Norman	P176	Director-General's Requirements There are a number of areas of non compliance. It would appear that this report, whilst very lengthy, has not addressed a number of issues and the applicant has not made any substantial changes from their previous application which was refused in March 2011 by the previous NSW State Government.
1660.	Flooding	Sandra Norman	P176	5.9.1. Predictions for the Local Roads The Dooralong Valley has two main access roads, viz; Dickson Road and Jilliby/Dooralong Road. Table 5.7 indicates that subsidence in these two roads alone could be up to 1350mm and 1750mm respectively. This valley is subject to flooding and if the roads subside at the predicted levels, residents will be isolated for many days with possible flood damage to property, infrastructure, homes, roads and stock loss.
1661.	Agriculture Subsidence	Sandra Norman	P176	5.22. Agriculture and Farm Lands The applicant admits that `farming could be affected by changes in the surface water and groundwater regimes.....'. The report recommends `that the WACJV develop management strategies, in consultation with the owners, to manage the potential for impacts to these agricultural businesses'. This is totally unnecessary - farmland, just like water, should be protected. These valleys, with their rich alluvial soils, have had a long history of productive farming and the proximity to the Sydney basin for future food production should ensure its protection.
1662.	Soils and Land Capability Agriculture	Sandra Norman	P176	Soils and Land Capability & Agriculture There are a number of inadequacies and contradictions in these assessments and a number of areas do not meet the Director General's Requirements. Some of these are:- * Insufficient baseline data collected * Survey methodology inadequate * Soil survey assessment inadequate * Soil mapping not consistent with reference material - the soil map is incorrect

No.	Aspect	Stakeholder	ID	Issue
				* Land capability mapping incorrect * Agricultural suitability mapping incorrect
1663.	General	Sandra Norman	P176	Conclusions drawn from incorrect and insufficient data is invalid and therefore any assumptions made by the applicant are meaningless.
1664.	General	Sandra Norman	P176	The report also does not address rehabilitation of the mine site - another requirement of the Director General.
1665.	Subsidence Agriculture	Walker Family	P177	Subsidence and water quality impacts would have significant effects on the condition and safety of our horses and would have a detrimental effect on our income
1666.	Groundwater Agriculture Economic	Walker Family	P177	The water table in the immediate vicinity of the Marena Stud property is close to the surface and provides the rich pastures for our stock to feed. Without this high quality feed available we would be forced to bring in feed sourced from other regions affecting both our income and increasing the carbon footprint of our business.
1667.	Monitoring	Walker Family	P177	Our questions to you: What level of measuring and monitoring was conducted during the original investigations?
1668.	Surface Water	Walker Family	P177	What level of protection will you provide to the water quality?
1669.	Ecology	Walker Family	P177	What level of protection will you give to threatened species?
1670.	Air quality Health	Alexa Coffey	P178	Our oxygen will become polluted with poisonous coal dust particles and we will start to produce cancer in our lungs. People can't go around wearing masks everyday.
1671.	Air quality	Alexa Coffey	P178	My new high school (Lakes Grammar) is located very close to the coal plant and I will have no option but to breathe toxic coal dust.
1672.	Subsidence	Alexa Coffey	P178	My parents built a brand new house and now we are told that parts of it might sink into the ground and crack.
1673.	ecology	Alexa Coffey	P178	The wyong river water catchment was found to be one of australia's cleanest water supplies in the whole of Australia and home to hundreds of platypus. Their habitat is protected by the federal government but is now being threatened.
1674.	Subsidence	Ashley Coombs	P179	Not only will the dwellings be exposed to subsidence but also hundreds of other rural structures and improvements such as driveways, inground pools, retaining walls, fencing and dams etc.
1675.	Subsidence Surface water	Ashley Coombs	P179	It should be noted that residents living within the proposed boundaries draw their water from onsite rainwater tanks located above and/or ground level. Many of these tanks are of concrete construction and will be highly susceptible to subsidence.
1676.	Subsidence	C Higgins	P180	Can you please advise of the plan to look after residents affected by subsidence
1677.	Subsidence	Halit Adasal	P181	245 homes will be potentially affected by subsidence of up to 2.6m. They may be entitled to compensation for damage to their homes, but only if the home owner pays for engineering inspections before mining begins, and after defects become apparent. There is no compensation for damage to dams, fences, outbuildings or other land. Compensation can take years – residents at Chain Valley Bay waited over 25 years for compensation.
1678.	Geology	Vikki Tyler	P182	I am concerned that no study has been released or done to my knowledge of the possibility of an Earthquake occurring in the area, during or after completion of the mine.
1679.	Subsidence	DVRA	P183	Structural damage to water supply infrastructure, such as weirs, irrigation pipelines, pump stations has not been ruled out. Domestic infrastructure: dams, farm bridges, grazing areas and loss of service water.
1680.	Geology	Valerie Williams	P184	I am extremely concerned that, to my knowledge, Wallarah 2 EIS as not addressed the impact of an earthquake in the area and how much greater the potential damage of a quake would be exacerbated because of a longwall mine it is a known fact that this area is already geologically unstable.
1681.	Geology	Valerie Williams	P184	On 28th December 1989, Newcastle had a disastrous 5.6 magnitude earthquake killing 13 people, injuring 160 and doing varying degrees of damage to 50,000 buildings. An article in the SMH January 9th 2007 by Wendy Frew an environmental reporter, told of a report by Dr Christian Klose. Dr Klose said a major fault beneath Newcastle was reactivated after coal was extracted and water was pumped out to keep the long wall mines dry. He believe this may have contributed to Newcastle's earthquake.
1682.	Geology	Valerie Williams	P184	In late 2006, Dr Klose said geomechanical pollution (ie the removal of millions of tonnes of coal and four times as much water) had significantly changed the stress field in the earth's upper crust below the Newcastle coalfield.

No.	Aspect	Stakeholder	ID	Issue
1683.	Geology	Valerie Williams	P184	On 10 September 2012, the CC was shaken by an earthquake. A 3.2 magnitude earthquake occurred approx 60km offshore of Woy Woy, and are common in the area. Will having a long wall mine under a pristine water catchent area, and being in such close proximity to such a large number of homes, create the potential for a much greater disaster.

Wallarah 2
COAL PROJECT

Wallarah 2 Coal Project

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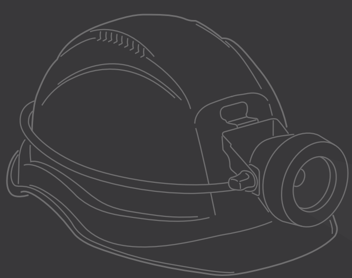
Appendix C

Revised EIS Figures



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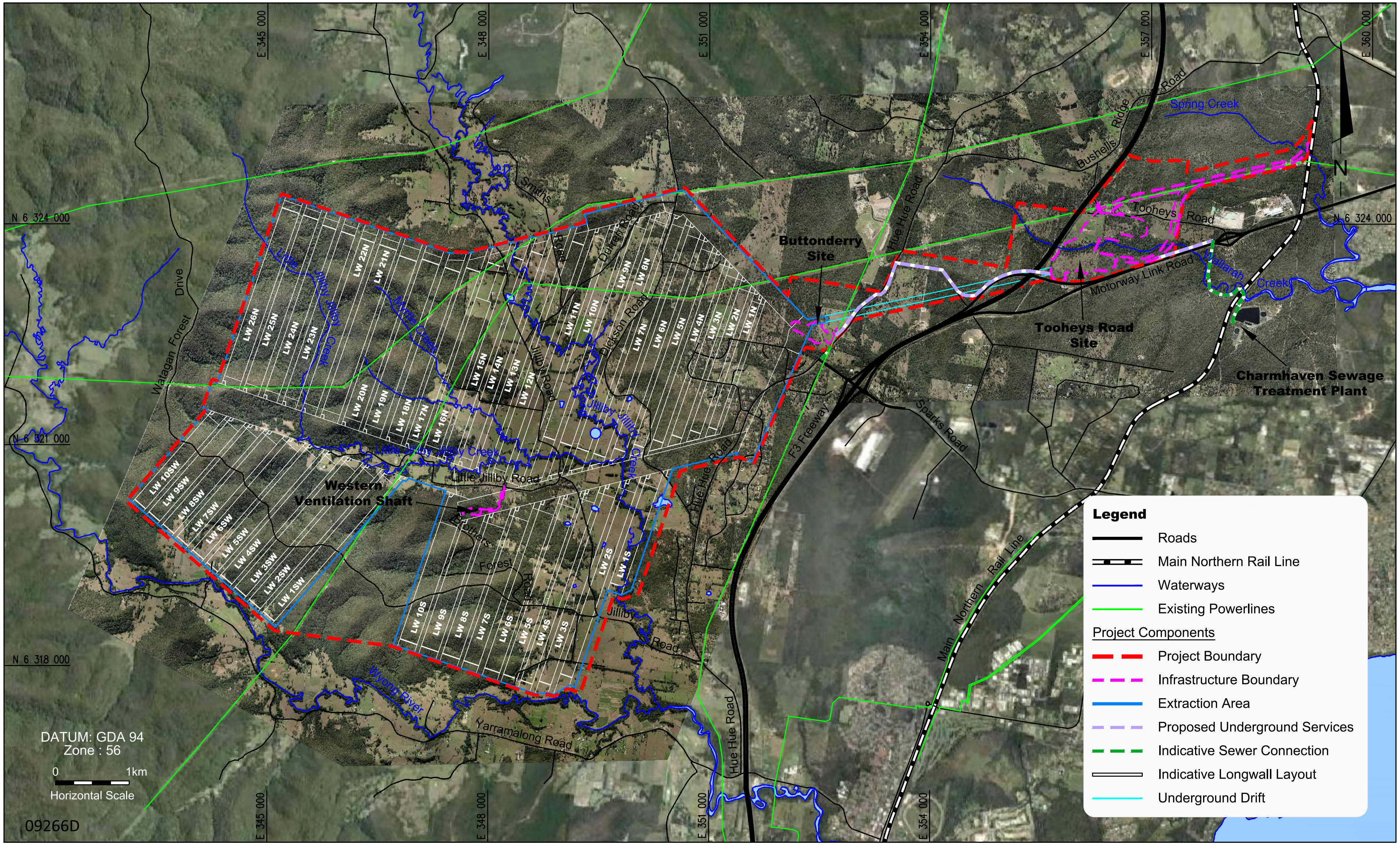

WALLARAH 2 COAL PROJECT

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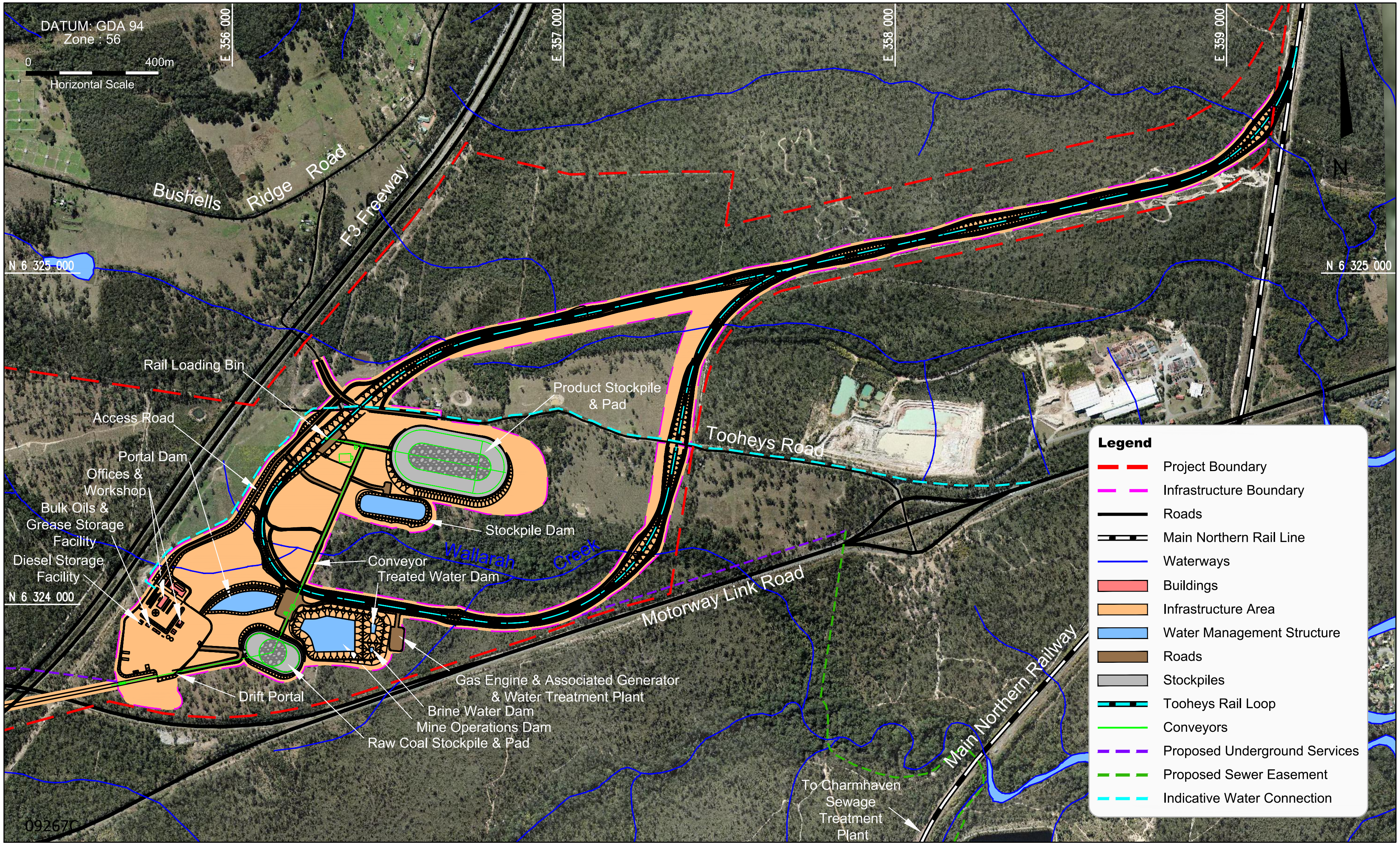
Conceptual Project Layout (Aerial)



WALLARAH 2 COAL PROJECT

Conceptual Tooheys Road Site Layout

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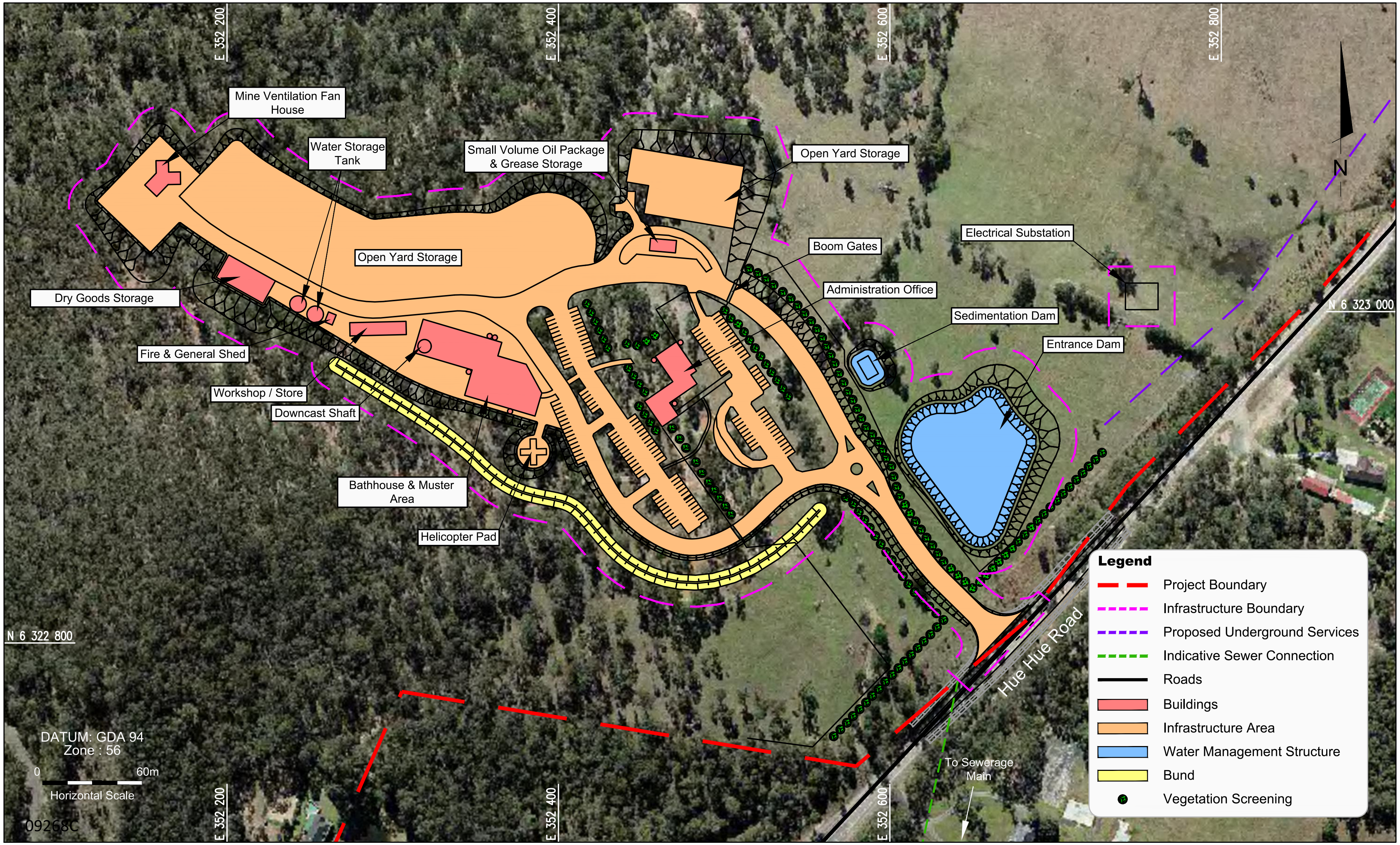

WALLARAH 2 COAL PROJECT

Conceptual Buttonderry Site Layout

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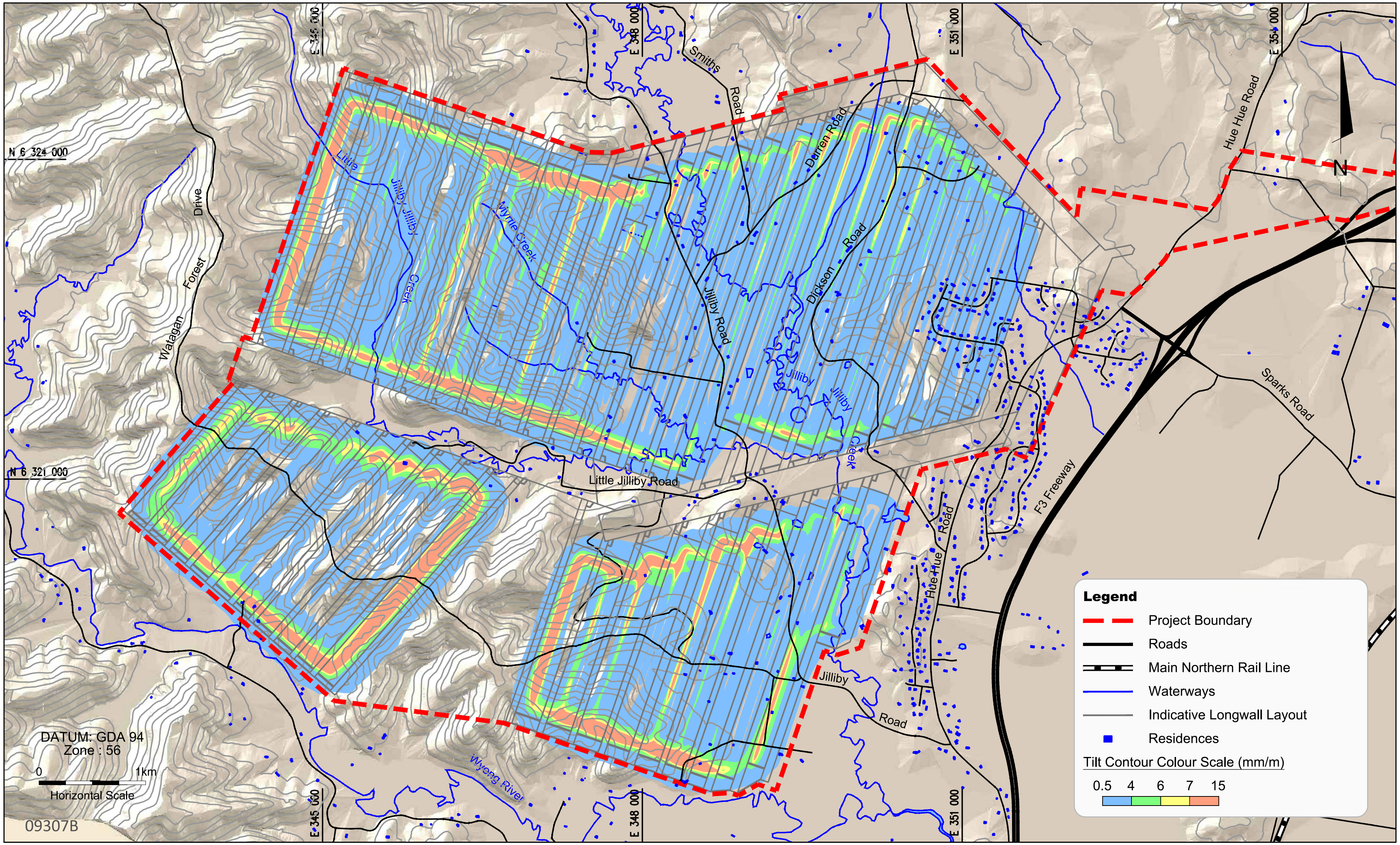

WALLARAH 2 COAL PROJECT

Predicted Conventional Tilt

Wallarah 2 COAL PROJECT

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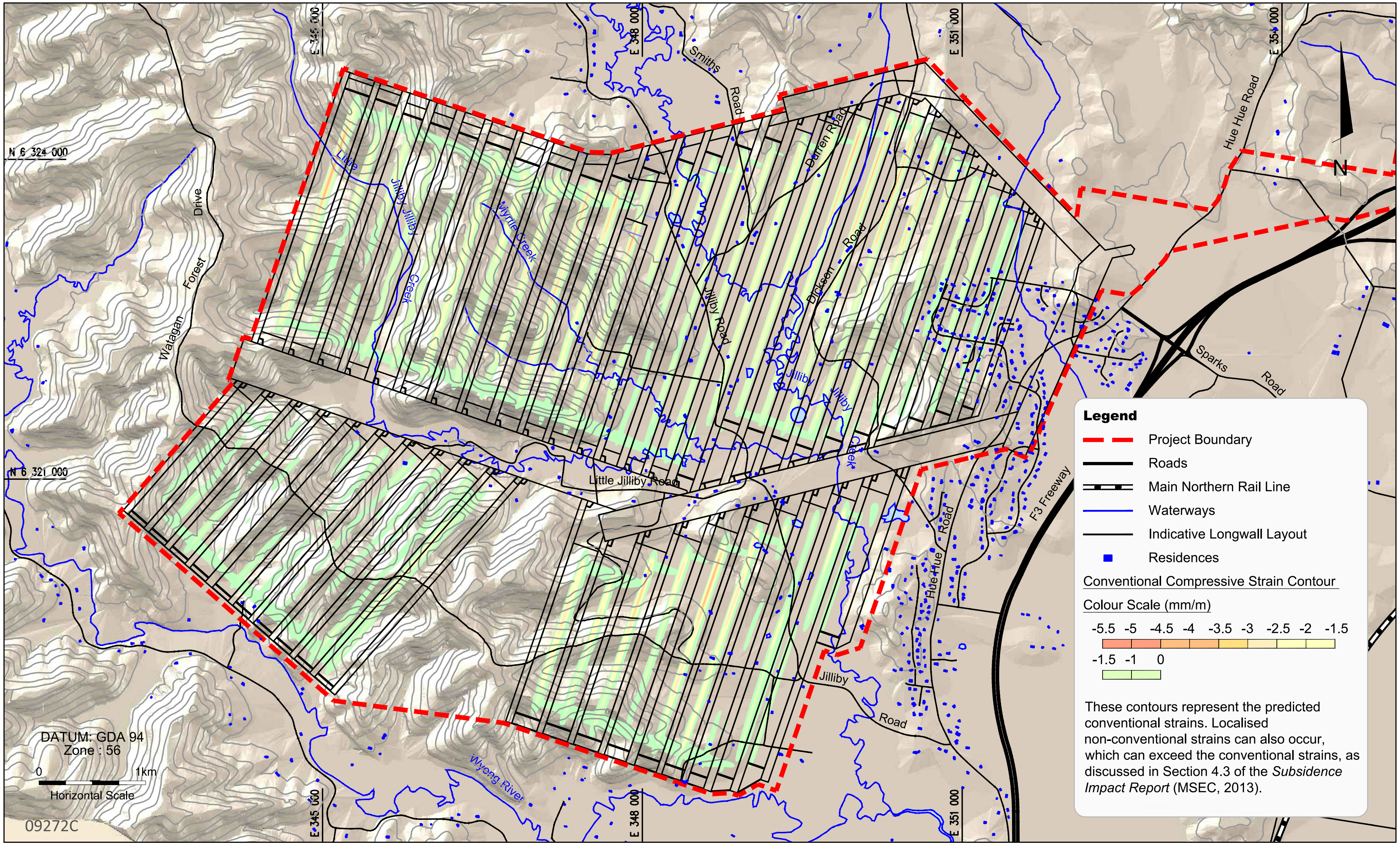

WALLARAH 2 COAL PROJECT

Predicted Conventional Compressive Strain

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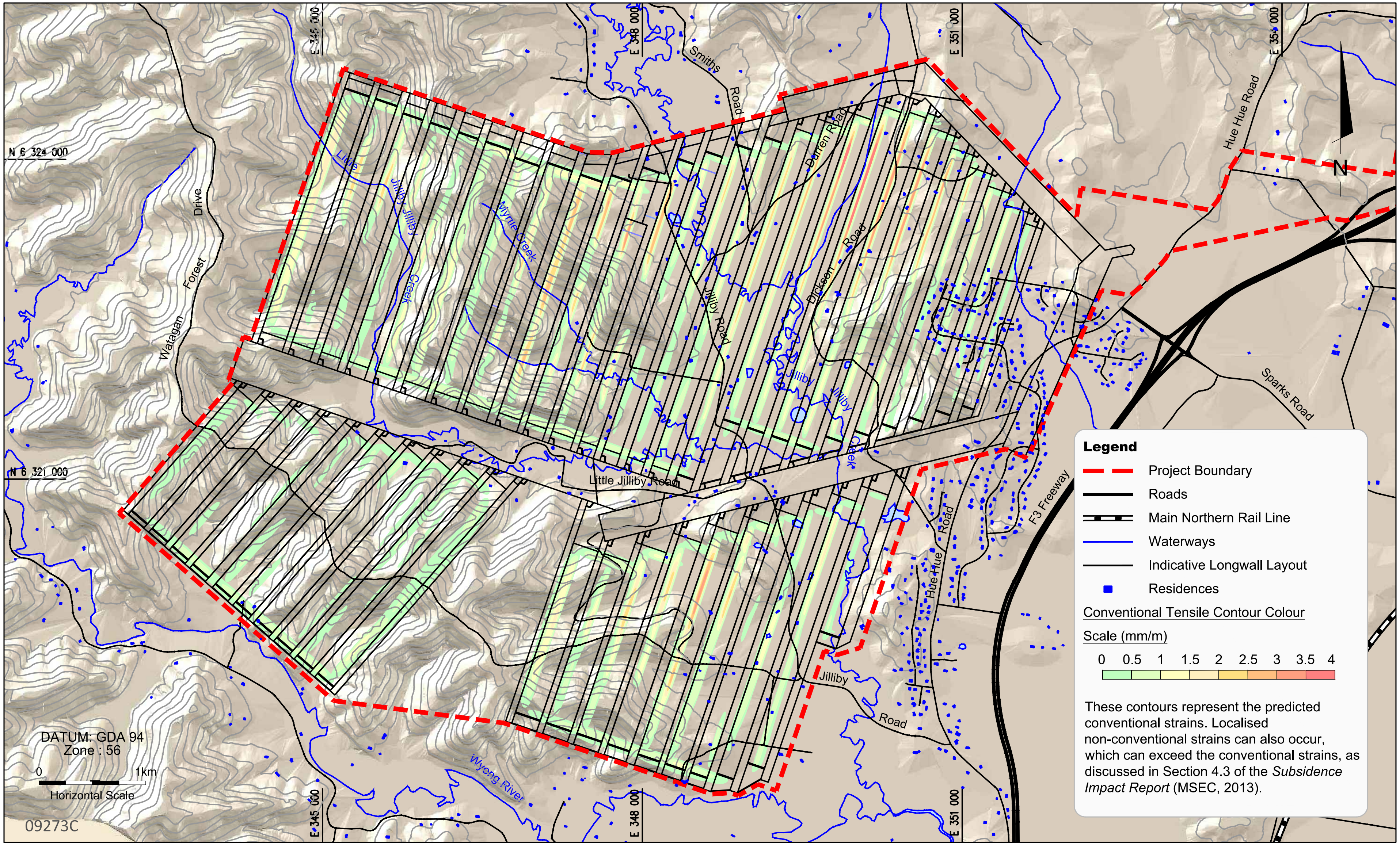

WALLARAH 2 COAL PROJECT

Predicted Conventional Tensile Strain

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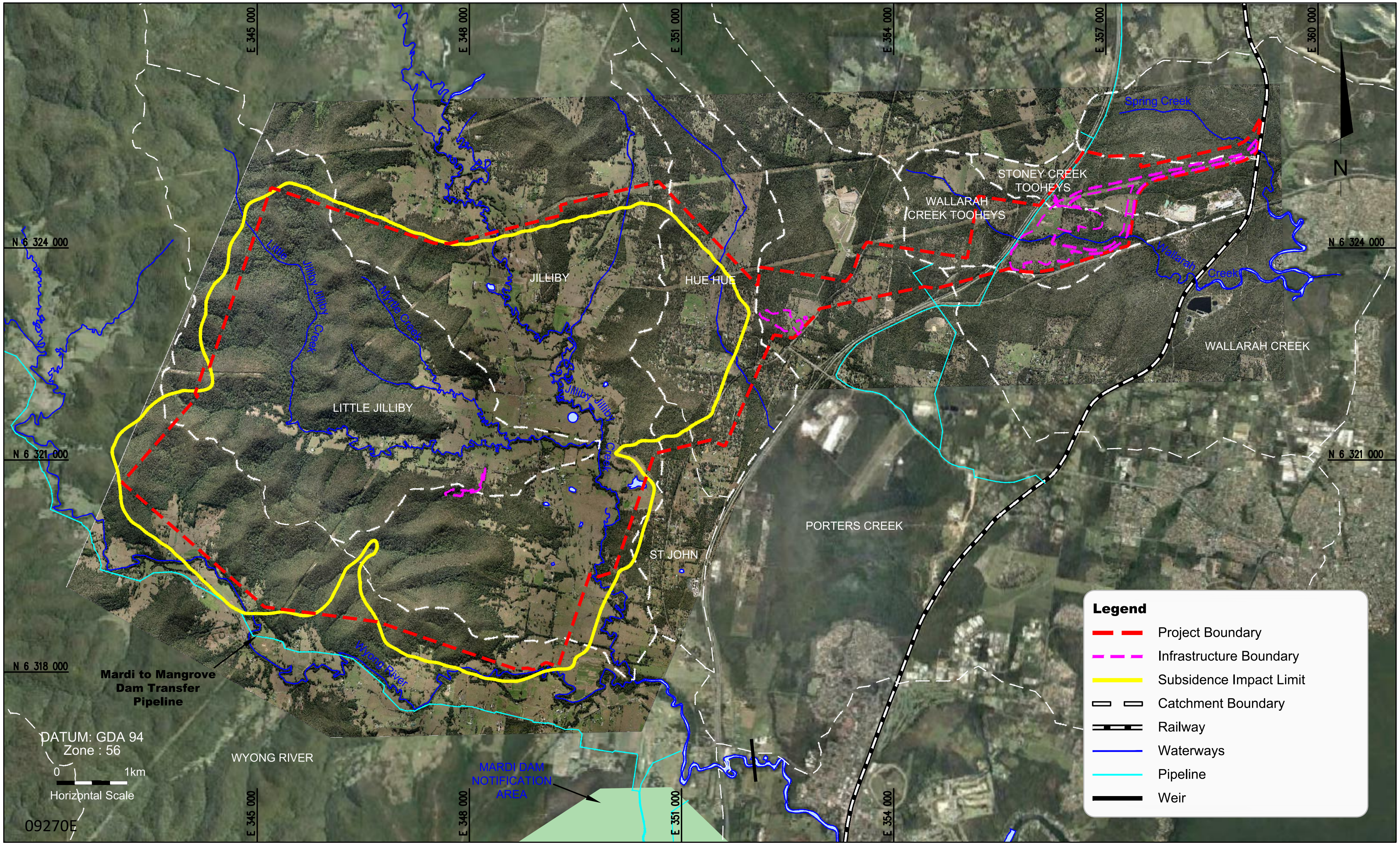

WALLARAH 2 COAL PROJECT

Surface Water Features

Wallarah 2 COAL PROJECT

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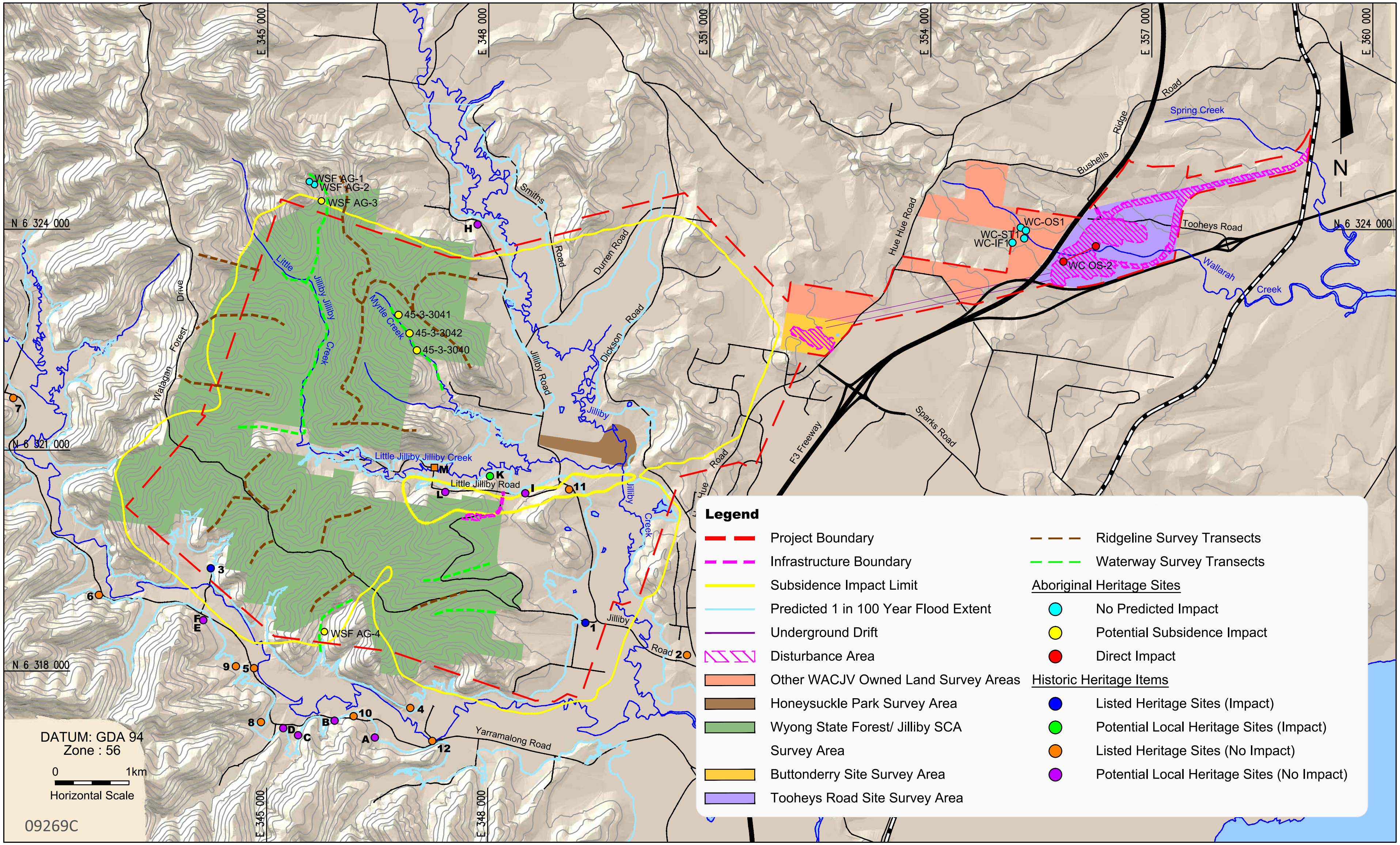

WALLARAH 2 COAL PROJECT

Heritage Items

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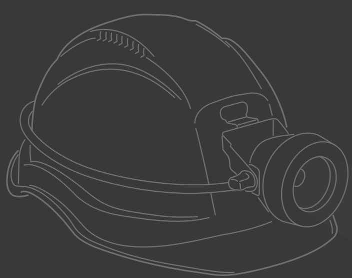
Appendix D

Issue Paper

'Review of the constrained zone hydraulic conductivity'



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1.1 Background

The depth of cover over the Great Northern seam ranges between 345m and 480m in the Dooralong Valley. Geomechanical modelling of subsidence in this area predicts a height of caving related changes beneath the alluvial lands, of about 190m. Within this zone, groundwater flow is expected to be become increasingly free draining downwards to goaves, with reducing height above the coal seam. Above this zone, groundwater flow is predicted to be governed by pre-mining hydraulic conductivity distributions within a so-called constrained zone. Hence for an alluvium thickness of say 30m, the constrained zone is expected to be at least 120m thick. Parameterisation of this zone has been questioned in a number of submissions, particularly in regard to the use of matrix hydraulic conductivities to represent the zone. Accordingly, the expected flow characteristics have been further considered using a column model to review the ‘bulk’ conductivities adopted in the reported regional flow models W3 and W4[1].

Formations that occur within the constrained zone include the Patonga Claystone and the underlying Tuggerah Formation. The Patonga Claystone is comprised of brown-green claystones and to a lesser extent, laminites, siltstones, and fine grained sandstones. The underlying Tuggerah Formation is also comprised of claystones which are not dissimilar to the Patonga Claystone but there is an increased presence of laminites, siltstones and sandstones. In both units, individual lithofacies range in thickness from less than 0.2 m to more than 10 m.

Figure 1 provides an overview of stratigraphy in the form of lithological logs for five exploration boreholes distributed as shown on Figure 2. Logged rock types are presented in a simplified form showing lithofacies that are either predominantly low conductivity claystones-siltstones (orange) or sandstones-conglomerates (blue). Layers associated with low conductivity strata are clearly present throughout much of the stratigraphic column. Hence the system from a matrix flow perspective is regarded as highly anisotropic.

Intermittent sub vertical joints are also observed in core samples. They occur as tight micro fractures or as calcite infilled micro fractures. The opposing faces of non infilled joints commonly appear to be freshly broken suggesting minimal historical groundwater movement. An exception to these general observations is the Terrigal Formation where strata at higher elevations (above the valley floor) exhibit weathering in the rock matrix and on joint faces.

A conceptual model of the pre-mining groundwater flow regime assumes:

1. a stratified hardrock system where matrix properties govern flow in strata below the valley floor while joints may enhance flow in strata above the valley floor;
2. the matrix flow system is highly anisotropic in all stratigraphic units ie. vertical hydraulic conductivities are significantly lower than horizontal conductivies;
3. flow may be enhanced by the presence of joints providing that joint characteristics including extents, apertures and connectivities are favourable;
4. vertical extents of individual joints in strata below the valley floor are assumed to be less than 10 m and horizontal separations between joints are assumed to be greater than 5m. They form a generally disconnected network;
5. hydraulic conductivities decline with increasing confinement (depth);

[1] Models reported in MER, 2013

1.2 Assessment of strata hydraulic conductivities

Regional strata conductivities (Kh) were assessed during the geological exploration programme by packer testing and core testing.

The packer test technique isolates a section of a borehole and water is then injected into the isolated section and the rate of flow measured. Analyses are generally based on the assumption of radially outwards horizontal flow from the borehole. Since large sections of a borehole were tested during the exploration programme, the test intervals included lithologies with different horizontal conductivities. This will have resulted in preferential flow to those lithologies exhibiting the highest conductivities – typically medium to coarse grained sandstones, and biased the results. Hence small scale variations in the hydraulic conductivities (and anisotropy) cannot be assessed using this test method.

More focused assessment of the matrix conductivity of the strata, was undertaken by laboratory analysis of cores as reported in the MER 2013. Tests could not be conducted on claystones since the finely bedded nature of this rock type combined with the age of the stored core, resulted in failure of test samples during preparation. Hence all reported core test results were for laminites, siltstones, sandstones and conglomerates which are generally considered to be more conductive than claystone by an order of magnitude. Values determined by laboratory testing for the Patonga Claystone range from 8.88E-07 up to 1.47e-03 m/day while for the Tuggerah Formation, values range from 1.49e-07 to 1.59e-02 m/day. The lower values are associated with laminites and siltstones while the higher values are associated with coarser grained sandstones. Matrix horizontal and vertical conductivity values for the claystone lithofacies are expected to be less than 1.0E-07 m/day and 5.0E-08 m/day respectively.

1.2.1 Joint assessment model

Core inspections[2] indicate the strata host intermittent joints. During inspections, joint apertures were commonly observed to be less than .04 mm this being the limit of resolution with a hand held loup magnifier[3]. Many were infilled with calcite while others were not. Inspection of non infilled joints also indicated apertures to be less than 0.04mm while the opposing faces were typically fresh. These observations suggested that in situ (confined) apertures that are not infilled, are less than .02 mm in width.

In order to understand the potential contributions from observed joints and to facilitate an upscaling from single joint characteristics to an equivalent porous media representation (EPM) for the regional flow models W3 and W4, a finite element flow model was developed using Feflow. This model code has a capacity to include discrete fractures. A conceptual model for this analysis assumed a single vertical joint extending across a 5 x 5 x 5 m block of rock and over the full thickness of the block. The equivalent saturated hydraulic conductivity was determined by applying the Hagen Poiseuille approximation for flow through a fracture. The analysis was based on a host matrix conductivity of 5.0E-07 m/day and indicated an upscaled Kv of about 1.4E-06 m/day for a fracture mechanical aperture of 0.02mm (hydraulic aperture of 0.01mm allowing for fracture roughness and other losses). Inclusion of additional fractures of limited extent[4] in the 5 x 5 x 5 m block model made little difference to the EPM thereby demonstrating that small but disconnected fracture clusters would be unlikely to enhance flow at the larger scale.

[2] inspections undertaken on numerous occasions by MER but long after core was obtained.
[3] 0.04mm is the approximate thickness of light weight note pad paper
[4] limited extent fractures did not full penetrate the block

1.2.2 Upscaled column model

The regional groundwater flow models W3 and W4 reported in the EA have relatively thick layers (30 to 50 m) assigned to the different geological formations. Hydraulic conductivities in these models were based on analyses of lithological logs and formation conductivity test results.

A column model CM1 was employed to explore sensitivities to localised variability in conductivities as reported in the EA[5]. This model is 1 Ha (100 x 100 m) in area and comprises 24 layers discretised into 5 x 5 x 5 m cells. The variability of hydraulic conductivities throughout the entire column was based on a log normal distribution. This model did not specifically the potential influence of joints pn the conductivity distribution. Additional models have since been developed which address conductivities derived as joint related EPM estimates.

A second model CM2 has been developed whereby vertical conductivities in each 5 x 5 x 5 m cell have been assigned a matrix conductivity of 5.0E-07 m/day. Imposed on this 'host' conductivity are randomly distributed cells with a vertical conductivity of 1.1E-05 m/day, this being the EPM conductivity for a non infilled joint that extends across an individual cell with an aperture of 0.02 mm. A 50% probability of occurrence has been assumed. Thus in a single model layer comprised of 400 cells, 200 cells are assumed to host a non infilled joint. These 200 'joint' cells are randomly distributed in each layer resulting in horizontal separations as low as 5 m in some areas, and more than 15 m in other areas. The assigned randomness also generates some parts of the model exhibiting joint heights of more than 20 m. A log normal distribution was adopted for horizontal hydraulic conductivities in each layer of the column model based on a mean value of 1.0E-02 m/day and a variance of 1. These elevated horizontal conductivities promote hydraulic connection between vertical joints.

The main differences between this model and the model CM1 reported in the EA are:

1. the randomisation on a layer by layer basis which is considered to more closely represent field conditions rather than randomisation of the entire column;
2. the simplified nomination of a jointed cell using a uniform random deviate to generate a 50% probability of occurrence while randomly introducing joint connectivity through the alignment of several vertical cells.

Figures 3a and 3b illustrate the vertical column and the potential for tortuous flow pathways (jointed cells shown in red), while Figures 4a and 4b show conductivity distributions for the uppermost eight layers. Figure 5 provides typical frequency histograms for horizontal conductivities in the uppermost eight layers. These histograms show that horizontal conductivities are nearly all greater than 1.0E-04 m/day while approximately 50% are greater than 1.0E-2 m/day or about 4.5 orders of magnitude higher than a claystone-laminite-siltstone conductivity.

The equivalent saturated vertical hydraulic conductivity for the column model has been assessed by determining the rate of flow through the model for a specified head gradient. This rate was then used to calculate the equivalent vertical conductivity (Kv) using Darcys Law. Repeated randomisations and simulations yielded vertical conductivities ranging from 3.17E-06 to 3.38E-06 m/day with a mean value of 3.27E-06 m/day. This mean value is lower than the value of 3.8E-06 m/day used in the regional groundwater flow models W3 and W4 for the Patonga Claystone, and higher than the value of 1.5E-06 m/day used for the Tuggerah Formation.

A third model CM3 was based on model CM2. However instead of applying a host matrix vertical conductivity of 5.0E-07 m/day uniformly throughout the model, alternating values were applied to represent either claystone-siltstone or sandstone layers. That is, layers 1 and 2 were assigned a value of 5.0E-07 m/day, layers 3 and 4 were assigned a value of 2.0E-06 m/day, layers 5 and 6 were assigned a value of 5.0E-07 m/day and so on. Imposed on this domain are randomly distributed cells determined in the same manner as model CM2 with a vertical conductivity of 1.1E-05 m/day representing a jointed cell. Repeated randomisations yielded vertical conductivities ranging from 3.39E-06 to 3.80E-06 m/day with a mean value of 3.70E-06 m/day. This mean value is similar to the

[5] See Section E7.4.1 in Appendix E, MER 2013.

value used in the regional groundwater flow models W3 and W4 for the Patonga Claystone and higher than the value used for the Tuggerah Formation. Importantly the model demonstrates that in an interbedded sequence, the lower conductivity layers tend to govern the EPM conductivity.

1.2.3 Uncertainty in joint occurrence

Uncertainty in the nominated intermittent occurrence of joints has been addressed in a fourth column model CM4 by adopting model CM3 layered structure but assuming a non infilled, fully penetrating joint is present in 90% of the 5 x 5 x 5 m blocks. This substantially increases the likelihood of connected cells in the vertical direction. Repeated randomisations and simulations of this scenario yielded an EPM vertical conductivity with a mean value of 1.04E-05 m/day. This mean value is about an order of magnitude higher than the values used in the regional groundwater flow models W3 and W4.

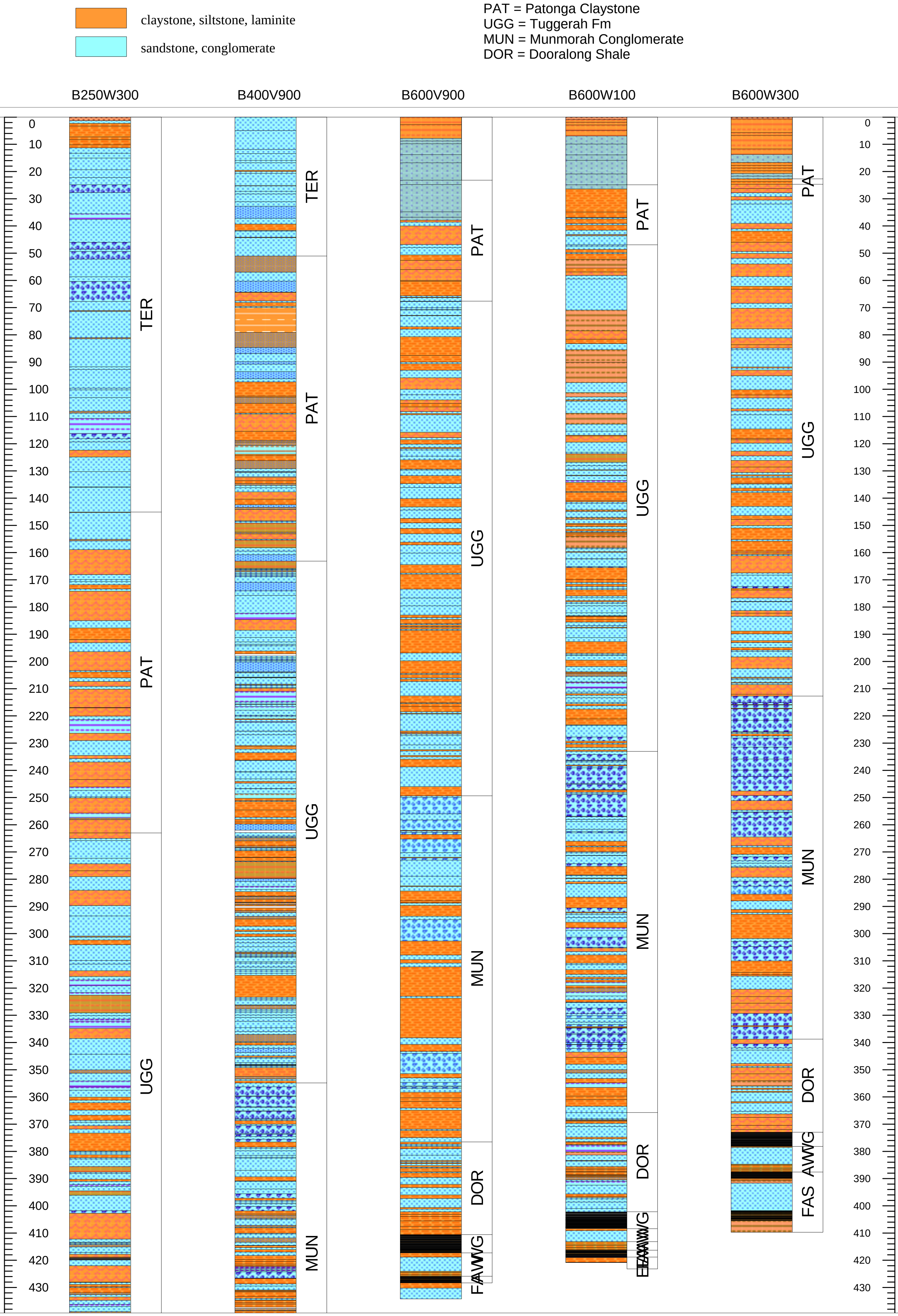
While inconsistent with observations, if the scenario simulated by model CM4 were to occur, then the predicted leakage from the alluvial lands would increase by about an order of magnitude from 2 millilitres per day per square metre to about 20 milliltres per day per square metre. This leakage rate remains low and would be offset by rainfall recharge which has been calculated at an average rate of 410 millilitres per day for the relatively dry period from 2002 to 2007.

1.2.4 Modelling outcomes

Column modelling outcomes can be summarised as follows:

- The adopted pre-mining vertical conductivities (Kv) for the Patonga Claystone and the Tuggerah Formation in the regional flow models is higher than the expected conductivity for a claystone -siltstone matrix by at least an order of magnitude;
- The adopted pre-mining horizontal conductivity (Kh) for the Patonga Claystone and the Tuggerah Formation in the regional flow model is higher than the expected matrix conductivity for a claystone -siltstone matrix by two orders of magnitude;
- Inclusion of joint related conductivity enhancement in a randomised way in a uniform vertical conductivity environment yields an EPM Kv value of similar magnitude to the values used in the regional flow models W3 and W4 reported in the EA;
- Inclusion of joint related conductivity enhancement in a randomised way in a layered vertical conductivity environment, also yields an EPM Kv value of similar magnitude to the values used in the regional flow models W3 and W4;
- Increasing the frequency of non infilled joints to a fully penetrating joint in 90% of the model cells yields an EPM Kv about one order of magnitude higher than values used in the regional flow models W3 and W4;
- Enhancing the horizontal conductivity (Kh) in a randomised way by several orders of magnitude above the values adopted in the regional flow models, does not significantly affect the EPM vertical conductivity (Kv);

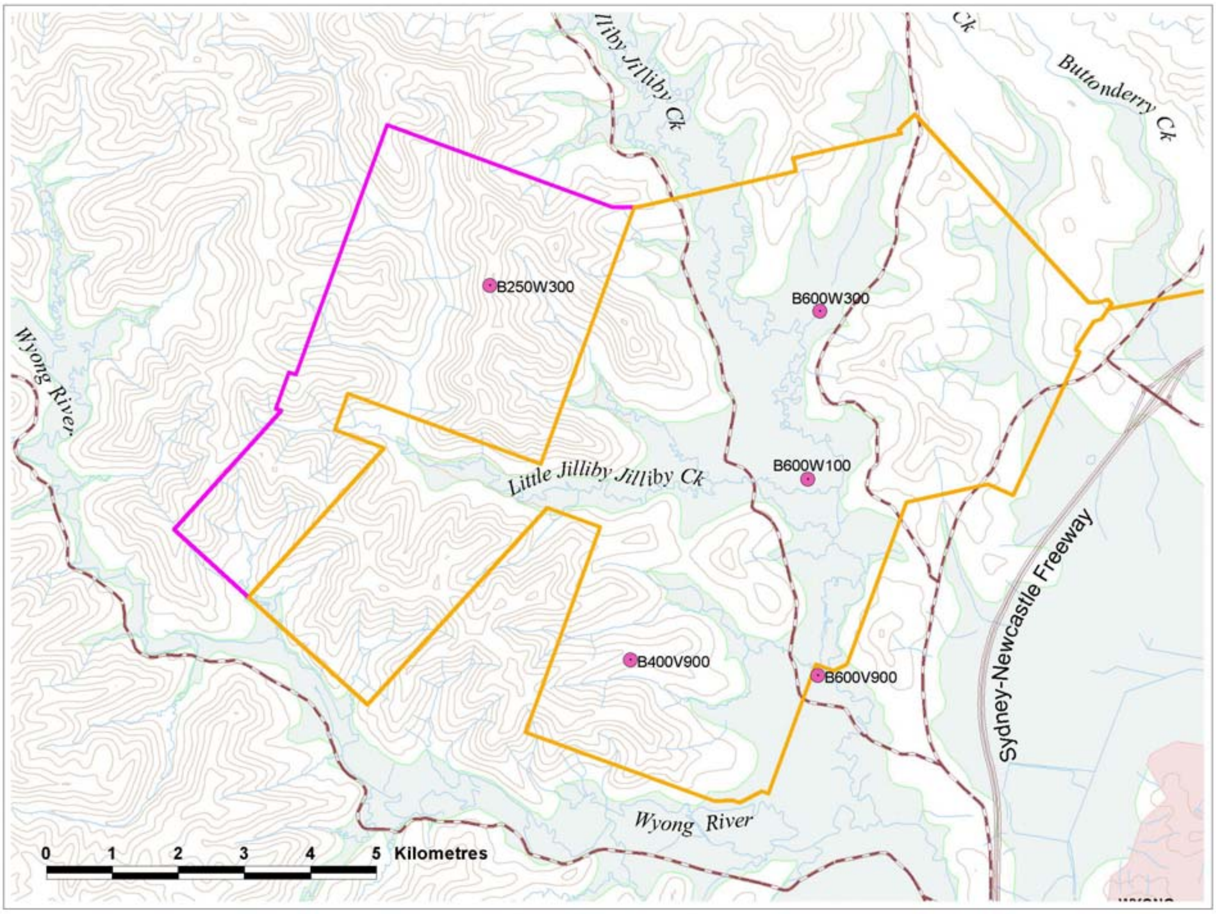
Overall outcomes demonstrate that the groundwater system can be viewed either as a matrix flow system or a fracture flow system reduced to an equivalent porous media representation.



Mackie Environmental Research

Comparison of logged lithofacies

Figure 1



Locations of boreholes for litho-logs
Figure 2

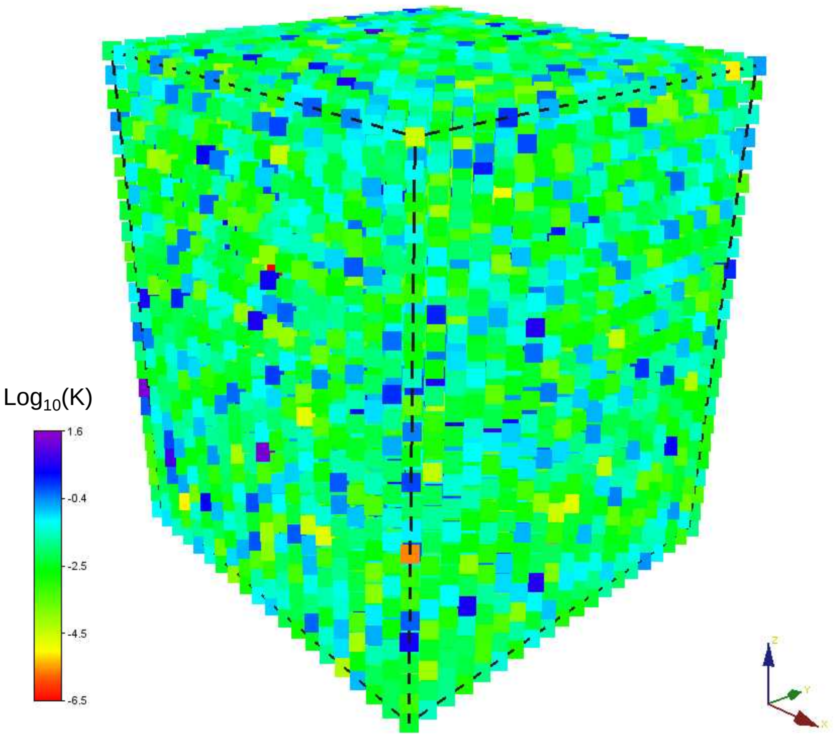


Figure 3a: Horizontal conductivity Kh

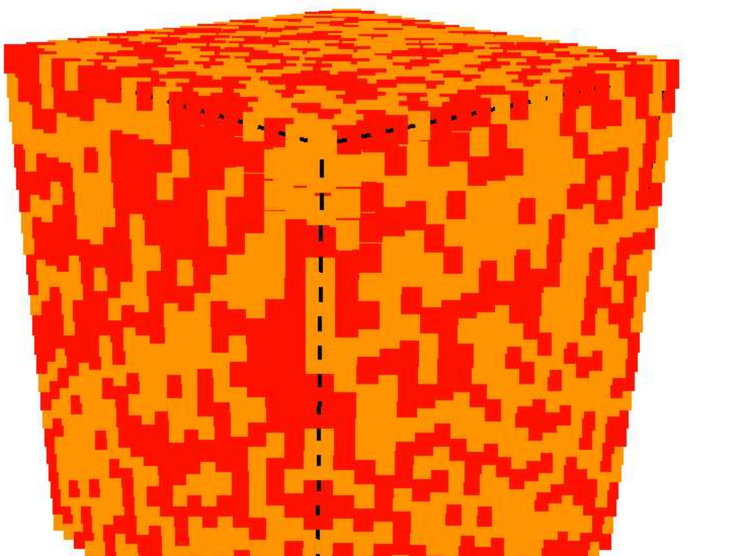
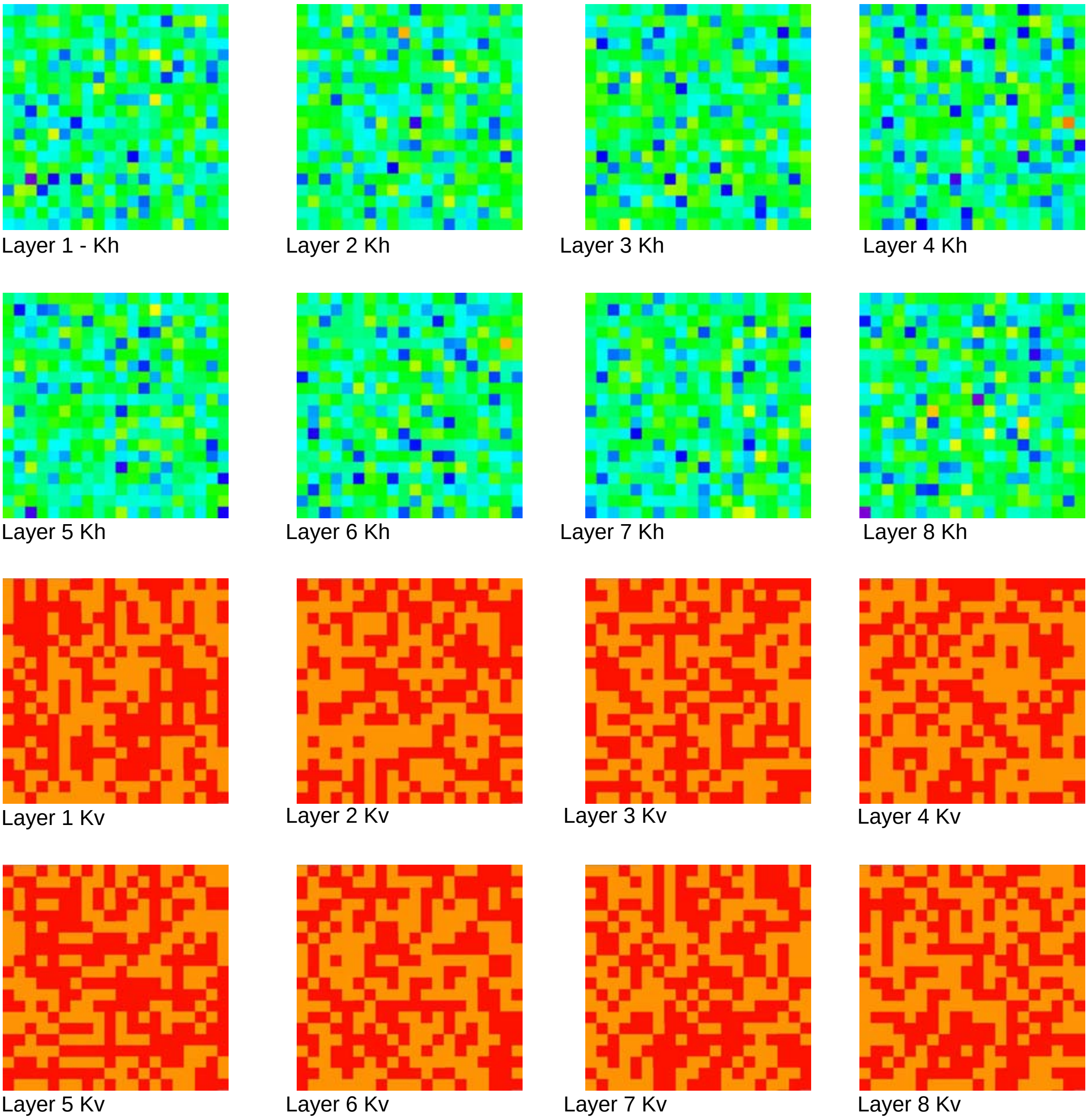
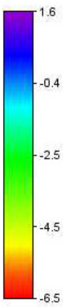
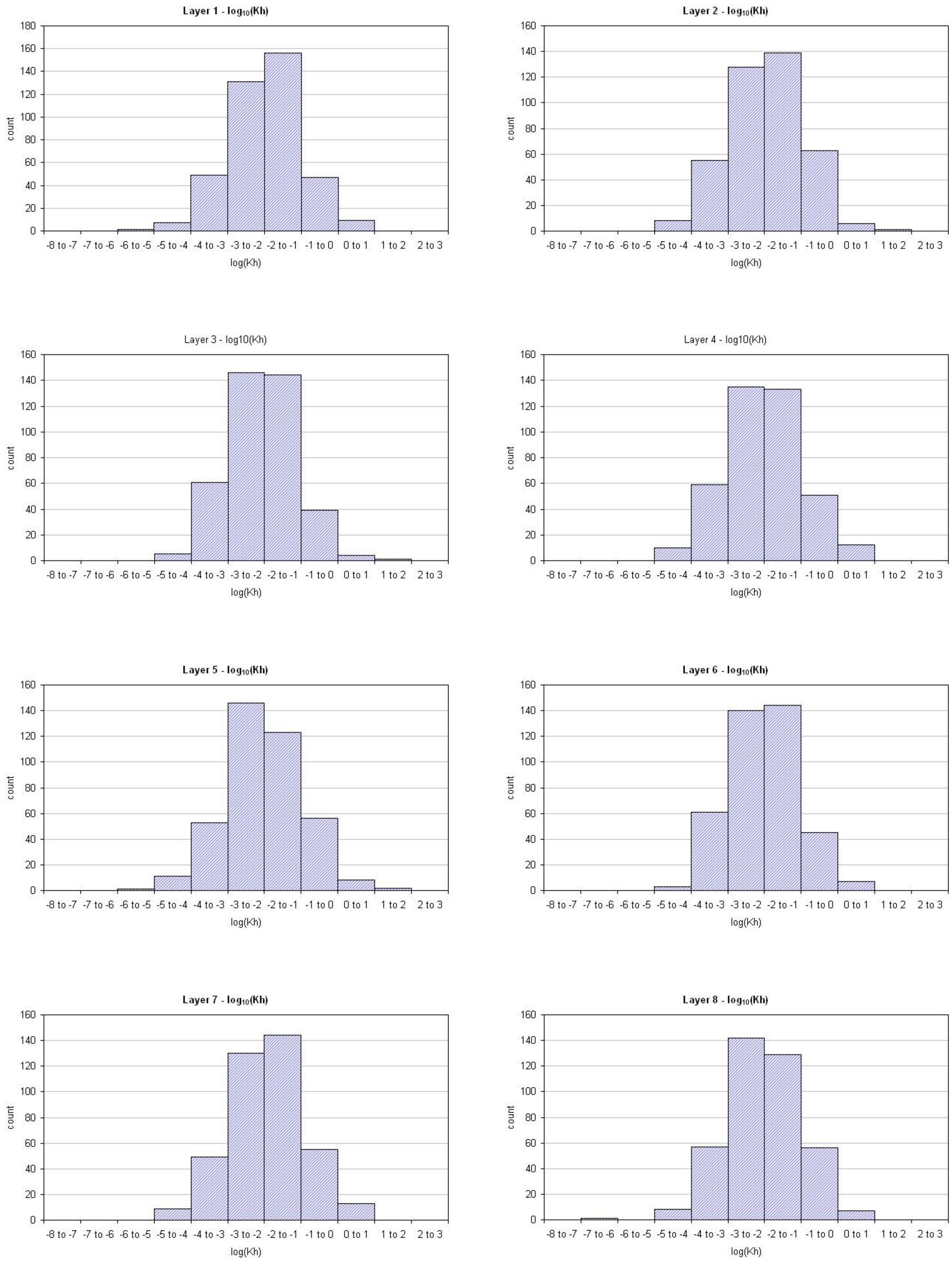


Figure 3b: Vertical conductivity Kz



Uppermost layers 1 to 8 illustrating distributions





Frequency histograms for horizontal conductivity in layers 1 to 8
Figure 5

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Appendix E

Aquatic Ecology Survey Results

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AQUATIC ECOLOGY SAMPLING
WYONG RIVER & WALLARAH CREEK CATCHMENTS

SPRING 2012 & AUTUMN 2013

Large Sydney crayfish from Little Jilliby Jilliby Creek site LJ3 Spring 2012

REPORT PREPARED FOR WACJV

MARINE POLLUTION RESEARCH PTY LTD
AUGUST 2013

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APPENDIX A FIELD NOTES, SITE PHOTOGRAPHS AND SAMPLING DATA

1 INTRODUCTION

The Wyong Areas Coal Joint Venture (WACJV) is seeking Development Consent under Division 4.1 in Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Wallarah 2 Coal Project (the Project). Hansen Bailey Environmental Consultants prepared an Environmental Impact Statement ('The Wallarah 2 Coal Project Environmental Impact Statement' (Wallarah 2 EIS) to support the application and Marine Pollution Research Pty Ltd (MPR) prepared an Aquatic Ecology Impact Assessment for the EIS in accordance with the Director-General's Environmental Assessment Requirements (DGRs) for the Project issued 12 January 2012.

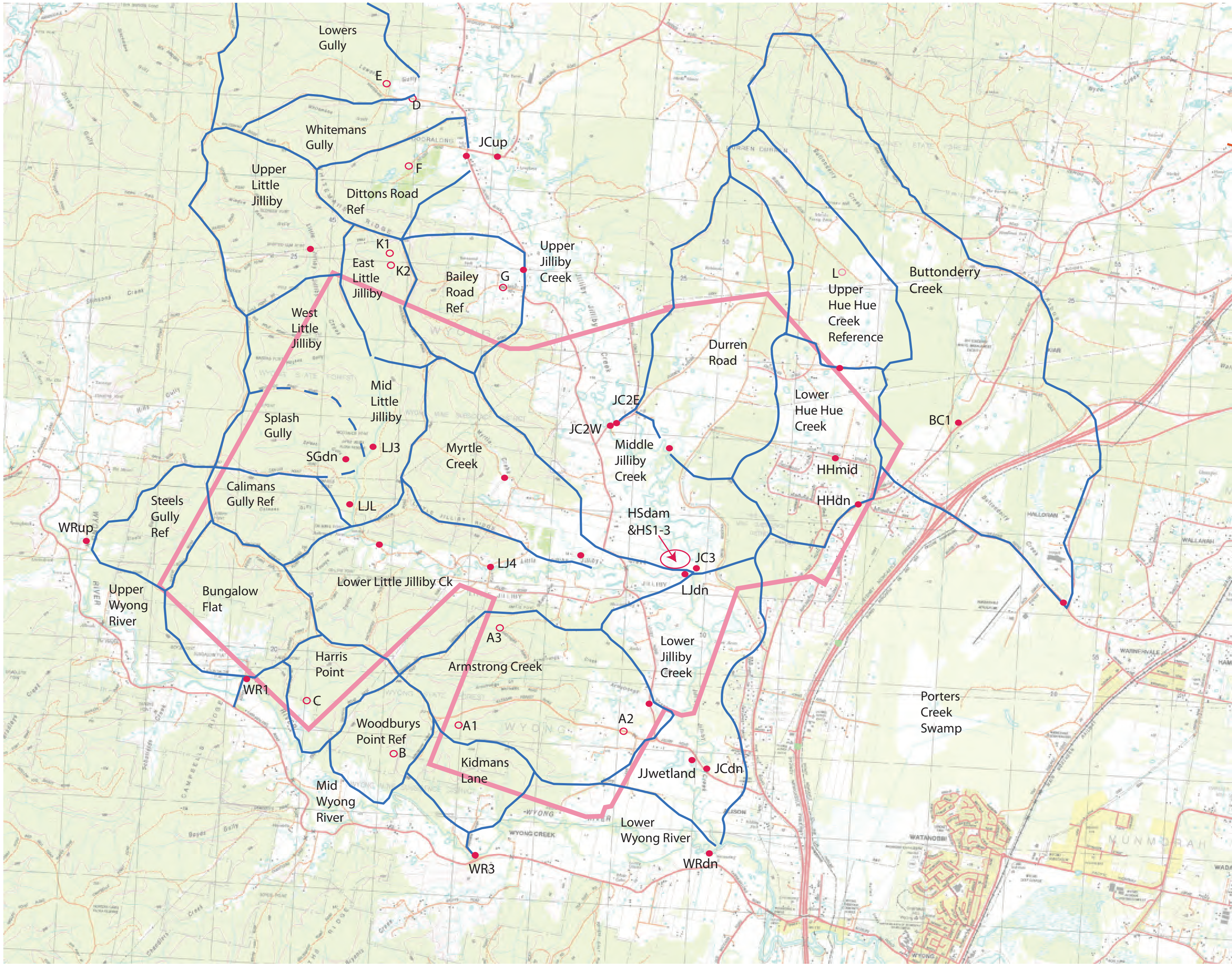
This report provides the results of continuing baseline aquatic ecology surveys for the W2CP that have been undertaken in accordance with the commitment to provide an Environmental Management Plan (EMP) which will incorporate the existing aquatic ecology study sites and data, and data from on-going biannual (Autumn and Spring) studies, in order to provide baseline data against which changes that may be attributable to construction or operation of the mine can be measured.

1.1 Streamhealth Study Area

The aquatic ecology (streamhealth) study area comprises the combined drainages above the proposed underground mine footprint, the Buttonderry mine access site, the Tooheys Rd CHPP site works and offset areas and the receiving aquatic habitats downstream of the mine footprint area. The combined project drainages all eventually discharge to the Tuggerah Lakes estuary, which comprises three coastal lagoons, Tuggerah Lake, Budgewoi Lake and Lake Munmorah draining a total catchment area of around 700km^2

Figures 1 and 2 show the relationship of the proposal to the various river and creek drainage sub-catchments draining under or through it. These drainages are grouped as follows:

- Drainages over the mining footprint discharge to Wyong River via thee different pathways;
  - o via Wyong River direct (ridge sub-catchments west of Watagan Forest Drive ridge),
  - o via Jilliby Jilliby Creek draining through the Dooralong Valley to Wyong River (ridge sub-catchments east of Watagan Forest Drive ridge and west of the foothill ridge line west of Dickson Road,
  - o via Hue Hue Creek east of the Dickson Road ridge line which then drains to Wyong River via Porters Creek Wetland.



Sub-catchment Aquatic Ecology Sampling Site Network

Outline of Proposed LOng Wall Mine

FIGURE 1

W2CP PROPOSED LONGWALL MINING & BUTTONDERRY INFRASTRUCTURE AREA FOOTPRINT AND ASSOCIATED WYONG RIVER SUB-CATCHMENT TRIBUTARIES

FIGURE 2
PROPOSED W2CP
TOOHEYS RD
INFRASTRUCTURE
& ASSOCIATED
WALLARAH CREEK
SUB-CATCHMENTS

- The Jilliby Jilliby Creek and Wyong River catchments form part of the Wyong LGA potable water supply system with water take-off located at the Wyong Weir, some 3.2 km downstream of the Jilliby Jilliby Creek confluence.
- The Buttonderry infrastructure area drains to Buttonderry Creek and this creek plus Hue Hue Creek (partially located over a portion of the underground mine) drain to Porters Creek Wetland, a regionally important wetland protected under a State Environmental Protection Policy (SEPP14). Porters Creek drains to Wyong River below the weir.
- The Wyong River below the weir is brackish to estuarine and tidal.
- The Tooheys Road infrastructure area is located in semi rural areas on small sub-catchments of Wallarah Creek discharging to Budgewoi Lake, which in turn drains to Budgewoi Lake.

1.2 Study Methods

In terms of overall study aims, the Aquatic Ecology baseline study endeavours to answer the following questions:

- Where are the aquatic habitat resources in the study area?
- What are the ecological and riparian attributes of the study area aquatic habitats?
- Which of the aquatic resources provide suitable and sustained aquatic habitat for fish and other aquatic biota?
- Do the creeks and streams provide suitable fish passage?
- Are there any protected or threatened aquatic species or communities residing within the study area, or any mammals such as platypus and Australian water rat that may utilise the aquatic resources of the study area?

1.2.1 Sample site selection and aquatic ecology sampling methods

The overall study design for assessing current surface water aquatic ecological condition and potential condition during and post infrastructure construction and mining aims to locate key sampling sites upstream and downstream of proposed activities and of important stream confluences that will allow discrimination of possible impacts from mining and other sources in tributary streams. A further aim is to target important streams or stream reaches as defined as *Key Fish Habitat* by Fisheries NSW.

The major constraint on design for this project has been site accessibility, either to stream sections or water bodies in public lands with no or closed-road access (particularly during wet weather, as was the case for the original baseline study program reported for the EIS) and access to suitable sites within private property. An additional constraint, especially for sub-catchment stream head-waters, is availability of suitable aquatic habitats for sampling. That is, for some low-order headwater streams there may not be any permanent or even semi-permanent water bodies to sample.

Accordingly, the initial design has had to utilise public access sites (at road bridges or stream verges below public roads) for locating many of the sites. As study sites generally represent a stream reach of around 100 m long, this has meant that that as the project has progressed and additional site access becomes available, some of the sites can be moved to optimise their location. The continuing seasonal sampling program also allows more sites to be added so as to increase the spread and representativeness of the combined streamhealth survey over time.

Figures 1 and 2 show the sites that have been visited or sampled to date and the sites able to be sampled in Spring 2012 and Autumn 2013. It should also be noted that there are a number of off-stream storages/farm dams that are designated key fish habitat and there are numerous other large farm dams or ponded areas, particularly on the Jilliby Jilliby Creek floodplain that are also likely to provide valuable aquatic habitat. Few of these are currently accessible, but it is expected that more could become available for sampling in subsequent seasons.

Note that the base-line study does not aim to sample all sites at each season but rather aims to sample a representative number of sites each time to provide change-over-time information for the major streams and increase the overall aquatic habitat knowledge base by spot sampling additional sites at least once over the pre-approval sampling period. The sampling methods to achieve the study aims are as follows:

- Sampling the aquatic macroinvertebrate fauna twice a year (in spring and autumn) using the AusRivAS sampling, sorting and identification protocols. Note that for AusRivAS standardised sampling purposes the 'autumn' sample season is defined as March 15 to June 15 and 'spring' is defined as Sept 15 to Dec 15.
- Recording of changes in site riparian and aquatic habitat condition and of aquatic plant distribution within the study areas at each sampling time, including site photographic log.
- Estimation of fish occurrence by a combination of overnight and short-term bait-trapping, dip netting and observation, with all captured fish identified in-situ and immediately released wherever possible
- Metered depth profiles of basic water quality parameters at each site.
- Platypus and Australian water rat habitat and collection of turtle, reptile and aquatic bird observations during field sampling activities.

Table 1 Wallarah Site Sample Schedule Spring 2012 and Autumn 2013

Catchment	Site	Coordinates		Full sample	SDL WQ	Overnight Fish	RCE
		E	N				
Wyong River	WR1	344202	6319627	Au13,Sp12		Au13	
Jilliby Jilliby Ck	JC3	349885	6321367	Au13,Sp12		Sp12	
	JCDn	350145	6318801				Au13
	JJ Wetland	349681	6319065		Au13	Au13,Sp12	Au13
Little Jilliby Jilliby Ck	LJ3	345629	6322449	Au13,Sp12			
	LJDn	349770	6321259	Au13,Sp12		Au13,Sp12	
	LJL	345473	6322100	Au13,Sp12			
	SGDn	345417	6322470	Au13,Sp12			
Honeysuckle Park	HSDam	349780	6321487	Au13,Sp12		Au13,Sp12	
	HS1	349208	6321465		Sp12		
	HS2	349474	6321440		Sp12		
	HS3	349670	6321604		Sp12		
Spring Ck	SW1	357437	6324827	Au13,Sp12			
Wallarah Ck	WC1	356608	6324188	Au13,Sp12		Au13,Sp12	
Hue Hue Creek	HHMd	351545	6322809	Au13,Sp12			
Note: Full sample includes SDL, macroinvertebrate sampling and RCE Overnight fish represents setting multiple overnight fish traps							

Table 1 provides site information and shows the fish and aquatic macroinvertebrate sampling schedule adopted for the Spring 2012 and Autumn 2013 surveys, and Figures 1 and 2 show the location of sampling sites. Additional field water quality readings, overnight fish trapping and/ or RCE descriptions were undertaken at a number of locations in Honeysuckle Park, Jilliby Jilliby Creek and a wetland adjacent to Jilliby Jilliby Creek.

For both of the Spring 2012 and Autumn 2013 surveys there were five new monitoring sites sampled in the catchments of Little Jilliby Jilliby and Jilliby Jilliby Creek catchments;

- Site JC3 was sampled in Jilliby Jilliby Creek above the confluence with Little Jilliby Jilliby Creek, adjacent the Honeysuckle Park property.
- Site LJ3 is located midway along the length of Little Jilliby Jilliby Creek in Wyong State Forest, above the confluence with Splash Gully Creek.
- Site LJL is a lagoon situated in Wyong State Forest adjacent to the main drainage channel of Little Jilliby Jilliby Creek.
- Splash Gully site SGDn is located within the Wyong State Forest, at the downstream end of Splash Gully Creek.
- Site HSDam was sampled in a Honeysuckle Park dam located within a close proximity to Jilliby Jilliby Creek.

1.2.2 Macroinvertebrate Sampling Methods

The aquatic macroinvertebrate assemblages are determined using the standardised AusRivAS sampling protocol (Turak et al 1999, Turak et al 2004, Chessman 2003b), which provides a number of definitions of sites, and of habitats within sites, for selection of sampling locations. The following AusRivAS definitions are relevant and sampling has conformed to these definitions:

- A site is "a stream reach with a length of 100 m or 10 times the stream width, whichever is the greater"
- A riffle habitat is "an area of broken water with rapid current that has some cobble or boulder substratum". However, “sampling riffles where the substratum consists predominantly of large boulders may be difficult and may not produce reliable results".
- Edge habitat is "an area along the creek with little or no current".

Ideally, AusRivAS recommends that, wherever possible, two habitats (riffles and edges) be sampled at each site and that a particular reach within each of the sample locations is selected on the basis of it being (i) a reach with high drought resistance (generally based on pool size, depth and riparian cover) and (ii) a reach with high aquatic habitat diversity; ideally deep pools connected by gentle riffles, abundance of stream bed litter, presence of snags, presence of aquatic vegetation and good extent of cover of overhanging riparian vegetation. In practice, given that the study area catchment does not provide many AusRivAS defined riffle zones and those that do exist are generally ephemeral, it was decided that the main sampling unit should be pool 'edge' samples, as riffle samples cannot be guaranteed for all (or possibly even for most) sites at all sample times. This is in line with most aquatic ecology sampling practice for Hunter/Newcastle coal mining areas.

1.2.3 Field methods for macroinvertebrate sampling

Macroinvertebrate assemblages are sampled using a 250 μm mesh dip net over as many aquatic 'edge' habitat types as can be located within each of the pools along the defined stream reach. Net samples are then placed into white sorting trays for in situ live sorting. Live sorting (picking) is undertaken for up to 1 person-hour (with a minimum of 40 minutes), as per the AusRivAS protocol. Following cessation of live picking, further observations are made of the pool edges for surface aquatic macroinvertebrate taxa (e.g., water skaters and spiders) and any other taxa (such as freshwater crayfish) not collected by the dip netting process. Where possible (or necessary) representatives of these organisms are collected and added to the dip net samples.
Specimens for which positive identifications can be made in the field (especially the

rarer specimens such as e.g., water scorpions), were generally released. That is, for protection of the pool macroinvertebrate integrity, we adopt a 'sampling with replacement' approach. Notwithstanding this procedure, for most taxa that can be positively identified in the field, at least one of each of the field identified taxa are retained as a representative of that taxa for that sampling event. For all other macroinvertebrate taxa where field identifications are not definitive, specimens are retained for later detailed taxonomic analysis in the laboratory. Notes are also kept of the presence of burrows and holes that are present in the site aquatic habitats (i.e., as indications of yabbies or burrowing dragonflies).

All retained specimens are placed in sample jars preserved in 70% ethanol for subsequent laboratory identification. Sample jars are labelled and paper laundry tags are inserted noting the sample site, sample date and sample collector/picker initials.

1.2.4 Laboratory methods for macroinvertebrate samples

In the laboratory, taxonomic identifications are generally facilitated using Maggy lights or binocular dissecting microscopes. The following taxonomic guides have been found to be the most useful; CSIRO, Land and Water Resources & Environment Australia (1999), Hawking & Smith (1997), Hawking & Theischinger (1999) and Williams (1980).

Organisms are identified (as a minimum) to the appropriate taxa level as per AusRivAS protocols. These are as follows; family level for all insect taxa except Chironomids which are taken to sub-family). Collembola arthropods (springtails) are classified as a single class and the arachnid arthropods (spiders and mites) are classified as two orders. For the mites (Order Acarina) we have taken them to sub-order classification level where possible. Crustaceans were taken to Family level where suitable keys are available. Ostracoda were left at Class level. The worm like taxa are shown at Phylum or Class level. For all taxa, where suitable keys were available, taxa were identified to lower levels of taxonomy.

The sorted specimens are then transferred to individual glass vials (one per family/sub-family) and paper laundry tags inserted into each glass vial with the sample site, sample date and initials of taxonomist noted on the tags. Glass vials are then topped up with 70 % alcohol, sealed with plastic lids and placed back into the original field sample jars. Where there are any individual specimens where the collected material is too indistinct or fragmented to assign a definitive identification, the samples are dispatched to relevant Australian Museum specialists or other specialists, as recommended by EPA.
For all samples the following taxonomic QA/QC procedure is followed:

- At least ten percent of the samples/sites are selected at random and the individual retained taxa are identified without reference to the original identifications. A table is then made of the original identifications verses the second identifications, indicating where there were any anomalies in identification (if any).
- If there are no anomalies, the QA/QC sample protocol is accepted and no further QA/QC checking is undertaken. If there are differences in identifications, all the samples containing the related taxa are re-examined to clear up the anomalies.
- Following this procedure, and if there have been anomalies, an additional 10 percent of the remaining samples are chosen and the QA/QC procedure re-applied.
- This process continues until there are no differences between original identifications and QA/QC identifications.

1.2.5 Site SIGNAL index calculations

The aquatic invertebrate assemblage for each sample site is described in terms of site taxa diversity (number of individual AusRivAS taxa) and in terms of a site SIGNAL score. SIGNAL (Stream Invertebrate Grade Number Average Level) is a pollution tolerance index for stream macroinvertebrates. The indices are derived by correlation analysis of macroinvertebrate occurrence against water chemical analysis (Chessman 1995). The water chemistry attributes generally used are temperature, turbidity, conductivity, alkalinity, pH, dissolved oxygen, total nitrogen and total phosphorus (Chessman 2003a). Site SIGNAL scores are graded into the following generalised categories (Chessman *et al*. 1997):

- SIGNAL Index > 6 = Healthy Unimpaired
- SIGNAL Index 5-6 = Mildly Impaired
- SIGNAL Index 4-5 = Moderately Impaired
- SIGNAL Index < 4 = Severely Impaired.

SIGNAL indices may be regionally specific (e.g. SIGNAL HU-97 developed for the Hunter Valley Catchment - Chessman 1997), or applicable Australia wide (e.g. SIGNAL-2, Chessman 2003a). For the present study SIGNAL-2 scores will be applied as over time, MPR has found that the HU-97 scores have proved to be limited in that only a limited proportion of the aquatic macroinvertebrate taxa now known from the Hunter/Newcastle region has allocated HU-97 SIGNAL scores. Taxa with no published SIGNAL score are excluded from the site SIGNAL analysis.

Once individual taxa SIGNAL indices have been applied, site SIGNAL scores are calculated as the mean of the individual taxa SIGNAL indices. For coherent groups of sites (e.g., all sites within a stream/river or all dam sites within a catchment), combined weighted stream or habitat type (dams) scores can be calculated in the same way from the combined taxa for the stream/habitat types. Site and stream/habitat SIGNAL scores can then be compared spatially (across each survey) and temporally (between surveys).

1.3 Sampling Methods for Fish and other Vertebrates

At each macroinvertebrate sampling site four fish bait traps (dimensions 250 mm by 250 mm by 400 mm, 4 - 5 mm mesh size and 50 mm diameter entrance) are set at suitable locations. These are left in the stream either overnight, or for the duration of the combined macroinvertebrate sampling and live picking survey (minimum 1.5 hours), and then retrieved. Captured fish are identified in situ and released. Any fish caught or observed as part of the macroinvertebrate dip net sampling are also identified, noted and released. Fish specimens that die during the sample process are retained with macroinvertebrate samples, and identified using suitable keys - Allen et all (2002) and McDowall (1996).

Following completion of the fish and macroinvertebrate sampling, any further observations of fish during the pool condition survey are also noted, with fish species-name only noted if positively identified. Any fish retained that are not positively identified are sent to the Australian Museum for confirmation of species identification.

For each survey, tadpoles (which are not macroinvertebrates but chordates) are noted in the results but are not kept or identified. Notes are also kept of the presence of reptiles, turtles, aquatic birds and bats that directly utilise the aquatic habitats. Spotlighting surveys for platypus and Australian water rat are undertaken at suitable river and creek locations within the hour before dark, and for a short period after dark to detect the emergence and activity of these aquatic animals.

1.4 Field Water Quality Sampling

A submersible Yeo-Kal 911 water quality data logger is used to record water depth, temperature, dissolved oxygen concentration and saturation, pH, conductivity and turbidity at all aquatic ecology sampling sites. Where possible depth profiles of water quality are made to test for layering/mixing. Physical observations are also taken in the field to highlight any aquatic habitat variations (e.g. recent rain, subsequent infilling, detritus in water column or on benthos, scum or flocculates in or on water body etc.). The data logger is calibrated prior to each sample occasion.

1.5 Site RCE and Aquatic Plant Descriptions

A standardised description of site condition is used to compile a stream site condition index, based on a modified version of the Riparian-Channel-Environment (RCE) Inventory originally developed by Petersen (1992), as reported by Chessman *et al* (1997) for the greater Hunter River catchment. The index is compiled by rating each RCE descriptor (13 in total), a score between 0 and 4, then summing the scores to reach a maximum possible score of 52. Scores are expressed as a percentage. Each site description also includes documentation of the aquatic plants (macrophytes) within each site length or more generally for the extended study area waterbody. Where possible the site descriptions include site photographs.

2 SPRING 2012 & AUTUMN 2013 SURVEY RESULTS

The Spring 2012 aquatic ecology survey was undertaken between the 22nd and 25th October 2012 and the Autumn 2013 survey was undertaken between the 21st and 29th May 2013. Note that the AusRivAS 'Spring' sample season is defined as September 15 to December 15 and the 'Autumn' sample season is defined as March 15 to June 15.

Field notes and site descriptions for all study sites over both seasonal surveys are presented in Appendix Table A-1, and the full results of the RCE site condition inventories are shown in Appendix Tables A-2 and A-3 (for Spring 2012 and Autumn 2013 respectively) and summarised below in Tables 3 and 5. Appendix A also includes site photographs comparing site conditions encountered during Spring 2012 and Autumn 2013.

In the months leading up to the Spring 2012 survey rainfall within the study area was generally well below average, despite an initial month of heavy rainfall encountered in July (as measured at Bureau of Meteorology Jilliby Jilliby rain gauge, and compared with Wyong Golf Club gauge for mean totals):

- Rainfall for the month of June totalled 148mm, much higher than the average monthly total of 113mm.
- The combined monthly rainfalls for July to September totalled 120mm, which is significantly less than the combined mean total of 217.3mm for the same three months.
- The month leading into the Spring 2012 survey was very dry, with only 7mm recorded over 4 rainfall days during mid October.

Following on from the the Spring 2012 survey, rainfall patterns were mostly above average with some significant rainfall events occurring within the inter-survey period:

- The months of October and December 2012 were dry with only 7mm and 49mm recorded respectively.
- November was above average with a total of 100mm, compared to the monthly mean of 81.7mm.
- A total of 751mm was recorded over the first four months of 2013, which is significantly higher than the combined average of 471.9mm over the same four months.
- This included a rainfall event of 306mm recorded over an eight day period in late January to early February, 162mm of which was recorded on the 29th January.
- Prior to the commencement of sampling for the Autumn 2013 survey there was

10mm of rain recorded over a nine day period between the 7th and 15th May.

- A total of 72mm was recorded over the week prior to sampling the remaining three sites in upper Little Jilliby Jilliby Creek catchment (LJ3, SGDn and LJL) on the 29th May.

2.1 Aquatic Ecology Site Sample Conditions

For both the Spring 2012 and Autumn 2013 surveys there were a total of ten sites (including five new sites that had not been sampled on previous sample occasions) that were sampled for fish and macroinvertebrates; one site in the Wyong River, one in Jilliby Jilliby Creek (plus an off-line farm dam at *Honeysuckle Park*, three sites in Little Jilliby Jilliby Creek (including an off-stream swamp/billabong site and a site in Splash Gully) plus one site each in Wallarah Creek, the western tributary to Spring Creek, and Hue Hue Creek.

Additional water quality measurements were taken in Jilliby Jilliby Creek and from surface water storages in Honeysuckle Park and a floodplain wetland adjacent to Jilliby Jilliby Creek (see Table 1 for the combined survey site sample descriptions).

2.1.1 Descriptions of new sampling sites

As noted above, there were five monitoring sites sampled for the first time during the Spring 2012 survey; Jilliby Jilliby Creek site JC3, Little Jilliby Jilliby Creek site LJ3 and lagoon site LJL, Splash Gully site SGDn and Honeysuckle Park dam site HSDam. These are described below.

Site JC3 is located in Jilliby Jilliby Creek upstream from the confluence of Little Jilliby Jilliby Creek. The Jilliby Jilliby Creek channel at the site is located on the eastern extent of the Dooralong Valley floodplain and the slopes bordering the valley are vegetated with native forest.

The land-use and riparian vegetation at the site is similar to that encountered at other Jilliby Jilliby Creek sites (JCUp, JC2E and JC2W), with a narrow riparian vegetated strip along the creek edge surrounded by agricultural lands throughout the shallow inclines of the valley basin.

The riparian corridor is continuous throughout the site length, consisting of mostly native rainforest and woodland vegetation with a high degree of cover. The meandering site channel is incised to a depth of 3 to 5m into the alluvial floodplain with undercut banks and sections of ongoing erosion, and there were numerous fallen trees and log jams within the site with a number of pool sections created from log jams (see Figure 3 below). During the Spring 2012 survey the maximum pool width was 6m with an average width of 2.5m, maximum depth was 1.4m with an average depth of 0.5m.

Figure 3: Jilliby Jilliby Creek site JC3 in Spring 2012 showing undercut and eroding banks (left) and pool sections created by log jams (right).

The site substrate consisted of mobile sandy sediments with sections of accumulated pebbles and gravels, and at the time of sampling the pool substrates were smothered in leaf detritus and the pool surfaces were covered in a film of algae. Stream flows were continuous throughout the site length and the water was mostly clear. There were no macrophytes observed at JC3.

In terms of site condition Site JC3 recorded a Riparian, Catchment and Environment Inventory (RCE) score of 79.8% (see Table 3 in Section 2.1.2 for site RCE score comparisons). There were higher site condition category scores for the continuity and quality of the riparian corridor, the depth/ width ratio of the channel, the alternation of riffle and pools, and the lack of excessive aquatic vegetation. Geomorophological features including channel instability, excessive sediment build-up and bank undercutting contributed to lower site condition category scores.

Site LJ3 is located midway along the length of the Little Jilliby Jilliby Creek drainage within the Wyong State Forest, above the Splash Gully confluence. The catchment area upstream of and surrounding the site is characterised by steep-sided narrow valleys with a number of small tributaries entering from the west. The main vegetation community along the watercourses within the sub-catchments and bordering the site channel within the riparian corridor consists of well established rainforest with high degree of cover.

The site channel is generally straight with a shallow incision into the surrounding valley floor, with the banks undercut on the bends but mostly shallow in profile (see Figure 4 below).

Figure 4: Site LJ3 showing undercut banks on corners (left) and orange precipitate (right).

The maximum stream width was 5m (average 2m), and maximum pool depth was 1.0m although the average depth at the time of sampling was only 0.3m.

There were numerous log-jams through the site length which created long pool sections that were intersected by shallow sandy races. For the Spring 2012 survey there was continuous trickle flow through the site length and the water was clear.

The substrate consisted mostly of sand with some boulder outcrops and pebble to gravel sized rock fragments intermixed with sand. Sections of the site substrates were smothered in a layer of orange precipitate, which was leaching from the edge bank areas (see Figure 4). There were no macrophytes observed and there was a sheen on the water surface noted during the site inspection.

Site LJ3 returned a relatively high RCE score of 87.5%. As for JC3, the lowest condition scores were for the categories relating to channel sediments, however LJ3 recorded 3 of the highest site condition category cores for the quality and continuity of the riparian environment and the channel structures.

Site SGDn is located at the downstream end of Splash Gully, which flows in an easterly direction from Watagan Forest Rd to meet with Little Jilliby Jilliby Creek a short distance downstream from site LJ3. The sub-catchment valley is steep sided and supports similar vegetation communities to that encountered at LJ3.

The channel is mostly narrow and highly meandering through the base of the valley, with a shallow incision into the valley floor. The edge banks are of low relief with some localised areas of undercutting on bends (see Figure 5 below). At the time of sampling the site channel area consisted of a series of disconnected pools (with the majority of the channel area being dry) however within the middle of the site there were some sections of trickle flows in between surface pools. It should be noted that there was no fish passage connection downstream with Little Jilliby Jilliby Creek (see Appendix Plate 40).

During the Spring 2012 survey the maximum pool lengths were 20m, with maximum pool widths of 1.5m and average width 0.9m. The maximum pool depths in SGDn reached 1.0m however the average depth was much shallower at 0.2m.

Sections of the site were overgrown with rainforest understory vegetation and there were a number of fallen logs and log-jams across the channel. There was a sheed noted on the pool water surfaces and throughout the site (including the dry sections of the creek bed) and there was prolific orange precipitation and staining on the stream substrates (see Figure 5 below). The site channel substrates comprised firm gravelly sand, and there were no macrophytes observed within the site.

Figure 5: Site SGDn remnant pool (left) and dry channel area showing orange precipitation on the stream bed (right).

Site SGDn returned a high RCE score of 85.6%, with similar site riparian and channel condition attributes to site LJ3 and lower scores for channel sediments.

Site LJL is in a lagoon that is located adjacent to Little Jilliby Jilliby Creek, within the Wyong State Forest. There is an access track next to the site that crosses the catchment from west to east. At this location the Little Jilliby Jilliby Creek alluvial floodplain broadens to accommodate two significant lagoons on the western side of the main creek-line and the northern most lagoon was sampled as LJL.

With the exception of localised catchment runoff, there are no tributaries or drainages that contribute stream flows to the lagoons under normal flow conditions, and the lagoons would only be connected with the main drainage channel of Little Jilliby Jilliby Creek during flood flow periods.

The LJL pool basin is broad with shallow sloped banks, closely bordered by dense and overhanging rainforest vegetation along the pool edges (See Figure 6 below). The total pool length was estimated at 130m with a maximum width of 30m and maximum depth of 1.5m. The substrate consisted of fine sand and was blanketed with a thick layer of leaf detritus throughout the pool basin, with some black stained water noted along the pool edges. At the time of sampling the water was turbid brown and there was a film of algae floating on the pool water surface, and there was no surface flow into or out of the pool.

LJL received a moderately high RCE score of 79.8%. The factors for which LJL recorded high category scores were the riparian vegetation attributes, stream bank structure and aquatic vegetation, whereas the lower scores were for the sediment accumulations, lack of riffle/ pool sequencing and lack of retention devices.

Figure 6: Site LJL lagoon pool.

Site HSDam is a large u-shaped dam located near the eastern limits of the *Honeysuckle Park* property. Surface water drains through the *Honeysuckle Park* property via a series of semi-permanent to permanent dams interconnected by shallow and meandering drainage swales. During the Spring 2012 survey the majority of the channel areas were dry however there was intermittently occurring shallow surface water present within the depressions (see Figure 7 below).

The main dam storage basin at HSDam is 90m wide, with a maximum breadth of 30m, and at the time of sampling reached a maximum depth of 1.3m. There was a 50m long pool within a narrow drainage channel leading into the main dam from the 'upstream' end. There is a pipe culvert at the lower end of the dam that drains into a broad drainage basin leading into Jilliby Jilliby Creek (see Figure 8 below) and HSDam water levels were around 20cm below the overflow point through the culvert. Given the flat topography of the site there would be fish passage 'upstream' from Jilliby Jilliby Creek into HSDam during flood flows, however during the Spring 2012 survey the lower drainage basin was dry.

There is little riparian woody vegetation associated with the Honeysuckle Park dams and there was cattle access to HSDam noted during sampling. The riparian vegetation comprised spike rushes (*Juncus sp*), and native grasses (*Carex appressa*) on the banks and submerged around the perimeter of the dam (see Figure 8 below).

Figure 7: Honeysuckle Park surface water dam and intermittent drainage channels.

Figure 8: Site HSDam looking downstream from the dam culvert toward Jilliby Jilliby Creek (left) and upstream of the culvert in the dam (right).

There were a number of macrophytes recorded from the dam including swamp lily (*Ottelia ovalifolia*), blunt pondweed (*Potamogeton ochreatus*), water primrose (*Ludwigia peploides*), slender knotweed (*Persicaria decipens*) and water ribbons (*Triglochin sp*). The site substrates consisted of consolidated mud, with exposed clay in some sections of the banks.

Site HSDam had a relatively low site condition (RCE) score of 51.9%. In comparison to the majority of the other sites, there is very little riparian vegetation surrounding the site water-body and the channel form is less structured than the creek or river sites.

2.1.2 Spring 2012 site habitat conditions and macrophyte occurrence

Daily flow rates are measured at the NSW Office of Water station #211010 in Jilliby Jilliby Creek (below site JC3) and #211009 in the Wyong River (at site WR3). Flow rates over the three-month period leading into the Spring 2012 survey were less than 50 ML/day in the Wyong River and 0.1 ML/day in Jilliby Jilliby Creek and gradually declining. During the course of the Spring 2012 survey flow rates in Jilliby Jilliby Creek varied between 1.37 ML/day and 1.69 ML/day, and in the Wyong River from 10.2 ML/day on the 22nd October to 9.3 ML/day on the 25th.

Of the pre Spring 2012 monitoring sites that were sampled for the Spring 2012 survey, WR1 and LJDn were the only sites that supported surface flow within the site lengths. Water levels at these sites were between 10 and 20cm lower than the previous survey in Autumn 2012 and the overall pool widths and depths had decreased.

Water levels at HHMd had receded to the extent that the sample site length only included two shallow surface pools each with a maximum pool length of 10m, maximum width of 1m and maximum depth of 10cm (see Figure 9 below for seasonal comparison of surface water).

Figure 9: Site HHMd showing variation in surface water levels during Autumn 2012 (left) and Spring 2012 (right).

Pool water levels at Spring Creek tributary site SW1 had receded by 20 to 30cm since the previous survey and the original pool length had receded to 8m with width 3m, and a maximum depth to 0.6m. In contrast to the recession and disconnection of pools at sites HHMd and SW1, the pool at Wallarah Creek site WC1was still continuous throughout the site length channel area and, although water levels had receded by 10cm there were no major variations in overall pool sizes.

For the sites sampled previously, the site channel substrates were unchanged from former survey occasions. For WR1 and LJDn the channel substrates were mostly mobile sand drifts and for SW1, WC1 and HHMd the substrates comprised clay-dominated sediments. Most of the site channels, pool surfaces and substrates were smothered in a layer of leaf matter (see Appendix Plates for comparisons with Autumn 2013 survey). At WC1 and LJL there was a strong odour of sulphur emanating from the substratum when disturbed, and parts of the site contained black water along the edges of the site pools. Both sites also had an algal film smothering the pool surfaces.

For all sites other than HHMd the pool aquatic habitat attributes available for macroinvertebrate and fish sampling were consistent with former sample occasions, and consisted of trailing bank vegetation, macrophytes and charophytes, detritus and undercut banks. At site HHMd the water levels were so low that macrophytes (mostly slender knotweed *Persicaria decipens*) and edge bank vegetation were stranded on the bank and the only pool aquatic habitat available for sampling was bottom detritus.

The site aquatic macrophyte occurrence for Spring 2012 is shown below in Table 2 below. A total of 13 macrophyte and one algae taxa (charophytes) were recorded from the ten sites.

Table 2 Wallarah Site Macrophyte Occurrence Spring 2012

	Carex appressa	Tall Spikerush *Eleocharis sphacelata*	Spikerush *Eleocharis ?gracilis*	Spikerush *Juncus sp*	Water Primrose *Ludwigia peploides*	Swamp Lily *Ottelia ovalifolia*	Slender Knotweed *Persicaria decipens*	Frogsmouth *Philydrum lanuginosum*	Blunt Pondweed *Potamogeton ochreatus*	River Buttercup *Ranunculus inundatus*	Duck Weed *Spirodela sp*	Water Ribbons *Triglochin sp*	Ribbonweed *Vallisneria sp*	Charophytes
WR1													1	
JC3														
LJ3														
LJDn														
SGDn														
LJL	1													
HSDam	1			1	1	1	1		1		1	1		
SW1												1		1
WC1		1	1									1		
HHMd			1				1	1		1				

The highest diversity of macrophytes was recorded at HSDam with 8 taxa, followed by HHMd with 4 taxa and WC1 with 3 taxa. Sites WR1, SW1 and LJL each supported one and there were no macrophytes at the remaining four study sites (JC3, LJ3, SGDn and LJDn).

Table 3 summarises the RCE category and site total scores for each of the Spring 2012 study sites, and the previous Autumn 2012 total scores are included for comparison. The RCE total scores have been expressed as percentages, with higher percentages indicating better overall aquatic habitat condition.

Table 3 Summary of RCE Results – Spring 2012

Category	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd
Land-use pattern beyond immediate riparian zone	3	3	4	3	4	4	2.5	4	4	3
Width of riparian strip-of woody vegetation	4	3.5	4	3.5	4	4	2	4	4	4
Completeness of riparian strip of woody vegetation	4	4	4	4	4	4	1	4	4	4
Vegetation of riparian zone within 10 m of channel	3	3.5	4	3.5	4	4	3	4	4	3
Stream bank structure	4	3.5	4	3.5	3.5	3.5	3	4	4	4
Bank undercutting	2	2	3	2	3	4	3	4	2	4
Channel form	4	4	4	4	4	3	2	2	4	2
Riffle/pool sequence	3	3.5	3.5	3	3.5	2	0	2	3.5	2
Retention devices in stream	3	3.5	3.5	2	3	2	1	3	3.5	2
Channel sediment accumulations	1.5	2	2	2	2	2	2	4	3.5	1
Stream bottom	1	2	2	1	2	2	2	1	2	2
Stream detritus	2	3	3.5	1	3.5	3	3	4	4	2
Aquatic vegetation	4	4	4	4	4	4	2.5	4	2.5	4
RCE Score	38.5	41.5	45.5	36.5	44.5	41.5	27.0	44.0	45.0	37.0
Spring 2012 RCE %age	74.0	79.8	87.5	70.2	85.6	79.8	51.9	84.6	86.5	71.2
Autumn 2012 RCE %age	74.0			70.2				84.6	89.4	70.2

For the majority of sites the RCE scores were generally good ranging between 70.2% at LJDn and 88.5% at WC1, with higher scores relating to the riparian condition in terms of the quality and continuity of the riparian corridors. Lower category scores were generally related to poor channel sediment and stream bottom conditions.

For the previously sampled sites there were minor variations in site RCE scores at sites WC1 and HHMd; for the Spring 2012 survey site WC1 had reduced category scores for aquatic vegetation in response to slight increases in the macrophyte abundance, minor decreases in the levels of filamentous green algae, and increases in the amounts of silt on the substrates. Site HHMd recorded an increase in score for the aquatic vegetation category due to decreased levels of filamentous green algae.

2.1.3 Autumn 2013 site habitat conditions and macrophyte occurrence

Following on from the Spring 2012 survey, which concluded on the 25th October, Wyong River and Jilliby Jilliby Creek flow rates remained low until late January 2013. During this dry period mean daily flow rates were less than 40 ML/day in the Wyong River and less than 3 ML/day in Jilliby Jilliby Creek.

There were three high flow events in response to significant rainfall events in late January to early March. In the Wyong River the mean daily flow rates for each of the flow events peaked at 2389 ML/day on the 30th January, 10622 ML/day on the 24th February and 4072 ML/day on the 4th March. The Jilliby Jilliby Creek flow events were similar in size, with peaks of 2266 ML/day on the 29th January, 2323 ML/day on the 24th February and 2364 ML/day on the 3rd March.

The Autumn 2013 survey commenced on the tail end of a three-week post-rainfall flow period with mean daily flow rates dropping in the Wyong River from 31.6 ML/day to 30.9 ML/day for the 21st and 22nd May respectively, and from 3.8 ML/day to 3.7 ML/day in Jilliby Jilliby Creek over the same two days.

There was a brief increase in Jilliby Jilliby Creek discharge rates in response to a three-day 65mm rain event in which the flow rates peaked at 187.0 ML/day in Jilliby Jilliby Creek on the 24th May, prior to the sampling of the Little Jilliby Jilliby Creek catchment sites within the Wyong State Forest on the 29th May, by which time Jilliby Jilliby Creek flows had subsided to 15.8 ML/day.

For the Autumn 2013 survey there was evidence of high flow channel scouring throughout the study area sites. In the Wyong River there were debris lines to 4m above the water level with sections of the banks undercut and root masses exposed. In Jilliby Jilliby Creek and Little Jilliby Jilliby Creek water levels reached 4m and 3m height above the normal water levels respectively, with removal and settlement of new log jams, infilling and deepening of site pools and redistribution of the flow paths within the site substrates (see Figures 12 to 14 below). In Splash Gully there were indications of high flows to 2m above the background water levels.

Whilst water levels were higher than the Spring 2012 survey at all sites, only half of the sites supported surface flow. There was no flow within the site lengths at LJL, HSDam, SW1, WC1 or HHMd. For the Spring 2012 survey the creek at Spring Gully site SGDn had receded into a series of disconnected pools (with the majority of the site being dry) however for this survey there was continuous surface water and flow throughout the site length and downstream to the connection with Little Jilliby Jilliby Creek.

Figure 12: Looking upstream at Little Jilliby Jilliby Creek site LJ3 in Spring 2012 (left) and Autumn 2013 (right). Note the effects of high flows on the distribution of large woody debris.

Figure 13: Little Jilliby Jilliby Creek site LJDn in Spring 2012 (left) and Autumn 2013 (right). This site had experienced in significant redistribution of sediments and large woody debris.

Figure 14: Looking upstream at Jilliby Jilliby Creek site JC3 in Spring 2012 (left) and Autumn 2013 (right). Note the deepening of pools and build up of debris between surveys.

Maximum pool depths for the lotic sites ranged between 0.9m (sites LJDn and SGDn) and 1.4m to 1.6m at sites WR1, JC3 and LJ3. At LJL water levels had risen by 40 to 50cm since the Spring 2012 survey to a maximum depth of around 2m. Although the water levels at HHMd had were only slightly higher than the Spring 2012 survey, this increased the size of the site pools from two small remnant pools in Spring 2012 (maximum length 10m) to one much longer pool (maximum length 60m).

The higher water levels at HHMd and LJL increased the availability of submerged trailing bank vegetation (principally *Carex appressa*, slender knotweed and grasses) for macroinvertebrate sampling around the perimeters of the site pools. For the remainder of the sites the aquatic habitat attributes were similar to former surveys.

Mobile sandy sediments dominated the site substrates in the Wyong River, Jilliby Jilliby Creek and Little Jilliby Jilliby Creek catchment sites. At site SGDn there were higher compositions of coarser gravelly sediments compared to the previous survey, possibly as a result of scouring out of fine sediments. For the other sites the substrates consisted of finer, more consolidated sediments. Most of the sites with running water contained relatively small amounts of detritus on the channel substrate and on aquatic habitats.

As for the Spring 2012 survey, there were large amounts of decaying organic matter, that when disturbed released a strong sulphur odour at sites LJL and WC1 At both these sites there was black stained water along the edges of the pools and an algal film noted on the pool surfaces (see Figure 15 below). Orange precipitate was present at JC3, LJ3 and SGDn, with levels from the latter site much less pronounced than the low flow survey of Spring 2012.

Figure 15: Algal film on water surfaces at WC1 (left) and LJL (right).

Table 4 presents the site macrophyte occurrence results for Autumn 2013. There were a total of 14 macrophyte taxa and one algae taxa recorded from the ten aquatic ecology sample sites.

Table 4 Wallarah Site Macrophyte Occurrence Autumn 2013															
	Ferny Azolla *Azolla pinnata*	*Carex appressa*	Tall Spikerush *Eleocharis sphacelata*	Spikerush *Eleocharis ?gracilis*	Spikerush *Juncus sp*	Water Primrose *Ludwigia peploides*	Swamp Lily *Ottelia ovalifolia*	Slender Knotweed *Persicaria decipens*	Frogsmouth *Philydrum lanuginosum*	Blunt Pondweed *Potamogeton ochreatus*	River Buttercup *Ranunculus inundatus*	Duck Weed *Spirodela sp*	Water Ribbons *Triglochin sp*	Bladderwort *Utricularia sp*	Charophytes
WR1															
JC3															
LJ3															
LJDn															1
SGDn															
LJL		1													
HSDam	1	1			1	1	1	1		1	1	1	1	1	
SW1													1		1
WC1			1	1									1		
HHMd				1				1	1		1				

As for the Spring 2012 survey, Honeysuckle Park site HSDam supported the highest diversity of macrophytes with 11 taxa, followed by HHMd with 4 taxa, WC1 with 3 taxa and LJL and SW1 with one taxa from each site. None of the macrophytes were widespread throughout the study area, with water ribbons being the most prevalent and recorded from three sites. There were no macrophytes recorded from WR1, JC3, LJ3, LJDn or SGDn.

The site RCE results for Autumn 2013 are presented below in Table 5, with the Spring and Autumn 2012 RCE% results included for comparison. Additional RCE assessments were made at site JCDn in Jilliby Jilliby Creek and a floodplain wetland adjacent to Jilliby Jilliby Creek (site JJWetland).

Over all sites the RCE scores ranged between 44.2% at JJ Wetland and 88.5% at WC1. With the exception of HSDam and JJ Wetland, most of the sites are situated in areas with continuous riparian corridors that are dominated by native woodland communities. As noted in Section 2.1.2, lower category scores across the study area were generally related to unsuitable channel sediment and stream bottom conditions.

The only variation in site RCE scores from the previous survey was at HHMd, in response to increased levels of filamentous green algae for the Autumn 2013 survey, which caused the RCE site condition score to decrease from 71.2% in Spring 2012 to 69.2% in Autumn 2013.

Site JJ Wetland is a shallow, floodplain drainage depression situated in agricultural lands adjacent to Jilliby Jilliby Creek (see Plates 83 and 84 in Appendix A). The site supported similar RCE attributes to HSDam; there was very little riparian woody vegetation, the channel substrates were mostly fine sediments and there was lack of stream structure.

In contrast site JCDn had similar habitat attributes to JC3; the riparian corridor was continuous and greater than 30m wide and consisting mostly of a native rainforest community, the channel was deeply incised with numerous log jams and the substrate was mostly sandy sediments (see Plates 80 to 82 in Appendix A).

Table 5 Summary of RCE Results – Autumn 2013

Category	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd	JCDn	JJ Wetland
Land-use pattern beyond immediate riparian zone	3	3	4	3	4	4	2.5	4	4	3	3	2
Width of riparian strip-of woody vegetation	4	3.5	4	3.5	4	4	2	4	4	4	4	1
Completeness of riparian strip of woody vegetation	4	4	4	4	4	4	1	4	4	4	4	0
Vegetation of riparian zone within 10 m of channel	3	3.5	4	3.5	4	4	3	4	4	3	3.5	1.5
Stream bank structure	4	3.5	4	3.5	3.5	3.5	3	4	4	4	3.5	3
Bank undercutting	2	2	3	2	3	4	3	4	2	4	3	3
Channel form	4	4	4	4	4	3	2	2	4	2	4	2
Riffle/pool sequence	3	3.5	3.5	3	3.5	2	0	2	3.5	2	2.5	2
Retention devices in stream	3	3.5	3.5	2	3	2	1	3	3.5	2	3.5	1
Channel sediment accumulations	1.5	2	2	2	2	2	2	4	3.5	1	2	1
Stream bottom	1	2	2	1	2	2	2	1	2	2	2	1
Stream detritus	2	3	3.5	1	3.5	3	3	4	4	2	3	3
Aquatic vegetation	4	4	4	4	4	4	2.5	4	2.5	3	4	2.5
RCE Score	38.5	41.5	45.5	36.5	44.5	41.5	27.0	44.0	45.0	36.0	42.0	23.0
Autumn 2012 RCE %age	74.0			70.2				84.6	89.4	70.2		
Spring 2012 RCE %age	74.0	79.8	87.5	70.2	85.6	79.8	51.9	84.6	86.5	71.2		
Autumn 2013 RCE %age	74.0	79.8	87.5	70.2	85.6	79.8	51.9	84.6	86.5	69.2	80.8	44.2

2.2 Field Water Quality Results

Appendix Table A-4 provides full depth profile results of metered water quality sampling for all sites visited over the Spring 2012 and Autumn 2013 sample seasons. Table 6 below provides the seasonal site comparison data for surface water quality at all sites. Water quality results for the Spring 2012 survey are summarised as follows:

- Despite the low flow conditions experienced throughout the study area in Spring 2012, there were no signs of depth stratification at any of the sites.
- There was considerable variation in site water temperatures between sites. Higher temperatures (20.6°C to 29.2°C) were recorded at the standing open water bodies with no riparian cover in Honeysuckle Park (HS1 to HS3 and HSDam) and in the very shallow surface water depressions at HHMd. Lower temperatures (14.1°C to 16.6°C) were recorded for the sites with good riparian cover, including the other standing water sites (SGDn, LJL, SW1 and WC1) and the sites with stream flows (WR1, JC3, LJ3 and LJDn).
- Surface water conductivity also exhibited some considerable variation across the study area for Spring 2012 and values were low in the Honeysuckle Park dams and reservoirs (154 to 225 μS/cm at HSDam and HS3), and 267 μS/cm at Wyong River site WR1. In contrast the readings in Jilliby Jilliby and Little Jilliby Creeks were elevated; Jilliby Jilliby Creek site JC3 (831 μS/cm), Little Jilliby Jilliby Creek sites LJ3 (799 μS/cm) and LJDn (576 μS/cm), and Splash Gully site SGDn (1228 μS/cm). Conductivity values for both surface and bottom readings at Little Jilliby Jilliby Creek lagoon site LJL were lower than the creek readings (328 μS/cm and 340 μS/cm respectively).
- Conductivity of surface waters for the remainder of sites that had no surface flow were moderate to high; SW1 (888 μS/cm), WC1 (1614 μS/cm) and HHMd (1705 μS/cm).
- Dissolved Oxygen (DO) was low DO (< 43 % saturation) at a number of sites; JC3, SGDn, LJL, SW1 and WC1 and DO values for the Honeysuckle Park water storages were high ranging between 83.6% saturation at HSDam and 102.1% saturation at HS1. For the remaining sites (WR1, LJ3, LJDn and HHMd) the range of DO levels was more moderate at 59.3% saturation to 85.7% saturation.
- Water Ph was acidic at all sites except for HS1 recorded a reading of 8.8 pH units. The lowest pH readings were recorded at HHMd and SW1 (at 3.6 pH units and 4.2 pH units respectively). Water pH values for the other sites ranged between 5.9 pH units at LJL and 6.8 pH units at LJ3.
- Turbidity of surface waters ranged from 10.2 NTU at LJ3 to 115.6 NTU at HHMd, with HS2 recording an elevated reading of 501.4 NTU.

Table 6 Stream Surface Water Quality Results Spring 2012 & Autumn 2013

Site	Date	Time	Depth M	Temp °C	Cond µS/cm	Sal ppt	DO %sat	DO mg/l	pH Units	Turb ntu
Spring 2012										
WR1	25/10/12	13:35	0.1	16.03	267	0.14	85.7	7.4	6.16	28.6
JC3	23/10/12	13:29	0.1	14.76	831	0.43	31.3	2.8	6.59	44.8
LJ3	22/10/12	13:37	0.1	14.86	799	0.42	59.3	5.3	6.78	10.2
LJDn	23/10/12	12:12	0.1	14.57	576	0.30	74.0	6.6	6.57	36.5
SGDn	22/10/12	12:39	0.1	14.07	1228	0.63	33.3	3.0	6.57	14.7
LJL	22/10/12	10:49	0.1	16.64	328	0.18	32.9	2.8	5.89	99.2
HSDam	23/10/12	9:58	0.1	20.57	154	0.09	83.6	6.6	6.13	20.6
HS3	23/10/12	15:21	0.1	26.88	225	0.12	97.3	6.8	6.73	50.6
HS2	23/10/12	15:29	0.1	23.02	190	0.11	91.0	6.9	6.47	501.4
HS1	23/10/12	15:41	0.1	22.96	180	0.10	102.1	7.7	8.77	106.2
SW1	25/10/12	9:35	0.1	14.52	888	0.46	42.1	3.8	4.21	64.2
WC1	25/10/12	10:39	0.1	14.32	1614	0.85	28.4	2.5	6.09	40.0
HHMd	25/10/12	11:57	0.1	29.21	1705	0.92	70.8	4.8	3.56	115.6
			Min	14.07	154	0.09	28.4	2.5	3.56	10.2
			Max	29.21	1705	0.92	102.1	7.7	8.77	501.4
			Mean	18.6	691.2	0.4	64.0	5.2	6.2	87.1
			SE	1.5	151.5	0.1	7.6	0.5	0.3	35.8
Autumn 2013										
WR1	22/05/13	9:33	0.2	10.86	238	0.07	101.6	10.2	6.81	18.9
JC3	21/05/13	15:22	0.2	12.32	445	0.17	96.6	9.4	6.79	38.1
JCDn	22/05/13	12:55	0.1	12.02	438	0.16	103.7	10.1	7.03	51.0
JJ Wetland	22/05/13	11:11	0.2	14.24	125	0.01	80.3	7.5	6.54	108.7
LJ3	29/05/13	12:19	0.1	12.12	536	0.21	63.4	6.2	6.87	12.9
LJDn	21/05/13	13:54	0.1	12.77	483	0.19	97.1	9.3	6.89	49.2
SGDn	29/05/13	12:10	0.1	12.92	840	0.35	57.6	5.5	6.71	15.5
LJL	29/05/13	10:57	0.2	11.44	139	0.01	45.1	4.5	6.62	53.7
HSDam	22/05/13	11:34	0.1	14.11	115	0.01	97.6	9.1	6.51	76.9
SW1	22/05/13	15:15	0.1	11.86	395	0.14	47.9	4.7	5.40	20.6
WC1	22/05/13	14:29	0.1	12.49	916	0.39	19.5	1.9	5.90	65.8
HHMd	22/05/13	13:18	0.1	14.08	664	0.27	108.1	10.1	6.48	92.9
			Min	10.86	115	0.01	19.5	1.9	5.40	12.9
			Max	14.24	916	0.39	108.1	10.2	7.03	108.7
			Mean	12.6	444.5	0.2	76.5	7.4	6.5	50.4
			SE	0.3	77.2	0.0	8.4	0.8	0.1	9.1

Notes: LJ3d/s taken from Little Jilliby Jilliby Creek downstream from Splash Gully confluence.
Readings containing -1 or -2 are recorded in separate upstream and downstream site pools respectively.

For the Autumn 2013 survey the surface flow rates were higher than that encountered during the Spring 2012 survey, and water quality showed less variation across the study area sites for most of the parameters measured. The results for the Autumn 2013 survey are summarised as follows:

- There were no indications of any stratification at any of the sites.
- The surface water temperatures were relatively uniform across all sites ranging from 10.9°C at WR1 to 14.2°C at JJ Wetland.
- Compared to the Spring 2012 survey there was also less variation in surface water conductivity values. The highest surface water conductivity readings were at HHMd (664 μS/cm), SGDn (840 μS/cm) and WC1 (916 μS/cm), whereas the lowest readings were recorded at HSDam (115 μS/cm), JJ Wetland (125 μS/cm) and WR1 (238 μS/cm). The other sites had values ranging between 395 μS/cm and 536 μS/cm.
- DO levels did show considerable variation between sites with values ranging from 19.5% saturation at WC1 to 108.1% saturation at HHMd, with a survey mean (± standard error SE) of 76.5 ± 8.4% saturation recorded over all of the sites.
- Water pH values were fairly uniform across the study area with values ranging between 5.4 pH units at SW1 and 7.0 pH units at JCDn.
- Water turbidity values ranged between 12.9 NTU at LJ3 and 108.7 NTU at JJ Wetland, with a survey mean of 50.4 ± 9.1 NTU recorded over all sites.

2.3 Site Macroinvertebrate & Fish Survey Results

Appendix Tables A-5 and A-6 show the results of aquatic macroinvertebrate taxonomic identifications to the levels required by AusRivAS, plus occurrence data for all aquatic macroinvertebrates, fish and any amphibian fauna that were encountered over the Spring 2012 and Autumn 2013 surveys. The table provides basic site statistics including site SIGNAL and EPT scores, and are summarised in Table 7 below. The aquatic macroinvertebrate sampling results for all sites over both seasons are summarised as follows:

- A total of 58 macroinvertebrate taxa were recorded from ten sample sites for Spring 2012, and 57 macroinvertebrate taxa were recorded from the same ten sites for Autumn 2013.
- Over both surveys there were 67 macroinvertebrate taxa identified from the study area sites.
- From the combined surveys, the majority of the macroinvertebrate fauna were insects (49 taxa), with the remainder being made up of molluscs (6 taxa including

2 bivalve and 4 gastropod snails), crustaceans (5 taxa), annelid worms and flatworms (each with 2 taxa), one freshwater mite taxa, one seed shrimp and one springtail taxa.

- The most commonly occurring taxa were bloodworm sub-family Chironominae and caddis-fly family Leptoceridae, which were recorded from every site over both sample seasons. Other common taxa (occurring at 15 or more of the 20 sample sites) included diving beetles (family Dytiscidae), mayfly family Leptophlebiidae, freshwater shrimp (family Atyidae) and bloodworm sub-family Tanypodinae
- More than half (57%) of the macroinvertebrate taxa recorded from the study area over both survey were recorded from less than one quarter of the study sites.
- In terms of SIGNAL grades, the most sensitive taxa occurring within the study area were members of the dragonfly family Telephlebiidae (with a SIGNAL score of 9), followed by mayfly family Leptophlebiidae and caddisfly families Hydrobiosidae and Philorheithridae (each with a SIGNAL value of 8), and damselfly family Synlestidae, dixid midges (family Dixidae), riffle beetles (family Elmidae), dobsonflies (family Cordyalidae), and caddisfly families Atriplectididae, Calamoceratidae and Odontoceridae with a 7 SIGNAL score.

Table 7 Macroinvertebrate Summary Statistics Spring 2012 & Autumn 2013

Index	Season	WR1	JC3	LJ3	LJDn	SGDn	LJS	HSDam	SW1	WC1	HHMd
Diversity	Sp12	22	18	21	20	13	14	30	15	14	11
	Au13	23	17	18	20	13	20	26	15	15	22
	Combined	27	24	25	27	18	25	34	20	21	25
SIGNAL2	Sp12	5.55	4.00	4.35	4.84	3.83	4.00	3.25	3.80	4.17	3.64
	Au13	5.09	4.06	4.78	4.16	4.31	3.56	3.27	4.38	4.20	3.62
EPT	Sp12	9	2	2	5	2	2	4	3	2	2
	Au13	7	2	3	5	2	2	3	3	2	2

The seasonal site macroinvertebrate diversity, summary SIGNAL and EPT results for the Spring 2012 and Autumn 2013 surveys are shown in Table 7 and are summarised as follows:

- For the Spring 2012 survey the individual site diversity ranged from 11 taxa at HHMd to 30 taxa at HSDam, with a survey mean of 17.8 ± 1.8 taxa per site.
- For Autumn 2013 the individual site diversity ranged from 13 taxa at SGDn and 26 taxa at HSDam, with an overall survey mean of 18.9 ± 1.3 taxa per site.
- Over the combined surveys, Splash Gully site SGDn recorded the lowest diversity of macroinvertebrates with 18 taxa whereas HSDam recorded the highest diversity with 34 taxa.
- The individual site SIGNAL scores ranged between 3.25 at HSDam and 5.55 at WR1 for Spring 2012 and 3.27 at HSDam and 5.09 at WR1 for Autumn 2013.

The site fish and tadpole occurrence is shown below in Table 8. There were a total of five confirmed species of freshwater fish recorded from the ten study area sites over the combined surveys, including four native gudgeons and one introduced species:

- All sites recorded at least one fish taxa over both of the surveys. The introduced pest species plague minnow (*Gambusia holbrooki*) was the most widespread species recorded; from four sites in Spring 2012 and six sites in Autumn 2013.
- Flathead gudgeons (*Philypnodon grandiceps*) were recorded from LJS for both surveys, from HSDam in Spring 2012, and from overnight traps deployed in JJ Wetland (See Appendix Plates 48, 55 and 85).
- An adult striped gudgeon (*Gobiomorphus australis*) was recorded from LJDn in Autumn 2013 (see Appendix Plate 33), a large Coxs gudgeon (*Gobiomorphus coxii*) was recorded from LJ3 for both surveys (see Appendix Plate 25).
- Firetail gudgeons (*Hypseleotris galii*) were recorded from four sites in Spring 2012 (WR1, JC3, LJDn and HSDam) and from HSDam only in Autumn 2013.
- A number of juvenile gudgeon occurrences (most likely to be flathead gudgeons) were recorded from six sites over both surveys, and a single juvenile gudgeon (either striped gudgeon or Coxs gudgeon) was recorded from LJ3 in Spring 2012.
- Fish larvae were recorded from HSDam in Autumn 2013.
- Tadpoles were recorded from five different sites over both sample seasons. A striped marsh frog (*Lymnodynastes peronii*) was recorded from WR1 in Spring 2012 and a tusked frog (*Adelotus brevis*) was recorded from LJ3 in Spring 2012 also (see Appendix Plates 7 and 24 respectively).

Table 8 Seasonal Site Fish Occurrence

Common Name	Genus/spp	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd
Gudgeon	*Gobiomorphus/ Philypnodon sp*			S							
Striped Gudgeon	*Gobiomorphus australis*				A						
Cox's Gudgeon	*Gobiomorphus coxii*			S/A							
Firetail Gudgeon	*Hypseleotris galii*	A	A		A			S/A			
Flathead Gudgeon	*Philypnodon grandiceps*						S/A	S			
Flathead Gudgeon	*Philypnodon sp*	S	S	A	A	A		A			
Eastern Gambusia	*Gambusia holbrooki*		A		A			S/A	S/A	S/A	S/A
Fish Larva	*?*							A			
Tadpoles				S/A		A	S/A	S			A

Note: S- Spring 2012 survey, A- Autumn 2013 survey

4 SUMMARY & CONCLUSIONS

The Wyong Areas Coal Joint Venture has commissioned MPR to undertake baseline sampling of aquatic ecology for the Wallarah 2 Coal Project in the Dooralong and Yarramalong Valleys located on the Central Coast of NSW. This report presents the findings for the combined aquatic ecological surveys undertaken in Spring 2012 and Autumn 2013.

For both surveys there were a total of ten sites sampled for fish and macroinvertebrates, which included five new sites that had not been sampled on previous sample occasions; one site in the Wyong River, one in Jilliby Jilliby Creek, three sites in Little Jilliby Jilliby Creek (including one lagoon site), and one site each in Splash Gully, a *Honeysuckle Park* dam, Wallarah Creek, the western tributary to Spring Creek, and Hue Hue Creek. Additional water quality measurements were recorded in Jilliby Jilliby Creek and from surface water storages in Honeysuckle Park and a floodplain wetland adjacent to Jilliby Jilliby Creek.

The Spring 2012 aquatic ecology survey was undertaken between the 22nd and 25th October 2012 during a low flow period and at the time of sampling only four sites (WR1, JC3, LJ3 and LJDn) contained surface flows throughout the site lengths. Water levels at Hue Hue Creek site HHMd had receded to two shallow surface pools and Splash Gully site SGDn channel area consisted of a series of disconnected pools. The overall water levels for most of the sites were lower than that encountered during former sample occasions.

In the period between the Spring 2012 and Autumn 2013 surveys there were three distinct flood flow events over a five week period between late January and early April 2013, the effects of which were evident and noted during the course of the latter survey, including high flow debris lines on banks, re-distribution of flow paths through substrates, scouring and deposition of sandbanks and creation and removal of log jams.

The Autumn 2013 survey was undertaken between the 21st and 29th May 2013. During the course of the study period flow rates were higher than during the former survey and water levels had increased at most of the sample sites. There was surface flow throughout the length of SGDn and the pool dimensions at HHMd had increased from two small (maximum length 10m) pools to one 60m long pool.

The aquatic habitats consisted of trailing bank vegetation, detritus, undercut banks and macrophytes (for sites which supported macrophyte growth). The site substrates were mobile sandy sediments in the Wyong River, Jilliby Jilliby Creek and Little Jilliby

Jilliby Creek catchment sites, and finer more consolidated sediments for HSDam, HHMd, SW1 and WC1.

There were much higher loads of small detritus (leaves) blanketing the site pool surfaces and substrates, and channel banks throughout most of the sites in Spring 2012 compared to Autumn 2013. Orange precipitate was prevalent on at least one sample occasion at JC3, LJ3 and SGdn, and algal films were noted on the pool water surfaces at WC1 and LJL for both surveys, and at JC3 for the Spring 2012 survey only.

There were a total of 15 macrophyte and one algae taxa recorded from the ten sample sites over both surveys. The highest diversity of macrophytes was from the dam site in Honeysuckle Park (HSDam) - 11 macrophyte taxa over both surveys, followed by HHMd with four macrophyte taxa. There were no macrophytes observed at JC3, LJ3, LJDn and SGDn, and the only occurrence recorded at WR1 was for a single ribbonweed plant (*Vallisneria sp*) during the Spring 2012 survey. None of the macrophyte taxa were particularly prevalent throughout the study area over the survey period. Water ribbons (*Triglochin sp*) were the most widespread, being found from three sample sites on each survey occasion, with all the other taxa being present from two sites or less per survey.

In regard to aquatic habitat condition, there was very little variation in the individual site Riparian-Channel-Environment (RCE) Inventory scores between surveys, with only minor differences resultant from fluctuations in the levels of filamentous green algae and silt within site pools at 2 sites. For most of the sites, the RCE scores were greater than 70%, indicating moderate to good condition of the riparian and channel environments. Most of these sites contained continuous riparian corridors throughout the site lengths which were composed mostly of established native vegetation communitiess.

The lowest site RCE scores were recorded at HSDam and the Jilliby Jilliby Creek lower floodplain site JJ Wetland with scores of 52% and 44% respectively. The main site attributes for which these sites recorded low scores were lack of riparian corridor bordering the site channels, and poor quality of the site channel structures such as no or few riffle-pool sequences or retentions devices. The majority of sites returned low category scores for channel sediment accumulations and stream bottom.

Water quality varied across the study area, particularly during the low flow survey conducted in Spring 2012. Water temperatures for the Spring 2012 survey ranged from 14.1°C to 16.6°C at sites containing overhanging riparian vegetation, and from 20.6°C to 29.2°C for sites with nor riparian corridor (Honeysuckle Park sites) or very shallow sites (HHMd). For the Autumn2 013 survey the water temperatures were relatively uniform across all sites, ranging between 10.9°C and 14.2°C.

The differences in water conductivity between sites were more exacerbated during the low flow survey of Spring 2012, for which overall higher conductivities were recorded from the study area sites. In Spring 2012 a number of sites recorded elevated conductivity values, including LJDn (576 μS/cm), LJ3 (799 μS/cm), JC3 (831 μS/cm), SW1 (888 μS/cm), SGDn (1228 μS/cm), WC1 (1614 μS/cm), and HHMd (1705 μS/cm), whereas the remainder of sites recorded low to moderate water conductivity values ranging between 154 μS/cm and 328 μS/cm.

For the Autumn 2013 survey, whilst the conductivity range was less (115 μS/cm to 916 μS/cm), sites HHMd, SGDn and WC1 still recorded the highest conductivity values (664 μS/cm, 840 μS/cm and 916 μS/cm respectively).

Dissolved oxygen values showed considerable variation between sites for both surveys, with values ranging from 28.4% saturation to 102.1% saturation for the Spring 2012 survey and 19.5% saturation to 108.1% saturation for the Autumn 2013 survey. With the exception of site WC1, all sites recorded higher dissolved oxygen concentrations during the Autumn 2013 survey. Water ph was mildly acidic for most sites over both surveys with SW1 and HHMd recording very low pH values for the Spring 2012 survey; at 4.2 pH units and 3.6 pH units respectively.

The Jilliby Jilliby Creek floodplain drainage sites in Honeysuckle Park (HSDam, HS1, HS2 and HS3) and JJ Wetland had similar water quality characteristics over both survey with low conductivity (115 μS/cm to 225 μS/cm), moderate to high dissolved oxygen levels (80.3% saturation to 102.1% saturation) and (with the exception of HS1 at 8.77 pH units), mildly acidic ph values from 6.1 pH units to 6.7 pH units.

The seasonal macroinvertebrate diversity figures were similar between surveys, with a total of 58 taxa recorded from the ten sites for the Spring 2012 survey and 57 taxa for the Autumn 2013 survey, and a total of 67 taxa identified from the study area over both surveys. For the Spring 2012 survey the individual site diversity ranged between 11 taxa at HHMd and 30 taxa at HSDam, and for the Autumn 2013 survey the site diversity ranged from 13 taxa at SGDn and 26 taxa at HSDam. The survey mean values were also similar at 17.8 ± 1.8 taxa per site for Spring 2012 and 18.9 ± 1.3 taxa per site for Autumn 2013.

In terms of SIGNAL grades, site WR1 recorded the highest site SIGNAL scores for the Spring 2012 and Autumn 2013 surveys at 5.55 and 5.09 respectively, whereas HSDam recorded the lowest SIGNAL scores at 3.25 and 3.27 respectively.

There were five confirmed species of fish over both surveys, including four native gudgeon species and one introduced pest species. All of the sites recorded at least one fish species during the combined study period. The introduced plague minnow was the most widespread, being recorded from 10 samples (from six different sites) over both surveys. Native gudgeons were recorded from all sites except SW1, WC1 and HHMd.

Judging from the flood levels of detritus in adjacent creeks noted in Autumn 2013, it is concluded that fish passage would have existed from the main creek-line drainages during the flooding events between the two surveys to the dam or lagoon sites in Jilliby Jilliby Creek (JJ Wetland and HSDam) and Little Jilliby Jilliby Creek (LJL) floodplains. At least three fish species (firetail gudgeons, flathead gudgeons and plague minnow) were recorded from these sites and is probable that at least one of the gudgeon species was breeding in HSDam, as indicated by the presence of fish larvae during the Autumn 2013 survey (which had not experienced high flows within the preceding 2 months). Unconfirmed juvenile gudgeons were also recorded from six sites over both surveys.

There were two frog species identified from the study area sites, both of which were recorded during the Spring 2012 survey; a tusked frog from LJ3 and a striped marsh frog from WR1. There were tadpoles recorded on both survey occasions from LJ3 and LJL, and from HSDam in Spring 2012, plus SGDn and HHMd in Autumn 2013.

There were no platypus burrows and no native water rat tracks or feeding sites observed and no observations of either animal over the two surveys. Crayfish were generally identified in the field, with confirmation from photographs submitted to Mr Robert McCormack. Specific searches for threatened aquatic species (Adams emerald dragonfly *Archaeophya adamsi*, and for *Maundia triglochinoides)* did not indicate either of these two species over the two surveys.

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APPENDIX A

FIELD NOTES

SITE PHOTOGRAPHS

&

SAMPLING DATA

WALLARAH 2 COAL PROJECT

STREAMHEALTH

MONITORING PROGRAM

SPRING 2012 & AUTUMN 2013

Table A1 Field Comments –Aquatic Ecology Monitoring Sites Spring 2012 and Autumn 2013		
Date	Site	Comments
25/10/12	WR1	Water level around 20cm lower than Autumn 2012 survey. Water moderately clear and flowing through site length. Maximum width to 12m, average width 7m, maximum depth to 1.5m and average depth around 0.5m. The edge habitats were unchanged and consisted of detritus, undercut banks and trailing edge bank vegetation. Log jams with build ups of debris were prevalent through site. The site substrate was mostly unconsolidated sandy sediments. No filamentous green algae observed.
23/10/12	JC3	Site sampled in Jilliby Jilliby Creek above confluence with Little Jilliby Jilliby Creek. Site channel incised to depth of 3 to 5m below surrounding floodplain, meandering with undercut banks and sections of bank erosion along site length, and numerous log jams creating pools from damming. Riparian corridor continuous along length. Water mostly clear and flowing through site, with the downstream sections of larger pools (at log jams) water surface being smothered with algal film. Maximum width to 6m, average width 2.5m, maximum depth to 1.4m and average depth 0.5m. The edge habitats were similar to the JCUp and consisted of undercut banks, trailing bank vegetation and detritus. Substrate mostly sand, with some accumulations of finer sediments in some sections. Leaf litter detritus abundant throughout site length on substrate. No filamentous green algae observed.
22/10/12	LJ3	Site sampled upstream from confluence with Splash Gully. Site length channel bordered by dense rainforest. Channel mostly straight with shallow incision into surrounding valley floor, and sections of undercut banks on bends. Numerous large logs fallen over creek and also embedded into substrate and forming a natural weir (with sediments built up behind). Water clear and flowing through site length. Maximum stream width to 5m, average width ~2m, maximum depth to 1.0m and average depth 0.3m. The edge habitats sampled consisted of undercut banks, trailing bank vegetation and detritus. The site substrate was mostly sand, with some boulder outcrops and pebble to gravel sized rock fragments intermixed with sand. The edge areas and parts of the substrate were blanketed with orange precipitate throughout most of the site, and there was a film on the water surface. No filamentous green algae observed.

23/10/12	LJDn	Water level around 10cm lower than previous survey. Water clear and flowing throughout site length. Maximum width to 2m, average width 1.0m, maximum depth to 0.6m and average depth to 0.1m. The aquatic habitats were mostly unchanged from former survey occasions, and consisted of trailing bank vegetation, detritus and undercut banks. Abundant leaf detritus throughout site length. The site substrates were soft unconsolidated sandy sediments with the channel walls being mostly clay. No filamentous green algae observed.
22/10/12	SGdn	Site sampled in downstream section of Splash Gully. Site channel highly meandering with shallow incision into forest floor, with areas of undercut banks (mostly on bends). The riparian corridor consists of dense rainforest. The creek within the site length consists of series of disconnected pools. Water mostly clear with orange staining and orange flocculant prevalent throughout site length, and film on pool surfaces (on some of the site pools). The substrate within the dry sections contained intense orange staining. Most of the site channel area was dry. No surface flow within the upstream end of the site, or the downstream end leading into Little Jilliby Jilliby Creek however there were some sections that supported a trickle flow between surface pools within the middle of the site. Maximum pool length 20m, maximum pool width 1.5m and average width 0.9m, maximum depth to 1.0m, average depth 0.2m. The edge habitats consisted of undercut banks and detritus. The channel basins were smothered in a layer of rainforest detritus, mostly leaves. The site substrates consisted of firm gravelly sand. No filamentous green algae observed.
22/10/12	LJL	Site sampled in lagoon adjacent main Little Jilliby Jilliby Creek channel. Pool basin shallow with mostly flat bottom, and dense rainforest surrounding the pool in the riparian areas. Water turbid with no surface flow into or out of site pool. Total pool length around 130m, maximum width 30m, average width 20m, maximum depth 1.5m and average depth 1.0m. The main edge habitats sampled included trailing bank vegetation (mostly *Carex appressa*), submerged branches and detritus. Large amounts of submerged organic matter in site pool with a prominent layer of leaf detritus smothering pool basin throughout site pool, and with humic substances staining the water black along edge sections in some parts of the pool. There was smell of sulphur emanating from substrate when disturbed. The site substrates consist of soft muddy sediments and sand. Layer of algae floating on pool water surface, though no filamentous green algae observed.

23/10/12	HSDam	Honeysuckle dam site sampled in large boomerang shaped dam in eastern extent of property (on upstream side of pipe culvert). Dam basin mostly broad with shallow inline banks, sparse riparian trees and bordered with grasses (mostly *Carex appressa*) and rushes (*Juncus sp*). The lower adjoining dam located between the sample site and Jilliby Jilliby Creek (downstream from culvert crossing) was dry at the time of sampling. Water clear with no flow into or out of site length waterbody. Dam length around 140m, maximum width 30m, maximum depth to 1.3m and average depth 0.5m. The perimeter and upper end of the dam supported extensive macrophyte beds including swamp lily (*Ottelia ovalifolia*), slender knotweed (*Persicaria decipens*) and blunt pondweed (*Potamogeton ochreatus*). The edge habitats included macrophytes and trailing bank vegetation. The substrate consisted of consolidated mud, with exposed clay in some sections of the banks. Filamentous green algae present in small amounts in the main dam abundant in the shallower upper end of the dam. Cattle access throughout site length.
25/10/12	SW1	Water level around 20-30cm lower than previous Autumn 2012 survey. Site length water level receded into separate pools, with no surface water present at crossing. Water slightly turbid with no surface flow within site. Maximum pool length 8m and width to 3m, maximum depth to 0.6m. The edge habitats were similar to former samples and consisted of detritus, undercut banks, trailing bank vegetation, water ribbons (*Triglochin sp*) and charophytes. Substrate firm clay with layer of detritus in both pools. No filamentous green algae observed.
25/10/12	WC1	Water level around 10cm lower than Autumn 2012 survey, though general stream widths and habitats unchanged. Water tannin stained with no flow throughout site length and film on pool water surface. Maximum depth to 1.0m, average depth 0.4m. The aquatic edge habitats sampled included trailing bank vegetation, spike rushes (*Eleocharis sp*), water ribbons and river clubrush (*Schoenoplectus validus*), detritus and undercut banks. The channel banks and substrate firm clay, with some sand accumulations, overlain with detritus. There was a strong odour of sulphur when the detritus was disturbed. Filamentous green algae absent.
25/10/12	HHMd	Water level receded to two remnant narrow and very shallow pools. Water turbid with no flow or any other surface water observed in channel up or downstream. Maximum pool length 10m, maximum width 1m and average width 0.9m, maximum depth 0.1m. The only available edge habitat was detritus, as there were no macrophytes or trailing bank vegetation. Pool substrates mostly soft clayey fine sand. No filamentous green algae observed.

22/5/13	WR1	Water levels a little higher than the Spring 2012 survey. Evidence of high flows to 4m above current water level. Water slightly turbid and flowing through site length. Maximum width 13m, average width 10m, maximum depth to 1.4m and average depth 0.8m. The edge habitats sampled were consistent with that encountered on former survey occasions, consisting of trailing bank vegetation, detritus and undercut banks. No animal tracks observed on instream banks, which look recently settled. Substrates consisted of firm sandy sediments with some sections of the site having experienced scouring out and deepening of pools. No filamentous green algae observed.
21/5/13	JC3	Site water levels similar to Spring 2012 with slightly higher flow rate. Evidence of flow rates to at least 4m above current water level, with a number of log jams present that weren't for the previous survey. Water slightly turbid and flowing through site length. Pool dimensions similar to the Spring 2012 survey, maximum depth to 1.4m and average depth 0.6m.The edge habitats consisted of undercut banks, trailing bank vegetation and detritus. Substrate mostly mobile sandy sediments with some deepening and infilling having occurred since previous survey. Bank erosion and undercutting prevalent throughout site length. Small amounts of orange precipitate emanating from banks. No filamentous green algae observed.
29/5/13	LJ3	The site stream flow paths and distribution of sand banks had been modified since the Spring 2012 survey, with some pool sections deepened and some experienced infilling. Evidence of high flows to at least 3m above current water level, with numerous log jams having established throughout the site length. Water clear and flowing through site length. Maximum width 5m and average width 2.5m, maximum depth to 1.6m and average depth around 0.3m. The edge habitats consisted of undercut banks, trailing bank vegetation and detritus. The site substrates were mostly sand with some pebble to gravel sized rock fragments and sparse rock outcrops. Orange precipitate present on substrate throughout most of the site. No filamentous green algae observed.

21/5/13	LJDn	Water level and flows higher than the recent Spring 2012 survey. Evidence of high flows to +3m above current water level. Some of the flow channels had experienced localised re-course with some of the bank areas undercut and eroding. Water slightly brown and flowing through site length. Maximum width to 5m, average width 1.5m, maximum depth 0.9m, and average depth 0.3m. The aquatic edge habitats were unchanged from former survey occasions and consisted of trailing bank vegetation, detritus and undercut banks. The abundant leaf litter that was recorded smothering the channel banks and pool substrates for the previous survey was absent for this survey. The site substrates were comprised of sandy sediments (unconsolidated in parts) and since the previous survey there had been some localised infilling and deepening of site pools. Parts of the channel the sediments had been scoured back to clay substrate. Filamentous green algae present in small amounts.
29/5/13	SGdn	Surface water and flow continuous throughout site length. Water clear with orange precipitation present throughout site length. Evidence of high flows to +1.5-2m above current water level. Maximum stream width to 3.5m, average width 1.5m, maximum depth 0.9m and average depth 0.2m. The aquatic edge habitats were the same as the previous survey, consisting of undercut banks and detritus. The site channel substrates consisted of gravelly sediments with sections containing larger fragments (cobble size). Not very many sand accumulations observed. Orange precipitation present but less pronounced than previous survey. Filamentous green algae present in small amounts.
29/5/13	LJL	Water level around 30-50cm higher than previous survey, and some of the rainforest trees and palms around the perimeter of the pool were submerged. No observable surface flow into or out of site pool. At the time of sampling there was an algal film present on the surface of the site pool. Maximum depth to 2m. The edge habitats included trailing bank vegetation (mostly *Carex appressa*), submerged branches and detritus. The site substrates were mostly soft mud with some sections of sand accumulations, and the entire pool basin was smothered in a layer of detritus. As for the Spring 2012 survey, there was smell of sulphur emanating from substrate when disturbed, and there was some black staining of the water observed along the pool edges. No filamentous green algae observed.

22/5/13	HSDam	Site water levels and pool dimensions similar to previous survey, around 15cm below the level of the pipe culvert. Lower adjoining channel with shallow surface water present in basin. Water of slight to moderate turbidity with no flow in channel areas up or downstream from site dam. The dam dimensions were unchanged from the previous Spring 2012 survey and maximum depths in the dam reached 1.3m. The Aquatic habitats were similar to those encountered during the Spring 2012 survey, and consisted of trailing bank vegetation, macrophyte beds including swamp lily (*Ottelia ovalifolia*), slender knotweed (*Persicaria decipens*) and blunt pondweed (*Potamogeton ochreatus*). The site substrate consisted of firm clay. Filamentous green algae present in moderate to abundant amounts. Evidence of recent cattle usage.
22/5/13	SW1	More surface water available to sample than the Spring 2012 survey, though water level still lower than pre-Spring 2012 surveys. Water clear with no surface flow into or out of site pools. Maximum pool length to 8m, maximum width to 3m, maximum depth to 0.7m. The edge habitats sampled included detritus, undercut banks, trailing bank vegetation, water ribbons (*Triglochin sp*) and charophytes. The pool substrates were unchanged and were comprised of firm clay covered with a layer of detritus. No filamentous green algae observed.
22/5/13	WC1	Water level similar to the Spring 2012 survey and general pool dimensions similar to previous surveys. No observable surface water flow within site length, and layer of green algae smothering pool surfaces. Maximum depth to 1.3m. The aquatic edge habitats were consistent with former survey occasions, consisting of trailing bank vegetation, spike rushes (*Eleocharis sp*), water ribbons and river clubrush (*Schoenoplectus validus*), detritus and undercut banks. Substrate mostly firm clay with some sand drifts. Channel basin smothered in layer of detritus which released a strong sulphur smell when disturbed and black water was noted around the pool edges. No filamentous green algae observed.
22/5/13	HHMd	Water level a little higher than the previous survey, though still relatively sparse surface water availability compared to pre-Spring 2012 surveys. Pool length to 60m, maximum width to 5m and average width 1.5m, maximum depth to 40cm, though average depth mostly shallow around 20cm. Water moderately turbid with no flow within site length. No surface water observed up or downstream from site pool. The slender knotweed and other macrophytes (including Frogsmouth *Philydrum lanuginosum*) have increased in area since the Spring 2012 survey. The aquatic habitats consisted of slender knotweed, detritus and trailing bank vegetation. The site pool substrates were comprised of soft clayey sand. Filamentous green algae abundant.

Appendix Table A-2 Modified Riparian, Channel and Environment (RCE) Inventory (after Chessman et al 1997) - Spring 2012.

Descriptor	Category	Value	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd
1	Land-use pattern beyond immediate riparian zone											
	Undisturbed native vegetation	4			4		4	4		4	4	
	Mixed native vegetation and pasture/exotics	3	3	3		3						3
	Mainly pasture, crops or pine plantation	2							2.5			
	Urban, some vegetation	1										
	Industrial, little vegetation	0										
2	Width of riparian strip-of woody vegetation											
	More than 30 m	4	4		4		4	4		4	4	4
	Between 5 and 30 m	3		3.5		3.5						
	Less than 5 m	2							2			
	No woody vegetation	1										
	No Vegetation	0										
3	Completeness of riparian strip of woody vegetation											
	Riparian strip without breaks in vegetation	4	4	4	4	4	4	4		4	4	4
	Breaks at intervals of more than 50 m	3										
	Breaks at intervals of 10-50 m	2										
	Breaks at intervals of less than 10 m	1							1			
	No riparian strip at all	0										
4	Vegetation of riparian zone within 10 m of channel											
	Native tree and shrub species	4			4		4	4		4	4	
	Mixed native and exotic trees and shrubs	3	3	3.5		3.5			3			3
	Exotic trees and shrubs	2										
	Exotic grasses/weeds	1										
	No vegetation at all	0										
5	Stream bank structure											
	Banks fully stabilized by trees, shrubs, concrete	4	4		4					4	4	4
	Banks firm but held mainly by grass and herbs	3		3.5		3.5	3.5	3.5	3			
	Banks loose, partly held by sparse grass, rubble	2										
	Banks unstable, mainly loose sand or soil	1										
	Banks actively eroding	0										
6	Bank undercutting											
	None, or restricted by tree roots or man-made	4						4		4		4
	Only on curves and at constrictions	3			3		3		3			
	Frequent along all parts of stream	2	2	2		2					2	
	Severe; bank collapses common	1										
	Total bank collapse	0										
7	Channel form											
	Deep; width:depth ratio less than 8:1	4	4	4	4	4	4				4	
	Medium; width:depth ratio 8:1 to 15:1	3						3				
	Shallow; width:depth ratio greater than 15:1	2							2	2		2
	Artificial; concrete or excavated channel< 8:1	1										
	Artificial; concrete or excavated channel > 8:1	0										
8	Riffle/pool sequence											
	Frequent alternation of riffles and pools	4										
	Long pools with infrequent short riffles	3	3	3.5	3.5	3	3.5				3.5	
	Natural channel without riffle/pool sequence	2						2		2		2
	Artificial channel; some riffle/pool sequence	1										
	Artificial channel; no riffle/pool sequence	0							0			
9	Retention devices in stream											
	Many large boulders and/or debris dams	4										
	Rocks/logs present; limited damming effect	3	3	3.5	3.5		3			3	3.5	
	Rocks/logs present but unstable; no damming	2				2		2				2
	Stream or channel with few or no rocks/logs	1							1			
	Artificial channel; no retention devices	0										
10	Channel sediment accumulations											
	Little or no accumulation of loose sediments	4								4		
	Some gravel bars but little sand or silt	3									3.5	
	Bars of sand and silt common	2		2	2	2	2	2	2			
	Braiding by loose sediment	1	1.5									1
	Complete in-filled muddy channel	0										
11	Stream bottom											
	Mainly clean stones with obvious interstices	4										
	Mainly stones with some cover of algae/silt	3										
	Bottom heavily silted but stable	2		2	2		2	2	2		2	2
	Bottom mainly loose and mobile sandy sediment	1	1			1				1		
	Bottom mainly loose and mobile muddy sediment	0										
12	Stream detritus											
	Mainly unsilted wood, bark, leaves	4								4	4	
	Some wood, leaves, etc. with much fine detritus	3		3	3.5		3.5	3	3			
	Mainly fine detritus mixed with sediment	2	2									2
	Little or no organic detritus, mainly sandy	1				1						
	No organic detritus, mainly mud	0										
13	Aquatic vegetation											
	Little or no macrophyte or algal growth	4	4	4	4	4	4	4		4		4
	Substantial algal growth; few macrophytes	3										
	Substantial macrophyte growth; little algal growth	2							2.5		2.5	
	Substantial macrophyte and algal growth	1										
	Total cover of macrophytes plus algae	0										
	RCE Score		38.5	41.5	45.5	36.5	44.5	41.5	27.0	44.0	45.0	37.0
	RCE %age		74.0	79.8	87.5	70.2	85.6	79.8	51.9	84.6	86.5	71.2

Appendix Table A-3 Modified Riparian, Channel and Environment (RCE) Inventory (after Chessman et al 1997) - Autumn 2013.

Descriptor	Category	Value	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd	JCDn	JJ Wetland
1	Land-use pattern beyond immediate riparian zone													
	Undisturbed native vegetation	4			4		4	4		4	4			
	Mixed native vegetation and pasture/exotics	3	3	3		3						3	3	
	Mainly pasture, crops or pine plantation	2							2.5					2
	Urban, some vegetation	1												
	Industrial, little vegetation	0												
2	Width of riparian strip-of woody vegetation													
	More than 30 m	4	4		4		4	4		4	4	4	4	
	Between 5 and 30 m	3		3.5		3.5								
	Less than 5 m	2							2					
	No woody vegetation	1												1
	No Vegetation	0												
3	Completeness of riparian strip of woody vegetation													
	Riparian strip without breaks in vegetation	4	4	4	4	4	4	4		4	4	4	4	
	Breaks at intervals of more than 50 m	3												
	Breaks at intervals of 10-50 m	2												
	Breaks at intervals of less than 10 m	1							1					
	No riparian strip at all	0												0
4	Vegetation of riparian zone within 10 m of channel													
	Native tree and shrub species	4			4		4	4		4	4			
	Mixed native and exotic trees and shrubs	3	3	3.5		3.5			3			3	3.5	
	Exotic trees and shrubs	2												
	Exotic grasses/weeds	1												1.5
	No vegetation at all	0												
5	Stream bank structure													
	Banks fully stabilized by trees, shrubs, concrete	4	4		4					4	4	4		
	Banks firm but held mainly by grass and herbs	3		3.5		3.5	3.5	3.5	3				3.5	3
	Banks loose, partly held by sparse grass, rubble	2												
	Banks unstable, mainly loose sand or soil	1												
	Banks actively eroding	0												
6	Bank undercutting													
	None, or restricted by tree roots or man-made	4						4		4		4		
	Only on curves and at constrictions	3			3		3		3				3	3
	Frequent along all parts of stream	2	2	2		2					2			
	Severe; bank collapses common	1												
	Total bank collapse	0												
7	Channel form													
	Deep; width:depth ratio less than 8:1	4	4	4	4	4	4				4		4	
	Medium; width:depth ratio 8:1 to 15:1	3						3						
	Shallow; width:depth ratio greater than 15:1	2							2	2		2		2
	Artificial; concrete or excavated channel< 8:1	1												
	Artificial; concrete or excavated channel > 8:1	0												
8	Riffle/pool sequence													
	Frequent alternation of riffles and pools	4												
	Long pools with infrequent short riffles	3	3	3.5	3.5	3	3.5				3.5			
	Natural channel without riffle/pool sequence	2						2		2		2	2.5	2
	Artificial channel; some riffle/pool sequence	1												
	Artificial channel; no riffle/pool sequence	0							0					
9	Retention devices in stream													
	Many large boulders and/or debris dams	4												
	Rocks/logs present; limited damming effect	3	3	3.5	3.5		3			3	3.5		3.5	
	Rocks/logs present but unstable; no damming	2				2		2				2		
	Stream or channel with few or no rocks/logs	1							1					1
	Artificial channel; no retention devices	0												
10	Channel sediment accumulations													
	Little or no accumulation of loose sediments	4								4				
	Some gravel bars but little sand or silt	3									3.5			
	Bars of sand and silt common	2		2	2	2	2	2	2				2	
	Braiding by loose sediment	1	1.5									1		1
	Complete in-filled muddy channel	0												
11	Stream bottom													
	Mainly clean stones with obvious interstices	4												
	Mainly stones with some cover of algae/silt	3												
	Bottom heavily silted but stable	2		2	2		2	2	2		2	2	2	
	Bottom mainly loose and mobile sandy sediment	1	1			1				1				1
	Bottom mainly loose and mobile muddy sediment	0												
12	Stream detritus													
	Mainly unsilted wood, bark, leaves	4								4	4			
	Some wood, leaves, etc. with much fine detritus	3		3	3.5		3.5	3	3				3	3
	Mainly fine detritus mixed with sediment	2	2									2		
	Little or no organic detritus, mainly sandy	1				1								
	No organic detritus, mainly mud	0												
13	Aquatic vegetation													
	Little or no macrophyte or algal growth	4	4	4	4	4	4	4		4			4	
	Substantial algal growth; few macrophytes	3										3		
	Substantial macrophyte growth; little algal growth	2							2.5		2.5			2.5
	Substantial macrophyte and algal growth	1												
	Total cover of macrophytes plus algae	0												
	RCE Score		38.5	41.5	45.5	36.5	44.5	41.5	27.0	44.0	45.0	36.0	42.0	23.0
	RCE %age		74.0	79.8	87.5	70.2	85.6	79.8	51.9	84.6	86.5	69.2	80.8	44.2

Appendix Table A-4 W2CP Field Water Quality Readings Spring 2012 & Autumn 2013											
Site	Date	Time	Depth	Temp	Cond	Sal	DO	DO	pH	ORP	Turb
			M	°C	µS/cm	ppt	%sat	mg/l	Units	mv	ntu
WR1	25/10/12	13:35	0.1	16.03	267	0.14	85.7	7.4	6.16	418	28.6
WR1	25/10/12	13:36	0.4	16.03	304	0.17	85.8	7.5	6.16	418	28.5
JC3	23/10/12	13:29	0.1	14.76	831	0.43	31.3	2.8	6.59	388	44.8
JC3	23/10/12	13:29	0.3	14.76	826	0.43	31.1	2.8	6.57	388	41.1
LJ3	22/10/12	13:37	0.1	14.86	799	0.42	59.3	5.3	6.78	344	10.2
LJ3	22/10/12	13:37	0.3	14.84	804	0.42	59.1	5.3	6.74	345	10.2
LJDn	23/10/12	12:12	0.1	14.57	576	0.30	74.0	6.6	6.57	389	36.5
SGDn-1	22/10/12	12:31	0.1	14.19	1129	0.58	30.8	2.8	5.91	286	32.6
SGDn-1	22/10/12	12:32	0.6	13.98	1169	0.61	24.7	2.2	6.06	282	16.9
SGDn-2	22/10/12	12:39	0.1	14.07	1228	0.63	33.3	3.0	6.57	289	14.7
LJL	22/10/12	10:49	0.1	16.64	328	0.18	32.9	2.8	5.89	324	99.2
LJL	22/10/12	10:49	0.5	16.41	340	0.18	33.5	2.9	5.91	322	128.5
HSDam	23/10/12	9:58	0.1	20.57	154	0.09	83.6	6.6	6.13	377	20.6
HSDam	23/10/12	9:58	0.5	20.16	153	0.09	83.8	6.7	6.13	377	18.2
HS3	23/10/12	15:21	0.1	26.88	225	0.12	97.3	6.8	6.73	374	50.6
HS2	23/10/12	15:29	0.1	23.02	190	0.11	91.0	6.9	6.47	371	501.4
HS1	23/10/12	15:41	0.1	22.96	180	0.10	102.1	7.7	8.77	350	106.2
HS1	23/10/12	15:42	0.4	22.97	189	0.11	102.9	7.8	8.82	347	104.0
SW1-1	25/10/12	9:35	0.1	14.52	888	0.46	42.1	3.8	4.21	445	64.2
SW1-2	25/10/12	9:38	0.1	14.25	812	0.42	41.0	3.7	4.27	447	36.9
SW1-2	25/10/12	9:38	0.4	13.15	851	0.44	41.8	3.9	4.29	448	37.8
WC1	25/10/12	10:39	0.1	14.32	1614	0.85	28.4	2.5	6.09	448	40.0
HHMd-1	25/10/12	11:57	0.1	29.21	1705	0.92	70.8	4.8	3.56	432	115.6
HHMd-2	25/10/12	11:59	0.1	30.08	1657	0.89	72.6	4.8	3.48	441	180.9
WR1	22/05/13	9:33	0.2	10.86	238	0.07	101.6	10.2	6.81	362	18.9
JC3	21/05/13	15:22	0.2	12.32	445	0.17	96.6	9.4	6.79	347	38.1
JJDn	22/05/13	12:55	0.1	12.02	438	0.16	103.7	10.1	7.03	382	51.0
JJ Wetland	22/05/13	11:11	0.2	14.24	125	0.01	80.3	7.5	6.54	369	108.7
LJ3	29/05/13	12:19	0.1	12.12	536	0.21	63.4	6.2	6.87	311	12.9
LJ3d/s	29/05/13	12:28	0.1	12.31	584	0.23	61.6	6	6.91	307	34.1
LJDn	21/05/13	13:54	0.1	12.77	483	0.19	97.1	9.3	6.89	340	49.2
SGDn	29/05/13	12:10	0.1	12.92	840	0.35	57.6	5.5	6.71	311	15.5
LJL	29/05/13	10:57	0.2	11.44	139	0.01	45.1	4.5	6.62	420	53.7
HSDam	22/05/13	11:34	0.1	14.11	115	0.01	97.6	9.1	6.51	385	76.9
HSDam	22/05/13	11:35	0.5	14.08	114	0.01	92.0	8.6	6.49	386	124.4
SW1	22/05/13	15:15	0.1	11.86	395	0.14	47.9	4.7	5.40	416	20.6
SW1	22/05/13	15:15	0.4	11.76	390	0.14	48.9	4.8	5.34	421	22.4
WC1	22/05/13	14:29	0.1	12.49	916	0.39	19.5	1.9	5.90	402	65.8
HHMd	22/05/13	13:18	0.1	14.08	664	0.27	108.1	10.1	6.48	386	92.9
Note:	LJ3d/s taken from Little Jilliby Jilliby Creek downstream from Splash Gully confluence.										
	Readings containing -1 or -2 are recorded in separate upstream and downstream site pools respectively.										

Appendix Table A-5 Wallarah Macroinvertebrate and Fish Surveys Results - Spring 2012

Phylum	Class	Sub-Cl	Order	Sub-Order	Family	Sub-F	Genus/spp	Common name	Description	L	N	A	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd	Occurrence	SIG-2
										Life Stage			25/10/12	23/10/12	22/10/12	23/10/12	22/10/12	22/10/12	23/10/12	25/10/12	25/10/12	25/10/12		
Arthropoda	Insecta		Coleoptera		Dytiscidae			Diving Beetles		x		x	1	1	1	1	1	1	1	1	1	1	10	2
Arthropoda	Insecta		Coleoptera		Elmidae			Riffle Beetles		x		x	1			1							2	7
Arthropoda	Insecta		Coleoptera		Gyrinidae			Whirligig Beetles		x		x	1	1	1	1	1						5	4
Arthropoda	Insecta		Coleoptera		Haliplidae			Crawling Water Beetles				x								1			1	2
Arthropoda	Insecta		Coleoptera		Hydrochidae			Scavenger Water Beetles														1	1	4
Arthropoda	Insecta		Coleoptera		Hydrophilidae			Scavenger Water Beetles				x			1		1		1			1	4	2
Arthropoda	Insecta		Coleoptera		Scirtidae			Marsh Beetles		x						1		1			1		3	6
Arthropoda	Insecta		Diptera		Ceratopogonidae			Biting Midges		x					1				1				2	4
Arthropoda	Insecta		Diptera		Chironomidae	Chironominae		Bloodworms		x			1	1	1	1	1	1	1	1	1	1	10	3
Arthropoda	Insecta		Diptera		Chironomidae	Tanypodinae		Bloodworms		x			1	1	1	1	1		1				6	4
Arthropoda	Insecta		Diptera		Culicidae			Mosquitoes		x					1	1	1						3	1
Arthropoda	Insecta		Ephemoptera		Baetidae			Mayflies			x		1			1			1				3	5
Arthropoda	Insecta		Ephemoptera		Caenidae			Mayflies			x		1										1	4
Arthropoda	Insecta		Ephemoptera		Leptophlebiidae			Mayflies			x		1	1	1	1	1	1		1	1	1	9	8
Arthropoda	Insecta		Hemiptera		Corixidae			Lesser Water Boatmen						1					1			1	3	2
Arthropoda	Insecta		Hemiptera		Gelastocoridae			Toad Bugs										1					1	5
Arthropoda	Insecta		Hemiptera		Gerridae			Water Striders					1										1	4
Arthropoda	Insecta		Hemiptera		Hydrometridae			Water Measurers													1		1	3
Arthropoda	Insecta		Hemiptera		Mesoveliidae			Water Treaders						1					1				2	2
Arthropoda	Insecta		Hemiptera		Naucoridae			Creeping Water Bugs											1				1	2
Arthropoda	Insecta		Hemiptera		Notonectidae			Backswimmers									1	1	1				3	1
Arthropoda	Insecta		Hemiptera		Pleidae			Pygmy Backswimmers											1				1	2
Arthropoda	Insecta		Hemiptera		Veliidae			Small Water Striders					1	1			1		1			1	5	3
Arthropoda	Insecta		Lepidoptera		Pyralidae			Moths		x									1				1	3
Arthropoda	Insecta		Megaloptera		Sialidae			Alderflies		x				1									1	5
Arthropoda	Insecta		Odonata	Epiproctophora	Aeshnidae			Dragonflies		x									1	1			2	4
Arthropoda	Insecta		Odonata	Epiproctophora	Cordulephyidae			Dragonflies		x					1					1			2	5
Arthropoda	Insecta		Odonata	Epiproctophora	Gomphidae			Dragonflies		x			1							1			2	5
Arthropoda	Insecta		Odonata	Epiproctophora	Hemicorduliidae			Dragonflies		x									1	1		1	3	5
Arthropoda	Insecta		Odonata	Epiproctophora	Libellulidae			Dragonflies		x									1				1	4
Arthropoda	Insecta		Odonata	Epiproctophora	Telephlebiidae			Dragonflies		x			1		1								2	9
Arthropoda	Insecta		Odonata	Zygoptera	Coenagrionidae			Damselflies		x									1	1	1		3	2
Arthropoda	Insecta		Odonata	Zygoptera	Isostictidae			Damselflies		x				1		1					1		3	3
Arthropoda	Insecta		Odonata	Zygoptera	Lestidae			Damselflies		x									1				1	1
Arthropoda	Insecta		Odonata	Zygoptera	Megapodagrionidae			Damselflies		x					1		1				1		3	5
Arthropoda	Insecta		Odonata	Zygoptera	Synlestidae			Damselflies		x			1	1	1	1	1						5	7
Arthropoda	Insecta		Trichoptera		Atriplectididae			Caddis Flies		x			1										1	7
Arthropoda	Insecta		Trichoptera		Calamoceratidae			Caddis Flies		x			1						1				2	7
Arthropoda	Insecta		Trichoptera		Ecnomidae			Caddis Flies		x										1			1	4
Arthropoda	Insecta		Trichoptera		Hydrobiosidae			Caddis Flies		x			1			1							2	8
Arthropoda	Insecta		Trichoptera		Hydroptilidae			Caddis Flies		x									1				1	4
Arthropoda	Insecta		Trichoptera		Leptoceridae			Caddis Flies		x			1	1	1	1	1	1	1	1	1	1	10	6
Arthropoda	Insecta		Trichoptera		Odontoceridae			Caddis Flies		x			1										1	7
Arthropoda	Insecta		Trichoptera		Philorheithridae			Caddis Flies		x			1			1							2	8
Arthropoda	Arachnida		Acarina	Hydracarina				Freshwater Mites					1	1	1	1		1	1		1		7	6
Arthropoda	Crustacea	Branch	Diplostra	Cladocera				Water Fleas								1		1	1		1		4	*
Arthropoda	Crustacea	Copepe	Calanoida		Centropagidae			Copepods										1	1				2	*
Arthropoda	Crustacea	Copepe	Cyclopoida		Cyclopidae			Copepods							1		1				1		3	*
Arthropoda	Crustacea		Decapoda		Atyidae			Freshwater Shrimp					1	1	1	1		1	1	1		1	8	3
Arthropoda	Crustacea		Decapoda		Parastacidae			Crayfish/ Yabbie							1					1	1		3	4
Annelida	Oligochaeta							Freshwater Worms						1	1	1			1	1			5	2
Mollusca	Bivalvia				Hyriidae			Freshwater Mussels					1	1									2	5
Mollusca	Bivalvia				Sphaeriidae			Pea Shells						1	1	1			1				4	5
Mollusca	Gastropoda				Ancylidae			Freshwater Limpets								1		1	1				3	4
Mollusca	Gastropoda				Physidae			Freshwater Snails											1				1	1
Mollusca	Gastropoda				Planorbidae			Freshwater Snails										1	1	1	1	1	5	2
Platyhelmint	Turbellaria		Dalyellioida		Temnocephalidae			Temnocephalans							1								1	5
Platyhelmint	Turbellaria		Seriata		Dugesiidae			Flatworms						1	1			1					3	2
Chordata	Amphibia							Tadpoles							1			1	1				3	*
Chordata	Amphibia				Myobatrachidae		*Adelotus brevis*	Tusked Frog							1								1	*
Chordata	Amphibia				Myobatrachidae		*Lymnodynastes peronii*	Striped Marsh Frog					1										1	*
Chordata	Osteichthyes				Eleotridae		*Gobiomorphus/ Philypnodon*	Gudgeon							1								1	*
Chordata	Osteichthyes				Eleotridae		*Gobiomorphus coxii*	Cox's Gudgeon							1								1	*
Chordata	Osteichthyes				Eleotridae		*Hypseleotris galii*	Firetail Gudgeon											1				1	*
Chordata	Osteichthyes				Eleotridae		*Philypnodon grandiceps*	Flathead Gudgeon										1	1				2	*
Chordata	Osteichthyes				Eleotridae		*Philypnodon sp*	Flathead Gudgeon					1	1									2	*
Chordata	Osteichthyes				Poeciliidae		*Gambusia holbrooki*	Eastern Gambusia											1	1	1	1	4	*
								Total number of invertebrate taxa per site:					22	18	21	20	13	14	30	15	14	11	58	
									Site SIGNAL2 Scores:				5.55	4.00	4.35	4.84	3.83	4.00	3.25	3.80	4.17	3.64		
												EPT:	9	2	2	5	2	2	4	3	2	2		
Notes:	* Represents those taxa for which SIGNAL-2 scores are not available or do not apply																							

Appendix Table A-6 Wallarah Macroinvertebrate and Fish Surveys Results - Autumn 2013										Life Stage			22/05/13	21/05/13	29/05/13	21/05/13	29/05/13	29/05/13	22/05/13	22/05/13	22/05/13	22/05/13		
Phylum	Class	Sub-C	Order	Sub-Order	Family	Sub-F	Genus/spp	Common name	Description	L	N	A	WR1	JC3	LJ3	LJDn	SGDn	LJL	HSDam	SW1	WC1	HHMd	Occurrence	SIG-2
Arthropoda	Insecta		Coleoptera		Dytiscidae			Diving Beetles		x		x	1		1	1	1	1	1		1	1	8	2
Arthropoda	Insecta		Coleoptera		Elmidae			Riffle Beetles		x		x	1	1									2	7
Arthropoda	Insecta		Coleoptera		Gyrinidae			Whirligig Beetles		x		x	1	1	1	1	1						5	4
Arthropoda	Insecta		Coleoptera		Hydrophilidae			Scavenger Water Beetles				x					1	1			1	1	4	2
Arthropoda	Insecta		Coleoptera		Scirtidae			Marsh Beetles		x								1		1		1	3	6
Arthropoda	Insecta		Diptera		Ceratopogonidae			Biting Midges		x			1		1	1			1			1	5	4
Arthropoda	Insecta		Diptera		Chironomidae	Chironominae		Bloodworms		x			1	1	1	1	1	1	1	1	1	1	10	3
Arthropoda	Insecta		Diptera		Chironomidae	Tanypodinae		Bloodworms		x			1		1	1	1	1	1	1	1	1	9	4
Arthropoda	Insecta		Diptera		Culicidae			Mosquitoes		x									1				1	1
Arthropoda	Insecta		Diptera		Dixidae			Dixid Midges		x							1	1					2	7
Arthropoda	Insecta		Diptera		Simuliidae			Black Flies		x			1	1	1								3	5
Arthropoda	Insecta		Diptera		Tipulidae			Crane Flies		x			1	1	1		1						4	5
Arthropoda	Insecta		Ephemoptera		Baetidae			Mayflies			x		1			1			1			1	4	5
Arthropoda	Insecta		Ephemoptera		Caenidae			Mayflies			x		1										1	4
Arthropoda	Insecta		Ephemoptera		Leptophlebiidae			Mayflies			x		1	1	1	1	1	1		1	1		8	8
Arthropoda	Insecta		Hemiptera		Corixidae			Lesser Water Boatmen						1		1		1	1			1	5	2
Arthropoda	Insecta		Hemiptera		Gerridae			Water Striders					1			1		1					3	4
Arthropoda	Insecta		Hemiptera		Hydrometridae			Water Measurers										1					1	3
Arthropoda	Insecta		Hemiptera		Mesoveliidae			Water Treaders						1		1		1	1				4	2
Arthropoda	Insecta		Hemiptera		Notonectidae			Backswimmers							1	1	1	1	1				5	1
Arthropoda	Insecta		Hemiptera		Pleidae			Pygmy Backswimmers											1				1	2
Arthropoda	Insecta		Hemiptera		Veliidae			Small Water Striders					1	1		1		1					4	3
Arthropoda	Insecta		Lepidoptera		Pyralidae			Moths		x									1				1	3
Arthropoda	Insecta		Megaloptera		Cordyalidae			Dobsonflies		x							1						1	7
Arthropoda	Insecta		Odonata	Epiproctophora	Aeshnidae			Dragonflies		x									1	1	1	1	4	4
Arthropoda	Insecta		Odonata	Epiproctophora	Cordulephyidae			Dragonflies		x											1		1	5
Arthropoda	Insecta		Odonata	Epiproctophora	Gomphidae			Dragonflies		x											1		1	5
Arthropoda	Insecta		Odonata	Epiproctophora	Hemicorduliidae			Dragonflies		x				1					1	1		1	4	5
Arthropoda	Insecta		Odonata	Epiproctophora	Libellulidae			Dragonflies		x									1			1	2	4
Arthropoda	Insecta		Odonata	Epiproctophora	Synthemistidae			Dragonflies		x												1	1	5
Arthropoda	Insecta		Odonata	Epiproctophora	Telephlebiidae			Dragonflies		x			1		1								2	9
Arthropoda	Insecta		Odonata	Zygoptera	Coenagrionidae			Damselflies		x									1	1	1	1	4	2
Arthropoda	Insecta		Odonata	Zygoptera	Isostictidae			Damselflies		x			1	1		1							3	3
Arthropoda	Insecta		Odonata	Zygoptera	Megapodagrionidae			Damselflies		x				1	1						1		3	5
Arthropoda	Insecta		Odonata	Zygoptera	Synlestidae			Damselflies		x					1								1	7
Arthropoda	Insecta		Trichoptera		Calamoceratidae			Caddis Flies		x			1			1			1				3	7
Arthropoda	Insecta		Trichoptera		Ecnomidae			Caddis Flies		x										1			1	4
Arthropoda	Insecta		Trichoptera		Leptoceridae			Caddis Flies		x			1	1	1	1	1	1	1	1	1	1	10	6
Arthropoda	Insecta		Trichoptera		Odontoceridae			Caddis Flies		x			1										1	7
Arthropoda	Insecta		Trichoptera		Philorheithridae			Caddis Flies		x			1		1	1							3	8
Arthropoda	Arachnida		Acarina	Hydracarina				Freshwater Mites					1		1	1		1	1	1	1	1	8	6
Arthropoda	Collembola							Springtails											1				1	1
Arthropoda	Crustacea	Branch	Diplostra	Cladocera				Water Fleas								1		1	1				3	*
Arthropoda	Crustacea	Copep	Calanoida		Centropagidae			Copepods											1				1	*
Arthropoda	Crustacea	Copep	Cyclopoida		Cyclopidae			Copepods										1	1	1		1	4	*
Arthropoda	Crustacea		Decapoda		Atyidae			Freshwater Shrimp					1	1	1	1			1	1	1	1	8	3
Arthropoda	Crustacea		Decapoda		Parastacidae			Crayfish/ Yabbie							1					1	1	1	4	4
Arthropoda	Ostracoda							Seed Shrimps											1	1			2	*
Annelida	Hirudinea				Glossiphoniidae			Leeches						1									1	1
Annelida	Oligochaeta							Freshwater Worms							1		1	1				1	4	2
Mollusca	Bivalvia				Hyriidae			Freshwater Mussels					1										1	5
Mollusca	Bivalvia				Sphaeriidae			Pea Shells					1	1			1						3	5
Mollusca	Gastropoda				Ancylidae			Freshwater Limpets								1			1		1	1	4	4
Mollusca	Gastropoda				Lymnaeidae			Freshwater Snails										1					1	1
Mollusca	Gastropoda				Physidae			Freshwater Snails											1			1	2	1
Mollusca	Gastropoda				Planorbidae			Freshwater Snails												1		1	2	2
Platyhelmint	Turbellaria		Seriata		Dugesiidae			Flatworms						1				1					2	2
Chordata	Amphibia							Tadpoles							1		1	1				1	4	*
Chordata	Osteichthyes				Eleotridae		*Gobiomorphus australis*	Striped Gudgeon								1							1	*
Chordata	Osteichthyes				Eleotridae		*Gobiomorphus coxii*	Cox's Gudgeon							1								1	*
Chordata	Osteichthyes				Eleotridae		*Hypseleotris galii*	Firetail Gudgeon					1	1		1			1				4	*
Chordata	Osteichthyes				Eleotridae		*Philypnodon grandiceps*	Flathead Gudgeon										1					1	*
Chordata	Osteichthyes				Eleotridae		*Philypnodon sp*	Flathead Gudgeon							1	1	1		1				4	*
Chordata	Osteichthyes				Poeciliidae		*Gambusia holbrooki*	Eastern Gambusia						1		1			1	1	1	1	6	*
Chordata	Osteichthyes						?	Fish Larva											1				1	*
								Total number of invertebrate taxa per site:					23	17	18	20	13	20	26	15	15	22	57	
									Site SIGNAL2 Scores:				5.09	4.06	4.78	4.16	4.31	3.56	3.27	4.38	4.20	3.62		
Notes:	* Represents those taxa for which SIGNAL-2 scores are not available or do not apply											EPT:	7	2	3	5	2	2	3	3	2	2		


Plate 1: Looking upstream at WR1 Spring 2012.


Plate 2: Looking upstream at WR1 in Autumn 2013.

Plate 3: Looking upstream at WR1 in Spring 2012.

Plate 4: Looking upstream at WR1 for Autumn 2013.


Plate 5: Looking downstream toward bridge at WR1 Spring 2012.


Plate 6: Looking downstream at WR1 (Autumn 2013).

Plate 7: Striped marsh frog *Lymnodynastes peronii* from WR1 in Spring 2012

Plate 8: Looking upstream, through log jam at JC3 in Spring 2012.


Plate 9: Looking upstream at JC3 for Autumn 2013.


Plate 10: Looking upstream at JC3 (Spring 2012).


Plate 11: Looking upstream at JC3 in Autumn 2013.


Plate 12: Looking upstream at JC3 (Spring 2012).


Plate 13: Looking upstream at JC3 (Autumn 2013).


Plate 14: Looking downstream from downstream end of JC3 in Spring 2012.

Plate 15: Looking downstream from downstream end of JC3 in Autumn 2013.

Plate 16: Looking upstream at upstream end of LJ3 (Spring 2012).

Plate 17: Looking upstream from the upstream end of LJ3 (Autumn 2013).

Plate 18: Looking upstream at LJ3 (Spring 2012).

Plate 19: Looking upstream at LJ3 in Autumn 2013. Note the difference in leaf litter throughout the channel banks and sites pool areas between surveys.

Plate 20: Looking upstream at LJ3 (Spring 2012).


Plate 21: Looking upstream at LJ3 (Autumn 2013) from the exact same location as in Plate 21
.


Plate 22: Looking upstream at LJ3 (Spring 2012).

Plate 23: Looking upstream at LJ3 (Autumn 2013).

Plate 24: Tusked frog *Adelotus brevis* encountered in Spring 2013.


Plate 25: Large Coxs gudgeon (*Gobiomorphus australis*) from LJ3 (Autumn 2013).


Plate 26: Freshwater crayfish from LJ3 (Spring 2012).

Plate 27: Looking upstream at LJDn (Spring 2012). Note the difference in water levels between the Autumn 2013 survey (below).

Plate 28: Looking upstream at LJDn in Autumn 2013. This location had experienced some deepening of the site pool since the Spring 2012 survey.

Plate 29: Looking upstream at LJDn Spring 2012.

Plate 30: Looking upstream at LJDn Autumn 2013.


Plate 31: Looking downstream at LJDn (Spring 2012).


Plate 32: Looking downstream at LJDn in Autumn 2013.

Plate 33: Striped gudgeon *Gobiomorphus australis* from LJDn in Autumn 2013.

Plate 34: Looking upstream at SGdn (Spring 2012).


Plate 35: Looking upstream at SGdn (Autumn 2013).


Plate 36: Looking upstream at SGDn (Spring 2012).

Plate 37: Looking upstream at SGDn in Autumn 2013.

Plate 38: Looking upstream at SGDn (Spring 2012).

Plate 39: Looking upstream at SGDn (Autumn 2013).

Plate 40: Looking downstream in Splash Gully toward confluence with Little Jilliby Jilliby Creek in Spring 2012.


Plate 41: Looking downstream in Splash Gully toward confluence with Little Jilliby Jilliby Creek in Autumn 2013.


Plate 42: Looking across LJL site pool (Spring 2012).

Plate 43: LJL site pool in Autumn 2013.

Plate 44: Looking across LJL site pool in Spring 2012.


Plate 45: Looking across LJL site pool in Autumn 2013.


Plate 46: LJL site pool (Spring 2012).

Plate 47: Looking across the southern arm of LJL in Autumn 2013.

Plate 48: Flathead gudgeon *Philypnodon grandiceps* from LJL (Autumn 2013).

Plate 49: Looking across HSDam (Spring 2012).

Plate 50: Site HSDam in Autumn 2013.

Plate 51: Honeysuckle farm site HSDam (Spring 2012).

Plate 52: Upper end of HSDam (Autumn 2013).

Plate 53: Dry dam below pipe culvert on the downstream side of HSDam in Spring 2012 (note Jilliby Jilliby Creek in the background).

Plate 54: Channel area below HSDam pipe culvert in Autumn 2013. There were small amounts of surface water within the channel basin.

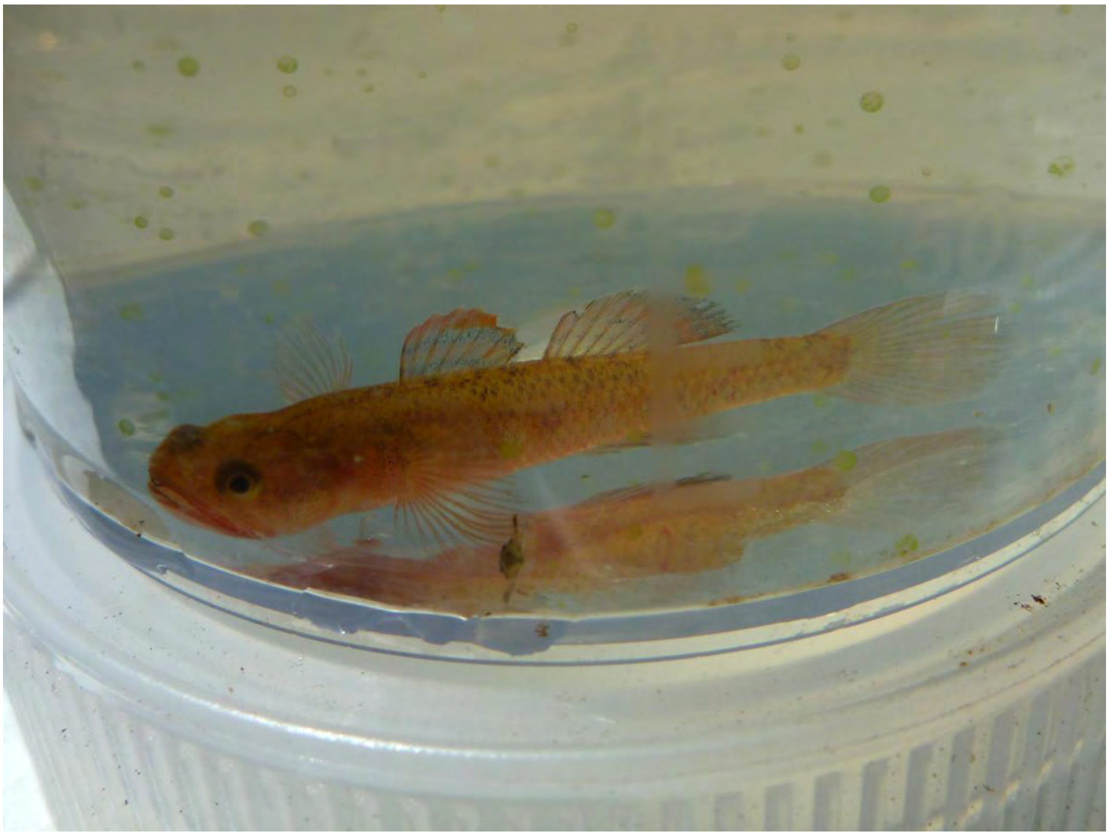

Plate 55: Flathead gudgeon *Philypnodon grandiceps* from HSDam (Spring 2012).

Plate 56: Looking across SW1 channel in Spring 2012.

Plate 57: Looking across SW1 channel in Autumn 2013.

Plate 58: Upstream pool at SW1 in Spring 2012.


Plate 59: Upstream site pool at SW1 Autumn 2013.


Plate 60: Looking upstream at SW1 Spring 2012.

Plate 61: Dry crossing at SW1 (Spring 2012).

Plate 62: Looking across crossing at SW1 in Autumn 2013.

Plate 63: Looking upstream at WC1 (Spring 2012).

Plate 64: Looking upstream at WC1 in Autumn 2013.


Plate 65: Looking downstream at WC1 in Spring 2012.


Plate 66: Looking downstream at WC1 (Autumn 2013).


Plate 67: Looking downstream from lower end of WC1 (Spring 2012).


Plate 68: Looking downstream at WC1 (Autumn 2013).


Plate 69: Looking upstream of HHMd in Spring 2012.


Plate 70: Looking upstream of HHMd in Autumn 2013.


Plate 71: Downstream side of road culvert at HHMd (Spring 2012).


Plate 72: Downstream side of culvert in Autumn 2013. Note the variation in macrophyte growth between surveys.

Plate 73: Looking downstream at HHMd in Spring 2012. Note the variation in water levels with Autumn 2013 below.

Plate 74: Looking downstream at HHMd in Autumn 2013.

Plate 75:Shallow remnant pool at HHMd Spring 2012.

Plate 76: Looking downstream at HHMd in Autumn 2013.

Plate 77: Honeysuckle Park water storage dam HS1 looking east toward Jilliby Jilliby Creek (Spring 2012).

Plate 78: Honeysuckle Park water storage dam HS2, looking west (Spring 2012).

Plate 79: Honeysuckle Park surface water in channel at HS3 (Spring 2012).

Plate 80: Looking upstream at JJDn in Autumn 2013.

Plate 81: Site JJDn site pool.

Plate 82: Looking downstream at JJDn in Autumn 2013.


Plate 83: Looking across JJ Wetland from Jilliby Rd eastern culvert (Autumn 2013).


Plate 84: Looking across JJ Wetland from western culvert (Autumn 2013).

Plate 85: Flathead gudgeon from JJ Wetland (Autumn 2013).

AQUATIC HABITAT

EVALUATION SURVEY

WINTER 2013

1 **INTRODUCTION**

Two additional aquatic ecology site evaluation surveys were undertaken, on 2nd August and 8th August 2013:

- The purpose of the 2nd August survey was to complete the aquatic habitat survey for the upper 3rd order forested section of Little Jilliby Jilliby Creek and select a site for Spring 2013 sampling. This was the last forested section of Little Jilliby Jilliby Creek that had not been inspected by WACJV or consultants to date.
- The purpose of the 8th August survey was to locate the OEH Wallarah Creek reference site, inspect the condition of Wallarah Creek south arm for a possible reference catchment sample site for Wallarah Creek north arm, locate a new Wallarah Creek sample site downstream of the proposed mine discharge point and investigate suitable Spring Creek sites for monitoring rail crossing construction impacts.

1.1 Little Jilliby Jilliby Creek Inspection 2nd August 2013

To date there have been specific walkover aquatic ecology habitat inspections of the Upper 1st to 2nd order East Branch of Little Jilliby Jilliby Creek, of the middle forested 3rd order section of Little Jilliby Jilliby Creek, parts of the lower farm land 3rd order creek and inspections of the 4th order section of the creek at and below Jilliby Road (see Figure 1). Access to the private properties for the upper 4th order section of the creek between the Myrtle Creek confluence and Jilliby Road has not been granted, so this section has only been evaluated from aerial photographs to date.

The EIS aquatic ecology report provided an assessment of the aquatic ecology of the study area based on field surveys over three seasons (Autumn and Spring 2011 and Autumn 2012) plus site aquatic habitat evaluation surveys in winter 2012. Additional seasonal aquatic habitat surveys were undertaken in Spring 2012 and Autumn 2013 and these have been reported in a combined baseline report (Annexure A to this report). These latter surveys included new sampling sites in the lower forested portion of Little Jilliby Jilliby Creek. This present aquatic habitat survey (2nd August 2013) had the aim of 'filling in the gap' for the forested 3rd order creek section of Little Jilliby Jilliby Creek between Window Pane Gully and the confluence with the eastern arm of Little Jilliby Jilliby Creek (see Figure 1).

Figure 2 provides a portion of topographic map for the section of creek surveyed, showing start and finish points, gps waypoints, metered water quality site locations and the locations of photographs grouped between side drainage confluences. Table 1 provides the results of metered water quality at two creek sites located as indicated on Figure 2. Plates 1 to 30 provide views of the creek generally in downstream order.

The survey commenced some 400m downstream of the upper point of the 3rd order creek section (which is located at the Window Pane Gully confluence), where the creek is cutting down through the Terrigal Formation sandstones, and continued through the transition from Terrigal Formation to Patonga Claystones (around the mid way mark between North Pole Point Ck and Hughes Gully on Figure 2). The survey terminated some 200m downstream of Hughes Gully confluence.

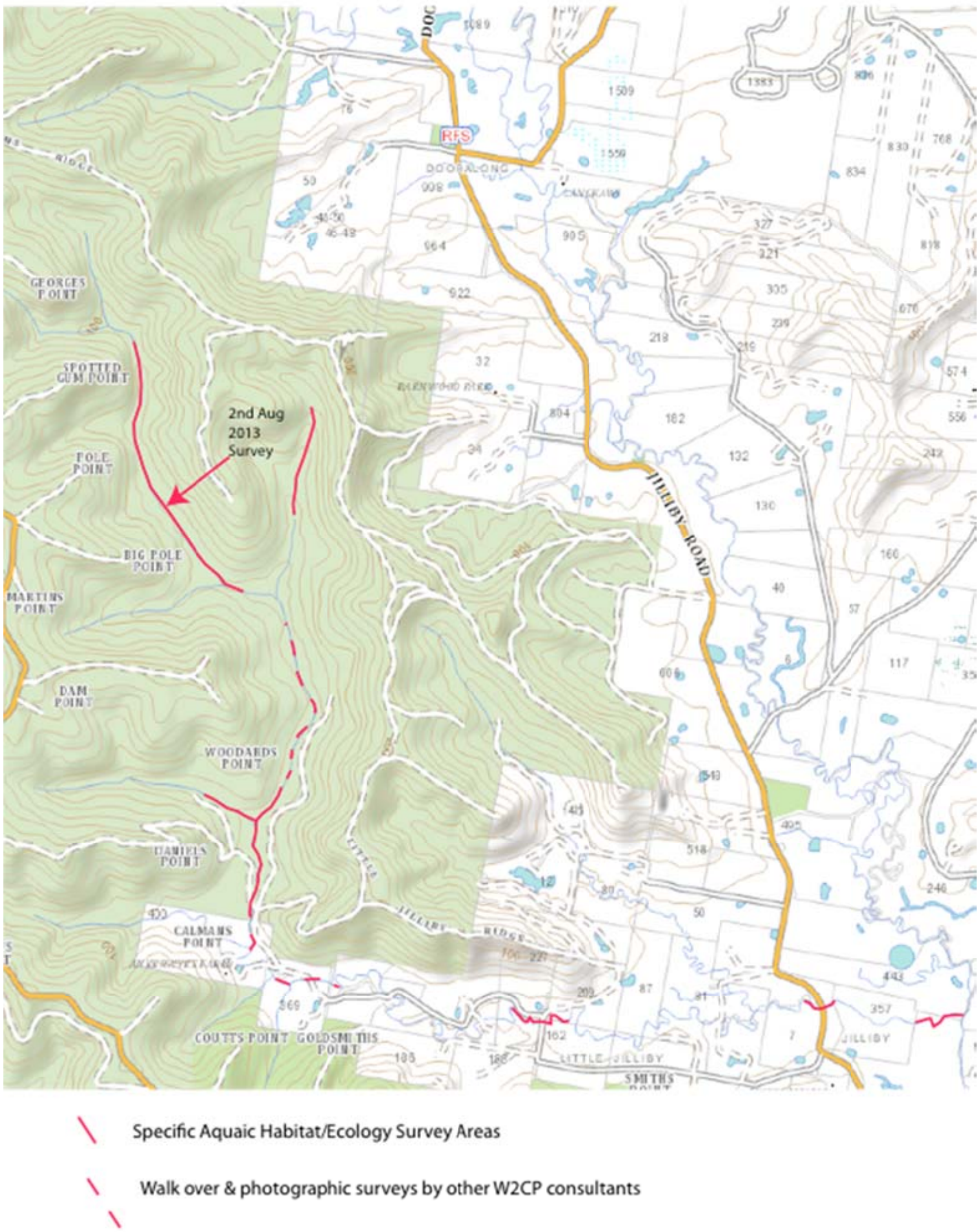

Figure 1 Extent of geomorphology and aquatic ecology survey undertaken in Little Jilliby Jilliby Creek to date.

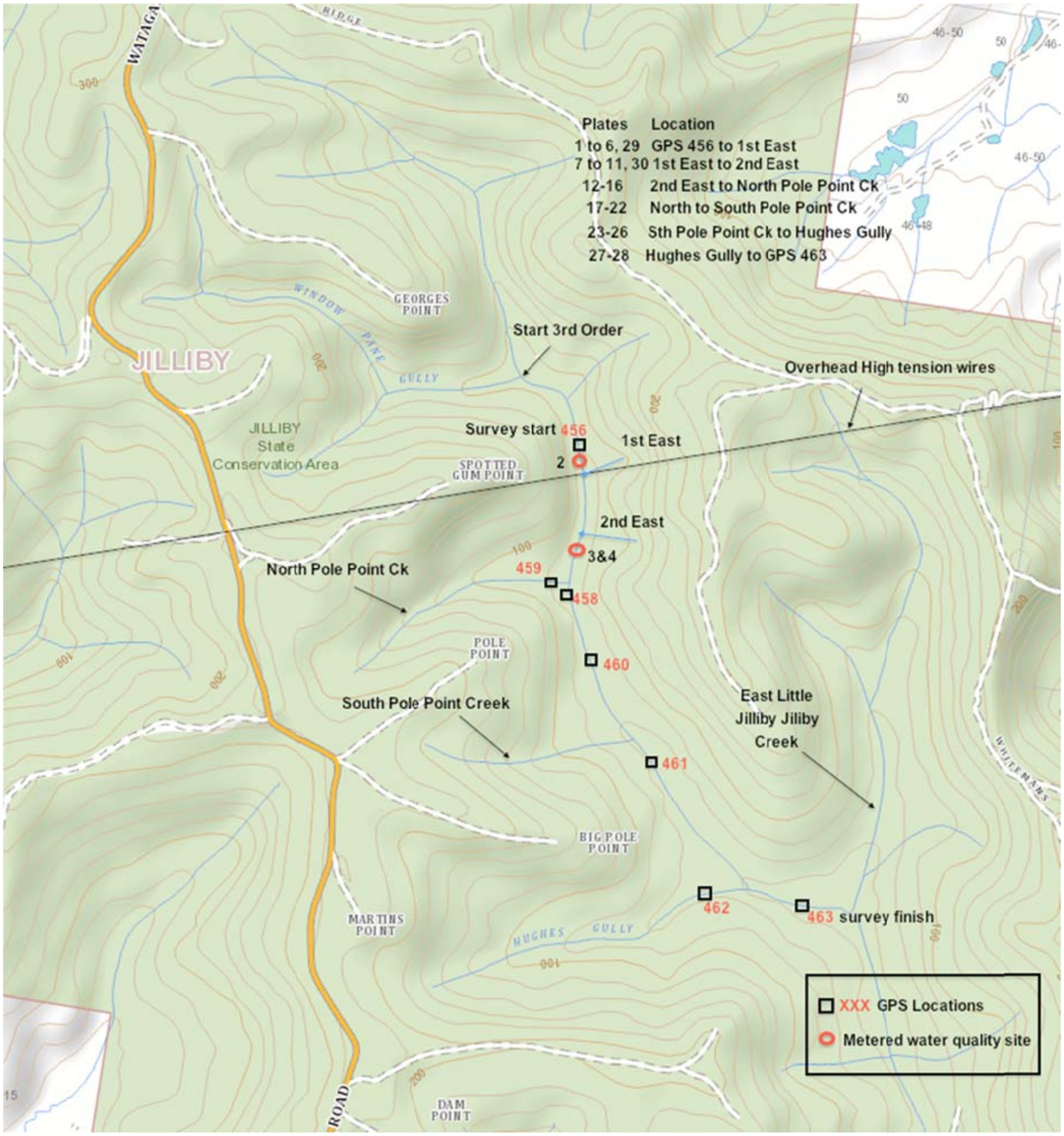

Figure 2 Upper portion of Little Jilliby Jilliby Creek showing location of GPS marks, Metered water quality sites and locations for photographs (Plates 1 to 30).

The geomorphology of the creek in the study area generally comprises four sections:

- The upper section from GPS waypoint 456 to just above the 2nd eastern drainage is a narrow v-shaped boulder-constrained gully, generally with short pools confined behind boulder or tree-confined pools (Plates 1 to 8). There are a few areas of sandstone-benched rock that support shallow pools (Plate 4).

- The creek then broadens and levels out with gravel lined pools and rock boulder or gravel bars interrupted with occasional steeper V-shaped boulder or fractured sandstone bench steps through to about North Pole Point Creek.
- There are progressively wider shallow gravel and gravel bar pools (but with occasional boulder strewn bars) through to Hughes Gully.
- There is progressively more sand and less gravel in the creek bed below Hughes Gully as the creek starts to cut down through accumulated sands. The creek edges are now sandy banks and pools are generally formed behind sand drifts plus accumulated flood debris (although there are still localised accumulations of boulders/rock rubble in alluvium that are either in or alongside the creek or form shallow low gradient cascades. At the end point of the survey the creek geomorphology was similar to that described for Little Jillibi Jilliby Creek at the aquatic ecology sampling site LJ3, sampled in spring 2012 and autumn 2013 (see report in annexure A).

Table 1 provides the results of the two pool sites sampled on the day. The first site is in a rock constrained pool just below the survey start point, which was around 0.3m deep (SDL site 2 in Figure 2 and Plate 2) and the second site was in a gravel bottomed and gravel bench plus rock rubble constrained pool just upstream of the second east drainage confluence (Figure 2 and Plate 13). This pool had a maximum depth of 0.5m:

- Water temperatures reflected the sheltered/shaded locations and the season.
- Conductivity was elevated at both sites and in the range of values for the aquatic ecology sampling site LJ3 sampled in spring 2012 and autumn 2013 (500 to 800µS/cm). Bottom waters at the lower pool site were slightly elevated with respect to the surface waters but mean conductivity was almost the same as the upstream site value.
- Dissolved oxygen concentrations and saturation were excellent for the protection of aquatic biota.
- The waters were slightly acidic and more acidic than waters previously sampled at the aquatic ecology sampling site LJ3 (6.7 to 6.9 pH units).
- ORP values were elevated with respect to waters previously sampled at the aquatic ecology sampling site LJ3 (310 to 340 mV).
- Turbidity was elevated for both sites and elevated with respect to LJ3 values (10-13 NTU).

Table 1 Metered Water Quality Results, Upper Little Jillliby Jilliby Creek 2nd Aug 2013

SDL	Time	Depth	Temp	Cond	DO	DO	pH	ORP	Turb
Store		m	°C	µS/cm	%sat	mg/l	Units	mV	NTU
2	11:40	0.2	10.15	727	103.6	10.6	6.51	409	61.0
3	12:29	0.1	9.85	711	100.6	10.3	6.44	412	56.7
4	12:30	0.4	9.82	748	100.5	10.3	6.50	414	73.7

General observations were made of aquatic habitat condition and a Coxs gudgeon *Gobiomorphus coxii* and several crayfish *Euastacus spinifer* were observed (Plates 29 and 30) in pools above North Pole Point Creek. Habitats in this section were rated v*ery good to excellent*.

As the creek transitioned from the Terrigal formation into the Patonga Claystones there was an increase in iron staining, clay induced turbidity and iron bacteria flocking. Overall habitat condition was still rated *very good* through to the Hughes Gully confluence. These upper to middle survey habitats also included shallow gravel riffle sections. The more sandy aquatic habitats below Hughes Gully were rated *good to very-good* and more closely matched the habitat conditions outlined for site LJ3 in the Spring 2012/Autumn 2013 base-line report (Annexure A).

These habitat observations, stream-reach physical characteristics and water quality results were discussed with Mr Gunter Theischinger of EPA in relation to the possibility of the habitats supporting *Adams emerald dragonfly*. From these discussions it was concluded that there may be suitable *Adams emerald dragonfly* habitat available in the upper-most 3rd order section of Little Jilliby Jilliby Creek, within the mining footprint above the Hughes Gully confluence. Accordingly, this reach of Little Jilliby Jilliby Creek which was to be included for full seasonal aquatic ecology baseline sampling in Spring 2013 will now also include extended specific riffle surveys for *Adams emerald dragonfly* larvae, as this will be the optimum time for the searches.

1.2 Wallarah Creek Inspections 8 August 2013

As noted in the introduction, the purpose of the 8th August survey was to locate the OEH Wallarah Creek reference site, inspect the condition of Wallarah Creek south arm for a possible reference catchment sample site for Wallarah Creek north arm, locate a new Wallarah Creek sample site downstream of the proposed mine discharge point and investigate suitable Spring Creek sites for monitoring rail crossing construction impacts. Figure 3 shows a portion of the Wallarah Creek catchment with inspection and existing sites noted. Figure 4 shows an aerial view of the rail crossings over Spring Creek:

- In the time available for the survey suitable access tracks into the OEH site or into other parts of the southern Wallarah Creek could not be found as tracks have been closed off with locked gates.
- Access to South Wallarah Creek (on the south side of the motorway) was made by foot from the motorway and possible reference site inspections were undertaken around the confluence of the 2nd order NW Arm and the 1st Order SW Arm (see Figure 3).
- The original North Wallarah Creek downstream site (for future downstream monitoring of proposed mine discharge impact) was to be located just upstream or downstream of the motorway bridge, but as these pools are impacted by road runoff, a search was undertaken for a more suitable site upstream.

- Spring Creek downstream rail crossing sample sites were accessed by road under site access agreements that were previously not available.
- Plates 31 to 38 show views of the Wallarah Creek NW and SW arms and of the creek below the confluence of these two arms.
- Plates 39 and 40 show the old and new Wallarah Creek downstream of discharge sites.
- Plates 41 to 46 show views of the NW and SW arms of Spring Creek in the vicinity of the two existing rail bridges.
- Table 2 provides the metered water quality data obtained from the Wallarah Creek NW and SW Arm site inspections.

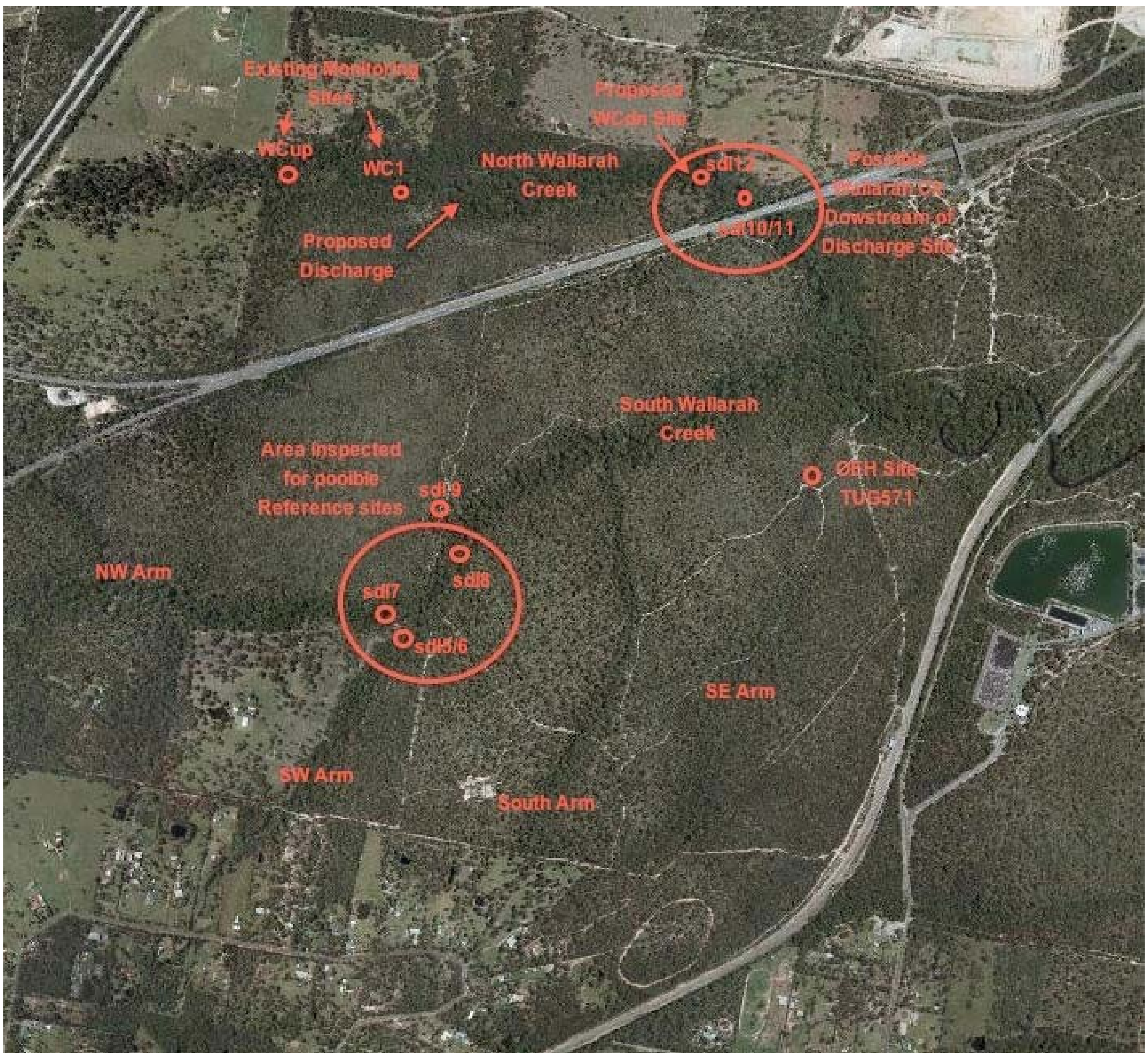

Figure 3 Existing Wallarah Creek Sampling sites and areas investigated for additional sites. See Table 2 for water quality data at indicated *sdl* sites.

Figure 4 Aerial view of rail crossings at Spring Creek NW and SW Arms.

The search for a possible aquatic ecology site in the sub-catchment of Wallarah Creek south of the motorway (i.e., South Wallarah Creek) was concentrated around the confluence of the north-west (NW) and south-west (SW) arms of the creek (Figure 3). The NW arm is a 2nd order creek that takes drainage from a predominantly forested sub-catchment between the freeway/motorway exchange and Wallarah, and the SW arm is a 1st order stream that drains the rural residential and market garden area of Wallarah.

On the sample day there was a moderate surface flow in the SW arm drainage (see Plate 35) with trickle surface flow in the SW arm drainage, even though the SW arm sub-catchment is much smaller than the NW arm sub-catchment. The difference in flows is most likely attributable to the difference in the ratio of natural vegetated area to cleared and developed area in each upstream catchment with far less development in the NW arm. Further, there had been sufficient rainfall in the weeks preceding the survey such that the myriad of on-line small farm dams on the SW arm sub-catchment would have been full and spilling.

Table 2 Metered Water Quality Data for South Wallarah Creek site investigations 8 August 2013										
Site	SDL	Time	Depth	Temp	Cond	DO	DO	pH	ORP	Turb
Location	No.		m	°C	µS/cm	%sat	mg/l	Units	mV	NTU
NW Arm	5	10:31	0.1	10.76	988	97.0	9.7	5.78	438	80.5
NW Arm	6	10:31	0.7	10.65	989	97.3	9.8	5.78	439	80.1
SW Arm	7	10:33	0.3	11.29	2013	95.7	9.5	6.11	430	108.5
DS of Conf	8	10:42	0.3	11.15	1740	99.2	9.8	6.23	424	102.4
Swamp Seep	9	10:57	0.1	12.32	162	96.9	9.4	4.35	515	45.7
WCk Bridge pool	10	11:23	0.1	10.84	1103	97.2	9.7	5.28	492	72.7
WCk Bridge Pool	11	11:24	0.8	10.78	1105	97.4	9.8	5.27	493	73.4
New WCdn Site	12	11:46	0.3	10.71	1157	97.7	9.8	5.38	487	75.3

The differences in sub-catchment land-use is also reflected in the water quality data collected on the day:

- NW arm water temperatures are slightly higher than SW arm presumable owing to proportionally more rainfall runoff in the SW arm flow and lower flow rates overland for the forested NW arm (see also Swamp seep temperature).
- Conductivity in the SW arm waters derived from the predominantly cleared and developed lands was considerably higher than conductivity in runoff waters from the predominantly undeveloped NW arm.
- Water dissolved oxygen concentrations and saturation were good for both streams.
- The pH of waters from the undeveloped NW arm was lower than that derived from the SW arm. This may be attributable to waters in the undeveloped arm being derived from proportionally more undeveloped land that included more boggy land and, as can be seen for the waters derived from a boggy land seep (see swamp seep data in Table 2) is quite acid.
- Turbidity was elevated in both streams ad higher in the SW stream taking proportionally more runoff from cleared and developed lands.
- Whilst the downstream of confluence pool had water quality readings that generally reflect the mixing of the two upstream drainages some differences are probably attributable to additional runoff of track sediments (e.g., pH higher than combined discharges and ORP lower than combined discharges).

It is concluded that the sites could be utilised as suitable reference sites for comparing upstream North Wallarah Creek upper catchment discharge into the Tooheys Road infrasturucture area for the purposes of assessing construction and eventual mine water discharge impact.

The original site indicated in the EIS Aquatic Ecology report for downstream impacts of construction and eventual mine water discharge impact from the Tooheys Road infrastructure area was located in the Wallarah Creek North Arm pool backed up behind the motorway (Plate 39). This site was considered sub-optimum as it took road runoff from the motorway. Since site access to the remaining section of the creek between the infrastructure area and the motorway has become available a more suitable site that is not impacts by motoway runoff has been located (see Figure 3 for location and Plate 40).

In regards to the selection of sites for downstream impacts of construction and eventual use of the rail crossings over Spring Creek, the EIS Aquatic Ecology report nominated a possible downstream site off Thompson Vale Road, Blue Haven and no upstream sites (owing to access restrictions at the time). This present survey has allowed a search of the two potentially impacted Spring Creek arms at the points were the existing northern rail crosses the streams (Plates 41 to 46). It is concluded that there are suitable stream segments immediately upstream of the two crossings to located suitable impact monitoring sites.

Wallarah 2
COAL PROJECT

Wallarah 2 Coal Project

Response to Submissions

September 2013

Appendix F

SIDRA Intersection Performance Results

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

PROJECT TRAFFIC GENERATION PEAK

Year 2015 No-Project traffic conditions

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	43	17.1	0.054	14.8	LOS B	0.2	1.6	0.22	0.95	50.6
3	R	193	26.2	0.473	45.6	LOS D	3.7	31.9	0.94	0.80	29.9
Approach		236	24.6	0.473	39.9	LOS C	3.7	31.9	0.81	0.82	32.4
East: Sparks Rd (E)											
5	T	92	17.2	0.104	5.6	LOS A	1.3	10.7	0.40	0.32	57.4
6	R	294	16.1	1.019	106.9	LOS F	21.2	169.2	1.00	1.23	16.5
Approach		385	16.4	1.019	82.9	LOS F	21.2	169.2	0.86	1.01	19.9
West: Sparks Rd (W)											
10	L	74	10.0	0.189	32.0	LOS C	2.2	16.4	0.77	0.76	36.0
11	T	113	10.3	0.197	21.9	LOS B	3.2	24.7	0.77	0.62	39.9
Approach		186	10.2	0.197	25.9	LOS B	3.2	24.7	0.77	0.67	38.2
All Vehicles		807	17.3	1.019	57.2	LOS E	21.2	169.2	0.82	0.88	25.7

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	78	5.4	0.091	13.9	LOS A	0.4	3.0	0.24	0.95	50.5
3	R	493	4.5	0.653	38.2	LOS C	9.0	65.3	0.93	0.85	32.4
Approach		571	4.6	0.653	34.9	LOS C	9.0	65.3	0.84	0.86	34.1
East: Sparks Rd (E)											
5	T	129	2.4	0.163	9.8	LOS A	2.5	17.8	0.53	0.44	51.4
6	R	95	3.3	0.280	35.1	LOS C	2.9	21.2	0.83	0.79	33.8
Approach		224	2.8	0.280	20.5	LOS B	2.9	21.2	0.66	0.59	42.2
West: Sparks Rd (W)											
10	L	54	7.8	0.237	40.8	LOS C	1.8	13.8	0.89	0.76	31.6
11	T	88	2.4	0.257	30.5	LOS C	3.0	21.3	0.90	0.70	34.5
Approach		142	4.4	0.257	34.4	LOS C	3.0	21.3	0.90	0.72	33.3
All Vehicles		937	4.2	0.653	31.4	LOS C	9.0	65.3	0.81	0.78	35.6

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	575	8.1	0.327	9.8	X	X	X	X	0.65	54.6
5	T	311	14.9	0.175	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		885	10.5	0.327	6.4	NA	0.0	0.0	0.00	0.42	59.1
North East: Median (Right Turn Stage 2)											
26	R	75	22.5	0.190	16.7	LOS B	0.7	6.1	0.57	0.84	47.6
Approach		75	22.5	0.190	16.7	LOS B	0.7	6.1	0.57	0.84	47.6
North: SYD-NCL Fwy ramps (N)											
7	L	133	7.9	0.075	9.8	X	X	X	X	0.65	54.6
9	R	75	22.5	0.114	16.6	LOS B	0.4	3.5	0.46	0.92	49.4
Approach		207	13.2	0.114	12.2	LOS A	0.4	3.5	0.17	0.75	52.6
West: Sparks Rd (W)											
11	T	203	26.4	0.122	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	102	8.2	0.209	15.6	LOS B	0.8	6.2	0.55	0.86	47.9
Approach		305	20.3	0.209	5.2	NA	0.8	6.2	0.18	0.29	60.7
All Vehicles		1473	13.5	0.327	7.5	NA	0.8	6.2	0.09	0.46	57.7

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	256	5.8	0.143	9.7	X	X	X	X	0.65	54.6
5	T	155	3.4	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		411	4.9	0.143	6.0	NA	0.0	0.0	0.00	0.41	59.5
North East: Median (Right Turn Stage 2)											
26	R	72	2.9	0.100	12.1	LOS A	0.4	2.8	0.34	0.67	57.4
Approach		72	2.9	0.100	12.1	LOS A	0.4	2.8	0.34	0.67	57.4
North: SYD-NCL Fwy ramps (N)											
7	L	189	9.4	0.109	9.8	X	X	X	X	0.65	54.6
9	R	72	2.9	0.116	15.8	LOS B	0.4	3.0	0.54	0.97	48.5
Approach		261	7.7	0.116	11.5	LOS A	0.4	3.0	0.15	0.74	52.8
West: Sparks Rd (W)											
11	T	549	3.3	0.288	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	33	19.4	0.060	13.4	LOS A	0.2	1.7	0.35	0.71	51.2
Approach		582	4.2	0.288	0.8	NA	0.2	1.7	0.02	0.04	68.6
All Vehicles		1325	5.0	0.288	5.1	NA	0.4	3.0	0.06	0.32	61.4

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	24	8.7	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	115	12.8	0.136	12.4	LOS A	0.4	3.2	0.19	0.70	57.9
Approach		139	12.1	0.136	10.3	NA	0.4	3.2	0.16	0.58	60.9
East: Sparks Rd (E)											
4	L	82	11.5	0.137	11.4	LOS A	0.3	2.1	0.14	0.68	54.6
6	R	52	24.5	0.076	13.6	LOS A	0.2	1.9	0.30	0.72	53.5
Approach		134	16.5	0.137	12.2	LOS A	0.3	2.1	0.20	0.69	54.2
North: Hue Hue Rd (N)											
7	L	74	7.1	0.042	11.5	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	18	11.8	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		92	8.0	0.042	9.2	NA	0.0	0.0	0.00	0.59	62.2
All Vehicles		364	12.7	0.137	10.7	NA	0.4	3.2	0.14	0.62	58.5

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	37	2.9	0.019	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	103	4.1	0.112	11.4	LOS A	0.3	2.3	0.12	0.70	58.3
Approach		140	3.8	0.112	8.4	NA	0.3	2.3	0.09	0.51	62.9
East: Sparks Rd (E)											
4	L	132	4.0	0.198	10.9	LOS A	0.4	3.0	0.21	0.63	54.2
6	R	76	2.8	0.123	12.4	LOS A	0.5	3.3	0.36	0.71	52.9
Approach		207	3.6	0.198	11.4	LOS A	0.5	3.3	0.26	0.66	53.7
North: Hue Hue Rd (N)											
7	L	39	5.4	0.022	11.3	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	9	0.0	0.005	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		48	4.3	0.022	9.1	NA	0.0	0.0	0.00	0.59	62.2
All Vehicles		396	3.7	0.198	10.1	NA	0.5	3.3	0.17	0.60	57.7

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	44	9.5	0.025	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
5	T	426	5.7	0.227	7.9	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		471	6.0	0.227	7.9	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	103	16.3	0.059	8.7	LOS A	0.0	0.0	0.00	0.67	49.3
29	R	38	5.6	0.054	11.4	LOS A	0.2	1.4	0.48	0.75	45.9
Approach		141	13.4	0.059	9.4	NA	0.2	1.4	0.13	0.69	48.3
South West: Hue Hue Rd (SW)											
30	L	22	9.5	0.042	11.4	LOS A	0.1	0.9	0.47	0.72	46.1
32	R	22	4.8	0.064	16.2	LOS B	0.2	1.7	0.63	0.85	41.6
Approach		44	7.1	0.064	13.8	LOS A	0.2	1.7	0.55	0.79	43.7
All Vehicles		656	7.7	0.227	8.6	NA	0.2	1.7	0.06	0.66	48.8

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	34	3.1	0.019	8.0	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	180	1.2	0.093	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		214	1.5	0.093	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	284	2.6	0.148	8.0	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	18	5.9	0.019	9.7	LOS A	0.1	0.5	0.32	0.64	47.5
Approach		302	2.8	0.148	8.1	NA	0.1	0.5	0.02	0.66	49.2
South West: Hue Hue Rd (SW)											
30	L	31	0.0	0.046	9.1	LOS A	0.1	0.8	0.29	0.63	47.7
32	R	80	1.3	0.192	14.5	LOS A	0.7	5.2	0.60	0.86	42.9
Approach		111	1.0	0.192	13.0	LOS A	0.7	5.2	0.52	0.80	44.1
All Vehicles		626	2.0	0.192	8.8	NA	0.7	5.2	0.10	0.68	48.3

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	5	0.0	0.003	0.0	LOS A	0.0	0.1	0.03	0.00	59.5
3	R	1	0.0	0.003	8.9	LOS A	0.0	0.1	0.03	1.12	48.2
Approach		6	0.0	0.003	1.5	NA	0.0	0.1	0.03	0.19	57.2
North: Tooheys Rd (N)											
7	L	1	0.0	0.002	8.2	LOS A	0.0	0.0	0.00	0.89	49.0
8	T	2	0.0	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		3	0.0	0.002	2.7	NA	0.0	0.0	0.00	0.30	55.8
West: Mwy Link ramp (W)											
10	L	4	25.0	0.007	9.3	LOS A	0.0	0.1	0.04	0.64	48.8
11	T	1	0.0	0.002	7.0	LOS A	0.0	0.1	0.05	0.53	50.0
12	R	1	0.0	0.002	9.0	LOS A	0.0	0.1	0.05	0.75	47.9
Approach		6	16.7	0.007	8.9	LOS A	0.0	0.1	0.05	0.64	48.8
All Vehicles		16	6.7	0.007	4.7	NA	0.0	0.1	0.03	0.39	53.3

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	0.0	0.002	0.0	LOS A	0.0	0.1	0.03	0.00	59.4
3	R	1	0.0	0.002	8.9	LOS A	0.0	0.1	0.03	1.06	48.2
Approach		4	0.0	0.002	2.2	NA	0.0	0.1	0.03	0.26	56.2
North: Tooheys Rd (N)											
7	L	1	0.0	0.002	8.2	LOS A	0.0	0.0	0.00	0.89	49.0
8	T	2	0.0	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		3	0.0	0.002	2.7	NA	0.0	0.0	0.00	0.30	55.8
West: Mwy Link ramp (W)											
10	L	1	0.0	0.001	8.2	LOS A	0.0	0.0	0.03	0.65	48.8
11	T	2	0.0	0.003	7.0	LOS A	0.0	0.1	0.05	0.55	50.1
12	R	1	0.0	0.003	9.0	LOS A	0.0	0.1	0.05	0.78	48.0
Approach		4	0.0	0.003	7.8	LOS A	0.0	0.1	0.04	0.63	49.2
All Vehicles		12	0.0	0.003	4.4	NA	0.0	0.1	0.02	0.41	53.3

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	5	80.0	0.013	10.8	LOS A	0.1	0.5	0.14	0.51	49.5
6	R	3	33.3	0.013	11.1	LOS A	0.1	0.5	0.14	0.74	47.8
Approach		8	62.5	0.013	10.9	LOS A	0.1	0.5	0.14	0.60	48.8
North: Tooheys Rd (N)											
9	R	22	19.0	0.014	9.8	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		22	19.0	0.014	9.8	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		31	31.0	0.014	10.1	NA	0.1	0.5	0.04	0.69	48.4

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.004	6.9	LOS A	0.0	0.1	0.02	0.53	50.2
6	R	3	0.0	0.004	8.9	LOS A	0.0	0.1	0.02	0.74	48.0
Approach		4	0.0	0.004	8.4	LOS A	0.0	0.1	0.02	0.69	48.5
North: Tooheys Rd (N)											
9	R	2	0.0	0.001	8.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		2	0.0	0.001	8.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		6	0.0	0.004	8.6	NA	0.0	0.1	0.01	0.70	48.4

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	29	28.6	0.065	13.1	LOS A	0.0	0.0	0.00	1.30	59.3
22	T	83	11.4	0.065	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		113	15.9	0.065	3.4	NA	0.0	0.0	0.00	0.34	73.4
North West: Hue Hue Rd (NW)											
28	T	123	9.4	0.082	1.2	LOS A	0.7	5.1	0.36	0.00	68.0
29	R	12	36.4	0.082	15.7	LOS B	0.7	5.1	0.36	1.46	59.9
Approach		135	11.7	0.082	2.4	NA	0.7	5.1	0.36	0.13	67.2
West: Jilliby Rd (W)											
10	L	17	25.0	0.143	19.5	LOS B	0.6	4.4	0.41	0.81	52.4
12	R	64	4.9	0.143	16.0	LOS B	0.6	4.4	0.41	0.93	54.0
Approach		81	9.1	0.143	16.7	LOS B	0.6	4.4	0.41	0.90	53.7
All Vehicles		328	12.5	0.143	6.3	NA	0.7	5.1	0.25	0.39	65.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	60	1.8	0.124	10.8	LOS A	0.0	0.0	0.00	1.15	59.3
22	T	178	0.6	0.124	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		238	0.9	0.124	2.7	NA	0.0	0.0	0.00	0.29	73.6
North West: Hue Hue Rd (NW)											
28	T	119	0.9	0.076	1.3	LOS A	0.5	3.7	0.40	0.00	66.9
29	R	14	0.0	0.076	12.7	LOS A	0.5	3.7	0.40	1.16	60.0
Approach		133	0.8	0.076	2.5	NA	0.5	3.7	0.40	0.12	66.1
West: Jilliby Rd (W)											
10	L	14	15.4	0.098	19.6	LOS B	0.4	2.8	0.48	0.84	51.4
12	R	36	2.9	0.098	16.8	LOS B	0.4	2.8	0.48	0.94	52.9
Approach		49	6.4	0.098	17.6	LOS B	0.4	2.8	0.48	0.91	52.5
All Vehicles		420	1.5	0.124	4.4	NA	0.5	3.7	0.18	0.31	68.0

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	12	9.1	0.027	10.5	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	36	14.7	0.027	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		47	13.3	0.027	11.4	NA	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.047	9.9	LOS A	0.2	1.6	0.14	0.60	56.7
9	R	77	6.8	0.047	11.4	LOS A	0.2	1.6	0.14	0.68	58.6
Approach		80	6.6	0.047	11.3	NA	0.2	1.6	0.14	0.68	58.5
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.021	8.2	LOS A	0.1	0.5	0.18	0.60	45.5
32	R	16	6.7	0.021	8.8	LOS A	0.1	0.5	0.18	0.65	45.5
Approach		20	5.3	0.021	8.6	LOS A	0.1	0.5	0.18	0.64	45.5
All Vehicles		147	8.6	0.047	11.0	NA	0.2	1.6	0.10	0.69	56.4

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	16	13.3	0.042	10.7	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	61	6.9	0.042	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		77	8.2	0.042	11.0	NA	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.032	10.0	LOS A	0.1	1.1	0.18	0.57	56.4
9	R	49	6.4	0.032	11.4	LOS A	0.1	1.1	0.18	0.67	58.4
Approach		53	6.0	0.032	11.3	NA	0.1	1.1	0.18	0.67	58.3
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.025	8.2	LOS A	0.1	0.6	0.21	0.60	45.5
32	R	20	5.3	0.025	8.7	LOS A	0.1	0.6	0.21	0.64	45.4
Approach		24	4.3	0.025	8.6	LOS A	0.1	0.6	0.21	0.64	45.4
All Vehicles		154	6.8	0.042	10.7	NA	0.1	1.1	0.09	0.69	56.1

Traffic conditions for the construction phase in 2015

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	81	9.1	0.105	14.4	LOS A	0.7	5.5	0.25	0.95	50.4
3	R	193	26.2	0.473	45.6	LOS D	5.1	43.8	0.94	0.80	29.9
Approach		274	21.2	0.473	36.3	LOS C	5.1	43.8	0.74	0.84	34.0
East: Sparks Rd (E)											
5	T	329	10.2	0.370	7.0	LOS A	7.6	57.7	0.49	0.43	53.0
6	R	308	9.8	1.025	109.1	LOS F	23.3	176.5	1.00	1.24	16.2
Approach		637	9.9	1.024	56.3	LOS D	23.3	176.5	0.74	0.82	25.4
West: Sparks Rd (W)											
10	L	78	9.5	0.200	32.1	LOS C	3.3	25.1	0.77	0.76	35.9
11	T	118	9.8	0.206	21.9	LOS B	4.7	35.9	0.77	0.62	39.9
Approach		196	9.7	0.206	26.0	LOS B	4.7	35.9	0.77	0.68	38.2
All Vehicles		1106	12.7	1.024	46.0	LOS D	23.3	176.5	0.74	0.80	28.9

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	78	5.4	0.091	13.9	LOS A	0.6	4.7	0.24	0.95	50.5
3	R	493	4.5	0.653	38.2	LOS C	10.7	77.5	0.93	0.85	32.4
Approach		571	4.6	0.653	34.9	LOS C	10.7	77.5	0.84	0.86	34.1
East: Sparks Rd (E)											
5	T	129	2.4	0.163	9.8	LOS A	3.6	25.6	0.53	0.44	51.4
6	R	195	1.6	0.569	37.5	LOS C	8.4	59.3	0.91	0.83	32.6
Approach		324	1.9	0.569	26.4	LOS B	8.4	59.3	0.76	0.67	38.3
West: Sparks Rd (W)											
10	L	98	4.3	0.421	41.9	LOS C	4.8	35.1	0.93	0.79	31.1
11	T	145	1.4	0.419	31.6	LOS C	6.7	47.2	0.93	0.75	33.9
Approach		243	2.6	0.422	35.7	LOS C	6.7	47.2	0.93	0.76	32.7
All Vehicles		1138	3.4	0.653	32.7	LOS C	10.7	77.5	0.84	0.79	34.8

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	575	8.1	0.327	9.8	X	X	X	X	0.65	54.6
5	T	415	11.2	0.228	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		989	9.4	0.327	5.7	LOS A	0.0	0.0	0.00	0.38	60.1
North East: Median (Right Turn Stage 2)											
26	R	222	7.6	0.554	21.6	LOS B	4.4	32.5	0.73	1.04	42.5
Approach		222	7.6	0.554	21.6	LOS B	4.4	32.5	0.73	1.04	42.5
North: SYD-NCL Fwy ramps (N)											
7	L	136	7.8	0.077	9.7	X	X	X	X	0.65	54.6
9	R	222	7.6	0.282	14.9	LOS B	1.5	10.9	0.49	0.94	49.8
Approach		358	7.6	0.282	12.9	LOS A	1.5	10.9	0.30	0.83	51.5
West: Sparks Rd (W)											
11	T	205	26.2	0.123	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	105	8.0	0.264	18.5	LOS B	1.4	10.3	0.62	0.93	45.2
Approach		311	20.0	0.265	6.3	LOS A	1.4	10.3	0.21	0.31	59.1
All Vehicles		1880	10.6	0.554	9.0	NA	4.4	32.5	0.18	0.53	55.5

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	256	5.8	0.143	9.7	X	X	X	X	0.65	54.6
5	T	155	3.4	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		411	4.9	0.143	6.0	LOS A	0.0	0.0	0.00	0.41	59.5
North East: Median (Right Turn Stage 2)											
26	R	172	1.2	0.240	12.2	LOS A	1.3	9.5	0.38	0.69	57.1
Approach		172	1.2	0.240	12.2	LOS A	1.3	9.5	0.38	0.69	57.1
North: SYD-NCL Fwy ramps (N)											
7	L	275	6.5	0.155	9.7	X	X	X	X	0.65	54.6
9	R	172	1.2	0.300	17.3	LOS B	1.6	11.3	0.61	1.03	47.0
Approach		446	4.5	0.301	12.6	LOS A	1.6	11.3	0.24	0.80	51.4
West: Sparks Rd (W)											
11	T	568	3.1	0.297	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	71	9.0	0.114	12.4	LOS A	0.5	3.9	0.35	0.72	51.5
Approach		639	3.8	0.297	1.4	LOS A	0.5	3.9	0.04	0.08	67.4
All Vehicles		1667	4.0	0.301	6.6	NA	1.6	11.3	0.12	0.41	59.4

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	37	5.7	0.020	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	115	12.8	0.134	12.5	LOS A	0.5	4.1	0.21	0.70	57.9
Approach		152	11.1	0.134	9.5	LOS A	0.5	4.1	0.16	0.53	62.1
East: Sparks Rd (E)											
4	L	82	11.5	0.137	11.4	LOS A	0.3	2.7	0.14	0.68	54.5
6	R	153	8.3	0.191	12.2	LOS A	0.8	6.0	0.32	0.73	53.7
Approach		235	9.4	0.191	11.9	LOS A	0.8	6.0	0.26	0.71	54.0
North: Hue Hue Rd (N)											
7	L	82	6.4	0.046	11.4	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	19	11.1	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		101	7.3	0.046	9.3	LOS A	0.0	0.0	0.00	0.59	62.0
All Vehicles		487	9.5	0.191	10.6	NA	0.8	6.0	0.17	0.63	57.9

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	37	2.9	0.019	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	103	4.1	0.117	12.0	LOS A	0.5	3.3	0.25	0.71	57.6
Approach		140	3.8	0.117	8.8	LOS A	0.5	3.3	0.18	0.52	62.3
East: Sparks Rd (E)											
4	L	132	4.0	0.203	11.0	LOS A	0.6	4.0	0.18	0.68	54.3
6	R	76	2.8	0.136	13.3	LOS A	0.6	4.6	0.42	0.75	51.9
Approach		207	3.6	0.203	11.9	LOS A	0.6	4.6	0.27	0.71	53.4
North: Hue Hue Rd (N)											
7	L	140	1.5	0.076	11.0	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	22	0.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		162	1.3	0.076	9.5	LOS A	0.0	0.0	0.00	0.63	61.1
All Vehicles		509	2.9	0.203	10.3	NA	0.6	4.6	0.16	0.63	58.0

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	44	9.5	0.025	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
5	T	426	5.7	0.227	7.9	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		471	6.0	0.227	7.9	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	103	16.3	0.059	8.7	LOS A	0.0	0.0	0.00	0.67	49.3
29	R	65	3.2	0.092	11.3	LOS A	0.4	3.0	0.49	0.77	45.9
Approach		168	11.3	0.092	9.7	LOS A	0.4	3.0	0.19	0.71	47.9
South West: Hue Hue Rd (SW)											
30	L	24	8.7	0.045	11.3	LOS A	0.2	1.2	0.47	0.72	46.1
32	R	22	4.8	0.067	16.8	LOS B	0.3	2.2	0.65	0.87	41.1
Approach		46	6.8	0.067	13.9	LOS A	0.3	2.2	0.55	0.79	43.6
All Vehicles		685	7.4	0.227	8.8	NA	0.4	3.0	0.08	0.67	48.7

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	34	3.1	0.019	8.0	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	180	1.2	0.093	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		214	1.5	0.093	7.7	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	284	2.6	0.148	8.0	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	18	5.9	0.019	9.7	LOS A	0.1	0.6	0.33	0.65	47.4
Approach		302	2.8	0.148	8.1	LOS A	0.1	0.6	0.02	0.66	49.2
South West: Hue Hue Rd (SW)											
30	L	58	0.0	0.087	9.1	LOS A	0.3	1.9	0.30	0.65	47.6
32	R	80	1.3	0.192	14.5	LOS A	0.9	6.5	0.60	0.86	42.9
Approach		138	0.8	0.192	12.2	LOS A	0.9	6.5	0.47	0.77	44.8
All Vehicles		654	1.9	0.192	8.8	NA	0.9	6.5	0.11	0.68	48.3

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	5	0.0	0.003	0.0	LOS A	0.0	0.1	0.06	0.00	58.7
3	R	1	0.0	0.003	8.9	LOS A	0.0	0.1	0.06	1.09	48.2
Approach		6	0.0	0.003	1.5	NA	0.0	0.1	0.06	0.18	56.7
North: Tooheys Rd (N)											
7	L	1	0.0	0.007	8.2	LOS A	0.0	0.0	0.00	1.04	49.0
8	T	13	0.0	0.007	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		14	0.0	0.007	0.6	NA	0.0	0.0	0.00	0.08	59.0
West: Mwy Link ramp (W)											
10	L	275	0.4	0.348	8.9	LOS A	1.0	7.3	1.00	0.15	44.8
11	T	1	0.0	0.002	7.0	LOS A	0.0	0.1	0.08	0.52	49.8
12	R	1	0.0	0.002	9.0	LOS A	0.0	0.1	0.08	0.74	47.9
Approach		277	0.4	0.348	8.9	LOS A	1.0	7.3	0.99	0.15	44.9
All Vehicles		297	0.4	0.348	8.3	NA	1.0	7.3	0.93	0.15	45.6

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	0.0	0.002	0.8	LOS A	0.0	0.1	0.35	0.00	53.1
3	R	1	0.0	0.002	9.7	LOS A	0.0	0.1	0.35	0.85	48.4
Approach		4	0.0	0.002	3.0	NA	0.0	0.1	0.35	0.21	51.8
North: Tooheys Rd (N)											
7	L	1	0.0	0.140	8.2	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	273	0.0	0.140	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		274	0.0	0.140	0.0	NA	0.0	0.0	0.00	0.00	59.9
West: Mwy Link ramp (W)											
10	L	1	0.0	0.001	8.2	LOS A	0.0	0.0	0.03	0.65	48.8
11	T	2	0.0	0.004	8.9	LOS A	0.0	0.1	0.40	0.56	48.0
12	R	1	0.0	0.004	10.9	LOS A	0.0	0.1	0.40	0.69	46.5
Approach		4	0.0	0.004	9.2	LOS A	0.0	0.1	0.31	0.61	47.8
All Vehicles		282	0.0	0.140	0.2	NA	0.0	0.1	0.01	0.02	59.6

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	5	80.0	0.015	11.0	LOS A	0.1	0.8	0.17	0.51	49.3
6	R	4	50.0	0.015	12.1	LOS A	0.1	0.8	0.17	0.73	47.6
Approach		9	66.7	0.015	11.5	LOS A	0.1	0.8	0.17	0.61	48.5
North: Tooheys Rd (N)											
9	R	32	23.3	0.020	10.1	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		32	23.3	0.020	10.1	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		41	33.3	0.020	10.4	NA	0.1	0.8	0.04	0.70	48.2

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.005	8.5	LOS A	0.0	0.1	0.38	0.55	47.9
6	R	3	0.0	0.005	10.5	LOS A	0.0	0.1	0.38	0.68	46.6
Approach		4	0.0	0.005	10.0	LOS A	0.0	0.1	0.38	0.64	46.9
North: Tooheys Rd (N)											
9	R	273	0.0	0.147	8.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		273	0.0	0.147	8.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		277	0.0	0.147	8.9	NA	0.0	0.1	0.01	0.73	48.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	29	28.6	0.071	13.1	LOS A	0.0	0.0	0.00	1.34	59.3
22	T	96	9.9	0.071	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		125	14.3	0.071	3.1	LOS A	0.0	0.0	0.00	0.32	74.0
North West: Hue Hue Rd (NW)											
28	T	124	9.3	0.083	1.3	LOS A	0.9	6.6	0.38	0.00	67.5
29	R	12	36.4	0.083	15.8	LOS B	0.9	6.6	0.38	1.45	59.9
Approach		136	11.6	0.083	2.5	LOS A	0.9	6.6	0.38	0.12	66.8
West: Jilliby Rd (W)											
10	L	17	25.0	0.146	19.7	LOS B	0.7	5.6	0.43	0.81	52.2
12	R	64	4.9	0.147	16.2	LOS B	0.7	5.6	0.43	0.93	53.8
Approach		81	9.1	0.147	16.9	LOS B	0.7	5.6	0.43	0.91	53.4
All Vehicles		342	12.0	0.147	6.2	NA	0.9	6.6	0.25	0.38	65.3

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	60	1.8	0.124	10.8	LOS A	0.0	0.0	0.00	1.15	59.3
22	T	178	0.6	0.124	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		238	0.9	0.124	2.7	LOS A	0.0	0.0	0.00	0.29	73.6
North West: Hue Hue Rd (NW)											
28	T	132	0.8	0.083	1.3	LOS A	0.7	5.2	0.40	0.00	66.8
29	R	14	0.0	0.082	12.7	LOS A	0.7	5.2	0.40	1.16	60.1
Approach		145	0.7	0.083	2.4	LOS A	0.7	5.2	0.40	0.11	66.1
West: Jilliby Rd (W)											
10	L	14	15.4	0.100	19.8	LOS B	0.5	3.5	0.49	0.84	51.2
12	R	36	2.9	0.100	17.0	LOS B	0.5	3.5	0.49	0.95	52.7
Approach		49	6.4	0.100	17.8	LOS B	0.5	3.5	0.49	0.92	52.3
All Vehicles		433	1.5	0.124	4.3	NA	0.7	5.2	0.19	0.30	67.9

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	12	9.1	0.027	10.5	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	36	14.7	0.027	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		47	13.3	0.027	11.4	LOS A	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.047	9.9	LOS A	0.3	2.0	0.14	0.60	56.7
9	R	77	6.8	0.047	11.4	LOS A	0.3	2.0	0.14	0.68	58.6
Approach		80	6.6	0.047	11.3	LOS A	0.3	2.0	0.14	0.68	58.5
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.021	8.2	LOS A	0.1	0.7	0.18	0.60	45.5
32	R	16	6.7	0.021	8.8	LOS A	0.1	0.7	0.18	0.65	45.5
Approach		20	5.3	0.021	8.6	LOS A	0.1	0.7	0.18	0.64	45.5
All Vehicles		147	8.6	0.047	11.0	NA	0.3	2.0	0.10	0.69	56.4

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	16	13.3	0.042	10.7	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	61	6.9	0.042	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		77	8.2	0.042	11.0	LOS A	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.032	10.0	LOS A	0.2	1.3	0.18	0.57	56.4
9	R	49	6.4	0.032	11.4	LOS A	0.2	1.3	0.18	0.67	58.4
Approach		53	6.0	0.032	11.3	LOS A	0.2	1.3	0.18	0.67	58.3
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.026	8.2	LOS A	0.1	0.8	0.21	0.60	45.5
32	R	20	5.3	0.025	8.7	LOS A	0.1	0.8	0.21	0.64	45.4
Approach		24	4.3	0.025	8.6	LOS A	0.1	0.8	0.21	0.64	45.4
All Vehicles		154	6.8	0.042	10.7	NA	0.2	1.3	0.09	0.69	56.1

Year 2025 No-Project traffic conditions

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	56	24.5	0.103	16.5	LOS B	0.4	3.7	0.31	0.93	49.7
3	R	384	9.3	0.848	55.1	LOS D	9.0	68.4	1.00	0.96	26.2
Approach		440	11.2	0.848	50.2	LOS D	9.0	68.4	0.91	0.96	27.9
East: Sparks Rd (E)											
5	T	500	13.8	0.576	8.5	LOS A	11.0	86.0	0.60	0.54	50.5
6	R	298	14.3	1.022	108.6	LOS F	21.8	171.0	1.00	1.23	16.3
Approach		798	14.1	1.022	45.9	LOS D	21.8	171.0	0.75	0.80	28.4
West: Sparks Rd (W)											
10	L	144	16.1	0.386	34.0	LOS C	4.5	36.2	0.83	0.80	35.0
11	T	255	17.4	0.465	24.2	LOS B	8.1	65.4	0.85	0.72	38.1
Approach		399	16.9	0.465	27.8	LOS B	8.1	65.4	0.84	0.75	36.9
All Vehicles		1637	14.0	1.022	42.6	LOS D	21.8	171.0	0.82	0.83	30.0

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	120	8.8	0.247	18.5	LOS B	1.7	12.8	0.48	0.91	46.8
3	R	975	5.5	1.511	369.0	LOS F	108.4	794.7	1.00	1.88	5.7
Approach		1095	5.9	1.511	330.5	LOS F	108.4	794.7	0.94	1.78	6.3
East: Sparks Rd (E)											
5	T	775	6.8	1.061	116.4	LOS F	66.6	509.3	1.00	1.59	14.8
6	R	316	14.3	1.007	98.6	LOS F	21.8	170.9	1.00	1.21	17.5
Approach		1092	11.9	1.061	111.3	LOS F	66.6	509.3	1.00	1.48	15.5
West: Sparks Rd (W)											
10	L	162	7.1	0.712	46.3	LOS D	6.5	47.9	0.99	0.89	29.4
11	T	247	9.4	0.750	36.2	LOS C	9.7	73.7	1.00	0.90	31.6
Approach		409	8.5	0.750	40.2	LOS C	9.7	73.7	1.00	0.90	30.7
All Vehicles		2596	8.8	1.511	192.5	LOS F	108.4	794.7	0.98	1.51	10.1

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	838	6.4	0.472	9.7	X	X	X	X	0.65	54.5
5	T	518	16.1	0.293	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1356	10.1	0.472	6.0	NA	0.0	0.0	0.00	0.40	59.5
North East: Median (Right Turn Stage 2)											
26	R	280	10.5	1.023	98.9	LOS F	19.9	151.9	1.00	2.15	17.5
Approach		280	10.5	1.023	98.9	LOS F	19.9	151.9	1.00	2.15	17.5
North: SYD-NCL Fwy ramps (N)											
7	L	316	9.3	0.181	9.8	X	X	X	X	0.65	54.6
9	R	280	10.5	0.579	23.1	LOS B	3.5	26.8	0.76	1.15	42.9
Approach		596	9.9	0.579	16.0	LOS B	3.5	26.8	0.36	0.88	48.4
West: Sparks Rd (W)											
11	T	498	11.8	0.275	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	140	14.3	0.553	32.0	LOS C	2.9	22.9	0.83	1.09	36.0
Approach		638	12.4	0.553	7.0	NA	2.9	22.9	0.18	0.24	58.1
All Vehicles		2869	10.6	1.023	17.4	NA	19.9	151.9	0.21	0.64	46.3

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	664	9.4	0.382	9.9	X	X	X	X	0.65	54.5
5	T	772	10.0	0.421	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1436	9.7	0.421	4.6	NA	0.0	0.0	0.00	0.30	61.9
North East: Median (Right Turn Stage 2)											
26	R	320	16.4	2.823	1701.2	LOS F	139.4	1113.2	1.00	4.27	1.4
Approach		320	16.4	2.823	1701.2	LOS F	139.4	1113.2	1.00	4.27	1.4
North: SYD-NCL Fwy ramps (N)											
7	L	451	11.9	0.263	10.0	X	X	X	X	0.65	54.6
9	R	320	16.4	2.072	1016.0	LOS F	111.1	887.6	1.00	5.02	2.2
Approach		771	13.8	2.072	427.8	LOS F	111.1	887.6	0.42	2.46	5.0
West: Sparks Rd (W)											
11	T	1114	6.0	0.593	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	108	9.7	0.789	69.2	LOS E	4.3	32.4	0.96	1.24	22.6
Approach		1222	6.3	0.789	6.1	NA	4.3	32.4	0.09	0.11	59.2
All Vehicles		3748	10.0	2.823	236.9	NA	139.4	1113.2	0.20	1.02	8.7

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade 7-8

Wallarah Mine TIA
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

* 02AMFU00

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	26	12.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	236	7.6	0.293	13.0	LOS A	1.1	7.9	0.35	0.75	56.9
Approach		262	8.0	0.293	11.7	NA	1.1	7.9	0.32	0.68	58.7
South East: Sparks Rd Stage 2 (E)											
23	R	81	40.3	0.112	12.4	LOS A	0.4	4.2	0.14	0.62	55.5
Approach		81	40.3	0.112	12.4	LOS A	0.4	4.2	0.14	0.62	55.5
East: Sparks Rd Stage 1 (E)											
4	L	186	6.2	0.299	11.5	LOS A	0.7	5.3	0.25	0.69	54.0
6	R	81	40.3	0.179	17.7	LOS B	0.6	5.4	0.48	0.85	50.3
Approach		267	16.5	0.299	13.4	LOS A	0.7	5.4	0.32	0.74	52.8
North: Hue Hue Rd (N)											
7	L	126	33.3	0.084	13.5	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	48	26.1	0.029	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		175	31.3	0.084	9.8	NA	0.0	0.0	0.00	0.53	63.6
All Vehicles		785	19.4	0.299	11.9	NA	1.1	7.9	0.23	0.66	57.2

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade 3-4

Wallarah Mine TIA
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

* 02AMFU00

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	67	3.1	0.035	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	271	6.6	0.312	12.4	LOS A	1.2	8.7	0.30	0.72	57.4
Approach		338	5.9	0.312	10.0	NA	1.2	8.7	0.24	0.58	60.9
South East: Sparks Rd Stage 2 (E)											
23	R	196	12.4	0.223	10.8	LOS A	1.0	7.7	0.23	0.62	54.9
Approach		196	12.4	0.223	10.8	LOS A	1.0	7.7	0.23	0.62	54.9
East: Sparks Rd Stage 1 (E)											
4	L	242	4.3	0.375	11.4	LOS A	0.9	6.8	0.29	0.67	53.8
6	R	196	12.4	0.306	14.4	LOS A	1.2	9.2	0.47	0.85	51.6
Approach		438	7.9	0.375	12.7	LOS A	1.2	9.2	0.37	0.75	52.8
North: Hue Hue Rd (N)											
7	L	99	13.8	0.059	12.0	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	48	8.7	0.026	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		147	12.1	0.059	8.0	NA	0.0	0.0	0.00	0.49	64.6
All Vehicles		1119	8.7	0.375	10.9	NA	1.2	9.2	0.26	0.64	56.8

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM 7-8

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	78	9.5	0.045	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
5	T	362	3.8	0.190	7.8	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		440	4.8	0.190	7.9	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	288	9.1	0.157	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
29	R	257	2.5	0.348	12.1	LOS A	1.7	12.3	0.55	0.87	45.0
Approach		545	6.0	0.348	10.1	NA	1.7	12.3	0.26	0.76	47.2
South West: Hue Hue Rd (SW)											
30	L	32	6.7	0.055	10.8	LOS A	0.1	1.1	0.44	0.71	46.6
32	R	34	9.4	0.211	31.6	LOS C	0.7	5.4	0.85	0.96	32.2
Approach		65	8.1	0.211	21.5	LOS B	0.7	5.4	0.65	0.84	37.9
All Vehicles		1051	5.6	0.348	9.9	NA	1.7	12.3	0.18	0.72	47.4

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM 3-4

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	84	0.0	0.045	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	392	2.2	0.204	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		476	1.8	0.204	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	665	7.0	0.357	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	101	2.1	0.146	11.6	LOS A	0.5	3.8	0.51	0.80	45.6
Approach		766	6.3	0.357	8.6	NA	0.5	3.8	0.07	0.68	48.7
South West: Hue Hue Rd (SW)											
30	L	66	4.8	0.115	11.0	LOS A	0.3	2.3	0.47	0.74	46.3
32	R	95	1.1	0.891	107.6	LOS F	5.4	38.4	0.99	1.37	15.1
Approach		161	2.6	0.891	67.8	LOS E	5.4	38.4	0.77	1.11	20.9
All Vehicles		1403	4.4	0.891	15.1	NA	5.4	38.4	0.13	0.72	42.4

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM 7-8

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	104	19.2	0.061	0.5	LOS A	0.3	2.5	0.27	0.00	55.0
3	R	1	0.0	0.061	9.4	LOS A	0.3	2.5	0.27	1.08	48.8
Approach		105	19.0	0.061	0.6	NA	0.3	2.5	0.27	0.01	54.9
North: Tooheys Rd (N)											
7	L	1	0.0	0.081	8.2	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	137	23.1	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		138	22.9	0.081	0.1	NA	0.0	0.0	0.00	0.01	59.9
West: Mwy Link ramp (W)											
10	L	411	19.7	0.677	13.6	LOS A	4.3	35.0	0.82	0.64	44.4
11	T	1	0.0	0.003	8.7	LOS A	0.0	0.1	0.40	0.54	47.9
12	R	1	0.0	0.003	10.7	LOS A	0.0	0.1	0.40	0.67	46.5
Approach		413	19.6	0.677	13.6	LOS A	4.3	35.0	0.82	0.64	44.4
All Vehicles		656	20.2	0.677	8.7	NA	4.3	35.0	0.56	0.41	48.6

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM 3-4

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	34	18.8	0.021	3.1	LOS A	0.2	1.3	0.56	0.00	50.4
3	R	1	0.0	0.021	11.9	LOS A	0.2	1.3	0.56	1.00	47.8
Approach		35	18.2	0.021	3.3	NA	0.2	1.3	0.56	0.03	50.4
North: Tooheys Rd (N)											
7	L	6	16.7	0.342	8.9	LOS A	0.0	0.0	0.00	1.17	49.0
8	T	586	19.2	0.342	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		593	19.2	0.342	0.1	NA	0.0	0.0	0.00	0.01	59.9
West: Mwy Link ramp (W)											
10	L	124	22.9	0.207	9.7	LOS A	0.5	4.4	0.29	0.57	47.7
11	T	6	0.0	0.022	15.8	LOS B	0.1	0.5	0.68	0.80	41.7
12	R	1	0.0	0.022	17.8	LOS B	0.1	0.5	0.68	0.85	40.8
Approach		132	21.6	0.207	10.1	LOS A	0.5	4.4	0.31	0.58	47.3
All Vehicles		759	19.6	0.342	2.0	NA	0.5	4.4	0.08	0.11	56.8

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM 7-8

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.122	8.1	LOS A	0.5	3.8	0.31	0.56	48.2
6	R	104	19.2	0.122	11.1	LOS A	0.5	3.8	0.31	0.70	46.9
Approach		105	19.0	0.122	11.0	LOS A	0.5	3.8	0.31	0.70	46.9
North: Tooheys Rd (N)											
9	R	137	23.1	0.086	10.1	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		137	23.1	0.086	10.1	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		242	21.3	0.122	10.5	NA	0.5	3.8	0.13	0.72	47.6

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM 3-4

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.094	14.7	LOS B	0.3	2.5	0.67	0.84	41.9
6	R	34	18.8	0.094	17.7	LOS B	0.3	2.5	0.67	0.91	41.0
Approach		35	18.2	0.094	17.6	LOS B	0.3	2.5	0.67	0.91	41.0
North: Tooheys Rd (N)											
9	R	586	19.2	0.359	9.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		586	19.2	0.359	9.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		621	19.2	0.359	10.3	NA	0.3	2.5	0.04	0.74	47.7

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM 7-8

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	27	11.5	0.104	11.6	LOS A	0.0	0.0	0.00	1.36	59.3
22	T	166	4.4	0.104	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		194	5.4	0.104	1.6	NA	0.0	0.0	0.00	0.19	76.3
North West: Hue Hue Rd (NW)											
28	T	322	4.9	0.193	1.3	LOS A	1.5	10.9	0.42	0.00	66.6
29	R	22	0.0	0.193	12.7	LOS A	1.5	10.9	0.42	1.19	60.4
Approach		344	4.6	0.193	2.0	NA	1.5	10.9	0.42	0.08	66.1
West: Jilliby Rd (W)											
10	L	35	9.1	0.291	23.8	LOS B	1.3	9.4	0.58	0.85	46.9
12	R	75	5.6	0.291	22.0	LOS B	1.3	9.4	0.58	1.02	48.1
Approach		109	6.7	0.291	22.6	LOS B	1.3	9.4	0.58	0.97	47.7
All Vehicles		647	5.2	0.291	5.4	NA	1.5	10.9	0.32	0.26	64.6

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM 4-5

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	87	7.2	0.256	11.3	LOS A	0.0	0.0	0.00	1.27	59.3
22	T	394	3.7	0.256	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		481	4.4	0.256	2.0	NA	0.0	0.0	0.00	0.23	75.3
North West: Hue Hue Rd (NW)											
28	T	249	6.3	0.193	4.1	LOS A	1.8	13.5	0.63	0.00	60.6
29	R	39	8.1	0.193	16.2	LOS B	1.8	13.5	0.63	1.16	57.9
Approach		288	6.6	0.193	5.7	NA	1.8	13.5	0.63	0.16	60.2
West: Jilliby Rd (W)											
10	L	38	11.1	0.691	46.0	LOS D	4.3	31.3	0.88	1.25	33.3
12	R	118	2.7	0.691	43.7	LOS D	4.3	31.3	0.88	1.19	33.7
Approach		156	4.7	0.691	44.2	LOS D	4.3	31.3	0.88	1.21	33.6
All Vehicles		925	5.1	0.691	10.3	NA	4.3	31.3	0.35	0.37	58.7

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM 7-8

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	8	0.0	0.025	10.1	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	36	20.6	0.025	12.2	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		44	16.7	0.025	11.8	NA	0.0	0.0	0.00	0.73	59.1
North: Jilliby Rd (N)											
8	T	4	75.0	0.032	13.7	LOS A	0.1	1.1	0.13	0.59	56.7
9	R	48	6.5	0.032	11.3	LOS A	0.1	1.1	0.13	0.69	58.6
Approach		53	12.0	0.032	11.5	NA	0.1	1.1	0.13	0.68	58.5
South West: Little Jilliby Rd (SW)											
30	L	1	100.0	0.010	14.8	LOS B	0.0	0.2	0.19	0.64	47.1
32	R	7	0.0	0.010	8.3	LOS A	0.0	0.2	0.19	0.63	45.4
Approach		8	12.5	0.010	9.1	LOS A	0.0	0.2	0.19	0.63	45.7
All Vehicles		105	14.0	0.032	11.4	NA	0.1	1.1	0.08	0.70	57.3

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM 4-5

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	20	15.8	0.056	10.8	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	82	6.4	0.056	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		102	8.2	0.056	10.9	NA	0.0	0.0	0.00	0.72	59.1
North: Jilliby Rd (N)											
8	T	4	0.0	0.043	10.1	LOS A	0.2	1.4	0.21	0.55	56.2
9	R	65	6.5	0.043	11.5	LOS A	0.2	1.4	0.21	0.67	58.2
Approach		69	6.1	0.043	11.4	NA	0.2	1.4	0.21	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.032	8.4	LOS A	0.1	0.8	0.25	0.60	45.3
32	R	24	4.3	0.032	8.9	LOS A	0.1	0.8	0.25	0.65	45.3
Approach		29	3.6	0.032	8.8	LOS A	0.1	0.8	0.25	0.64	45.3
All Vehicles		201	6.8	0.056	10.8	NA	0.2	1.4	0.11	0.69	56.2

Traffic conditions for the mine operation phase in 2025

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	63	23.3	0.121	16.6	LOS B	0.5	4.5	0.32	0.93	49.5
3	R	384	9.3	0.848	55.1	LOS D	9.0	68.4	1.00	0.96	26.2
Approach		447	11.3	0.848	49.6	LOS D	9.0	68.4	0.90	0.96	28.1
East: Sparks Rd (E)											
5	T	528	15.9	0.614	8.8	LOS A	12.1	95.8	0.63	0.57	49.9
6	R	296	15.2	1.022	108.5	LOS F	21.6	171.0	1.00	1.23	16.3
Approach		824	15.5	1.022	44.7	LOS D	21.6	171.0	0.76	0.81	28.8
West: Sparks Rd (W)											
10	L	176	16.2	0.471	34.8	LOS C	5.7	45.6	0.85	0.81	34.6
11	T	294	16.8	0.535	24.9	LOS B	9.6	77.2	0.88	0.75	37.7
Approach		469	16.6	0.535	28.6	LOS C	9.6	77.2	0.87	0.77	36.5
All Vehicles		1741	14.7	1.022	41.6	LOS C	21.6	171.0	0.83	0.84	30.4

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	121	9.6	0.255	18.6	LOS B	1.7	13.1	0.49	0.91	46.7
3	R	975	5.5	1.511	369.0	LOS F	108.4	794.7	1.00	1.88	5.7
Approach		1096	6.0	1.511	330.3	LOS F	108.4	794.7	0.94	1.77	6.3
East: Sparks Rd (E)											
5	T	801	10.0	1.108	152.8	LOS F	79.0	613.1	1.00	1.80	12.0
6	R	315	14.9	1.007	98.6	LOS F	21.6	170.9	1.00	1.21	17.5
Approach		1116	13.3	1.108	137.5	LOS F	79.0	613.1	1.00	1.63	13.2
West: Sparks Rd (W)											
10	L	201	8.4	0.890	58.4	LOS E	9.6	72.0	1.00	1.06	25.5
11	T	296	9.6	0.898	46.5	LOS D	13.7	103.8	1.00	1.06	27.7
Approach		497	9.1	0.898	51.3	LOS D	13.7	103.8	1.00	1.06	26.8
All Vehicles		2708	9.6	1.511	199.7	LOS F	108.4	794.7	0.98	1.58	9.8

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	838	6.4	0.472	9.7	X	X	X	X	0.65	54.5
5	T	528	17.1	0.301	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1366	10.6	0.472	6.0	NA	0.0	0.0	0.00	0.40	59.6
North East: Median (Right Turn Stage 2)											
26	R	296	12.5	1.180	214.4	LOS F	38.8	300.5	1.00	3.01	9.3
Approach		296	12.5	1.180	214.4	LOS F	38.8	300.5	1.00	3.01	9.3
North: SYD-NCL Fwy ramps (N)											
7	L	321	10.5	0.186	9.9	X	X	X	X	0.65	54.6
9	R	296	12.5	0.676	26.7	LOS B	4.6	35.5	0.83	1.22	40.3
Approach		617	11.4	0.676	17.9	LOS B	4.6	35.5	0.40	0.92	46.8
West: Sparks Rd (W)											
11	T	514	12.3	0.284	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	163	12.9	0.657	36.1	LOS C	3.9	30.3	0.87	1.16	33.7
Approach		677	12.4	0.657	8.7	NA	3.9	30.3	0.21	0.28	55.7
All Vehicles		2956	11.4	1.180	30.0	NA	38.8	300.5	0.23	0.74	37.1

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	664	9.4	0.382	9.9	X	X	X	X	0.65	54.5
5	T	768	9.6	0.419	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1433	9.5	0.419	4.6	NA	0.0	0.0	0.00	0.30	61.9
North East: Median (Right Turn Stage 2)											
26	R	333	18.0	3.000	1861.0	LOS F	149.3	1207.1	1.00	4.32	1.3
Approach		333	18.0	3.000	1861.0	LOS F	149.3	1207.1	1.00	4.32	1.3
North: SYD-NCL Fwy ramps (N)											
7	L	460	12.6	0.270	10.0	X	X	X	X	0.65	54.6
9	R	333	18.0	2.528	1430.2	LOS F	134.2	1084.9	1.00	5.08	1.6
Approach		793	14.9	2.528	606.0	LOS F	134.2	1084.9	0.42	2.51	3.6
West: Sparks Rd (W)											
11	T	1133	6.2	0.604	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	138	8.4	0.946	101.7	LOS F	8.1	60.5	0.99	1.53	17.1
Approach		1271	6.5	0.946	11.0	NA	8.1	60.5	0.11	0.17	52.6
All Vehicles		3828	10.3	3.000	292.5	NA	149.3	1207.1	0.21	1.06	7.2

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade 7-8

Wallarah Mine TIA
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

* 02AMFU00

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	29	14.3	0.017	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	236	7.6	0.321	13.8	LOS A	1.3	9.4	0.42	0.81	55.8
Approach		265	8.3	0.321	12.3	NA	1.3	9.4	0.38	0.72	57.8
South East: Sparks Rd Stage 2 (E)											
23	R	107	39.2	0.148	12.4	LOS A	0.6	5.8	0.16	0.62	55.4
Approach		107	39.2	0.148	12.4	LOS A	0.6	5.8	0.16	0.62	55.4
East: Sparks Rd Stage 1 (E)											
4	L	186	6.2	0.305	11.8	LOS A	0.8	5.5	0.30	0.71	53.8
6	R	107	39.2	0.251	18.7	LOS B	0.9	8.2	0.52	0.89	49.2
Approach		294	18.3	0.305	14.3	LOS A	0.9	8.2	0.38	0.78	52.0
North: Hue Hue Rd (N)											
7	L	195	26.5	0.125	13.0	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	57	24.1	0.034	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		252	25.9	0.125	10.0	NA	0.0	0.0	0.00	0.57	62.7
All Vehicles		918	20.0	0.321	12.3	NA	1.3	9.4	0.25	0.68	56.7

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade 3-4

Wallarah Mine TIA
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

* 02AMFU00

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	68	4.6	0.036	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	271	6.6	0.346	13.4	LOS A	1.4	10.5	0.40	0.79	56.3
Approach		339	6.2	0.346	10.7	NA	1.4	10.5	0.32	0.63	59.9
South East: Sparks Rd Stage 2 (E)											
23	R	205	16.4	0.244	11.1	LOS A	1.1	8.9	0.24	0.62	54.9
Approach		205	16.4	0.244	11.1	LOS A	1.1	8.9	0.24	0.62	54.9
East: Sparks Rd Stage 1 (E)											
4	L	242	4.3	0.383	11.6	LOS A	1.0	7.2	0.29	0.71	53.8
6	R	205	16.4	0.362	16.0	LOS B	1.6	12.4	0.53	0.91	50.1
Approach		447	9.9	0.383	13.6	LOS A	1.6	12.4	0.40	0.80	52.1
North: Hue Hue Rd (N)											
7	L	184	12.6	0.108	11.9	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	59	8.9	0.032	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		243	11.7	0.108	9.0	NA	0.0	0.0	0.00	0.55	63.0
All Vehicles		1235	10.3	0.383	11.5	NA	1.6	12.4	0.27	0.67	56.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM 7-8

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	78	9.5	0.045	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
5	T	362	3.8	0.190	7.8	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		440	4.8	0.190	7.9	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	288	9.1	0.157	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
29	R	259	2.4	0.352	12.2	LOS A	1.8	12.5	0.56	0.88	45.0
Approach		547	6.0	0.352	10.1	NA	1.8	12.5	0.26	0.76	47.1
South West: Hue Hue Rd (SW)											
30	L	39	5.4	0.067	10.7	LOS A	0.2	1.3	0.44	0.71	46.6
32	R	34	9.4	0.212	31.8	LOS C	0.7	5.4	0.85	0.96	32.1
Approach		73	7.2	0.212	20.5	LOS B	0.7	5.4	0.63	0.83	38.6
All Vehicles		1060	5.6	0.352	9.9	NA	1.8	12.5	0.18	0.72	47.3

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM 3-4

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	84	0.0	0.045	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	392	2.2	0.204	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		476	1.8	0.204	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	665	7.0	0.357	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	101	2.1	0.146	11.6	LOS A	0.5	3.9	0.51	0.80	45.5
Approach		766	6.3	0.357	8.6	NA	0.5	3.9	0.07	0.68	48.7
South West: Hue Hue Rd (SW)											
30	L	77	4.1	0.132	10.9	LOS A	0.4	2.7	0.47	0.75	46.3
32	R	95	1.1	0.891	107.6	LOS F	5.4	38.4	0.99	1.37	15.1
Approach		172	2.5	0.891	64.3	LOS E	5.4	38.4	0.75	1.09	21.6
All Vehicles		1414	4.3	0.891	15.1	NA	5.4	38.4	0.13	0.72	42.5

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	6	66.7	0.005	0.1	LOS A	0.0	0.2	0.09	0.00	58.2
3	R	1	0.0	0.005	8.9	LOS A	0.0	0.2	0.09	1.08	48.3
Approach		7	57.1	0.005	1.3	NA	0.0	0.2	0.09	0.15	56.5
North: Tooheys Rd (N)											
7	L	5	80.0	0.014	11.8	LOS A	0.0	0.0	0.00	1.07	49.0
8	T	13	66.7	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		18	70.6	0.014	3.5	NA	0.0	0.0	0.00	0.31	56.3
West: Mwy Link ramp (W)											
10	L	11	90.0	0.034	12.4	LOS A	0.1	0.8	0.08	0.62	48.6
11	T	1	0.0	0.002	7.1	LOS A	0.0	0.1	0.12	0.52	49.6
12	R	1	0.0	0.002	9.1	LOS A	0.0	0.1	0.12	0.72	47.8
Approach		13	75.0	0.034	11.7	LOS A	0.1	0.8	0.09	0.62	48.6
All Vehicles		38	69.4	0.034	5.8	NA	0.1	0.8	0.05	0.39	53.5

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	7	57.1	0.006	0.1	LOS A	0.0	0.2	0.11	0.00	57.7
3	R	1	0.0	0.006	9.0	LOS A	0.0	0.2	0.11	1.08	48.3
Approach		8	50.0	0.006	1.2	NA	0.0	0.2	0.11	0.13	56.3
North: Tooheys Rd (N)											
7	L	11	50.0	0.022	10.4	LOS A	0.0	0.0	0.00	1.00	49.0
8	T	23	31.8	0.022	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		34	37.5	0.022	3.3	NA	0.0	0.0	0.00	0.31	56.1
West: Mwy Link ramp (W)											
10	L	12	90.9	0.038	12.5	LOS A	0.1	0.9	0.09	0.62	48.6
11	T	6	0.0	0.008	7.3	LOS A	0.0	0.2	0.17	0.54	49.4
12	R	1	0.0	0.008	9.3	LOS A	0.0	0.2	0.17	0.74	47.8
Approach		19	55.6	0.038	10.6	LOS A	0.1	0.9	0.12	0.60	48.8
All Vehicles		61	44.8	0.038	5.2	NA	0.1	0.9	0.05	0.38	53.6

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.010	7.1	LOS A	0.0	0.4	0.10	0.50	49.6
6	R	6	66.7	0.010	12.6	LOS A	0.0	0.4	0.10	0.71	47.8
Approach		7	57.1	0.010	11.8	LOS A	0.0	0.4	0.10	0.68	48.0
North: Tooheys Rd (N)											
9	R	13	66.7	0.010	12.3	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		13	66.7	0.010	12.3	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		20	63.2	0.010	12.1	NA	0.0	0.4	0.04	0.71	48.1

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.011	7.2	LOS A	0.0	0.4	0.12	0.50	49.5
6	R	7	57.1	0.011	12.1	LOS A	0.0	0.4	0.12	0.70	47.7
Approach		8	50.0	0.011	11.5	LOS A	0.0	0.4	0.12	0.67	47.9
North: Tooheys Rd (N)											
9	R	22	33.3	0.015	10.6	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		22	33.3	0.015	10.6	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		31	37.9	0.015	10.8	NA	0.0	0.4	0.03	0.71	48.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM 7-8

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	27	11.5	0.106	11.6	LOS A	0.0	0.0	0.00	1.36	59.3
22	T	169	5.0	0.106	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		197	5.9	0.106	1.6	NA	0.0	0.0	0.00	0.19	76.4
North West: Hue Hue Rd (NW)											
28	T	331	5.1	0.198	1.3	LOS A	1.5	11.3	0.42	0.00	66.4
29	R	22	0.0	0.198	12.7	LOS A	1.5	11.3	0.42	1.19	60.4
Approach		353	4.8	0.198	2.0	NA	1.5	11.3	0.42	0.07	66.0
West: Jilliby Rd (W)											
10	L	35	9.1	0.299	24.3	LOS B	1.3	9.7	0.58	0.85	46.5
12	R	75	5.6	0.299	22.4	LOS B	1.3	9.7	0.58	1.02	47.6
Approach		109	6.7	0.299	23.0	LOS B	1.3	9.7	0.58	0.97	47.3
All Vehicles		659	5.4	0.299	5.4	NA	1.5	11.3	0.32	0.26	64.4

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM 3-4

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	87	7.2	0.257	11.3	LOS A	0.0	0.0	0.00	1.27	59.3
22	T	395	4.0	0.257	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		482	4.6	0.257	2.0	NA	0.0	0.0	0.00	0.23	75.3
North West: Hue Hue Rd (NW)											
28	T	260	6.5	0.199	4.1	LOS A	1.9	14.1	0.64	0.00	60.5
29	R	39	8.1	0.199	16.3	LOS B	1.9	14.1	0.64	1.16	57.9
Approach		299	6.7	0.199	5.7	NA	1.9	14.1	0.64	0.15	60.2
West: Jilliby Rd (W)											
10	L	38	11.1	0.711	48.3	LOS D	4.5	32.8	0.88	1.27	32.3
12	R	118	2.7	0.711	45.9	LOS D	4.5	32.8	0.88	1.21	32.7
Approach		156	4.7	0.711	46.5	LOS D	4.5	32.8	0.88	1.22	32.6
All Vehicles		937	5.3	0.711	10.6	NA	4.5	32.8	0.35	0.37	58.2

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM 7-8

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	8	0.0	0.025	10.1	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	36	20.6	0.025	12.2	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		44	16.7	0.025	11.8	NA	0.0	0.0	0.00	0.73	59.1
North: Jilliby Rd (N)											
8	T	4	75.0	0.032	13.7	LOS A	0.1	1.1	0.13	0.59	56.7
9	R	48	6.5	0.032	11.3	LOS A	0.1	1.1	0.13	0.69	58.6
Approach		53	12.0	0.032	11.5	NA	0.1	1.1	0.13	0.68	58.5
South West: Little Jilliby Rd (SW)											
30	L	1	100.0	0.010	14.8	LOS B	0.0	0.2	0.19	0.64	47.1
32	R	7	0.0	0.010	8.3	LOS A	0.0	0.2	0.19	0.63	45.4
Approach		8	12.5	0.010	9.1	LOS A	0.0	0.2	0.19	0.63	45.7
All Vehicles		105	14.0	0.032	11.4	NA	0.1	1.1	0.08	0.70	57.3

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM 3-4

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	20	15.8	0.056	10.8	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	82	6.4	0.056	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		102	8.2	0.056	10.9	NA	0.0	0.0	0.00	0.72	59.1
North: Jilliby Rd (N)											
8	T	4	0.0	0.043	10.1	LOS A	0.2	1.4	0.21	0.55	56.2
9	R	65	6.5	0.043	11.5	LOS A	0.2	1.4	0.21	0.67	58.2
Approach		69	6.1	0.043	11.4	NA	0.2	1.4	0.21	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.032	8.4	LOS A	0.1	0.8	0.25	0.60	45.3
32	R	24	4.3	0.032	8.9	LOS A	0.1	0.8	0.25	0.65	45.3
Approach		29	3.6	0.032	8.8	LOS A	0.1	0.8	0.25	0.64	45.3
All Vehicles		201	6.8	0.056	10.8	NA	0.2	1.4	0.11	0.69	56.2

Year 2026 No-Project traffic conditions

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	58	25.5	0.108	16.5	LOS B	0.5	3.9	0.31	0.93	49.7
3	R	386	9.3	0.852	55.4	LOS D	9.1	69.1	1.00	0.97	26.1
Approach		444	11.4	0.852	50.4	LOS D	9.1	69.1	0.91	0.96	27.9
East: Sparks Rd (E)											
5	T	505	13.6	0.582	8.5	LOS A	11.2	87.6	0.61	0.55	50.4
6	R	298	14.4	1.022	108.6	LOS F	21.7	171.0	1.00	1.23	16.3
Approach		803	14.2	1.022	45.7	LOS D	21.7	171.0	0.75	0.80	28.5
West: Sparks Rd (W)											
10	L	145	15.9	0.388	34.0	LOS C	4.6	36.5	0.83	0.80	35.0
11	T	257	17.2	0.469	24.2	LOS B	8.2	66.0	0.85	0.72	38.1
Approach		402	16.8	0.469	27.8	LOS B	8.2	66.0	0.84	0.75	36.9
All Vehicles		1649	14.0	1.022	42.6	LOS D	21.7	171.0	0.82	0.83	30.0

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	120	8.8	0.249	18.5	LOS B	1.7	12.8	0.48	0.91	46.8
3	R	982	5.5	1.529	380.0	LOS F	111.6	818.0	1.00	1.90	5.5
Approach		1102	5.8	1.529	340.6	LOS F	111.6	818.0	0.94	1.79	6.1
East: Sparks Rd (E)											
5	T	787	8.1	1.081	131.4	LOS F	71.8	552.2	1.00	1.68	13.5
6	R	316	14.4	1.007	98.6	LOS F	21.7	170.9	1.00	1.21	17.5
Approach		1103	12.3	1.081	122.0	LOS F	71.8	552.2	1.00	1.55	14.4
West: Sparks Rd (W)											
10	L	165	7.6	0.728	46.8	LOS D	6.6	49.6	1.00	0.90	29.2
11	T	249	9.7	0.758	36.5	LOS C	9.9	75.0	1.00	0.91	31.5
Approach		415	8.9	0.758	40.6	LOS C	9.9	75.0	1.00	0.90	30.5
All Vehicles		2620	9.0	1.529	201.1	LOS F	111.6	818.0	0.98	1.55	9.8

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	844	6.4	0.475	9.7	X	X	X	X	0.65	54.5
5	T	522	16.1	0.296	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1366	10.1	0.475	6.0	NA	0.0	0.0	0.00	0.40	59.5
North East: Median (Right Turn Stage 2)											
26	R	281	10.5	1.040	109.1	LOS F	21.6	164.9	1.00	2.24	16.2
Approach		281	10.5	1.040	109.1	LOS F	21.6	164.9	1.00	2.24	16.2
North: SYD-NCL Fwy ramps (N)											
7	L	318	9.3	0.183	9.8	X	X	X	X	0.65	54.6
9	R	281	10.5	0.585	23.3	LOS B	3.6	27.3	0.77	1.15	42.7
Approach		599	9.8	0.585	16.1	LOS B	3.6	27.3	0.36	0.89	48.4
West: Sparks Rd (W)											
11	T	501	12.0	0.277	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	141	14.2	0.564	32.6	LOS C	3.0	23.5	0.84	1.10	35.6
Approach		642	12.5	0.564	7.2	NA	3.0	23.5	0.18	0.24	57.9
All Vehicles		2888	10.6	1.040	18.4	NA	21.6	164.9	0.21	0.64	45.4

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	668	9.3	0.384	9.9	X	X	X	X	0.65	54.5
5	T	765	8.7	0.415	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1434	9.0	0.415	4.6	NA	0.0	0.0	0.00	0.30	61.8
North East: Median (Right Turn Stage 2)											
26	R	321	16.4	2.662	1554.2	LOS F	135.2	1079.4	1.00	4.34	1.5
Approach		321	16.4	2.662	1554.2	LOS F	135.2	1079.4	1.00	4.34	1.5
North: SYD-NCL Fwy ramps (N)											
7	L	455	12.0	0.266	10.0	X	X	X	X	0.65	54.6
9	R	321	16.4	2.122	1061.4	LOS F	113.8	908.9	1.00	5.03	2.1
Approach		776	13.8	2.122	445.1	LOS F	113.8	908.9	0.41	2.46	4.9
West: Sparks Rd (W)											
11	T	1122	6.0	0.598	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	109	9.6	0.751	61.5	LOS E	3.9	29.7	0.95	1.20	24.5
Approach		1232	6.3	0.751	5.5	NA	3.9	29.7	0.08	0.11	60.2
All Vehicles		3762	9.7	2.662	228.0	NA	135.2	1079.4	0.20	1.03	9.0

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade 7-8

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	26	12.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	238	7.5	0.296	13.0	LOS A	1.1	8.0	0.36	0.75	56.9
Approach		264	8.0	0.296	11.7	NA	1.1	8.0	0.32	0.68	58.6
South East: Sparks Rd Stage 2 (E)											
23	R	82	39.7	0.113	12.3	LOS A	0.5	4.3	0.14	0.62	55.5
Approach		82	39.7	0.113	12.3	LOS A	0.5	4.3	0.14	0.62	55.5
East: Sparks Rd Stage 1 (E)											
4	L	189	6.7	0.306	11.6	LOS A	0.7	5.4	0.26	0.70	54.0
6	R	82	39.7	0.181	17.7	LOS B	0.6	5.5	0.48	0.85	50.3
Approach		272	16.7	0.306	13.4	LOS A	0.7	5.5	0.32	0.74	52.8
North: Hue Hue Rd (N)											
7	L	127	33.9	0.085	13.5	LOS A	0.0	0.0	0.00	0.74	58.9
8	T	48	26.1	0.029	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		176	31.7	0.085	9.8	NA	0.0	0.0	0.00	0.53	63.6
All Vehicles		794	19.5	0.306	11.9	NA	1.1	8.0	0.23	0.66	57.1

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade 3-4

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	68	3.1	0.036	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	273	6.6	0.314	12.4	LOS A	1.2	8.7	0.30	0.72	57.4
Approach		341	5.9	0.314	9.9	NA	1.2	8.7	0.24	0.58	60.9
South East: Sparks Rd Stage 2 (E)											
23	R	198	12.2	0.226	10.8	LOS A	1.0	7.8	0.23	0.62	54.9
Approach		198	12.2	0.226	10.8	LOS A	1.0	7.8	0.23	0.62	54.9
East: Sparks Rd Stage 1 (E)											
4	L	244	4.3	0.378	11.4	LOS A	0.9	6.9	0.29	0.67	53.8
6	R	198	12.2	0.309	14.4	LOS A	1.2	9.3	0.47	0.85	51.5
Approach		442	7.9	0.378	12.7	LOS A	1.2	9.3	0.37	0.75	52.8
North: Hue Hue Rd (N)											
7	L	99	13.8	0.059	12.0	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	48	8.7	0.026	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		147	12.1	0.059	8.0	NA	0.0	0.0	0.00	0.49	64.6
All Vehicles		1128	8.6	0.378	10.9	NA	1.2	9.3	0.26	0.64	56.8

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM 7-8

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	80	9.2	0.046	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
5	T	372	3.7	0.195	7.8	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		452	4.7	0.195	7.9	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	295	8.9	0.160	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
29	R	264	2.4	0.363	12.4	LOS A	1.8	13.1	0.56	0.89	44.8
Approach		559	5.8	0.363	10.2	NA	1.8	13.1	0.27	0.77	47.1
South West: Hue Hue Rd (SW)											
30	L	32	6.7	0.055	10.8	LOS A	0.1	1.1	0.44	0.71	46.5
32	R	35	9.1	0.226	33.2	LOS C	0.8	5.9	0.86	0.97	31.5
Approach		66	7.9	0.226	22.5	LOS B	0.8	5.9	0.66	0.84	37.2
All Vehicles		1077	5.5	0.363	10.0	NA	1.8	13.1	0.18	0.72	47.3

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM 3-4

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	86	0.0	0.046	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	401	2.1	0.208	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		487	1.7	0.208	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	682	6.9	0.366	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	103	2.0	0.151	11.7	LOS A	0.6	4.0	0.52	0.81	45.5
Approach		785	6.3	0.366	8.7	NA	0.6	4.0	0.07	0.68	48.7
South West: Hue Hue Rd (SW)											
30	L	67	4.7	0.117	11.0	LOS A	0.3	2.4	0.47	0.75	46.2
32	R	97	1.1	0.972	143.3	LOS F	7.4	52.1	1.00	1.52	12.1
Approach		164	2.6	0.972	89.0	LOS F	7.4	52.1	0.78	1.20	17.3
All Vehicles		1437	4.3	0.972	17.5	NA	7.4	52.1	0.13	0.73	40.5

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	2	0.0	0.002	0.0	LOS A	0.0	0.1	0.03	0.00	59.4
3	R	1	0.0	0.002	8.9	LOS A	0.0	0.1	0.03	1.00	48.2
Approach		3	0.0	0.002	3.0	NA	0.0	0.1	0.03	0.33	55.2
North: Tooheys Rd (N)											
7	L	1	0.0	0.002	8.2	LOS A	0.0	0.0	0.00	0.89	49.0
8	T	2	50.0	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		3	33.3	0.002	2.7	NA	0.0	0.0	0.00	0.30	55.8
West: Mwy Link ramp (W)											
10	L	3	66.7	0.008	11.2	LOS A	0.0	0.2	0.03	0.65	48.8
11	T	1	0.0	0.002	7.0	LOS A	0.0	0.1	0.04	0.54	50.1
12	R	1	0.0	0.002	9.0	LOS A	0.0	0.1	0.04	0.76	48.0
Approach		5	40.0	0.008	9.9	LOS A	0.0	0.2	0.04	0.65	48.9
All Vehicles		12	27.3	0.008	6.1	NA	0.0	0.2	0.02	0.47	52.3

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	0.0	0.002	0.0	LOS A	0.0	0.1	0.04	0.00	59.0
3	R	1	0.0	0.002	8.9	LOS A	0.0	0.1	0.04	1.04	48.2
Approach		4	0.0	0.002	2.2	LOS A	0.0	0.1	0.04	0.26	55.9
North: Tooheys Rd (N)											
7	L	6	16.7	0.004	8.9	LOS A	0.0	0.0	0.00	0.71	49.0
8	T	1	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		7	14.3	0.004	7.7	LOS A	0.0	0.0	0.00	0.61	50.3
West: Mwy Link ramp (W)											
10	L	4	75.0	0.012	11.6	LOS A	0.0	0.3	0.04	0.64	48.8
11	T	6	0.0	0.007	7.0	LOS A	0.0	0.3	0.06	0.55	50.0
12	R	1	0.0	0.007	9.0	LOS A	0.0	0.3	0.06	0.79	48.0
Approach		12	27.3	0.012	8.9	LOS A	0.0	0.3	0.05	0.61	49.4
All Vehicles		23	18.2	0.012	7.3	NA	0.0	0.3	0.03	0.54	50.7

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.003	6.9	LOS A	0.0	0.1	0.02	0.53	50.2
6	R	2	0.0	0.003	8.9	LOS A	0.0	0.1	0.02	0.75	48.0
Approach		3	0.0	0.003	8.3	LOS A	0.0	0.1	0.02	0.68	48.7
North: Tooheys Rd (N)											
9	R	2	50.0	0.002	11.4	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		2	50.0	0.002	11.4	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		5	20.0	0.003	9.5	NA	0.0	0.1	0.01	0.70	48.5

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.004	6.9	LOS A	0.0	0.1	0.01	0.53	50.3
6	R	3	0.0	0.004	8.9	LOS A	0.0	0.1	0.01	0.75	48.0
Approach		4	0.0	0.004	8.4	LOS A	0.0	0.1	0.01	0.69	48.6
North: Tooheys Rd (N)											
9	R	1	0.0	0.001	8.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		1	0.0	0.001	8.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		5	0.0	0.004	8.5	NA	0.0	0.1	0.01	0.70	48.5

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM 6-7

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	28	11.1	0.106	11.6	LOS A	0.0	0.0	0.00	1.35	59.3
22	T	171	4.3	0.106	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		199	5.3	0.106	1.7	NA	0.0	0.0	0.00	0.19	76.3
North West: Hue Hue Rd (NW)											
28	T	332	5.1	0.200	1.3	LOS A	1.6	11.4	0.43	0.00	66.3
29	R	23	0.0	0.200	12.8	LOS A	1.6	11.4	0.43	1.19	60.4
Approach		355	4.7	0.200	2.1	NA	1.6	11.4	0.43	0.08	65.9
West: Jilliby Rd (W)											
10	L	36	8.8	0.308	24.5	LOS B	1.4	10.2	0.59	0.86	46.3
12	R	77	5.5	0.308	22.6	LOS B	1.4	10.2	0.59	1.03	47.5
Approach		113	6.5	0.308	23.2	LOS B	1.4	10.2	0.59	0.97	47.1
All Vehicles		666	5.2	0.308	5.5	NA	1.6	11.4	0.33	0.26	64.2

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM 6-7

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	89	7.1	0.262	11.2	LOS A	0.0	0.0	0.00	1.27	59.3
22	T	403	3.7	0.262	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		493	4.3	0.262	2.0	NA	0.0	0.0	0.00	0.23	75.3
North West: Hue Hue Rd (NW)											
28	T	256	6.6	0.199	4.3	LOS A	1.9	14.1	0.64	0.00	60.4
29	R	40	7.9	0.199	16.3	LOS B	1.9	14.1	0.64	1.16	57.7
Approach		296	6.8	0.199	5.9	NA	1.9	14.1	0.64	0.16	60.0
West: Jilliby Rd (W)											
10	L	39	10.8	0.740	50.8	LOS D	4.9	35.6	0.90	1.30	31.3
12	R	121	2.6	0.740	48.5	LOS D	4.9	35.6	0.90	1.23	31.6
Approach		160	4.6	0.740	49.1	LOS D	4.9	35.6	0.90	1.25	31.5
All Vehicles		948	5.1	0.740	11.2	NA	4.9	35.6	0.35	0.38	57.5

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM 6-7

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	8	0.0	0.026	10.1	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	37	20.0	0.026	12.1	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		45	16.3	0.026	11.7	NA	0.0	0.0	0.00	0.73	59.1
North: Jilliby Rd (N)											
8	T	4	75.0	0.032	13.7	LOS A	0.1	1.1	0.14	0.59	56.7
9	R	48	6.5	0.032	11.3	LOS A	0.1	1.1	0.14	0.68	58.6
Approach		53	12.0	0.032	11.5	NA	0.1	1.1	0.14	0.68	58.4
South West: Little Jilliby Rd (SW)											
30	L	1	100.0	0.010	14.8	LOS B	0.0	0.2	0.19	0.64	47.1
32	R	7	0.0	0.010	8.3	LOS A	0.0	0.2	0.19	0.63	45.4
Approach		8	12.5	0.010	9.1	LOS A	0.0	0.2	0.19	0.63	45.7
All Vehicles		106	13.9	0.032	11.4	NA	0.1	1.1	0.08	0.70	57.3

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM 6-7

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	20	15.8	0.055	10.8	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	80	6.6	0.055	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		100	8.4	0.055	11.0	NA	0.0	0.0	0.00	0.72	59.1
North: Jilliby Rd (N)											
8	T	4	0.0	0.042	10.1	LOS A	0.2	1.4	0.21	0.55	56.2
9	R	64	6.6	0.042	11.5	LOS A	0.2	1.4	0.21	0.67	58.2
Approach		68	6.2	0.042	11.4	NA	0.2	1.4	0.21	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.033	8.4	LOS A	0.1	0.8	0.24	0.60	45.3
32	R	25	4.2	0.033	8.8	LOS A	0.1	0.8	0.24	0.65	45.3
Approach		31	3.4	0.033	8.8	LOS A	0.1	0.8	0.24	0.64	45.3
All Vehicles		199	6.9	0.055	10.8	NA	0.2	1.4	0.11	0.69	56.1

Traffic conditions for the construction of Western Ventilation shaft, mine operation phase in 2026

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	65	24.2	0.127	16.7	LOS B	0.6	4.7	0.32	0.93	49.5
3	R	386	9.3	0.852	55.4	LOS D	9.1	69.1	1.00	0.97	26.1
Approach		452	11.4	0.852	49.8	LOS D	9.1	69.1	0.90	0.96	28.1
East: Sparks Rd (E)											
5	T	536	16.0	0.623	8.9	LOS A	12.4	98.3	0.63	0.57	49.8
6	R	296	15.3	1.022	108.5	LOS F	21.6	171.0	1.00	1.23	16.3
Approach		832	15.6	1.022	44.4	LOS D	21.6	171.0	0.76	0.81	28.9
West: Sparks Rd (W)											
10	L	177	16.1	0.473	34.8	LOS C	5.8	45.9	0.85	0.81	34.6
11	T	296	16.7	0.538	24.9	LOS B	9.7	77.8	0.88	0.75	37.7
Approach		473	16.5	0.538	28.6	LOS C	9.7	77.8	0.87	0.77	36.4
All Vehicles		1756	14.7	1.022	41.5	LOS C	21.6	171.0	0.83	0.84	30.4

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	121	9.6	0.256	18.6	LOS B	1.7	13.1	0.49	0.91	46.7
3	R	982	5.5	1.529	380.0	LOS F	111.6	818.0	1.00	1.90	5.5
Approach		1103	5.9	1.529	340.4	LOS F	111.6	818.0	0.94	1.79	6.1
East: Sparks Rd (E)											
5	T	810	10.4	1.122	164.7	LOS F	83.2	646.6	1.00	1.86	11.3
6	R	315	15.0	1.007	98.6	LOS F	21.6	170.9	1.00	1.21	17.5
Approach		1125	13.5	1.122	146.2	LOS F	83.2	646.6	1.00	1.68	12.6
West: Sparks Rd (W)											
10	L	204	8.8	0.907	61.1	LOS E	10.1	75.6	1.00	1.09	24.8
11	T	298	9.9	0.906	47.7	LOS D	14.0	106.3	1.00	1.08	27.4
Approach		502	9.4	0.907	53.1	LOS D	14.0	106.3	1.00	1.08	26.3
All Vehicles		2731	9.7	1.529	207.5	LOS F	111.6	818.0	0.98	1.61	9.5

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM 7-8

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	844	6.4	0.475	9.7	X	X	X	X	0.65	54.5
5	T	533	17.2	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1377	10.6	0.475	6.0	NA	0.0	0.0	0.00	0.40	59.6
North East: Median (Right Turn Stage 2)											
26	R	297	12.4	1.199	230.9	LOS F	41.2	318.7	1.00	3.11	8.7
Approach		297	12.4	1.199	230.9	LOS F	41.2	318.7	1.00	3.11	8.7
North: SYD-NCL Fwy ramps (N)											
7	L	323	10.4	0.187	9.9	X	X	X	X	0.65	54.6
9	R	297	12.4	0.684	27.1	LOS B	4.7	36.3	0.83	1.23	40.1
Approach		620	11.4	0.684	18.1	LOS B	4.7	36.3	0.40	0.93	46.6
West: Sparks Rd (W)											
11	T	518	12.4	0.287	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	164	12.8	0.669	36.9	LOS C	4.0	31.3	0.88	1.17	33.3
Approach		682	12.5	0.669	8.9	NA	4.0	31.3	0.21	0.28	55.5
All Vehicles		2976	11.4	1.199	31.6	NA	41.2	318.7	0.23	0.75	36.1

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM 3-4

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	668	9.3	0.384	9.9	X	X	X	X	0.65	54.5
5	T	773	9.5	0.421	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1441	9.4	0.421	4.6	NA	0.0	0.0	0.00	0.30	61.9
North East: Median (Right Turn Stage 2)											
26	R	335	17.9	3.055	1910.7	LOS F	151.6	1224.3	1.00	4.31	1.2
Approach		335	17.9	3.055	1910.7	LOS F	151.6	1224.3	1.00	4.31	1.2
North: SYD-NCL Fwy ramps (N)											
7	L	464	12.7	0.273	10.0	X	X	X	X	0.65	54.6
9	R	335	17.9	2.595	1490.9	LOS F	137.3	1108.8	1.00	5.08	1.5
Approach		799	14.9	2.595	630.5	LOS F	137.3	1108.8	0.42	2.50	3.5
West: Sparks Rd (W)											
11	T	1141	6.3	0.609	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	139	8.3	0.965	109.6	LOS F	8.8	65.8	0.99	1.58	16.2
Approach		1280	6.5	0.965	11.9	NA	8.8	65.8	0.11	0.17	51.6
All Vehicles		3855	10.3	3.055	302.3	NA	151.6	1224.3	0.21	1.06	7.0

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade 7-8

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	29	14.3	0.017	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	240	7.9	0.329	13.9	LOS A	1.3	9.8	0.43	0.81	55.7
Approach		269	8.6	0.329	12.4	NA	1.3	9.8	0.38	0.73	57.7
South East: Sparks Rd Stage 2 (E)											
23	R	108	38.8	0.149	12.3	LOS A	0.6	5.8	0.16	0.62	55.4
Approach		108	38.8	0.149	12.3	LOS A	0.6	5.8	0.16	0.62	55.4
East: Sparks Rd Stage 1 (E)											
4	L	192	7.1	0.317	11.9	LOS A	0.8	5.8	0.30	0.72	53.7
6	R	108	38.8	0.254	18.8	LOS B	0.9	8.3	0.52	0.89	49.1
Approach		300	18.6	0.317	14.4	LOS A	0.9	8.3	0.38	0.78	52.0
North: Hue Hue Rd (N)											
7	L	196	26.9	0.126	13.0	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	57	24.1	0.034	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		253	26.3	0.126	10.1	NA	0.0	0.0	0.00	0.57	62.7
All Vehicles		931	20.1	0.329	12.4	NA	1.3	9.8	0.25	0.69	56.6

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade 3-4

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	69	4.5	0.037	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	275	6.9	0.353	13.5	LOS A	1.5	10.9	0.40	0.79	56.2
Approach		344	6.4	0.353	10.7	NA	1.5	10.9	0.32	0.63	59.9
South East: Sparks Rd Stage 2 (E)											
23	R	207	16.2	0.247	11.1	LOS A	1.1	9.0	0.24	0.62	54.9
Approach		207	16.2	0.247	11.1	LOS A	1.1	9.0	0.24	0.62	54.9
East: Sparks Rd Stage 1 (E)											
4	L	246	4.7	0.391	11.6	LOS A	1.0	7.4	0.29	0.71	53.8
6	R	207	16.2	0.367	16.1	LOS B	1.6	12.7	0.53	0.91	50.0
Approach		454	10.0	0.391	13.7	LOS A	1.6	12.7	0.40	0.80	52.0
North: Hue Hue Rd (N)											
7	L	184	12.6	0.108	11.9	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	59	8.9	0.032	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		243	11.7	0.108	9.0	NA	0.0	0.0	0.00	0.55	63.0
All Vehicles		1248	10.4	0.391	11.5	NA	1.6	12.7	0.27	0.68	56.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM 7-8

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	80	9.2	0.046	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
5	T	372	3.7	0.195	7.8	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		452	4.7	0.195	7.9	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	295	8.9	0.160	8.3	LOS A	0.0	0.0	0.00	0.67	49.3
29	R	266	2.4	0.367	12.4	LOS A	1.9	13.4	0.57	0.89	44.8
Approach		561	5.8	0.367	10.3	NA	1.9	13.4	0.27	0.77	47.0
South West: Hue Hue Rd (SW)											
30	L	39	5.4	0.067	10.7	LOS A	0.2	1.3	0.44	0.71	46.5
32	R	35	9.1	0.227	33.3	LOS C	0.8	5.9	0.86	0.97	31.4
Approach		74	7.1	0.227	21.4	LOS B	0.8	5.9	0.64	0.83	37.9
All Vehicles		1086	5.4	0.367	10.0	NA	1.9	13.4	0.18	0.73	47.2

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM 3-4

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	86	0.0	0.046	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	401	2.1	0.208	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		487	1.7	0.208	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	682	6.9	0.366	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	103	2.0	0.152	11.7	LOS A	0.6	4.0	0.52	0.81	45.4
Approach		785	6.3	0.366	8.7	NA	0.6	4.0	0.07	0.68	48.7
South West: Hue Hue Rd (SW)											
30	L	78	4.1	0.135	11.0	LOS A	0.4	2.8	0.47	0.76	46.2
32	R	97	1.1	0.972	143.3	LOS F	7.4	52.1	1.00	1.52	12.1
Approach		175	2.4	0.972	84.3	LOS F	7.4	52.1	0.76	1.18	18.0
All Vehicles		1447	4.3	0.972	17.5	NA	7.4	52.1	0.13	0.73	40.6

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	6	66.7	0.005	0.1	LOS A	0.0	0.2	0.09	0.00	58.2
3	R	1	0.0	0.005	8.9	LOS A	0.0	0.2	0.09	1.08	48.3
Approach		7	57.1	0.005	1.3	NA	0.0	0.2	0.09	0.15	56.5
North: Tooheys Rd (N)											
7	L	5	80.0	0.014	11.8	LOS A	0.0	0.0	0.00	1.07	49.0
8	T	13	66.7	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		18	70.6	0.014	3.5	NA	0.0	0.0	0.00	0.31	56.3
West: Mwy Link ramp (W)											
10	L	11	90.0	0.034	12.4	LOS A	0.1	0.8	0.08	0.62	48.6
11	T	1	0.0	0.002	7.1	LOS A	0.0	0.1	0.12	0.52	49.6
12	R	1	0.0	0.002	9.1	LOS A	0.0	0.1	0.12	0.72	47.8
Approach		13	75.0	0.034	11.7	LOS A	0.1	0.8	0.09	0.62	48.6
All Vehicles		38	69.4	0.034	5.8	NA	0.1	0.8	0.05	0.39	53.5

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	7	57.1	0.006	0.1	LOS A	0.0	0.3	0.11	0.00	57.7
3	R	1	0.0	0.006	9.0	LOS A	0.0	0.3	0.11	1.08	48.3
Approach		8	50.0	0.006	1.2	LOS A	0.0	0.3	0.11	0.13	56.3
North: Tooheys Rd (N)											
7	L	11	50.0	0.022	10.4	LOS A	0.0	0.0	0.00	1.00	49.0
8	T	23	31.8	0.022	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		34	37.5	0.022	3.3	LOS A	0.0	0.0	0.00	0.31	56.1
West: Mwy Link ramp (W)											
10	L	12	90.9	0.038	12.5	LOS A	0.1	1.1	0.09	0.62	48.6
11	T	6	0.0	0.008	7.3	LOS A	0.0	0.3	0.17	0.54	49.4
12	R	1	0.0	0.008	9.3	LOS A	0.0	0.3	0.17	0.74	47.8
Approach		19	55.6	0.038	10.6	LOS A	0.1	1.1	0.12	0.60	48.8
All Vehicles		61	44.8	0.038	5.2	NA	0.1	1.1	0.05	0.38	53.6

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.010	7.1	LOS A	0.0	0.5	0.10	0.50	49.6
6	R	6	66.7	0.010	12.6	LOS A	0.0	0.5	0.10	0.71	47.8
Approach		7	57.1	0.010	11.8	LOS A	0.0	0.5	0.10	0.68	48.0
North: Tooheys Rd (N)											
9	R	13	66.7	0.010	12.3	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		13	66.7	0.010	12.3	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		20	63.2	0.010	12.1	NA	0.0	0.5	0.04	0.71	48.1

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.011	7.2	LOS A	0.0	0.5	0.12	0.50	49.5
6	R	7	57.1	0.011	12.1	LOS A	0.0	0.5	0.12	0.70	47.7
Approach		8	50.0	0.011	11.5	LOS A	0.0	0.5	0.12	0.67	47.9
North: Tooheys Rd (N)											
9	R	22	33.3	0.015	10.6	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		22	33.3	0.015	10.6	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		31	37.9	0.015	10.8	NA	0.0	0.5	0.03	0.71	48.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM 6-7

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	32	10.0	0.110	11.5	LOS A	0.0	0.0	0.00	1.33	59.3
22	T	174	4.2	0.110	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		205	5.1	0.110	1.8	NA	0.0	0.0	0.00	0.20	76.0
North West: Hue Hue Rd (NW)											
28	T	332	5.1	0.225	1.5	LOS A	1.7	12.7	0.43	0.00	65.7
29	R	47	0.0	0.225	12.9	LOS A	1.7	12.7	0.43	1.13	60.0
Approach		379	4.4	0.225	2.9	NA	1.7	12.7	0.43	0.14	64.9
West: Jilliby Rd (W)											
10	L	36	8.8	0.326	25.6	LOS B	1.5	10.9	0.60	0.87	45.4
12	R	77	5.5	0.326	23.8	LOS B	1.5	10.9	0.60	1.03	46.4
Approach		113	6.5	0.326	24.4	LOS B	1.5	10.9	0.60	0.98	46.1
All Vehicles		697	5.0	0.326	6.0	NA	1.7	12.7	0.33	0.30	63.5

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM 3-4

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	89	7.1	0.262	11.2	LOS A	0.0	0.0	0.00	1.27	59.3
22	T	403	3.7	0.262	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		493	4.3	0.262	2.0	NA	0.0	0.0	0.00	0.23	75.3
North West: Hue Hue Rd (NW)											
28	T	259	6.5	0.201	4.4	LOS A	2.0	14.5	0.65	0.00	60.2
29	R	40	7.9	0.201	16.5	LOS B	2.0	14.5	0.65	1.16	57.6
Approach		299	6.7	0.201	6.0	NA	2.0	14.5	0.65	0.16	59.9
West: Jilliby Rd (W)											
10	L	63	6.7	0.794	52.9	LOS D	6.2	44.6	0.89	1.40	30.3
12	R	124	2.5	0.794	50.9	LOS D	6.2	44.6	0.89	1.30	30.6
Approach		187	3.9	0.794	51.6	LOS D	6.2	44.6	0.89	1.33	30.5
All Vehicles		979	4.9	0.794	12.7	NA	6.2	44.6	0.37	0.42	55.6

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM 6-7

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	35	0.0	0.040	10.1	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	37	20.0	0.040	12.1	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		72	10.3	0.040	11.1	NA	0.0	0.0	0.00	0.72	58.4
North: Jilliby Rd (N)											
8	T	4	75.0	0.032	13.7	LOS A	0.1	1.1	0.17	0.56	56.5
9	R	48	6.5	0.032	11.4	LOS A	0.1	1.1	0.17	0.68	58.4
Approach		53	12.0	0.032	11.6	NA	0.1	1.1	0.17	0.67	58.3
South West: Little Jilliby Rd (SW)											
30	L	1	100.0	0.010	14.9	LOS B	0.0	0.3	0.21	0.64	47.1
32	R	7	0.0	0.010	8.4	LOS A	0.0	0.3	0.21	0.63	45.4
Approach		8	12.5	0.010	9.2	LOS A	0.0	0.3	0.21	0.63	45.7
All Vehicles		133	11.1	0.040	11.2	NA	0.1	1.1	0.08	0.69	57.2

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM 6-7

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	20	15.8	0.055	10.8	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	80	6.6	0.055	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		100	8.4	0.055	11.0	NA	0.0	0.0	0.00	0.72	59.1
North: Jilliby Rd (N)											
8	T	4	0.0	0.042	10.1	LOS A	0.2	1.4	0.21	0.55	56.2
9	R	64	6.6	0.042	11.5	LOS A	0.2	1.4	0.21	0.67	58.2
Approach		68	6.2	0.042	11.4	NA	0.2	1.4	0.21	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.064	8.5	LOS A	0.2	1.6	0.26	0.61	45.3
32	R	52	2.0	0.064	8.8	LOS A	0.2	1.6	0.26	0.66	45.2
Approach		57	1.9	0.064	8.7	LOS A	0.2	1.6	0.26	0.65	45.2
All Vehicles		225	6.1	0.064	10.5	NA	0.2	1.6	0.13	0.69	54.5

TOTAL TRAFFIC PEAK

Year 2015 No-Project traffic conditions

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	45	27.9	0.088	16.5	LOS B	0.3	2.9	0.29	0.94	49.9
3	R	454	8.6	0.996	91.7	LOS F	15.0	112.6	1.00	1.17	18.5
Approach		499	10.3	0.996	84.9	LOS F	15.0	112.6	0.94	1.15	19.6
East: Sparks Rd (E)											
5	T	338	1.0	0.351	6.8	LOS A	6.0	42.4	0.49	0.43	55.1
6	R	292	17.5	1.021	108.5	LOS F	21.3	171.2	1.00	1.23	16.3
Approach		629	9.0	1.021	53.9	LOS D	21.3	171.2	0.72	0.80	26.4
West: Sparks Rd (W)											
10	L	84	8.8	0.215	32.1	LOS C	2.5	18.7	0.77	0.77	35.8
11	T	295	8.9	0.512	24.6	LOS B	9.6	72.1	0.87	0.74	37.9
Approach		379	8.9	0.512	26.3	LOS B	9.6	72.1	0.85	0.74	37.4
All Vehicles		1507	9.4	1.021	57.2	LOS E	21.3	171.2	0.83	0.90	25.4

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	109	9.6	0.149	14.7	LOS B	0.7	5.4	0.28	0.95	50.2
3	R	704	3.4	0.926	62.0	LOS E	18.9	135.9	1.00	1.05	24.2
Approach		814	4.3	0.926	55.6	LOS D	18.9	135.9	0.90	1.04	26.1
East: Sparks Rd (E)											
5	T	177	13.1	0.238	10.3	LOS A	3.6	27.9	0.56	0.47	50.7
6	R	294	7.9	0.896	57.2	LOS E	14.3	107.2	1.00	1.02	25.6
Approach		471	9.8	0.896	39.6	LOS C	14.3	107.2	0.84	0.81	31.5
West: Sparks Rd (W)											
10	L	153	4.1	0.657	44.6	LOS D	5.9	42.6	0.98	0.85	30.0
11	T	180	10.5	0.549	32.6	LOS C	6.5	49.5	0.96	0.78	33.3
Approach		333	7.6	0.657	38.1	LOS C	6.5	49.5	0.97	0.81	31.7
All Vehicles		1617	6.6	0.926	47.3	LOS D	18.9	135.9	0.90	0.93	28.6

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	718	6.0	0.403	9.7	X	X	X	X	0.65	54.5
5	T	408	9.8	0.223	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1126	7.4	0.403	6.2	NA	0.0	0.0	0.00	0.41	59.3
North East: Median (Right Turn Stage 2)											
26	R	221	7.6	0.537	20.8	LOS B	3.4	25.5	0.71	1.03	43.1
Approach		221	7.6	0.537	20.8	LOS B	3.4	25.5	0.71	1.03	43.1
North: SYD-NCL Fwy ramps (N)											
7	L	319	8.3	0.182	9.8	X	X	X	X	0.65	54.6
9	R	221	7.6	0.497	22.6	LOS B	2.6	19.1	0.76	1.10	43.0
Approach		540	8.0	0.497	15.0	LOS B	2.6	19.1	0.31	0.84	49.2
West: Sparks Rd (W)											
11	T	627	8.7	0.340	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	121	8.7	0.300	18.8	LOS B	1.3	10.0	0.63	0.94	45.0
Approach		748	8.7	0.340	3.0	NA	1.3	10.0	0.10	0.15	64.3
All Vehicles		2636	7.9	0.537	8.3	NA	3.4	25.5	0.15	0.48	56.4

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	426	12.1	0.249	10.0	X	X	X	X	0.65	54.6
5	T	460	10.5	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		886	11.3	0.252	4.8	NA	0.0	0.0	0.00	0.31	61.6
North East: Median (Right Turn Stage 2)											
26	R	113	15.0	0.357	23.7	LOS B	1.6	12.9	0.71	0.96	45.8
Approach		113	15.0	0.357	23.7	LOS B	1.6	12.9	0.71	0.96	45.8
North: SYD-NCL Fwy ramps (N)											
7	L	289	13.1	0.170	10.0	X	X	X	X	0.65	54.6
9	R	113	15.0	0.318	23.7	LOS B	1.3	10.0	0.75	1.04	42.7
Approach		402	13.6	0.318	13.8	LOS A	1.3	10.0	0.21	0.76	50.7
West: Sparks Rd (W)											
11	T	733	6.5	0.391	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	80	9.2	0.228	19.7	LOS B	0.9	6.7	0.65	0.92	44.3
Approach		813	6.7	0.391	1.9	NA	0.9	6.7	0.06	0.09	66.3
All Vehicles		2214	10.2	0.391	6.3	NA	1.6	12.9	0.10	0.34	59.7

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	29	10.7	0.016	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	245	3.9	0.289	12.4	LOS A	1.1	7.6	0.33	0.74	57.2
Approach		275	4.6	0.289	11.1	NA	1.1	7.6	0.29	0.66	59.1
East: Sparks Rd (E)											
4	L	313	1.0	0.481	11.6	LOS A	1.5	10.5	0.37	0.69	53.4
6	R	53	18.0	0.091	14.5	LOS B	0.3	2.2	0.43	0.79	51.9
Approach		365	3.5	0.481	12.1	LOS A	1.5	10.5	0.38	0.71	53.2
North: Hue Hue Rd (N)											
7	L	126	19.2	0.077	12.4	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	58	1.8	0.030	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		184	13.7	0.077	8.5	NA	0.0	0.0	0.00	0.50	64.3
All Vehicles		824	6.1	0.481	10.9	NA	1.5	10.5	0.27	0.64	57.3

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	83	3.8	0.044	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	239	4.4	0.267	12.1	LOS A	1.0	7.0	0.27	0.71	57.5
Approach		322	4.2	0.267	9.0	NA	1.0	7.0	0.20	0.53	62.1
East: Sparks Rd (E)											
4	L	183	4.6	0.283	11.1	LOS A	0.7	4.8	0.21	0.68	54.2
6	R	102	24.7	0.341	23.8	LOS B	1.5	13.1	0.65	0.96	43.7
Approach		285	11.8	0.341	15.7	LOS B	1.5	13.1	0.37	0.78	49.9
North: Hue Hue Rd (N)											
7	L	94	15.7	0.056	12.1	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	35	24.2	0.021	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		128	18.0	0.056	8.8	NA	0.0	0.0	0.00	0.53	63.5
All Vehicles		736	9.6	0.341	11.5	NA	1.5	13.1	0.23	0.63	57.0

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	71	6.0	0.040	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	259	6.5	0.138	7.9	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		329	6.4	0.138	8.0	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	197	3.2	0.103	8.0	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	76	2.8	0.092	10.4	LOS A	0.3	2.4	0.42	0.72	46.7
Approach		273	3.1	0.103	8.7	NA	0.3	2.4	0.12	0.68	48.5
South West: Hue Hue Rd (SW)											
30	L	53	20.0	0.105	11.2	LOS A	0.3	2.1	0.41	0.70	46.7
32	R	35	6.1	0.096	15.8	LOS B	0.3	2.6	0.62	0.86	42.0
Approach		87	14.5	0.105	13.0	LOS A	0.3	2.6	0.49	0.76	44.7
All Vehicles		689	6.1	0.138	8.9	NA	0.3	2.6	0.11	0.68	48.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	64	0.0	0.035	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	289	1.5	0.150	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		354	1.2	0.150	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	473	6.0	0.252	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	69	1.5	0.085	10.4	LOS A	0.3	2.2	0.42	0.72	46.7
Approach		542	5.4	0.252	8.4	NA	0.3	2.2	0.05	0.67	48.9
South West: Hue Hue Rd (SW)											
30	L	33	6.5	0.054	10.2	LOS A	0.1	1.0	0.39	0.68	47.1
32	R	73	1.4	0.340	27.6	LOS B	1.4	9.6	0.83	0.99	34.0
Approach		105	3.0	0.340	22.2	LOS B	1.4	9.6	0.69	0.89	37.3
All Vehicles		1001	3.7	0.340	9.6	NA	1.4	9.6	0.10	0.69	47.5

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	5	0.0	0.003	0.0	LOS A	0.0	0.1	0.03	0.00	59.5
3	R	1	0.0	0.003	8.9	LOS A	0.0	0.1	0.03	1.12	48.2
Approach		6	0.0	0.003	1.5	NA	0.0	0.1	0.03	0.19	57.2
North: Tooheys Rd (N)											
7	L	1	0.0	0.002	8.2	LOS A	0.0	0.0	0.00	0.89	49.0
8	T	2	0.0	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		3	0.0	0.002	2.7	NA	0.0	0.0	0.00	0.30	55.8
West: Mwy Link ramp (W)											
10	L	4	25.0	0.007	9.3	LOS A	0.0	0.1	0.04	0.64	48.8
11	T	1	0.0	0.002	7.0	LOS A	0.0	0.1	0.05	0.53	50.0
12	R	1	0.0	0.002	9.0	LOS A	0.0	0.1	0.05	0.75	47.9
Approach		6	16.7	0.007	8.9	LOS A	0.0	0.1	0.05	0.64	48.8
All Vehicles		16	6.7	0.007	4.7	NA	0.0	0.1	0.03	0.39	53.3

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	0.0	0.002	0.0	LOS A	0.0	0.1	0.03	0.00	59.4
3	R	1	0.0	0.002	8.9	LOS A	0.0	0.1	0.03	1.06	48.2
Approach		4	0.0	0.002	2.2	NA	0.0	0.1	0.03	0.26	56.2
North: Tooheys Rd (N)											
7	L	1	0.0	0.002	8.2	LOS A	0.0	0.0	0.00	0.89	49.0
8	T	2	0.0	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		3	0.0	0.002	2.7	NA	0.0	0.0	0.00	0.30	55.8
West: Mwy Link ramp (W)											
10	L	1	0.0	0.001	8.2	LOS A	0.0	0.0	0.03	0.65	48.8
11	T	2	0.0	0.003	7.0	LOS A	0.0	0.1	0.05	0.55	50.1
12	R	1	0.0	0.003	9.0	LOS A	0.0	0.1	0.05	0.78	48.0
Approach		4	0.0	0.003	7.8	LOS A	0.0	0.1	0.04	0.63	49.2
All Vehicles		12	0.0	0.003	4.4	NA	0.0	0.1	0.02	0.41	53.3

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	5	80.0	0.013	10.8	LOS A	0.1	0.5	0.14	0.51	49.5
6	R	3	v3.3	0.013	11.1	LOS A	0.1	0.5	0.14	0.74	47.8
Approach		8	62.5	0.013	10.9	LOS A	0.1	0.5	0.14	0.60	48.8
North: Tooheys Rd (N)											
9	R	22	19.0	0.014	9.8	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		22	19.0	0.014	9.8	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		31	31.0	0.014	10.1	NA	0.1	0.5	0.04	0.69	48.4

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.004	6.9	LOS A	0.0	0.1	0.02	0.53	50.2
6	R	3	0.0	0.004	8.9	LOS A	0.0	0.1	0.02	0.74	48.0
Approach		4	0.0	0.004	8.4	LOS A	0.0	0.1	0.02	0.69	48.5
North: Tooheys Rd (N)											
9	R	2	0.0	0.001	8.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		2	0.0	0.001	8.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		6	0.0	0.004	8.6	NA	0.0	0.1	0.01	0.70	48.4

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	53	8.0	0.111	11.3	LOS A	0.0	0.0	0.00	1.18	59.3
22	T	149	8.5	0.111	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		202	8.3	0.111	2.9	NA	0.0	0.0	0.00	0.31	73.4
North West: Hue Hue Rd (NW)											
28	T	403	0.8	0.241	1.5	LOS A	2.0	14.3	0.46	0.00	65.4
29	R	32	3.3	0.241	13.2	LOS A	2.0	14.3	0.46	1.19	60.4
Approach		435	1.0	0.241	2.4	NA	2.0	14.3	0.46	0.09	65.0
West: Jilliby Rd (W)											
10	L	36	8.8	0.456	30.3	LOS C	2.4	17.1	0.67	0.92	41.9
12	R	103	0.0	0.456	27.8	LOS B	2.4	17.1	0.67	1.07	42.7
Approach		139	2.3	0.456	28.5	LOS B	2.4	17.1	0.67	1.03	42.5
All Vehicles		776	3.1	0.456	7.2	NA	2.4	17.1	0.38	0.31	61.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	89	2.4	0.228	10.8	LOS A	0.0	0.0	0.00	1.20	59.3
22	T	344	2.1	0.228	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		434	2.2	0.228	2.2	NA	0.0	0.0	0.00	0.25	74.7
North West: Hue Hue Rd (NW)											
28	T	205	2.1	0.158	3.6	LOS A	1.4	10.4	0.60	0.00	61.4
29	R	34	12.5	0.158	16.1	LOS B	1.4	10.4	0.60	1.16	58.2
Approach		239	3.5	0.158	5.4	NA	1.4	10.4	0.60	0.16	61.0
West: Jilliby Rd (W)											
10	L	19	11.1	0.249	27.3	LOS B	1.0	7.1	0.70	0.97	44.3
12	R	53	2.0	0.249	24.9	LOS B	1.0	7.1	0.70	1.02	45.3
Approach		72	4.4	0.249	25.5	LOS B	1.0	7.1	0.70	1.00	45.0
All Vehicles		744	2.8	0.249	5.5	NA	1.4	10.4	0.26	0.29	65.8

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	12	9.1	0.024	10.5	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	33	6.5	0.024	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		44	7.1	0.024	10.9	NA	0.0	0.0	0.00	0.72	58.9
North: Jilliby Rd (N)											
8	T	3	0.0	0.047	9.9	LOS A	0.2	1.6	0.13	0.60	56.7
9	R	77	6.8	0.047	11.4	LOS A	0.2	1.6	0.13	0.69	58.6
Approach		80	6.6	0.047	11.3	NA	0.2	1.6	0.13	0.68	58.5
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.021	8.1	LOS A	0.1	0.5	0.17	0.60	45.6
32	R	16	6.7	0.021	8.7	LOS A	0.1	0.5	0.17	0.65	45.5
Approach		20	5.3	0.021	8.6	LOS A	0.1	0.5	0.17	0.64	45.5
All Vehicles		144	6.6	0.047	10.8	NA	0.2	1.6	0.10	0.69	56.4

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	16	13.3	0.042	10.7	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	61	6.9	0.042	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		77	8.2	0.042	11.0	NA	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.032	10.0	LOS A	0.1	1.1	0.18	0.57	56.4
9	R	49	6.4	0.032	11.4	LOS A	0.1	1.1	0.18	0.67	58.4
Approach		53	6.0	0.032	11.3	NA	0.1	1.1	0.18	0.67	58.3
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.025	8.2	LOS A	0.1	0.6	0.21	0.60	45.5
32	R	20	5.3	0.025	8.7	LOS A	0.1	0.6	0.21	0.64	45.4
Approach		24	4.3	0.025	8.6	LOS A	0.1	0.6	0.21	0.64	45.4
All Vehicles		154	6.8	0.042	10.7	NA	0.1	1.1	0.09	0.69	56.1

Traffic conditions for the construction phase in 2015

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	46	27.3	0.091	16.7	LOS B	0.6	5.0	0.30	0.93	49.7
3	R	454	8.6	0.996	91.7	LOS F	16.3	122.3	1.00	1.17	18.5
Approach		500	10.3	0.996	84.8	LOS F	16.3	122.3	0.94	1.15	19.6
East: Sparks Rd (E)											
5	T	352	1.6	0.370	6.9	LOS A	8.0	57.4	0.49	0.43	54.8
6	R	291	18.0	1.021	108.4	LOS F	22.0	177.7	1.00	1.23	16.3
Approach		643	9.7	1.021	52.8	LOS D	22.0	177.7	0.72	0.80	26.7
West: Sparks Rd (W)											
10	L	86	9.8	0.222	32.3	LOS C	3.7	27.8	0.78	0.77	35.8
11	T	298	9.2	0.518	24.7	LOS B	11.3	85.7	0.87	0.74	37.8
Approach		384	9.3	0.518	26.4	LOS B	11.3	85.7	0.85	0.75	37.3
All Vehicles		1527	9.8	1.021	56.6	LOS E	22.0	177.7	0.82	0.90	25.5

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	111	9.5	0.151	14.7	LOS B	1.1	8.5	0.28	0.95	50.2
3	R	704	3.4	0.926	62.0	LOS E	19.8	142.9	1.00	1.05	24.2
Approach		815	4.3	0.926	55.5	LOS D	19.8	142.9	0.90	1.04	26.1
East: Sparks Rd (E)											
5	T	181	14.0	0.245	10.3	LOS A	5.1	39.6	0.56	0.48	50.7
6	R	302	8.4	0.925	63.6	LOS E	17.1	128.0	1.00	1.06	23.9
Approach		483	10.5	0.925	43.7	LOS D	17.1	128.0	0.84	0.84	29.9
West: Sparks Rd (W)											
10	L	155	4.8	0.669	45.0	LOS D	7.7	55.8	0.98	0.86	29.9
11	T	183	10.9	0.560	32.7	LOS C	8.3	63.6	0.96	0.78	33.3
Approach		338	8.1	0.669	38.3	LOS C	8.3	63.6	0.97	0.82	31.6
All Vehicles		1636	6.9	0.926	48.5	LOS D	19.8	142.9	0.90	0.93	28.2

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	718	6.0	0.403	9.7	X	X	X	X	0.65	54.5
5	T	413	10.2	0.226	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1131	7.5	0.403	6.2	LOS A	0.0	0.0	0.00	0.41	59.3
North East: Median (Right Turn Stage 2)											
26	R	231	8.7	0.578	22.2	LOS B	4.7	35.6	0.74	1.06	42.0
Approach		231	8.7	0.578	22.2	LOS B	4.7	35.6	0.74	1.06	42.0
North: SYD-NCL Fwy ramps (N)											
7	L	322	8.5	0.184	9.8	X	X	X	X	0.65	54.6
9	R	231	8.7	0.532	23.6	LOS B	3.5	26.3	0.78	1.12	42.3
Approach		553	8.6	0.532	15.5	LOS B	3.5	26.3	0.33	0.85	48.8
West: Sparks Rd (W)											
11	T	629	8.9	0.341	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	122	8.6	0.306	19.0	LOS B	1.7	12.8	0.63	0.94	44.8
Approach		752	8.8	0.341	3.1	LOS A	1.7	12.8	0.10	0.15	64.2
All Vehicles		2665	8.2	0.578	8.6	NA	4.7	35.6	0.16	0.49	56.1

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	426	12.1	0.249	10.0	X	X	X	X	0.65	54.6
5	T	464	10.9	0.255	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		891	11.5	0.255	4.8	LOS A	0.0	0.0	0.00	0.31	61.7
North East: Median (Right Turn Stage 2)											
26	R	121	15.7	0.394	24.9	LOS B	2.3	18.5	0.73	0.98	44.8
Approach		121	15.7	0.394	24.9	LOS B	2.3	18.5	0.73	0.98	44.8
North: SYD-NCL Fwy ramps (N)											
7	L	293	13.3	0.173	10.0	X	X	X	X	0.65	54.6
9	R	121	15.7	0.349	24.4	LOS B	1.8	14.2	0.77	1.05	42.2
Approach		414	14.0	0.349	14.2	LOS A	1.8	14.2	0.22	0.77	50.3
West: Sparks Rd (W)											
11	T	735	6.6	0.393	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	81	9.1	0.234	19.9	LOS B	1.1	8.6	0.66	0.93	44.1
Approach		816	6.8	0.393	2.0	LOS A	1.1	8.6	0.07	0.09	66.2
All Vehicles		2241	10.5	0.394	6.6	NA	2.3	18.5	0.10	0.35	59.4

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	29	10.7	0.016	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	245	3.9	0.292	12.5	LOS A	1.3	9.6	0.34	0.74	57.1
Approach		275	4.6	0.292	11.2	LOS A	1.3	9.6	0.30	0.66	59.0
East: Sparks Rd (E)											
4	L	313	1.0	0.482	11.7	LOS A	1.9	13.4	0.37	0.70	53.4
6	R	59	21.4	0.107	15.1	LOS B	0.4	3.4	0.44	0.81	51.5
Approach		372	4.2	0.482	12.2	LOS A	1.9	13.4	0.38	0.71	53.1
North: Hue Hue Rd (N)											
7	L	134	20.5	0.083	12.5	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	58	1.8	0.030	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		192	14.8	0.083	8.7	LOS A	0.0	0.0	0.00	0.51	64.1
All Vehicles		838	6.8	0.482	11.1	NA	1.9	13.4	0.27	0.65	57.2

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM

Sparks Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		rop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	83	3.8	0.044	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	239	4.4	0.269	12.2	LOS A	1.2	8.8	0.28	0.72	57.5
Approach		322	4.2	0.269	9.0	LOS A	1.2	8.8	0.21	0.53	62.1
East: Sparks Rd (E)											
4	L	183	4.6	0.284	11.1	LOS A	0.8	6.0	0.21	0.68	54.2
6	R	108	26.2	0.374	25.0	LOS B	2.2	18.8	0.67	0.97	42.9
Approach		292	12.6	0.374	16.3	LOS B	2.2	18.8	0.38	0.79	49.4
North: Hue Hue Rd (N)											
7	L	100	17.9	0.061	12.3	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	35	24.2	0.021	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		135	19.5	0.061	9.1	LOS A	0.0	0.0	0.00	0.54	63.3
All Vehicles		748	10.3	0.374	11.9	NA	2.2	18.8	0.24	0.63	56.6

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	71	6.0	0.040	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	259	6.5	0.138	7.9	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		329	6.4	0.138	8.0	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	197	3.2	0.103	8.0	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	77	2.7	0.094	10.4	LOS A	0.4	3.1	0.42	0.72	46.7
Approach		274	3.1	0.103	8.7	LOS A	0.4	3.1	0.12	0.68	48.5
South West: Hue Hue Rd (SW)											
30	L	54	19.6	0.107	11.2	LOS A	0.3	2.7	0.41	0.70	46.7
32	R	35	6.1	0.096	15.8	LOS B	0.4	3.2	0.62	0.86	41.9
Approach		88	14.3	0.107	13.0	LOS A	0.4	3.2	0.49	0.76	44.7
All Vehicles		692	6.1	0.138	8.9	NA	0.4	3.2	0.11	0.68	48.4

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	64	0.0	0.035	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	289	1.5	0.150	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		354	1.2	0.150	7.7	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	473	6.0	0.252	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	71	1.5	0.087	10.4	LOS A	0.4	2.8	0.42	0.72	46.7
Approach		543	5.4	0.252	8.4	LOS A	0.4	2.8	0.06	0.67	48.9
South West: Hue Hue Rd (SW)											
30	L	34	6.3	0.056	10.2	LOS A	0.2	1.3	0.39	0.68	47.2
32	R	73	1.4	0.341	27.6	LOS B	1.7	11.9	0.83	0.99	34.0
Approach		106	3.0	0.340	22.1	LOS B	1.7	11.9	0.69	0.89	37.3
All Vehicles		1003	3.7	0.340	9.6	NA	1.7	11.9	0.10	0.69	47.5

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	5	0.0	0.003	0.0	LOS A	0.0	0.1	0.06	0.00	58.7
3	R	1	0.0	0.003	8.9	LOS A	0.0	0.1	0.06	1.09	48.2
Approach		6	0.0	0.003	1.5	NA	0.0	0.1	0.06	0.18	56.7
North: Tooheys Rd (N)											
7	L	1	0.0	0.007	8.2	LOS A	0.0	0.0	0.00	1.04	49.0
8	T	13	0.0	0.007	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		14	0.0	0.007	0.6	NA	0.0	0.0	0.00	0.08	59.0
West: Mwy Link ramp (W)											
10	L	275	0.4	0.348	8.9	LOS A	1.0	7.3	1.00	0.15	44.8
11	T	1	0.0	0.002	7.0	LOS A	0.0	0.1	0.08	0.52	49.8
12	R	1	0.0	0.002	9.0	LOS A	0.0	0.1	0.08	0.74	47.9
Approach		277	0.4	0.348	8.9	LOS A	1.0	7.3	0.99	0.15	44.9
All Vehicles		297	0.4	0.348	8.3	NA	1.0	7.3	0.93	0.15	45.6

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	0.0	0.002	0.8	LOS A	0.0	0.1	0.35	0.00	53.1
3	R	1	0.0	0.002	9.7	LOS A	0.0	0.1	0.35	0.85	48.4
Approach		4	0.0	0.002	3.0	NA	0.0	0.1	0.35	0.21	51.8
North: Tooheys Rd (N)											
7	L	1	0.0	0.140	8.2	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	273	0.0	0.140	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		274	0.0	0.140	0.0	NA	0.0	0.0	0.00	0.00	59.9
West: Mwy Link ramp (W)											
10	L	1	0.0	0.001	8.2	LOS A	0.0	0.0	0.03	0.65	48.8
11	T	2	0.0	0.004	8.9	LOS A	0.0	0.1	0.40	0.56	48.0
12	R	1	0.0	0.004	10.9	LOS A	0.0	0.1	0.40	0.69	46.5
Approach		4	0.0	0.004	9.2	LOS A	0.0	0.1	0.31	0.61	47.8
All Vehicles		282	0.0	0.140	0.2	NA	0.0	0.1	0.01	0.02	59.6

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	5	80.0	0.015	11.0	LOS A	0.1	0.8	0.17	0.51	49.3
6	R	4	50.0	0.015	12.1	LOS A	0.1	0.8	0.17	0.73	47.6
Approach		9	66.7	0.015	11.5	LOS A	0.1	0.8	0.17	0.61	48.5
North: Tooheys Rd (N)											
9	R	32	23.3	0.020	10.1	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		32	23.3	0.020	10.1	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		41	33.3	0.020	10.4	NA	0.1	0.8	0.04	0.70	48.2

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.005	8.5	LOS A	0.0	0.1	0.38	0.55	47.9
6	R	3	0.0	0.005	10.5	LOS A	0.0	0.1	0.38	0.68	46.6
Approach		4	0.0	0.005	10.0	LOS A	0.0	0.1	0.38	0.64	46.9
North: Tooheys Rd (N)											
9	R	273	0.0	0.147	8.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		273	0.0	0.147	8.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		277	0.0	0.147	8.9	NA	0.0	0.1	0.01	0.73	48.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	53	8.0	0.111	11.3	LOS A	0.0	0.0	0.00	1.18	59.3
22	T	149	8.5	0.111	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		202	8.3	0.111	2.9	LOS A	0.0	0.0	0.00	0.31	73.4
North West: Hue Hue Rd (NW)											
28	T	403	0.8	0.241	1.5	LOS A	2.5	17.7	0.46	0.00	65.4
29	R	32	3.3	0.241	13.2	LOS A	2.5	17.7	0.46	1.19	60.4
Approach		435	1.0	0.241	2.4	LOS A	2.5	17.7	0.46	0.09	65.0
West: Jilliby Rd (W)											
10	L	36	8.8	0.459	30.3	LOS C	3.0	21.1	0.67	0.92	41.9
12	R	103	0.0	0.456	27.8	LOS B	3.0	21.1	0.67	1.07	42.7
Approach		139	2.3	0.456	28.5	LOS B	3.0	21.1	0.67	1.03	42.5
All Vehicles		776	3.1	0.456	7.2	NA	3.0	21.1	0.38	0.31	61.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	89	2.4	0.228	10.8	LOS A	0.0	0.0	0.00	1.20	59.3
22	T	344	2.1	0.228	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		434	2.2	0.228	2.2	LOS A	0.0	0.0	0.00	0.25	74.7
North West: Hue Hue Rd (NW)											
28	T	205	2.1	0.158	3.6	LOS A	1.8	13.0	0.60	0.00	61.4
29	R	34	12.5	0.157	16.1	LOS B	1.8	13.0	0.60	1.16	58.2
Approach		239	3.5	0.158	5.4	LOS A	1.8	13.0	0.60	0.16	61.0
West: Jilliby Rd (W)											
10	L	19	11.1	0.249	27.3	LOS B	1.2	8.8	0.70	0.97	44.3
12	R	53	2.0	0.249	24.9	LOS B	1.2	8.8	0.70	1.02	45.3
Approach		72	4.4	0.249	25.5	LOS B	1.2	8.8	0.70	1.00	45.0
All Vehicles		744	2.8	0.249	5.5	NA	1.8	13.0	0.26	0.29	65.8

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	12	9.1	0.027	10.5	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	36	14.7	0.027	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		47	13.3	0.027	11.4	LOS A	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.047	9.9	LOS A	0.3	2.0	0.14	0.60	56.7
9	R	77	6.8	0.047	11.4	LOS A	0.3	2.0	0.14	0.68	58.6
Approach		80	6.6	0.047	11.3	LOS A	0.3	2.0	0.14	0.68	58.5
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.021	8.2	LOS A	0.1	0.7	0.18	0.60	45.5
32	R	16	6.7	0.021	8.8	LOS A	0.1	0.7	0.18	0.65	45.5
Approach		20	5.3	0.021	8.6	LOS A	0.1	0.7	0.18	0.64	45.5
All Vehicles		147	8.6	0.047	11.0	NA	0.3	2.0	0.10	0.69	56.4

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	16	13.3	0.042	10.7	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	61	6.9	0.042	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		77	8.2	0.042	11.0	LOS A	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	3	0.0	0.032	10.0	LOS A	0.2	1.3	0.18	0.57	56.4
9	R	49	6.4	0.032	11.4	LOS A	0.2	1.3	0.18	0.67	58.4
Approach		53	6.0	0.032	11.3	LOS A	0.2	1.3	0.18	0.67	58.3
South West: Little Jilliby Rd (SW)											
30	L	4	0.0	0.026	8.2	LOS A	0.1	0.8	0.21	0.60	45.5
32	R	20	5.3	0.025	8.7	LOS A	0.1	0.8	0.21	0.64	45.4
Approach		24	4.3	0.025	8.6	LOS A	0.1	0.8	0.21	0.64	45.4
All Vehicles		154	6.8	0.042	10.7	NA	0.2	1.3	0.09	0.69	56.1

Year 2025 No-Project traffic conditions

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	159	15.9	0.418	20.2	LOS B	3.8	30.5	0.54	0.91	45.9
3	R	1153	6.8	3.702	1975.3	LOS F	302.4	2240.9	1.00	3.14	1.1
Approach		1312	7.9	3.702	1738.4	LOS F	302.4	2240.9	0.94	2.87	1.3
East: Sparks Rd (E)											
5	T	1434	3.7	1.631	612.5	LOS F	301.0	2298.7	1.00	3.33	3.6
6	R	296	15.1	1.022	108.6	LOS F	22.4	177.2	1.00	1.23	16.3
Approach		1731	11.4	1.630	526.2	LOS F	301.0	2298.7	1.00	2.97	4.1
West: Sparks Rd (W)											
10	L	124	9.3	0.318	33.1	LOS C	5.2	39.4	0.81	0.79	35.4
11	T	432	7.8	0.744	28.6	LOS C	17.2	128.4	0.96	0.87	35.3
Approach		556	8.1	0.744	29.6	LOS C	17.2	128.4	0.92	0.85	35.3
All Vehicles		3598	9.6	3.702	891.4	LOS F	302.4	2298.7	0.97	2.61	2.5

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	147	10.0	0.243	16.0	LOS B	2.2	16.3	0.37	0.94	49.1
3	R	1714	4.2	3.377	1735.3	LOS F	438.4	3180.6	1.00	3.08	1.3
Approach		1861	4.7	3.378	1599.2	LOS F	438.4	3180.6	0.95	2.91	1.4
East: Sparks Rd (E)											
5	T	554	12.3	0.747	16.9	LOS B	18.4	139.0	0.83	0.77	41.2
6	R	335	6.3	1.011	99.3	LOS F	23.8	176.0	1.00	1.21	17.4
Approach		888	7.9	1.011	47.9	LOS D	23.8	176.0	0.90	0.94	27.3
West: Sparks Rd (W)											
10	L	231	6.8	1.010	97.5	LOS F	16.5	122.4	1.00	1.31	17.9
11	T	426	10.2	1.305	324.6	LOS F	60.4	457.6	1.00	2.32	6.4
Approach		657	8.7	1.305	244.9	LOS F	60.4	457.6	1.00	1.96	8.3
All Vehicles		3406	6.3	3.378	933.4	LOS F	438.4	3180.6	0.95	2.22	2.4

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1722	5.4	0.963	11.3	X	X	X	X	0.63	52.2
5	T	1072	10.0	0.585	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		2794	7.2	0.963	6.9	NA	0.0	0.0	0.00	0.39	57.9
North East: Median (Right Turn Stage 2)											
26	R	660	13.6	11.000	9074.2	LOS F	403.0	3148.6	1.00	4.06	0.3
Approach		660	13.6	11.000	9074.2	LOS F	403.0	3148.6	1.00	4.06	0.3
North: SYD-NCL Fwy ramps (N)											
7	L	721	7.4	0.409	9.8	X	X	X	X	0.65	54.5
9	R	660	13.6	5.500	4097.8	LOS F	352.1	2751.0	1.00	6.27	0.6
Approach		1381	10.4	5.500	1963.4	LOS F	352.1	2751.0	0.48	3.34	1.2
West: Sparks Rd (W)											
11	T	1452	6.8	0.779	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	130	9.2	1.086	155.3	LOS F	11.5	87.0	1.00	1.83	12.2
Approach		1582	7.1	1.086	12.8	NA	11.5	87.0	0.08	0.15	50.6
All Vehicles		6417	8.5	11.000	1362.1	NA	403.0	3148.6	0.23	1.34	1.7

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1063	5.3	0.594	9.7	X	X	X	X	0.65	54.5
5	T	746	8.2	0.403	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1809	6.5	0.594	5.7	NA	0.0	0.0	0.00	0.38	59.9
North East: Median (Right Turn Stage 2)											
26	R	142	7.4	0.849	68.1	LOS E	5.7	42.6	0.97	1.31	24.7
Approach		142	7.4	0.849	68.1	LOS E	5.7	42.6	0.97	1.31	24.7
North: SYD-NCL Fwy ramps (N)											
7	L	822	7.2	0.465	9.8	X	X	X	X	0.65	54.5
9	R	142	7.4	1.184	232.3	LOS F	17.9	133.1	1.00	2.25	8.7
Approach		964	7.2	1.184	42.6	LOS D	17.9	133.1	0.15	0.88	30.9
West: Sparks Rd (W)											
11	T	1910	5.0	1.013	12.1	LOS A	17.1	124.7	1.00	0.00	46.8
12	R	166	7.7	1.000 [3]	115.7	LOS F	11.6	86.7	1.00	1.75	15.5
Approach		2076	5.3	1.013	20.4	NA	17.1	124.7	1.00	0.14	40.4
All Vehicles		4992	6.2	1.184	20.7	NA	17.9	133.1	0.47	0.40	42.1

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	83	10.1	0.045	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	317	3.3	0.407	13.6	LOS A	2.0	14.1	0.44	0.82	55.6
Approach		400	4.7	0.407	10.8	NA	2.0	14.1	0.35	0.65	59.4
South East: Sparks Rd Stage 2 (E)											
23	R	117	13.5	0.139	11.0	LOS A	0.6	4.4	0.24	0.63	54.8
Approach		117	13.5	0.139	11.0	LOS A	0.6	4.4	0.24	0.63	54.8
East: Sparks Rd Stage 1 (E)											
4	L	373	0.8	0.584	13.0	LOS A	2.8	19.5	0.44	0.76	52.1
6	R	117	13.5	0.212	15.1	LOS B	0.7	5.4	0.49	0.86	50.9
Approach		489	3.9	0.584	13.5	LOS A	2.8	19.5	0.46	0.79	51.8
North: Hue Hue Rd (N)											
7	L	187	15.7	0.112	12.1	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	76	2.8	0.040	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		263	12.0	0.112	8.6	NA	0.0	0.0	0.00	0.52	63.8
All Vehicles		1269	6.7	0.584	11.4	NA	2.8	19.5	0.31	0.67	56.6

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	67	3.1	0.035	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	293	6.1	0.336	12.4	LOS A	1.3	9.6	0.31	0.73	57.3
Approach		360	5.6	0.336	10.1	NA	1.3	9.6	0.25	0.59	60.6
South East: Sparks Rd Stage 2 (E)											
23	R	214	11.3	0.241	10.7	LOS A	1.1	8.4	0.23	0.62	54.9
Approach		214	11.3	0.241	10.7	LOS A	1.1	8.4	0.23	0.62	54.9
East: Sparks Rd Stage 1 (E)											
4	L	266	4.0	0.411	11.5	LOS A	1.1	7.7	0.32	0.67	53.7
6	R	214	11.3	0.338	14.7	LOS B	1.4	10.7	0.49	0.88	51.2
Approach		480	7.2	0.411	12.9	LOS A	1.4	10.7	0.40	0.76	52.5
North: Hue Hue Rd (N)											
7	L	103	12.2	0.060	11.9	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	48	8.7	0.026	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		152	11.1	0.060	8.1	NA	0.0	0.0	0.00	0.50	64.4
All Vehicles		1205	7.9	0.411	11.1	NA	1.4	10.7	0.27	0.65	56.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	94	6.7	0.053	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	362	7.3	0.194	8.0	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		456	7.2	0.194	8.0	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	351	7.5	0.189	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	141	3.7	0.204	11.8	LOS A	1.0	7.0	0.53	0.82	45.4
Approach		492	6.4	0.204	9.3	LOS A	1.0	7.0	0.15	0.71	48.1
South West: Hue Hue Rd (SW)											
30	L	79	18.7	0.168	12.4	LOS A	0.6	4.7	0.49	0.78	45.5
32	R	46	6.8	0.253	29.3	LOS C	1.1	8.4	0.84	0.97	33.3
Approach		125	14.3	0.253	18.6	LOS B	1.1	8.4	0.62	0.85	40.1
All Vehicles		1073	7.7	0.253	9.8	NA	1.1	8.4	0.14	0.70	47.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM 3-4

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	84	0.0	0.045	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	379	1.7	0.196	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		463	1.4	0.196	7.7	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	616	6.0	0.328	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	106	1.0	0.152	11.5	LOS A	0.7	5.0	0.51	0.80	45.6
Approach		722	5.2	0.328	8.6	LOS A	0.7	5.0	0.08	0.68	48.7
South West: Hue Hue Rd (SW)											
30	L	84	3.8	0.143	10.9	LOS A	0.5	3.7	0.46	0.75	46.3
32	R	95	1.1	0.783	75.1	LOS F	4.9	34.7	0.97	1.24	19.5
Approach		179	2.4	0.785	44.8	LOS D	4.9	34.7	0.73	1.01	26.8
All Vehicles		1364	3.5	0.785	13.1	NA	4.9	34.7	0.14	0.71	44.2

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	33.3	0.003	0.7	LOS A	0.0	0.1	0.31	0.00	53.9
3	R	1	0.0	0.003	9.5	LOS A	0.0	0.1	0.31	0.88	48.4
Approach		4	25.0	0.003	2.9	NA	0.0	0.1	0.31	0.22	52.4
North: Tooheys Rd (N)											
7	L	1	0.0	0.115	8.2	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	194	22.8	0.115	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		195	22.7	0.115	0.0	NA	0.0	0.0	0.00	0.01	59.9
West: Mwy Link ramp (W)											
10	L	658	19.4	1.000[3]	13.4	LOS A	4.6	37.3	1.00	0.14	44.6
11	T	71	0.0	0.117	9.5	LOS A	0.5	3.7	0.42	0.62	47.2
12	R	2	50.0	0.117	14.1	LOS A	0.5	3.7	0.42	0.79	45.8
Approach		732	19.4	1.000	13.0	LOS A	4.6	37.3	0.94	0.19	44.8
All Vehicles		931	20.1	1.000	10.3	NA	4.6	37.3	0.74	0.15	47.4

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	1	0.0	0.005	5.9	LOS A	0.0	0.1	0.71	0.00	45.9
3	R	2	0.0	0.005	14.7	LOS B	0.0	0.1	0.71	0.80	43.5
Approach		3	0.0	0.005	11.8	NA	0.0	0.1	0.71	0.54	44.3
North: Tooheys Rd (N)											
7	L	11	0.0	0.483	8.2	LOS A	0.0	0.0	0.00	1.08	49.0
8	T	829	18.7	0.483	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		840	18.4	0.483	0.1	NA	0.0	0.0	0.00	0.01	59.8
West: Mwy Link ramp (W)											
10	L	208	18.7	0.322	9.8	LOS A	0.9	7.0	1.00	0.08	44.8
11	T	1	0.0	0.008	19.4	LOS B	0.0	0.2	0.77	0.82	38.7
12	R	1	0.0	0.008	21.4	LOS B	0.0	0.2	0.77	0.85	38.0
Approach		211	18.5	0.322	9.9	LOS A	0.9	7.0	1.00	0.09	44.8
All Vehicles		1054	18.4	0.483	2.1	NA	0.9	7.0	0.20	0.03	56.0

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	6	83.3	0.024	15.5	LOS B	0.1	1.0	0.48	0.64	44.9
6	R	3	33.3	0.024	15.6	LOS B	0.1	1.0	0.48	0.73	43.7
Approach		9	66.7	0.024	15.5	LOS B	0.1	1.0	0.48	0.67	44.5
North: Tooheys Rd (N)											
9	R	187	20.2	0.115	9.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		187	20.2	0.115	9.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		197	22.5	0.115	10.2	NA	0.1	1.0	0.02	0.73	48.0

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.012	25.4	LOS B	0.0	0.3	0.84	0.92	34.9
6	R	1	0.0	0.012	27.4	LOS B	0.0	0.3	0.84	0.93	34.4
Approach		2	0.0	0.012	26.4	LOS B	0.0	0.3	0.84	0.93	34.6
North: Tooheys Rd (N)											
9	R	829	18.7	0.506	9.8	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		829	18.7	0.506	9.8	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		832	18.6	0.506	9.9	NA	0.0	0.3	0.00	0.73	48.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	69	9.1	0.192	11.4	LOS A	0.0	0.0	0.00	1.26	59.3
22	T	282	7.8	0.192	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		352	8.1	0.192	2.3	LOS A	0.0	0.0	0.00	0.25	74.9
North West: Hue Hue Rd (NW)											
28	T	563	0.9	0.345	3.6	LOS A	4.9	34.9	0.69	0.00	59.9
29	R	43	2.4	0.345	15.2	LOS B	4.9	34.9	0.69	1.13	59.6
Approach		606	1.0	0.345	4.4	LOS A	4.9	34.9	0.69	0.08	59.9
West: Jilliby Rd (W)											
10	L	55	7.7	1.273	326.8	LOS F	35.2	250.9	1.00	3.28	6.9
12	R	135	0.0	1.271	324.5	LOS F	35.2	250.9	1.00	2.42	6.9
Approach		189	2.2	1.266	325.2	LOS F	35.2	250.9	1.00	2.67	6.9
All Vehicles		1147	3.4	1.266	56.7	NA	35.2	250.9	0.53	0.56	27.4

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	118	2.7	0.304	10.9	LOS A	0.0	0.0	0.00	1.21	59.3
22	T	459	2.3	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		577	2.4	0.304	2.2	LOS A	0.0	0.0	0.00	0.25	74.8
North West: Hue Hue Rd (NW)											
28	T	276	2.7	0.228	6.3	LOS A	3.2	23.3	0.73	0.00	58.5
29	R	44	14.3	0.228	18.9	LOS B	3.2	23.3	0.73	1.15	55.7
Approach		320	4.3	0.228	8.1	LOS A	3.2	23.3	0.73	0.16	58.1
West: Jilliby Rd (W)											
10	L	24	13.0	0.526	46.1	LOS D	2.9	21.4	0.87	1.12	33.4
12	R	68	1.5	0.526	43.4	LOS D	2.9	21.4	0.87	1.09	33.8
Approach		93	4.5	0.528	44.1	LOS D	2.9	21.4	0.87	1.10	33.7
All Vehicles		989	3.2	0.528	8.0	NA	3.2	23.3	0.32	0.30	62.0

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	14	7.7	0.035	10.5	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	47	15.6	0.035	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		61	13.8	0.035	11.5	LOS A	0.0	0.0	0.00	0.73	59.0
North: Jilliby Rd (N)											
8	T	4	0.0	0.065	10.0	LOS A	0.4	2.8	0.17	0.58	56.5
9	R	103	7.1	0.064	11.5	LOS A	0.4	2.8	0.17	0.68	58.4
Approach		107	6.9	0.064	11.4	LOS A	0.4	2.8	0.17	0.68	58.4
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.026	8.4	LOS A	0.1	0.8	0.21	0.60	45.4
32	R	19	5.6	0.026	8.9	LOS A	0.1	0.8	0.21	0.66	45.3
Approach		24	4.3	0.026	8.8	LOS A	0.1	0.8	0.21	0.64	45.4
All Vehicles		193	8.7	0.064	11.1	NA	0.4	2.8	0.12	0.69	56.5

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	20	15.8	0.056	10.8	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	82	6.4	0.056	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		102	8.2	0.056	10.9	LOS A	0.0	0.0	0.00	0.72	59.1
North: Jilliby Rd (N)											
8	T	4	0.0	0.043	10.1	LOS A	0.2	1.8	0.21	0.55	56.2
9	R	65	6.5	0.043	11.5	LOS A	0.2	1.8	0.21	0.67	58.2
Approach		69	6.1	0.043	11.4	LOS A	0.2	1.8	0.21	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.032	8.4	LOS A	0.1	1.0	0.25	0.60	45.3
32	R	24	4.3	0.032	8.9	LOS A	0.1	1.0	0.25	0.65	45.3
Approach		29	3.6	0.032	8.8	LOS A	0.1	1.0	0.25	0.64	45.3
All Vehicles		201	6.8	0.056	10.8	NA	0.2	1.8	0.11	0.69	56.2

Traffic conditions for the mine operation phase in 2025

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	160	16.4	0.428	20.3	LOS B	2.7	21.8	0.55	0.91	45.9
3	R	1153	6.8	3.702	1975.3	LOS F	302.4	2240.9	1.00	3.14	1.1
Approach		1313	8.0	3.702	1737.0	LOS F	302.4	2240.9	0.94	2.87	1.3
East: Sparks Rd (E)											
5	T	1449	5.1	1.654	634.4	LOS F	309.2	2375.3	1.00	3.39	3.4
6	R	296	15.5	1.022	108.5	LOS F	21.6	171.0	1.00	1.23	16.3
Approach		1744	12.1	1.654	545.2	LOS F	309.2	2375.3	1.00	3.02	4.0
West: Sparks Rd (W)											
10	L	129	13.0	0.340	33.4	LOS C	4.0	31.2	0.81	0.79	35.2
11	T	436	8.7	0.756	29.1	LOS C	16.4	123.0	0.96	0.88	35.1
Approach		565	9.7	0.756	30.1	LOS C	16.4	123.0	0.93	0.86	35.1
All Vehicles		3622	10.2	3.702	896.7	LOS F	309.2	2375.3	0.97	2.63	2.5

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	148	10.6	0.255	16.3	LOS B	1.5	11.7	0.39	0.93	48.9
3	R	1714	4.2	3.378	1735.3	LOS F	438.4	3180.6	1.00	3.08	1.3
Approach		1862	4.7	3.378	1598.3	LOS F	438.4	3180.6	0.95	2.91	1.4
East: Sparks Rd (E)											
5	T	571	15.3	0.779	18.9	LOS B	19.2	146.5	0.86	0.82	39.6
6	R	333	7.2	1.010	99.2	LOS F	23.0	170.9	1.00	1.21	17.4
Approach		903	9.4	1.010	48.5	LOS D	23.0	170.9	0.91	0.96	27.0
West: Sparks Rd (W)											
10	L	228	8.4	1.011	98.4	LOS F	15.2	114.0	1.00	1.31	17.8
11	T	439	11.5	1.356	370.0	LOS F	67.1	514.2	1.00	2.47	5.7
Approach		667	10.1	1.356	277.1	LOS F	67.1	514.2	1.00	2.07	7.4
All Vehicles		3433	7.0	3.378	933.7	LOS F	438.4	3180.6	0.95	2.24	2.4

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1722	5.4	0.963	11.3	X	X	X	X	0.63	52.2
5	T	1079	10.6	0.592	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		2801	7.4	0.963	6.9	NA	0.0	0.0	0.00	0.39	58.0
North East: Median (Right Turn Stage 2)											
26	R	667	14.5	11.123	9183.5	LOS F	407.4	3206.8	1.00	4.09	0.2
Approach		667	14.5	11.123	9183.5	LOS F	407.4	3206.8	1.00	4.09	0.2
North: SYD-NCL Fwy ramps (N)											
7	L	724	7.8	0.412	9.8	X	X	X	X	0.65	54.5
9	R	667	14.5	5.561	4152.6	LOS F	356.7	2807.4	1.00	6.33	0.5
Approach		1392	11.0	5.561	1996.6	LOS F	356.7	2807.4	0.48	3.37	1.1
West: Sparks Rd (W)											
11	T	1457	7.1	0.783	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	131	9.7	1.088	154.0	LOS F	11.5	87.0	1.00	1.83	12.3
Approach		1587	7.4	1.088	12.7	NA	11.5	87.0	0.08	0.15	50.7
All Vehicles		6447	8.9	11.123	1387.7	NA	407.4	3206.8	0.23	1.36	1.6

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1063	5.3	0.594	9.7	X	X	X	X	0.65	54.5
5	T	754	9.1	0.409	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1817	6.9	0.594	5.7	NA	0.0	0.0	0.00	0.38	60.0
North East: Median (Right Turn Stage 2)											
26	R	149	12.0	1.062	162.2	LOS F	14.3	110.2	1.00	1.81	12.6
Approach		149	12.0	1.062	162.2	LOS F	14.3	110.2	1.00	1.81	12.6
North: SYD-NCL Fwy ramps (N)											
7	L	826	7.6	0.469	9.8	X	X	X	X	0.65	54.5
9	R	149	12.0	1.246	280.7	LOS F	22.3	172.2	1.00	2.53	7.4
Approach		976	8.3	1.246	51.3	LOS D	22.3	172.2	0.15	0.94	27.7
West: Sparks Rd (W)											
11	T	1922	5.2	1.022	19.4	LOS B	26.5	194.2	1.00	0.00	40.8
12	R	158	8.1	1.007	123.1	LOS F	11.6	86.7	1.00	1.75	14.8
Approach		2080	5.5	1.022	27.3	NA	26.5	194.2	1.00	0.13	36.0
All Vehicles		5022	6.7	1.246	28.2	NA	26.5	194.2	0.47	0.43	37.1

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	94	6.7	0.053	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	362	7.3	0.194	8.0	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		456	7.2	0.194	8.0	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	351	7.5	0.189	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	141	3.7	0.204	11.8	LOS A	0.8	5.6	0.53	0.82	45.4
Approach		492	6.4	0.204	9.3	NA	0.8	5.6	0.15	0.71	48.1
South West: Hue Hue Rd (SW)											
30	L	79	18.7	0.168	12.4	LOS A	0.5	3.7	0.49	0.78	45.5
32	R	46	6.8	0.253	29.3	LOS C	0.9	6.7	0.84	0.97	33.3
Approach		125	14.3	0.253	18.6	LOS B	0.9	6.7	0.62	0.85	40.1
All Vehicles		1073	7.7	0.253	9.8	NA	0.9	6.7	0.14	0.70	47.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	84	0.0	0.045	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	379	1.7	0.196	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		463	1.4	0.196	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	616	6.0	0.328	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	106	1.0	0.153	11.5	LOS A	0.6	4.0	0.51	0.80	45.5
Approach		722	5.2	0.328	8.7	NA	0.6	4.0	0.08	0.68	48.7
South West: Hue Hue Rd (SW)											
30	L	95	3.3	0.161	10.9	LOS A	0.5	3.3	0.47	0.75	46.3
32	R	95	1.1	0.785	75.1	LOS F	4.0	28.5	0.97	1.24	19.5
Approach		189	2.2	0.785	43.0	LOS D	4.0	28.5	0.72	0.99	27.5
All Vehicles		1375	3.5	0.785	13.1	NA	4.0	28.5	0.14	0.71	44.2

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	7	71.4	0.006	0.7	LOS A	0.0	0.3	0.29	0.00	54.4
3	R	1	0.0	0.006	9.6	LOS A	0.0	0.3	0.29	0.97	48.6
Approach		8	62.5	0.006	1.8	NA	0.0	0.3	0.29	0.12	53.6
North: Tooheys Rd (N)											
7	L	5	80.0	0.119	11.8	LOS A	0.0	0.0	0.00	1.44	49.0
8	T	194	22.8	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		199	24.3	0.119	0.3	NA	0.0	0.0	0.00	0.04	59.6
West: Mwy Link ramp (W)											
10	L	655	19.4	1.000[3]	13.4	LOS A	4.6	37.3	1.00	0.24	44.6
11	T	74	0.0	0.124	9.6	LOS A	0.5	3.9	0.43	0.63	47.1
12	R	2	50.0	0.124	14.2	LOS A	0.5	3.9	0.43	0.80	45.7
Approach		732	19.4	1.000	13.1	LOS A	4.6	37.3	0.94	0.28	44.8
All Vehicles		939	20.9	1.000	10.3	NA	4.6	37.3	0.74	0.23	47.4

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	5	80.0	0.008	6.3	LOS A	0.1	0.5	0.73	0.00	47.0
3	R	2	0.0	0.008	15.2	LOS B	0.1	0.5	0.73	0.90	44.4
Approach		7	57.1	0.008	8.9	NA	0.1	0.5	0.73	0.26	46.2
North: Tooheys Rd (N)											
7	L	15	28.6	0.492	9.5	LOS A	0.0	0.0	0.00	1.22	49.0
8	T	836	19.3	0.492	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		851	19.4	0.492	0.2	NA	0.0	0.0	0.00	0.02	59.8
West: Mwy Link ramp (W)											
10	L	215	21.1	0.343	10.0	LOS A	0.9	7.7	0.91	0.24	45.2
11	T	1	0.0	0.009	20.2	LOS B	0.0	0.2	0.78	0.84	38.1
12	R	1	0.0	0.009	22.2	LOS B	0.0	0.2	0.78	0.85	37.5
Approach		217	20.9	0.343	10.1	LOS A	0.9	7.7	0.91	0.24	45.1
All Vehicles		1075	20.0	0.492	2.2	NA	0.9	7.7	0.19	0.07	56.0

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	6	83.3	0.036	15.7	LOS B	0.1	1.5	0.48	0.65	44.6
6	R	7	71.4	0.036	17.8	LOS B	0.1	1.5	0.48	0.77	43.4
Approach		14	76.9	0.036	16.8	LOS B	0.1	1.5	0.48	0.71	44.0
North: Tooheys Rd (N)											
9	R	194	22.8	0.121	10.0	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		194	22.8	0.121	10.0	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		207	26.4	0.121	10.5	NA	0.1	1.5	0.03	0.73	47.9

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.145	84.9	LOS F	0.4	4.3	0.95	0.98	17.8
6	R	5	80.0	0.145	91.0	LOS F	0.4	4.3	0.95	0.99	17.6
Approach		6	66.7	0.145	90.0	LOS F	0.4	4.3	0.95	0.99	17.6
North: Tooheys Rd (N)											
9	R	836	19.3	0.512	9.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		836	19.3	0.512	9.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		842	19.6	0.512	10.5	NA	0.4	4.3	0.01	0.73	47.5

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	69	9.1	0.193	11.4	LOS A	0.0	0.0	0.00	1.26	59.3
22	T	283	8.2	0.193	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		353	8.4	0.193	2.2	NA	0.0	0.0	0.00	0.25	74.9
North West: Hue Hue Rd (NW)											
28	T	564	1.1	0.346	3.6	LOS A	4.1	29.0	0.69	0.00	59.9
29	R	43	2.4	0.346	15.2	LOS B	4.1	29.0	0.69	1.13	59.6
Approach		607	1.2	0.346	4.4	NA	4.1	29.0	0.69	0.08	59.9
West: Jilliby Rd (W)											
10	L	55	7.7	1.273	333.3	LOS F	33.7	240.5	1.00	3.31	6.8
12	R	135	0.0	1.273	330.9	LOS F	33.7	240.5	1.00	2.44	6.8
Approach		189	2.2	1.273	331.6	LOS F	33.7	240.5	1.00	2.69	6.8
All Vehicles		1149	3.6	1.273	57.7	NA	33.7	240.5	0.53	0.56	27.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	118	2.7	0.304	10.9	LOS A	0.0	0.0	0.00	1.21	59.3
22	T	460	2.5	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		578	2.6	0.304	2.2	NA	0.0	0.0	0.00	0.25	74.8
North West: Hue Hue Rd (NW)											
28	T	279	3.0	0.230	6.3	LOS A	2.6	19.2	0.73	0.00	58.4
29	R	44	14.3	0.230	19.0	LOS B	2.6	19.2	0.73	1.15	55.7
Approach		323	4.6	0.230	8.1	NA	2.6	19.2	0.73	0.16	58.0
West: Jilliby Rd (W)											
10	L	24	13.0	0.533	46.7	LOS D	2.4	17.6	0.88	1.12	33.1
12	R	68	1.5	0.533	44.0	LOS D	2.4	17.6	0.88	1.09	33.5
Approach		93	4.5	0.533	44.7	LOS D	2.4	17.6	0.88	1.10	33.4
All Vehicles		994	3.4	0.533	8.1	NA	2.6	19.2	0.32	0.30	61.9

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	14	7.7	0.035	10.5	LOS A	0.0	0.0	0.00	0.71	57.1
22	T	47	15.6	0.035	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		61	13.8	0.035	11.5	NA	0.0	0.0	0.00	0.73	59.0
North: Jilliby Rd (N)											
8	T	4	0.0	0.064	10.0	LOS A	0.3	2.2	0.17	0.58	56.5
9	R	103	7.1	0.064	11.5	LOS A	0.3	2.2	0.17	0.68	58.4
Approach		107	6.9	0.064	11.4	NA	0.3	2.2	0.17	0.68	58.4
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.026	8.4	LOS A	0.1	0.6	0.21	0.60	45.4
32	R	19	5.6	0.026	8.9	LOS A	0.1	0.6	0.21	0.66	45.3
Approach		24	4.3	0.026	8.8	LOS A	0.1	0.6	0.21	0.64	45.4
All Vehicles		193	8.7	0.064	11.1	NA	0.3	2.2	0.12	0.69	56.5

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	20	15.8	0.056	10.8	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	82	6.4	0.056	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		102	8.2	0.056	10.9	NA	0.0	0.0	0.00	0.72	59.1
North: Jilliby Rd (N)											
8	T	4	0.0	0.043	10.1	LOS A	0.2	1.4	0.21	0.55	56.2
9	R	65	6.5	0.043	11.5	LOS A	0.2	1.4	0.21	0.67	58.2
Approach		69	6.1	0.043	11.4	NA	0.2	1.4	0.21	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.032	8.4	LOS A	0.1	0.8	0.25	0.60	45.3
32	R	24	4.3	0.032	8.9	LOS A	0.1	0.8	0.25	0.65	45.3
Approach		29	3.6	0.032	8.8	LOS A	0.1	0.8	0.25	0.64	45.3
All Vehicles		201	6.8	0.056	10.8	NA	0.2	1.4	0.11	0.69	56.2

Year 2026 No-Project traffic conditions

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	161	16.3	0.428	20.3	LOS B	3.9	31.2	0.55	0.91	45.9
3	R	1158	6.9	3.726	1994.7	LOS F	304.8	2260.3	1.00	3.15	1.1
Approach		1319	8.1	3.726	1753.6	LOS F	304.8	2260.3	0.94	2.88	1.3
East: Sparks Rd (E)											
5	T	1444	3.9	1.642	622.9	LOS F	305.5	2333.8	1.00	3.36	3.5
6	R	296	15.2	1.022	108.5	LOS F	22.4	177.2	1.00	1.23	16.3
Approach		1740	11.4	1.641	535.3	LOS F	305.5	2333.8	1.00	3.00	4.0
West: Sparks Rd (W)											
10	L	125	9.2	0.320	33.1	LOS C	5.3	39.7	0.81	0.79	35.4
11	T	435	7.7	0.750	28.8	LOS C	17.4	129.8	0.96	0.87	35.2
Approach		560	8.1	0.749	29.8	LOS C	17.4	129.8	0.92	0.85	35.3
All Vehicles		3619	9.7	3.726	901.1	LOS F	305.5	2333.8	0.97	2.62	2.5

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time   Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	149	10.6	0.250	16.0	LOS B	2.2	16.7	0.37	0.94	49.1
3	R	1722	4.3	3.400	1753.7	LOS F	442.3	3209.9	1.00	3.09	1.3
Approach		1872	4.8	3.400	1615.0	LOS F	442.3	3209.9	0.95	2.92	1.4
East: Sparks Rd (E)											
5	T	560	12.6	0.756	17.4	LOS B	18.9	142.7	0.84	0.78	40.8
6	R	335	6.3	1.011	99.3	LOS F	23.9	176.0	1.00	1.21	17.4
Approach		895	8.0	1.011	48.1	LOS D	23.9	176.0	0.90	0.94	27.2
West: Sparks Rd (W)											
10	L	231	6.7	1.012	98.7	LOS F	16.7	123.4	1.00	1.31	17.7
11	T	430	10.1	1.316	334.2	LOS F	61.9	469.3	1.00	2.35	6.2
Approach		661	8.6	1.316	251.9	LOS F	61.9	469.3	1.00	1.99	8.1
All Vehicles		3427	6.4	3.400	943.0	LOS F	442.3	3209.9	0.95	2.22	2.4

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1729	5.4	0.967	11.4	X	X	X	X	0.62	52.0
5	T	1076	10.1	0.588	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		2805	7.2	0.967	7.0	NA	0.0	0.0	0.00	0.39	57.8
North East: Median (Right Turn Stage 2)											
26	R	662	13.5	11.035	9105.5	LOS F	404.3	3157.6	1.00	4.06	0.3
Approach		662	13.5	11.035	9105.5	LOS F	404.3	3157.6	1.00	4.06	0.3
North: SYD-NCL Fwy ramps (N)											
7	L	725	7.5	0.412	9.8	X	X	X	X	0.65	54.5
9	R	662	13.5	5.518	4113.4	LOS F	353.4	2760.2	1.00	6.29	0.6
Approach		1387	10.4	5.518	1968.2	LOS F	353.4	2760.2	0.48	3.34	1.2
West: Sparks Rd (W)											
11	T	1462	6.9	0.784	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	130	9.7	1.084	154.9	LOS F	11.5	87.0	1.00	1.84	12.3
Approach		1592	7.1	1.084	12.7	NA	11.5	87.0	0.08	0.15	50.7
All Vehicles		6446	8.5	11.035	1365.0	NA	404.3	3157.6	0.23	1.34	1.6

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1067	5.3	0.597	9.7	X	X	X	X	0.65	54.5
5	T	753	8.3	0.407	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1820	6.5	0.597	5.7	NA	0.0	0.0	0.00	0.38	60.0
North East: Median (Right Turn Stage 2)											
26	R	143	7.4	0.874	74.1	LOS F	6.2	46.3	0.97	1.35	23.3
Approach		143	7.4	0.874	74.1	LOS F	6.2	46.3	0.97	1.35	23.3
North: SYD-NCL Fwy ramps (N)											
7	L	826	7.3	0.468	9.8	X	X	X	X	0.65	54.5
9	R	143	7.4	1.193	239.2	LOS F	18.5	137.7	1.00	2.29	8.5
Approach		969	7.3	1.193	43.7	LOS D	18.5	137.7	0.15	0.89	30.5
West: Sparks Rd (W)											
11	T	1922	5.0	1.020	18.2	LOS B	25.1	183.0	1.00	0.00	41.7
12	R	163	7.6	1.002	117.8	LOS F	11.5	85.9	1.00	1.75	15.3
Approach		2085	5.3	1.020	26.0	NA	25.1	183.0	1.00	0.14	36.8
All Vehicles		5018	6.2	1.193	23.4	NA	25.1	183.0	0.47	0.41	40.1

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	83	10.1	0.045	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	319	3.3	0.411	13.7	LOS A	2.0	14.4	0.44	0.82	55.5
Approach		402	4.7	0.411	10.9	NA	2.0	14.4	0.35	0.65	59.4
South East: Sparks Rd Stage 2 (E)											
23	R	117	13.5	0.139	11.0	LOS A	0.6	4.4	0.24	0.63	54.8
Approach		117	13.5	0.139	11.0	LOS A	0.6	4.4	0.24	0.63	54.8
East: Sparks Rd Stage 1 (E)											
4	L	377	1.1	0.591	13.2	LOS A	2.9	20.2	0.45	0.77	51.9
6	R	117	13.5	0.213	15.1	LOS B	0.7	5.4	0.50	0.86	50.9
Approach		494	4.1	0.591	13.6	LOS A	2.9	20.2	0.46	0.79	51.7
North: Hue Hue Rd (N)											
7	L	189	16.1	0.114	12.2	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	76	2.8	0.040	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		265	12.3	0.114	8.7	NA	0.0	0.0	0.00	0.52	63.8
All Vehicles		1278	6.8	0.591	11.5	NA	2.9	20.2	0.31	0.68	56.5

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade

Wallarah Mine TIA * 02AMFU00
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	68	3.1	0.036	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	296	6.0	0.341	12.5	LOS A	1.3	9.7	0.32	0.73	57.3
Approach		364	5.5	0.341	10.1	NA	1.3	9.7	0.26	0.59	60.6
South East: Sparks Rd Stage 2 (E)											
23	R	216	11.2	0.244	10.7	LOS A	1.1	8.5	0.23	0.62	54.9
Approach		216	11.2	0.244	10.7	LOS A	1.1	8.5	0.23	0.62	54.9
East: Sparks Rd Stage 1 (E)											
4	L	271	4.3	0.419	11.5	LOS A	1.1	7.9	0.33	0.67	53.6
6	R	216	11.2	0.343	14.7	LOS B	1.4	11.0	0.50	0.89	51.1
Approach		486	7.4	0.419	12.9	LOS A	1.4	11.0	0.40	0.77	52.5
North: Hue Hue Rd (N)											
7	L	105	13.0	0.062	11.9	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	49	8.5	0.027	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		155	11.6	0.062	8.1	NA	0.0	0.0	0.00	0.50	64.4
All Vehicles		1221	8.0	0.419	11.1	NA	1.4	11.0	0.28	0.65	56.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles							95% Back of Queue				
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	96	6.6	0.054	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	372	7.4	0.200	8.0	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		467	7.2	0.200	8.0	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	357	7.4	0.192	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	143	3.7	0.210	11.9	LOS A	1.0	7.3	0.53	0.83	45.3
Approach		500	6.3	0.210	9.3	LOS A	1.0	7.3	0.15	0.71	48.0
South West: Hue Hue Rd (SW)											
30	L	81	18.2	0.172	12.4	LOS A	0.6	4.9	0.50	0.78	45.4
32	R	47	6.7	0.268	30.5	LOS C	1.2	8.9	0.85	0.97	32.7
Approach		128	13.9	0.267	19.1	LOS B	1.2	8.9	0.63	0.85	39.7
All Vehicles		1096	7.6	0.267	9.9	NA	1.2	8.9	0.14	0.70	47.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles							95% Back of Queue				
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	86	0.0	0.046	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	389	1.6	0.202	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		476	1.3	0.202	7.7	LOS A	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	633	6.0	0.337	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	108	1.0	0.158	11.6	LOS A	0.7	5.2	0.52	0.81	45.5
Approach		741	5.3	0.337	8.7	LOS A	0.7	5.2	0.08	0.69	48.7
South West: Hue Hue Rd (SW)											
30	L	85	3.7	0.146	10.9	LOS A	0.5	3.8	0.47	0.75	46.3
32	R	97	1.1	0.857	93.5	LOS F	6.0	42.2	0.98	1.32	16.7
Approach		182	2.3	0.857	54.8	LOS D	6.0	42.2	0.74	1.06	23.9
All Vehicles		1399	3.5	0.857	14.3	NA	6.0	42.2	0.14	0.72	43.1

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	3	33.3	0.003	0.6	LOS A	0.0	0.1	0.30	0.00	54.0
3	R	1	0.0	0.003	9.5	LOS A	0.0	0.1	0.30	0.88	48.4
Approach		4	25.0	0.003	2.8	NA	0.0	0.1	0.30	0.22	52.5
North: Tooheys Rd (N)											
7	L	1	0.0	0.109	8.2	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	187	20.2	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		188	20.1	0.109	0.0	NA	0.0	0.0	0.00	0.01	59.9
West: Mwy Link ramp (W)											
10	L	665	18.7	1.000[3]	13.4	LOS A	4.6	37.3	1.00	0.14	44.6
11	T	59	0.0	0.095	9.3	LOS A	0.4	3.0	0.40	0.61	47.5
12	R	2	50.0	0.095	13.8	LOS A	0.4	3.0	0.40	0.78	46.0
Approach		725	18.7	1.000	13.0	LOS A	4.6	37.3	0.95	0.18	44.8
All Vehicles		918	19.0	1.000	10.3	NA	4.6	37.3	0.75	0.14	47.3

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	1	0.0	0.005	5.9	LOS A	0.0	0.1	0.71	0.00	45.9
3	R	2	0.0	0.005	14.7	LOS B	0.0	0.1	0.71	0.80	43.5
Approach		3	0.0	0.005	11.8	NA	0.0	0.1	0.71	0.54	44.3
North: Tooheys Rd (N)											
7	L	11	0.0	0.483	8.2	LOS A	0.0	0.0	0.00	1.08	49.0
8	T	829	18.7	0.483	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		840	18.4	0.483	0.1	NA	0.0	0.0	0.00	0.01	59.8
West: Mwy Link ramp (W)											
10	L	208	18.7	0.322	9.8	LOS A	0.9	7.0	1.00	0.08	44.8
11	T	1	0.0	0.008	19.4	LOS B	0.0	0.2	0.77	0.82	38.7
12	R	1	0.0	0.008	21.4	LOS B	0.0	0.2	0.77	0.85	38.0
Approach		211	18.5	0.322	9.9	LOS A	0.9	7.0	1.00	0.09	44.8
All Vehicles		1054	18.4	0.483	2.1	NA	0.9	7.0	0.20	0.03	56.0

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	6	83.3	0.024	15.5	LOS B	0.1	1.3	0.48	0.64	44.9
6	R	3	33.3	0.024	15.6	LOS B	0.1	1.3	0.48	0.73	43.7
Approach		9	66.7	0.024	15.5	LOS B	0.1	1.3	0.48	0.67	44.5
North: Tooheys Rd (N)											
9	R	187	20.2	0.115	9.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		187	20.2	0.115	9.9	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		197	22.5	0.115	10.2	NA	0.1	1.3	0.02	0.73	48.0

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.012	25.4	LOS B	0.0	0.3	0.84	0.92	34.9
6	R	1	0.0	0.012	27.4	LOS B	0.0	0.3	0.84	0.93	34.4
Approach		2	0.0	0.012	26.4	LOS B	0.0	0.3	0.84	0.93	34.6
North: Tooheys Rd (N)											
9	R	829	18.7	0.506	9.8	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		829	18.7	0.506	9.8	LOS A	0.0	0.0	0.00	0.73	48.2
All Vehicles		832	18.6	0.506	9.9	NA	0.0	0.3	0.00	0.73	48.1

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	71	9.0	0.195	11.4	LOS A	0.0	0.0	0.00	1.26	59.3
22	T	286	7.7	0.195	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		357	8.0	0.195	2.3	LOS A	0.0	0.0	0.00	0.25	74.9
North West: Hue Hue Rd (NW)											
28	T	578	0.9	0.358	3.8	LOS A	5.4	38.4	0.70	0.00	59.6
29	R	46	4.5	0.356	15.6	LOS B	5.4	38.4	0.70	1.14	59.4
Approach		624	1.2	0.358	4.7	LOS A	5.4	38.4	0.70	0.08	59.5
West: Jilliby Rd (W)											
10	L	56	7.5	1.361	421.0	LOS F	42.6	304.0	1.00	3.65	5.5
12	R	138	0.0	1.379	418.7	LOS F	42.6	304.0	1.00	2.64	5.4
Approach		194	2.2	1.375	419.4	LOS F	42.6	304.0	1.00	2.93	5.4
All Vehicles		1175	3.4	1.375	72.3	NA	42.6	304.0	0.54	0.60	23.4

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	121	2.6	0.311	10.8	LOS A	0.0	0.0	0.00	1.21	59.3
22	T	471	2.2	0.311	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		592	2.3	0.311	2.2	LOS A	0.0	0.0	0.00	0.25	74.8
North West: Hue Hue Rd (NW)											
28	T	283	2.6	0.242	7.0	LOS A	3.6	26.0	0.75	0.00	58.0
29	R	47	15.6	0.242	19.7	LOS B	3.6	26.0	0.75	1.15	55.0
Approach		331	4.5	0.242	8.8	LOS A	3.6	26.0	0.75	0.16	57.5
West: Jilliby Rd (W)											
10	L	25	12.5	0.574	50.2	LOS D	3.3	24.1	0.89	1.14	31.6
12	R	71	1.5	0.578	47.5	LOS D	3.3	24.1	0.89	1.11	32.0
Approach		96	4.4	0.577	48.2	LOS D	3.3	24.1	0.89	1.12	31.9
All Vehicles		1018	3.2	0.577	8.7	NA	3.6	26.0	0.33	0.30	61.2

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	16	13.3	0.036	10.7	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	47	15.6	0.036	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		63	15.0	0.036	11.5	LOS A	0.0	0.0	0.00	0.72	58.9
North: Jilliby Rd (N)											
8	T	4	0.0	0.065	10.0	LOS A	0.4	2.9	0.17	0.58	56.5
9	R	104	7.1	0.065	11.5	LOS A	0.4	2.9	0.17	0.68	58.4
Approach		108	6.8	0.065	11.4	LOS A	0.4	2.9	0.17	0.68	58.3
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.026	8.4	LOS A	0.1	0.8	0.22	0.60	45.4
32	R	19	5.6	0.026	8.9	LOS A	0.1	0.8	0.22	0.66	45.3
Approach		24	4.3	0.026	8.8	LOS A	0.1	0.8	0.22	0.64	45.4
All Vehicles		196	9.1	0.065	11.1	NA	0.4	2.9	0.12	0.69	56.5

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	22	19.0	0.058	11.0	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	83	6.3	0.058	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		105	9.0	0.058	11.0	LOS A	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	4	0.0	0.043	10.1	LOS A	0.3	1.9	0.22	0.54	56.2
9	R	66	6.3	0.043	11.5	LOS A	0.3	1.9	0.22	0.67	58.2
Approach		71	6.0	0.043	11.4	LOS A	0.3	1.9	0.22	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.034	8.4	LOS A	0.1	1.0	0.25	0.60	45.3
32	R	25	4.2	0.034	8.9	LOS A	0.1	1.0	0.25	0.65	45.2
Approach		31	3.4	0.034	8.8	LOS A	0.1	1.0	0.25	0.65	45.3
All Vehicles		206	7.1	0.058	10.8	NA	0.3	1.9	0.11	0.69	56.1

Traffic conditions for the construction of Western Ventilation shaft, mine operation phase in 2026

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd AM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 80 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	162	16.9	0.438	20.4	LOS B	2.8	22.4	0.55	0.91	45.8
3	R	1158	6.9	3.726	1994.7	LOS F	304.8	2260.3	1.00	3.15	1.1
Approach		1320	8.1	3.726	1752.2	LOS F	304.8	2260.3	0.95	2.87	1.3
East: Sparks Rd (E)											
5	T	1458	5.2	1.666	644.7	LOS F	313.6	2410.5	1.00	3.42	3.4
6	R	296	15.5	1.022	108.5	LOS F	21.6	171.0	1.00	1.23	16.3
Approach		1754	12.1	1.666	554.3	LOS F	313.6	2410.5	1.00	3.05	3.9
West: Sparks Rd (W)											
10	L	131	12.9	0.342	33.5	LOS C	4.0	31.4	0.81	0.79	35.2
11	T	440	8.9	0.764	29.5	LOS C	16.7	125.5	0.96	0.89	34.9
Approach		571	9.8	0.764	30.4	LOS C	16.7	125.5	0.93	0.87	34.9
All Vehicles		3644	10.3	3.726	906.2	LOS F	313.6	2410.5	0.97	2.64	2.5

MOVEMENT SUMMARY

Site: S1a_F3 (Northbound)_Sparks Rd PM

Sydney Newcastle Freeway (Northbound)/Sparks Road
Signals - Fixed Time Cycle Time = 78 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: SYD-NCL Fwy ramp (S)											
1	L	151	11.2	0.262	16.4	LOS B	1.6	12.0	0.39	0.93	48.8
3	R	1722	4.3	3.400	1753.7	LOS F	442.3	3209.9	1.00	3.09	1.3
Approach		1873	4.8	3.400	1614.1	LOS F	442.3	3209.9	0.95	2.92	1.4
East: Sparks Rd (E)											
5	T	577	15.5	0.787	19.6	LOS B	19.8	151.2	0.86	0.83	39.1
6	R	333	7.2	1.010	99.3	LOS F	23.0	170.9	1.00	1.21	17.4
Approach		909	9.5	1.010	48.7	LOS D	23.0	170.9	0.91	0.97	26.9
West: Sparks Rd (W)											
10	L	228	8.3	1.011	98.3	LOS F	15.2	114.0	1.00	1.31	17.8
11	T	445	11.4	1.375	386.6	LOS F	69.8	534.4	1.00	2.52	5.5
Approach		674	10.0	1.375	288.9	LOS F	69.8	534.4	1.00	2.11	7.2
All Vehicles		3456	7.1	3.400	943.8	LOS F	442.3	3209.9	0.95	2.25	2.4

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd AM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1729	5.4	0.967	11.4	X	X	X	X	0.62	52.0
5	T	1083	10.7	0.594	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		2813	7.4	0.967	7.0	NA	0.0	0.0	0.00	0.38	57.8
North East: Median (Right Turn Stage 2)											
26	R	669	14.5	11.158	9214.8	LOS F	408.7	3215.9	1.00	4.10	0.2
Approach		669	14.5	11.158	9214.8	LOS F	408.7	3215.9	1.00	4.10	0.2
North: SYD-NCL Fwy ramps (N)											
7	L	728	7.9	0.414	9.8	X	X	X	X	0.65	54.5
9	R	669	14.5	5.579	4168.2	LOS F	358.0	2816.6	1.00	6.34	0.5
Approach		1398	11.1	5.579	2001.3	LOS F	358.0	2816.6	0.48	3.37	1.1
West: Sparks Rd (W)											
11	T	1467	7.1	0.788	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R	130	10.3	1.084	153.8	LOS F	11.4	86.9	1.00	1.84	12.3
Approach		1597	7.4	1.084	12.5	NA	11.4	86.9	0.08	0.15	50.9
All Vehicles		6477	8.9	11.158	1390.6	NA	408.7	3215.9	0.23	1.36	1.6

MOVEMENT SUMMARY

Site: S1b_ F3 (Southbound)_Sparks Rd PM

Sydney Newcastle Freeway (Southbound)/Sparks Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Sparks Rd (E)											
4	L	1067	5.3	0.597	9.7	X	X	X	X	0.65	54.5
5	T	760	9.1	0.413	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		1827	6.9	0.597	5.7	NA	0.0	0.0	0.00	0.38	60.0
North East: Median (Right Turn Stage 2)											
26	R	151	11.9	1.093	183.9	LOS F	16.2	124.9	1.00	1.90	11.3
Approach		151	11.9	1.093	183.9	LOS F	16.2	124.9	1.00	1.90	11.3
North: SYD-NCL Fwy ramps (N)											
7	L	831	7.7	0.472	9.8	X	X	X	X	0.65	54.5
9	R	151	11.9	1.254	288.0	LOS F	23.0	177.1	1.00	2.57	7.2
Approach		981	8.4	1.254	52.5	LOS D	23.0	177.1	0.15	0.94	27.4
West: Sparks Rd (W)											
11	T	1939	5.2	1.031	27.5	LOS B	37.0	271.0	1.00	0.00	35.7
12	R	153	8.5	1.010	126.9	LOS F	11.5	86.2	1.00	1.75	14.4
Approach		2092	5.5	1.031	34.8	NA	37.0	271.0	1.00	0.13	32.3
All Vehicles		5051	6.8	1.254	32.1	NA	37.0	271.0	0.47	0.43	34.9

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd AM w upgrade

Wallarah Mine TIA
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

* 02AMFU00

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	84	11.3	0.046	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	321	3.6	0.423	14.0	LOS A	2.1	15.2	0.46	0.85	55.2
Approach		405	5.2	0.423	11.1	NA	2.1	15.2	0.37	0.67	59.1
South East: Sparks Rd Stage 2 (E)											
23	R	126	20.0	0.160	11.6	LOS A	0.7	5.4	0.26	0.63	54.7
Approach		126	20.0	0.160	11.6	LOS A	0.7	5.4	0.26	0.63	54.7
East: Sparks Rd Stage 1 (E)											
4	L	377	1.1	0.594	13.3	LOS A	2.9	20.6	0.45	0.78	51.8
6	R	126	20.0	0.257	16.7	LOS B	0.9	7.4	0.53	0.89	49.8
Approach		503	5.9	0.594	14.1	LOS A	2.9	20.6	0.47	0.81	51.3
North: Hue Hue Rd (N)											
7	L	199	20.1	0.123	12.5	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	77	4.1	0.040	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		276	15.6	0.123	9.0	NA	0.0	0.0	0.00	0.53	63.7
All Vehicles		1311	9.1	0.594	11.9	NA	2.9	20.6	0.32	0.69	56.2

MOVEMENT SUMMARY

Site: S2_ Sparks Rd_Hue Hue Rd PM w upgrade

Wallarah Mine TIA
Sparks Rd / Hue Hue Rd- FU AM
Giveway / Yield (Two-Way)

* 02AMFU00

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Hue Hue Rd (S)											
2	T	69	4.5	0.037	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
3	R	297	6.4	0.382	13.6	LOS A	1.7	12.7	0.42	0.80	55.9
Approach		366	6.0	0.382	11.1	NA	1.7	12.7	0.34	0.65	59.4
South East: Sparks Rd Stage 2 (E)											
23	R	225	15.0	0.264	11.1	LOS A	1.2	9.7	0.24	0.62	54.8
Approach		225	15.0	0.264	11.1	LOS A	1.2	9.7	0.24	0.62	54.8
East: Sparks Rd Stage 1 (E)											
4	L	271	4.3	0.429	11.8	LOS A	1.3	9.1	0.30	0.71	53.7
6	R	225	15.0	0.404	16.5	LOS B	1.8	14.6	0.55	0.93	49.5
Approach		496	9.1	0.429	13.9	LOS A	1.8	14.6	0.42	0.81	51.7
North: Hue Hue Rd (N)											
7	L	191	12.2	0.111	11.9	LOS A	0.0	0.0	0.00	0.73	58.9
8	T	60	8.8	0.033	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		251	11.3	0.111	9.0	NA	0.0	0.0	0.00	0.56	62.9
All Vehicles		1338	9.7	0.429	11.7	NA	1.8	14.6	0.29	0.69	56.1

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd AM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	96	6.6	0.054	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	372	7.4	0.200	8.0	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		467	7.2	0.200	8.0	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	357	7.4	0.192	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	143	3.7	0.210	11.9	LOS A	0.8	5.8	0.53	0.83	45.3
Approach		500	6.3	0.210	9.3	NA	0.8	5.8	0.15	0.71	48.0
South West: Hue Hue Rd (SW)											
30	L	81	18.2	0.172	12.4	LOS A	0.5	3.9	0.50	0.78	45.4
32	R	47	6.7	0.267	30.5	LOS C	1.0	7.2	0.85	0.97	32.7
Approach		128	13.9	0.267	19.1	LOS B	1.0	7.2	0.63	0.85	39.7
All Vehicles		1096	7.6	0.267	9.9	NA	1.0	7.2	0.14	0.70	47.5

MOVEMENT SUMMARY

Site: S3_Hue Hue Rd_Wyee Rd PM

Hue Hue Road/Wyee Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wyee Rd (E)											
4	L	86	0.0	0.046	7.8	LOS A	0.0	0.0	0.00	0.66	49.3
5	T	389	1.6	0.202	7.7	LOS A	0.0	0.0	0.00	0.64	49.6
Approach		476	1.3	0.202	7.7	NA	0.0	0.0	0.00	0.65	49.5
North West: Wyee Rd (NW)											
28	T	633	6.0	0.337	8.2	LOS A	0.0	0.0	0.00	0.66	49.3
29	R	108	1.0	0.159	11.7	LOS A	0.6	4.2	0.52	0.81	45.4
Approach		741	5.3	0.337	8.7	NA	0.6	4.2	0.08	0.69	48.7
South West: Hue Hue Rd (SW)											
30	L	97	4.3	0.166	11.0	LOS A	0.5	3.5	0.48	0.76	46.2
32	R	97	1.1	0.857	93.5	LOS F	4.9	34.9	0.98	1.32	16.7
Approach		194	2.7	0.857	52.3	LOS D	4.9	34.9	0.73	1.04	24.6
All Vehicles		1411	3.6	0.857	14.3	NA	4.9	34.9	0.14	0.72	43.1

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	7	71.4	0.006	0.7	LOS A	0.0	0.3	0.29	0.00	54.4
3	R	1	0.0	0.006	9.6	LOS A	0.0	0.3	0.29	0.97	48.6
Approach		8	62.5	0.006	1.8	NA	0.0	0.3	0.29	0.12	53.6
North: Tooheys Rd (N)											
7	L	5	80.0	0.119	11.8	LOS A	0.0	0.0	0.00	1.44	49.0
8	T	194	22.8	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		199	24.3	0.119	0.3	NA	0.0	0.0	0.00	0.04	59.6
West: Mwy Link ramp (W)											
10	L	655	19.4	1.000[3]	13.4	LOS A	4.6	37.3	1.00	0.24	44.6
11	T	74	0.0	0.124	9.6	LOS A	0.5	3.9	0.43	0.63	47.1
12	R	2	50.0	0.124	14.2	LOS A	0.5	3.9	0.43	0.80	45.7
Approach		732	19.4	1.000	13.1	LOS A	4.6	37.3	0.94	0.28	44.8
All Vehicles		939	20.9	1.000	10.3	NA	4.6	37.3	0.74	0.23	47.4

MOVEMENT SUMMARY

Site: S4a_Mwy Link (Eastbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Tooheys Rd (S)											
2	T	5	80.0	0.008	6.3	LOS A	0.1	0.5	0.73	0.00	47.0
3	R	2	0.0	0.008	15.2	LOS B	0.1	0.5	0.73	0.90	44.4
Approach		7	57.1	0.008	8.9	NA	0.1	0.5	0.73	0.26	46.2
North: Tooheys Rd (N)											
7	L	15	28.6	0.492	9.5	LOS A	0.0	0.0	0.00	1.22	49.0
8	T	836	19.3	0.492	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		851	19.4	0.492	0.2	NA	0.0	0.0	0.00	0.02	59.8
West: Mwy Link ramp (W)											
10	L	215	21.1	0.343	10.0	LOS A	0.9	7.7	0.91	0.24	45.2
11	T	1	0.0	0.009	20.2	LOS B	0.0	0.2	0.78	0.84	38.1
12	R	1	0.0	0.009	22.2	LOS B	0.0	0.2	0.78	0.85	37.5
Approach		217	20.9	0.343	10.1	LOS A	0.9	7.7	0.91	0.24	45.1
All Vehicles		1075	20.0	0.492	2.2	NA	0.9	7.7	0.19	0.07	56.0

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd AM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	6	83.3	0.036	15.7	LOS B	0.1	1.5	0.48	0.65	44.6
6	R	7	71.4	0.036	17.8	LOS B	0.1	1.5	0.48	0.77	43.4
Approach		14	76.9	0.036	16.8	LOS B	0.1	1.5	0.48	0.71	44.0
North: Tooheys Rd (N)											
9	R	194	22.8	0.121	10.0	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		194	22.8	0.121	10.0	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		207	26.4	0.121	10.5	NA	0.1	1.5	0.03	0.73	47.9

MOVEMENT SUMMARY

Site: S4b_Mwy Link (Westbound)_Tooheys Rd PM

Motorway Link/Tooheys Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mwy Link ramp (E)											
5	T	1	0.0	0.145	84.9	LOS F	0.4	4.3	0.95	0.98	17.8
6	R	5	80.0	0.145	91.0	LOS F	0.4	4.3	0.95	0.99	17.6
Approach		6	66.7	0.145	90.0	LOS F	0.4	4.3	0.95	0.99	17.6
North: Tooheys Rd (N)											
9	R	836	19.3	0.512	9.9	LOS A	0.0	0.0	0.00	0.73	48.2
Approach		836	19.3	0.512	9.9	NA	0.0	0.0	0.00	0.73	48.2
All Vehicles		842	19.6	0.512	10.5	NA	0.4	4.3	0.01	0.73	47.5

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd AM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	71	9.0	0.195	11.4	LOS A	0.0	0.0	0.00	1.26	59.3
22	T	287	8.1	0.195	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		358	8.2	0.195	2.2	NA	0.0	0.0	0.00	0.25	74.9
North West: Hue Hue Rd (NW)											
28	T	579	1.1	0.359	3.9	LOS A	4.5	32.2	0.71	0.00	59.5
29	R	46	4.5	0.359	15.7	LOS B	4.5	32.2	0.71	1.14	59.3
Approach		625	1.3	0.359	4.7	NA	4.5	32.2	0.71	0.08	59.5
West: Jilliby Rd (W)											
10	L	58	9.1	1.387	431.7	LOS F	42.1	301.4	1.00	3.68	5.4
12	R	138	0.0	1.387	429.2	LOS F	42.1	301.4	1.00	2.68	5.3
Approach		196	2.7	1.387	429.9	LOS F	42.1	301.4	1.00	2.98	5.3
All Vehicles		1179	3.7	1.387	74.6	NA	42.1	301.4	0.54	0.61	22.9

MOVEMENT SUMMARY

Site: S5_Jilliby Rd_Hue Hue Rd PM

Jilliby Road/Hue Hue Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Hue Hue Rd (SE)											
21	L	121	2.6	0.312	10.8	LOS A	0.0	0.0	0.00	1.21	59.3
22	T	472	2.5	0.312	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		593	2.5	0.312	2.2	NA	0.0	0.0	0.00	0.25	74.8
North West: Hue Hue Rd (NW)											
28	T	286	2.9	0.244	7.0	LOS A	3.0	21.6	0.75	0.00	57.9
29	R	47	15.6	0.244	19.8	LOS B	3.0	21.6	0.75	1.15	54.9
Approach		334	4.7	0.244	8.8	NA	3.0	21.6	0.75	0.16	57.5
West: Jilliby Rd (W)											
10	L	27	15.4	0.590	51.1	LOS D	2.8	20.4	0.89	1.14	31.4
12	R	71	1.5	0.590	48.1	LOS D	2.8	20.4	0.89	1.12	31.7
Approach		98	5.4	0.590	49.0	LOS D	2.8	20.4	0.89	1.12	31.6
All Vehicles		1024	3.5	0.590	8.8	NA	3.0	21.6	0.33	0.30	61.0

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd AM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	16	13.3	0.036	10.7	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	47	15.6	0.036	11.7	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		63	15.0	0.036	11.5	NA	0.0	0.0	0.00	0.72	58.9
North: Jilliby Rd (N)											
8	T	4	0.0	0.065	10.0	LOS A	0.3	2.3	0.17	0.58	56.5
9	R	104	7.1	0.065	11.5	LOS A	0.3	2.3	0.17	0.68	58.4
Approach		108	6.8	0.065	11.4	NA	0.3	2.3	0.17	0.68	58.3
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.030	8.5	LOS A	0.1	0.8	0.22	0.59	45.4
32	R	21	10.0	0.030	9.3	LOS A	0.1	0.8	0.22	0.66	45.3
Approach		26	8.0	0.030	9.1	LOS A	0.1	0.8	0.22	0.65	45.3
All Vehicles		198	9.6	0.065	11.1	NA	0.3	2.3	0.12	0.69	56.3

MOVEMENT SUMMARY

Site: S6_Jilliby Rd_Little Jilliby Rd PM

Jilliby Road/Little Jilliby Road
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Jilliby Rd (SE)											
21	L	22	19.0	0.058	11.0	LOS A	0.0	0.0	0.00	0.70	57.1
22	T	83	6.3	0.058	11.0	LOS A	0.0	0.0	0.00	0.73	59.5
Approach		105	9.0	0.058	11.0	NA	0.0	0.0	0.00	0.72	59.0
North: Jilliby Rd (N)											
8	T	4	0.0	0.043	10.1	LOS A	0.2	1.5	0.22	0.54	56.2
9	R	66	6.3	0.043	11.5	LOS A	0.2	1.5	0.22	0.67	58.2
Approach		71	6.0	0.043	11.4	NA	0.2	1.5	0.22	0.66	58.1
South West: Little Jilliby Rd (SW)											
30	L	5	0.0	0.037	8.5	LOS A	0.1	0.9	0.26	0.60	45.3
32	R	27	7.7	0.037	9.2	LOS A	0.1	0.9	0.26	0.66	45.2
Approach		33	6.5	0.037	9.0	LOS A	0.1	0.9	0.26	0.65	45.2
All Vehicles		208	7.6	0.058	10.8	NA	0.2	1.5	0.11	0.69	56.0

Wallarah 2
COAL PROJECT

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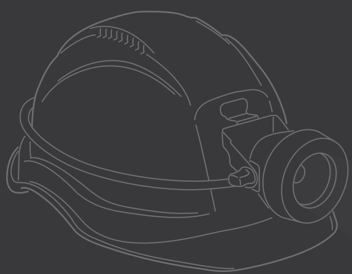
Appendix G

Statements of Heritage Impact



Hansen Bailey
ENVIRONMENTAL CONSULTANTS

STATEMENT OF HERITAGE IMPACT:

SILO AND DAIRY SHED - 2 WATAGAN FOREST DRIVE, JILLIBY, NSW 2259

The NSW Heritage Manual poses a series of questions that comprise the minimum information to form a Statement of Heritage Impact (SoHI), which is required to properly address proposals on heritage items that would result in modification to them. As the Project is to be assessed under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979*, if approved it will be exempt from the *Heritage Act 1977* and therefore SoHIs are not a requirement. However, the format used in formulating a SoHI is a useful tool for describing the heritage values and potential impacts to a site and is adopted here for this purpose.

Property location: 2 Watagan Forest Drive, Jilliby, NSW 2259

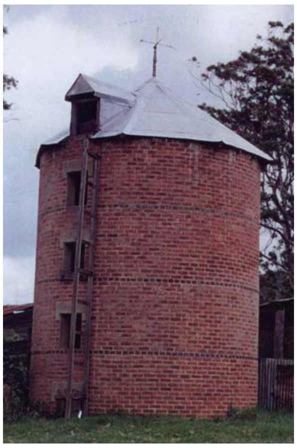
Statement of heritage significance: An early farm structure of historic value, unique in the Wyong shire and of great aesthetic significance as a visual landmark. Surviving generally intact, the silo and adjoining shed have retained their distinctive features and construction and have potential for valuable interpretation of building and farming techniques. They were substantial investments in agriculture, reflecting the importance of dairy activity in the economy of the shire.

Physical description: Brick silo, round in plan, rendered internally, and with a metal clad timber framed conical roof. A timber ladder, fixed to brickwork, grants access to five apertures - the uppermost being a dormer. Apertures, in brickwork have rendered lintels. Dairy Shed has original joinery.

Heritage listing: Wyong Local Environmental Plan 2012, Schedule 5, Item I18.

Heritage status: Local

Figure 1. View of the silo and dairy shed.



WHAT ASPECTS OF THE PROPOSAL RESPECT OR ENHANCE THE HERITAGE SIGNIFICANCE OF THE SILO AND DAIRY SHED?

Mine related impacts

The silo and dairy shed are located near the eastern boundary of the Extraction Area for the Project. As such, the only potential impact to the structure's heritage values may arise from possible mine-related subsidence.

The Project will not directly impact the structures or their landscape setting as no surface works are proposed in the vicinity.

The Project has undertaken detailed subsidence impact studies to ensure accurate information on the level of predicted impact to heritage items is known.

WHAT ASPECTS OF THE PROPOSAL COULD DETRIMENTALLY IMPACT ON THE HERITAGE SIGNIFICANCE OF THE SILO AND DAIRY SHED?

Mine related subsidence

The maximum predicted tilt for the brick and iron silo (and dairy shed) at the completion of the proposed longwalls is 7.5 mm/m (i.e. 0.8%). which represents a change in grade of 1 in 135. The silo structure comprises full masonry walls and, therefore, it is unlikely that a tilt of this magnitude would adversely affect the stability of this structure.

It is possible that the extraction of the proposed longwalls could result in cracking in the masonry walls of the silo. Any cracking would be expected to occur in the corners around the openings, possibly limited to the mortar, due to the robust construction of the structure. It would be expected that any cracking could be repaired using normal building maintenance techniques.

HAVE MORE SYMPATHETIC SOLUTIONS BEEN CONSIDERED AND DISCOUNTED? WHY?

It is assessed that there is probability that there will be no or minor impacts to the structures.

As the structures are privately owned, potential mine-related impacts will be addressed in the Subsidence Management Plan (SMP) that will formulated should the Project be approved. This SMP require consultation with the property owner and relevant regulators.

These items, having local heritage significance, should be managed under a precautionary program that maintains or enhances the item's heritage significance. This would involve a relevantly qualified heritage specialist inspecting and commenting on any remedial work to these items that may be recommended in the SMP.

It is predicted that the only proposed change to the heritage item would be:

Minor additions

How is the impact of the addition on the heritage significance of the item to be minimised?

- Should minor remediation works be required to the structure, these repairs/additions should be like for like as far as practical.

Can the additional area be located within an existing structure? If no, why not?

- The remediation works would not involve changes to the configuration of the structures.

Will the additions visually dominate the heritage item?

- If a like for like principle is followed, any remediation work should not detract from the structures' heritage values.

Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?

- No archaeological deposits are known to exist in association with these structures. The possible remediation works would not alter the building footprints.

Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?

- The SMP would ensure that a like for like principle is followed with the express aim of not altering the form, proportion or design of the structure.

REFERENCES

OEH 2013	NSW Office of the Environment and Heritage. *State Heritage Inventory*.
OzArk 2012	OzArk Environmental & Heritage Management Pty Ltd. *Historic Heritage Assessment, Wallarah 2 Coal Project.* Report prepared for Hansen Bailey Environmental Consultants on behalf of Wallarah Areas Coal Joint Venture.

STATEMENT OF HERITAGE IMPACT:

DWELLING - "BANGALOW" - NO 1187 YARRAMALONG ROAD

The NSW Heritage Manual poses a series of questions that comprise the minimum information to form a Statement of Heritage Impact (SoHI), which is required to properly address proposals on heritage items that would result in modification to them. As the Project is to be assessed under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979,* if approved it will be exempt from the *Heritage Act 1977* and therefore SoHIs are not required. However, the format used in formulating a SoHI is a useful tool for describing the heritage values and potential impacts to a site and is adopted here for this purpose.

Property location: RMB 1187 Yarramalong Road (Down Boyds Lane), Wyong Creek, NSW 2259

Statement of heritage significance: This dwelling is the second house in the Wyong study area to be considered for its historic significance for its association with the Boyd family. It is intact and aesthetically significant, being representative of early 20th Century farmhouses and permanent settlement in the area.

Physical description: Single storey house on sloping site, with access to sub-floor space, screened by lattice. Building has hipped roof and projecting bay with gable. House appears largely original and intact. Verandah to three sides features projecting corner bays not common in the study area, and partial lattice enclosure.

Heritage listing: Wyong Local Environmental Plan 2012, Schedule 5, Item I143.

Heritage status: Local

Figure 1. View of the dwelling "Bangalow".

WHAT ASPECTS OF THE PROPOSAL RESPECT OR ENHANCE THE HERITAGE SIGNIFICANCE OF THE DWELLING BANGALOW?

Mine related impacts

The dwelling Bangalow is located near the south-western boundary of the Extraction Area for the Project. As such, the only potential impact to the structure's heritage values may arise from possible mine-related subsidence.

The Project will not directly impact the structure or its landscape setting as no surface works are proposed in the vicinity.

The Project has undertaken detailed subsidence impact studies to ensure accurate information on the level of predicted impact to heritage items is known.

WHAT ASPECTS OF THE PROPOSAL COULD DETRIMENTALLY IMPACT ON THE HERITAGE SIGNIFICANCE OF THE DWELLING BANGALOW?

Mine related subsidence

The maximum predicted tilt for the dwelling "Bangalow" at the completion of the proposed longwalls is 8 mm/m (i.e. 0.8%), which represents a change in grade of 1 in 125. Tilts of around 7 mm/m can result in some minor serviceability impacts on houses, including door swings and issues with roof gutter and wet area drainage, all of which can be remediated using normal building maintenance techniques.

In this case, the predicted tilt is slightly greater than 7 mm/m and it is possible, therefore, that some more substantial remediation measures may be required, including the re-levelling of some wet areas.

The subsidence impact assessment indicates that there is a probability of approximately 95% that none or only minor impacts will occur as the result of the extraction of the proposed longwalls. There is a small probability (approximately 5%) that more substantial impacts could occur as the result of the extraction of the proposed longwalls.

HAVE MORE SYMPATHETIC SOLUTIONS BEEN CONSIDERED AND DISCOUNTED? WHY?

It is assessed that there is a 95% probability that there will be no or minor impacts to the structure.

As the structure is privately owned, potential mine-related impacts will be addressed in the Subsidence Management Plan (SMP) that will formulated should the Project be approved. This SMP will require consultation with the property owner and relevant regulators.

This item, having local heritage significance, should be managed under a precautionary program that maintains or enhances the item's heritage significance. This would involve a heritage consultant inspecting and commenting on any remedial work to these items that may be recommended in the SMP.

It is predicted that the only proposed change to the heritage item would be:

Minor additions

How is the impact of the addition on the heritage significance of the item to be minimised?

- Should minor remediation works be required to the structure, these repairs/additions should be like for like, where practical.

Can the additional area be located within an existing structure? If no, why not?

- The remediation works would not involve changes to the configuration of the structure.

Will the additions visually dominate the heritage item?

- If a like for like principle is followed, any remediation work should not detract from the structure's heritage values.

Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?

- No known archaeological deposits are known to exist in association with this structure. The possible remediation works would not alter the building footprint.

Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?

- The SMP would ensure that a like for like principle is followed with the express aim of not altering the form, proportion or design of the structure.

REFERENCES

OEH 2013 — NSW Office of the Environment and Heritage. *State Heritage Inventory*.

OzArk 2012 — OzArk Environmental & Heritage Management Pty Ltd. *Historic Heritage Assessment, Wallarah 2 Coal Project.* Report prepared for Hansen Bailey Environmental Consultants on behalf of Wallarah Areas Coal Joint Venture.

Statement of Heritage Impact:

Bridge - Little Jilliby Road

The NSW Heritage Manual poses a series of questions that comprise the minimum information to form a Statement of Heritage Impact (SoHI), which is required to properly address proposals on heritage items that would result in modification to them. As the Project is to be assessed under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979*, if approved it will be exempt from the *Heritage Act 1977* and therefore SoHIs are not a requirement. However, the format used in formulating a SoHI is a useful tool for describing the heritage values and potential impacts to a site and is adopted here for this purpose.

Property location: Little Jilliby Road, crossing Litlle Jilliby Jilliby Creek.

Statement of heritage significance: Built in 1894 (*Australian Town and Country Journal NSW*, Saturday 21 July 1894, p. 14), the bridge represents a form of infrastructure that was important to the residential and industrial growth of the area in the late nineteenth century. The bridge is a common construction type in itself but represents a class of items that collectively have the ability to inform of the development of infrastructure through regional areas of NSW at this time. Although this bridge is common on a state level, most bridges locally have been upgraded so that all original elements have been removed.

Physical description: Steel reinforcements have substantially detracted from the aesthetic significance of the item and many of the timbers forming the bridge's surface have been replaced. Additionally, some of the original timber piling has been removed, probably as part of the reinforcements. However, the majority of the original elements of the bridge remain intact and it very much retains the overall form of the structure built at the end of the nineteenth century.

Statement of Heritage Significance: Contained in *Historic Heritage Assessment, Wallarah 2 Coal Project* (December 2012). Report prepared by OzArk Environmental & Heritage Management Pty Ltd for Hansen Bailey Environmental Consultants on behalf of Wyong Areas Coal Joint Venture.

Heritage status: Local

Figure 1. View of the bridge on Little Jilliby Road.

WHAT ASPECTS OF THE PROPOSAL RESPECT OR ENHANCE THE HERITAGE SIGNIFICANCE OF THE BRIDGE - LITTLE JILLIBY ROAD?

Mine related impacts

The bridge is located within the Subsidence Impact Limit for the proposed Project. As such, the only potential impact to the structure's heritage values may arise from possible mine-related subsidence.

The Project will not directly impact the structure or its landscape setting as no surface works are proposed in the vicinity.

The Project has undertaken detailed subsidence impact studies to ensure accurate information on the level of predicted impact to heritage items is known.

WHAT ASPECTS OF THE PROPOSAL COULD DETRIMENTALLY IMPACT ON THE HERITAGE SIGNIFICANCE OF THE BRIDGE - LITTLE JILLIBY ROAD?

Mine related subsidence

The timber bridge over Little Jilliby Jilliby Creek is located approximately 200 metres south of the proposed Longwall 16N, at its closest point to the proposed longwalls.

At this distance, the bridge is predicted to experience around 50 mm of subsidence. While it is possible that the bridge could experience subsidence slightly greater than 50 mm, as the result of far-field vertical movements, it would not be expected to experience any significant tilts, curvatures or strains.

HAVE MORE SYMPATHETIC SOLUTIONS BEEN CONSIDERED AND DISCOUNTED? WHY?

It is assessed that there is probability that there will be no or minor impacts to the structures (at this location there is a 90% chance of no or minor impacts).

As the structure is publicly owned, potential mine-related impacts will be addressed in the Subsidence Management Plan (SMP) that will formulated should the Project be approved. This SMP will require consultation with the owner (Wyong Shire Council) and possibly the NSW Heritage Office.

This item, having local heritage significance, should be managed under a precautionary program that maintains or enhances the item's heritage significance. This would involve a heritage consultant inspecting and commenting on any remedial work to these items that may be recommended in the SMP.

It is predicted that the only proposed change to the heritage item would be:

Minor additions

How is the impact of the addition on the heritage significance of the item to be minimised?

- Should minor remediation works be required to the structure, these repairs/additions should be like for like, where practical.

Can the additional area be located within an existing structure? If no, why not?

- The remediation works would not involve changes to the configuration of the structure.

Will the additions visually dominate the heritage item?

- If a like for like principle is followed, any remediation work should not detract from the structure's heritage values.

Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?

- No known archaeological deposits are known to exist in association with this structure. The possible remediation works would not alter the structure's footprint.

Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?

- The SMP would ensure that a like for like principle is followed with the express aim of not altering the form, proportion or design of the structure.

REFERENCES

OzArk 2012 OzArk Environmental & Heritage Management Pty Ltd. *Historic Heritage Assessment, Wallarah 2 Coal Project.* Report prepared for Hansen Bailey Environmental Consultants on behalf of Wallarah Areas Coal Joint Venture.

Wallarah 2
COAL PROJECT

Wallarah 2 Coal Project

Response to Submissions

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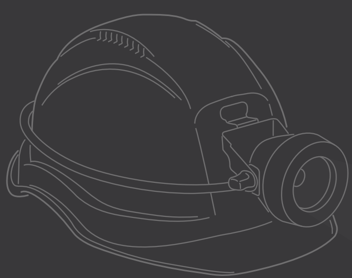
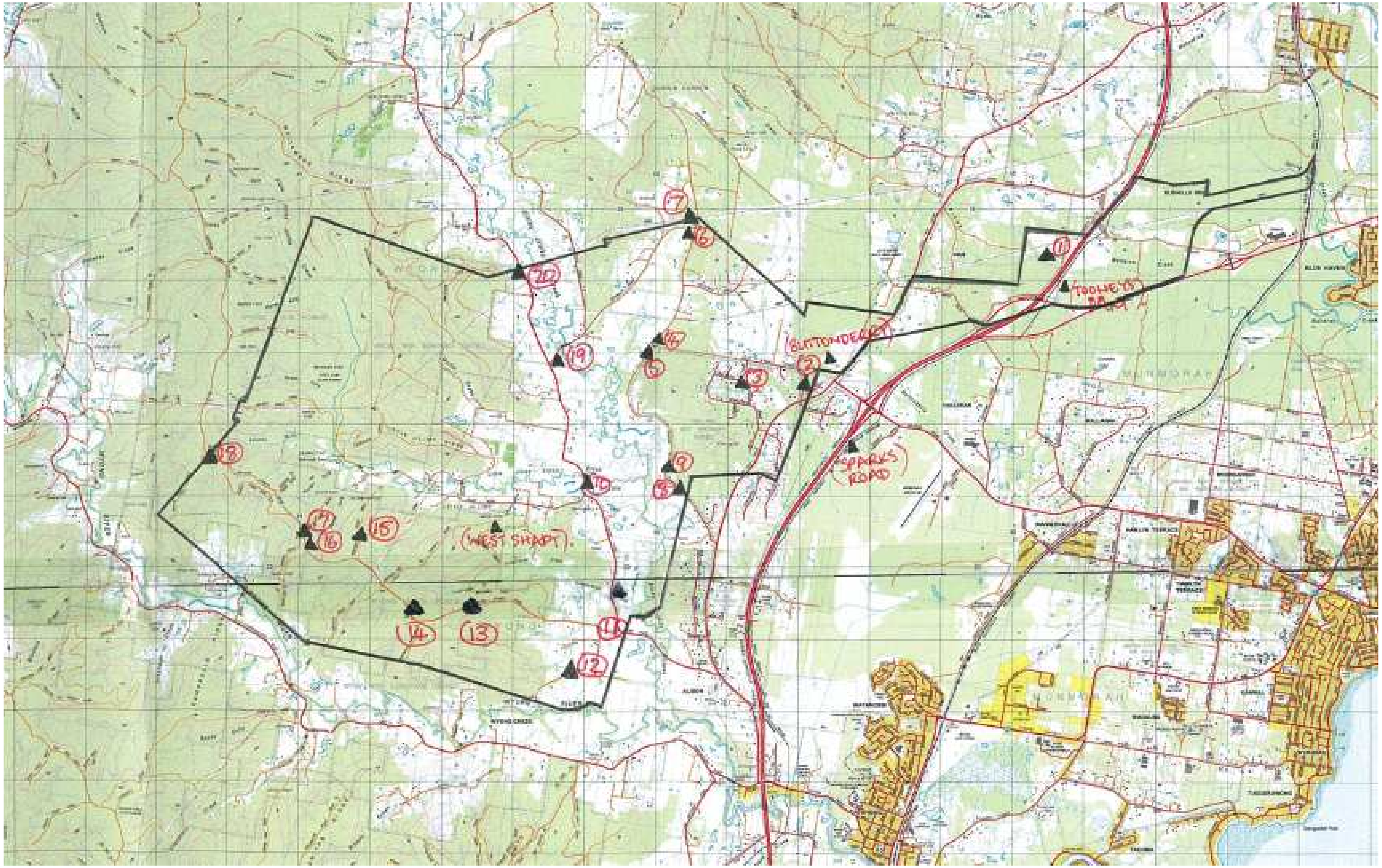
Appendix H

Soil Profile and Land Capability Sheets



Hansen Bailey
ENVIRONMENTAL CONSULTANTS



Based on the 1:25,000 Dooralong Topographic and Orthophoto Map, Land and Property Information NSW (2002).

ENVIRONMENTAL EARTH SCIENCES		Title: **Approximately Soil Profile Locations**	
		Location: **Wallarah 2 Project Site**	
Client: **Hansen Bailey**			Job No: **113056**
Drawn By: **NC**	Scale: **N.T.S.**		Source: **LPI, 2002**
Proj Man: **NC**	Date: **July 2013**		**Figure 1**

(1)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: Unknown

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 21

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	355355	MGA Northing:	6324610

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 09, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	4		

SOIL AND MAP CODES:

Geology Map Code:	Rnu	Soil Map Code:	gc
Aust. Soil Classification:			
Great Soil Group:	Soloth (Solod)	Northcote PPF:	Dy3.41
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	6%, measured		
Elevation:	40 m	Aspect:	south east

LANDFORM:

Site Morphology:	lower slope	Site Process:	40 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-quartz,sandstone-lithic	Substrate:	sandstone-quartz,sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	strong		
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	woodland grass u'storey
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:	85	Site Disturbance:	limited clearing
Current Condition (s):		Expected Dry Condition:	hardsetting

LAND USE:

Site:	volun./native pasture	General Area:	volun./native pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	high	Run-off:	low
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: moderate

SALINITY: no salting evident

FIELD NOTES: Sampled.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:		Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm)								
Type:	ironstone	Amount:		Distribution:		Orientation:		Weathering:	
Shape:									
Size:									

LAYER 1 A1 horizon
Depth: 00.00 - 00.05

TEXTURE: coarse sandy loam

COLOUR:
Moist: dark brown (10YR 3/3)
Dry:

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	
Dominant Peds:	10 - 20 mm		
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	ironstone	Amount:		Distribution:		Orientation:		Weathering:	
Shape:									
Size:									
Type:	sedimentary	Amount:	few (2-10%)	Distribution:		Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm)								

PANS:
Type: not evident Cementation: Continuity: Structure:

CONSISTENCE:
Degree of Plasticity: Stickiness: slightly sticky
Texture Modifier: no change Disruptive Test: moderately weak force
Shearing Test: Toughness:

SOIL WATER STATUS: dry

SOIL ERODIBILTY: high

SAMPLE TAKEN: unspecified

LAYER NOTES: A1 absent in some places.
Water Table: none

BOUNDARY:
Distinctiveness: abrupt (5-20 mm) Shape: smooth

LAYER 2 A2 horizon
Depth: 00.05 - 00.27

TEXTURE: coarse sandy loam

COLOUR:
Moist: brown (dull yellowish brown) (10YR 5/3)
Dry: light grey (dull yellow orange) (10YR 7/2)

STRUCTURE:
Grade of Pedality: massive Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:
Type: ironstone Amount: Distribution: Orientation: Weathering:
Shape:
Size:
Type: sedimentary Amount: few (2-10%) Distribution: Orientation: Weathering: weakly weathered
Shape: sub-rounded,sub-angular
Size: fine gravel (2-6 mm),gravel (6-20 mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

CONSISTENCE:
Degree of Plasticity: Stickiness: slightly sticky
Texture Modifier: no change Disruptive Test: moderately strong force
Shearing Test: Toughness:

SOIL WATER STATUS: dry

SAMPLE unspecified

TAKEN:

LAYER NOTES: A2 thicker on footslopes are hardsettingand bleached.
Water Table: perched

BOUNDARY:
Distinctiveness: abrupt (5-20 mm) Shape: wavy

LAYER 3 B2 horizon
Depth: 00.27 - 00.78

TEXTURE: medium clay

COLOUR:
Moist: yellowish brown (10YR 5/8)
Dry:

MOTTLES:
Dominant Mottles: Type: unspecified Colour: grey Contrast: distinct Abundance: 2% - 10%

STRUCTURE:
Grade of Pedality: strong pedality Fabric: rough-faced peds
Dominant Peds: 20 - 50 mm
Subdominant Peds: 10 - 20 mm
Artificial Aggregates:

COARSE FRAGMENTS:
Type: ironstone Amount: Distribution: Orientation: Weathering:
Shape:
Size:
Type: sedimentary Amount: few (2-10%) Distribution: Orientation: Weathering: weakly weathered
Shape: sub-rounded,sub-angular
Size: fine gravel (2-6 mm),gravel (6-20 mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

CRACKS AND MACROPORES:
Cracks
<5 mm width: 5-10 mm width: evident 10-20 mm width: 20-50 mm width: >50 mm width:
Macropores
<1 mm size: 1-2 mm size: 2-5 mm size: >5 mm size:

CONSISTENCE:
Degree of Plasticity: Stickiness: slightly sticky
Texture Modifier: no change Disruptive Test: moderately strong force
Shearing Test: Toughness:

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: low

SAMPLE TAKEN: unspecified

LAYER NOTES: B2 high in silt. Sub dominant peds 5-20mm. Very little fine sand present.
Ped Porosity: porous

Water Table: none

BOUNDARY:
Distinctiveness: gradual (50-100 mm) Shape:

LAYER 4 B3 horizon
Depth: 00.78 - 00.88

TEXTURE: medium clay

COLOUR:
Moist: light grey (10YR 7/1)
Dry:

COARSE FRAGMENTS:

Type:	ironstone	Amount:		Distribution:	Orientation:	Weathering:	
Shape:							
Size:							
Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	5-10 mm width:	evident	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:	1-2 mm size:		2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately strong force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moist

SOIL ERODIBILTY: low

SAMPLE TAKEN: unspecified

LAYER NOTES: *** Layer depth given as +0.78m.
Lower depth printed here is nominal.
Very little fine sand present.
Water Table: none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

(2)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: Unknown

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 17

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	352125	MGA Northing:	6322660

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 09, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:	Rnp	Soil Map Code:	
Aust. Soil Classification:	Kurosol, Yellow		
Great Soil Group:	Yellow Podzolic Soil	Northcote PPF:	Dy5.11
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	15%, measured		
Elevation:	60 m	Aspect:	west

LANDFORM:

Site Morphology:	upper slope	Site Process:	60 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-lithic	Substrate:	sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	strong		
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	dry sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:	90	Site Disturbance:	extensive clearing
Current Condition (s):	soft	Expected Dry Condition:	

LAND USE:

Site:	timber/scrub/unused	General Area:	volun./native pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	low	Run-off:	high
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: slight

SALINITY: no salting evident

FIELD NOTES: Sandstone on Patonga. Brown stringy barkand spotted gum. Sand fraction is medium.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:		Orientation:	Weathering:	
Shape:								
Size:								
Type:	sedimentary	Amount:	few (2-10%)	Distribution:		Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular							
Size:	gravel (6-20 mm),coarse gravel (20-60 mm)							

LAYER 1 A horizon
Depth: 00.00 - 00.25

TEXTURE: coarse sandy loam

COLOUR:
Moist: brown (7.5YR 4/3)
Dry:

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm		
Subdominant Peds:	5 - 10 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:		Orientation:	Weathering:	
Shape:								
Size:								
Type:	sedimentary	Amount:	very few (< 2%)	Distribution:		Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular							
Size:	gravel (6-20 mm),coarse gravel (20-60 mm)							

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately weak force
Shearing Test:		Toughness:	

SOIL WATER STATUS: dry

SOIL ERODIBILTY: high

Ped Porosity: porous
Root Distribution: in ped & ex ped
Water Table: none

BOUNDARY:

Distinctiveness: abrupt (5-20 mm) Shape:

LAYER 2 B horizon
Depth: 00.25 - 00.83

TEXTURE: medium clay

COLOUR:

Moist: yellowish brown (10YR 5/8)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	orange	Contrast:	faint	Abundance:	20% - 50%
Subdominant Mottles:	Type:	unspecified	Colour:	grey	Contrast:	distinct	Abundance:	10% - 20%

FIELD CHEMICAL TESTS:

pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:		Fabric:	rough-faced peds
Dominant Peds:	20 - 50 mm		
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:		Orientation:		Weathering:	
Shape:									
Size:									
Type:	sedimentary	Amount:	very few (< 2%)	Distribution:		Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular								
Size:	gravel (6-20 mm),coarse gravel (20-60 mm)								

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL WATER STATUS:	dry
Ped Porosity:	porous
Root Distribution:	in ped & ex ped
Water Table:	none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

3

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: SANDRA RD, NEW HOUSING SUB-DIVISION

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 18

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	351175	MGA Northing:	6322760

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 09, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	4		

SOIL AND MAP CODES:

Geology Map Code:	Rnu	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:	Soloth (Solod)	Northcote PPF:	Dy5.41
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	7%, measured		
Elevation:	22 m	Aspect:	north east

LANDFORM:

Site Morphology:	mid-slope	Site Process:	22 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-quartz,sandstone-lithic	Substrate:	sandstone-quartz,sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	strong		
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	woodland grass u'storey
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	
Species:	Angophora costata (sydney red gum)
Species:	Eucalyptus baxteri (brown stringybark)

SITE CONDITION:

Ground Cover %:	70	Site Disturbance:	limited clearing
Current Condition (s):	loose	Expected Dry Condition:	

LAND USE:

Site: General Area: other

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	moderate	Run-off:	moderate
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:

Wind Erosion: none,
Sheet Erosion: moderate, active

EROSION HAZARD: moderate

SALINITY: no salting evident

FIELD NOTES: Typ. Tuggerah sst. Bedr. 1.50m on lower slope. White sandy wash up to 3cm over profile. Rusty root mott in A2 & B hor. grass u'storey. D hor present below C.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type: sedimentary Amount: very few (< 2%) Distribution: Orientation: reoriented Weathering: weakly weathered
Shape: sub-rounded,sub-angular
Size: fine gravel (2-6 mm),gravel (6-20 mm)

LAYER 1 A1 horizon
Depth: 00.00 - 00.12

TEXTURE: coarse loamy sand

COLOUR:

Moist: brown (7.5YR 4/3)
Dry:

MOTTLES:

Dominant Mottles: Type: unspecified Colour: orange Contrast: prominent Abundance: 10% - 20%

FIELD CHEMICAL TESTS:

pH: 4.5 (Raupach)

STRUCTURE:

Grade of Pedality: massive Fabric: sandy
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type: sedimentary Amount: very few (< 2%) Distribution: dispersed Orientation: reoriented Weathering: weakly weathered
Shape: sub-rounded
Size: fine gravel (2-6 mm),gravel (6-20

mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

CRACKS AND MACROPORES:
Cracks
<5 mm width: evident 5-10 mm width: 10-20 mm width: 20-50 mm width: >50 mm width:
Macropores
<1 mm size: 1-2 mm size: 2-5 mm size: >5 mm size:

CONSISTENCE:
Degree of Plasticity: Stickiness:
Texture Modifier: no change Disruptive Test: moderately weak force
Shearing Test: Toughness:

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: high
Water Table: none

BOUNDARY:
Distinctiveness: gradual (50-100 mm) Shape: smooth

LAYER 2 A2 horizon
Depth: 00.12 - 00.35

TEXTURE: coarse clayey sand

COLOUR:
Moist: pale brown (dull yellow orange) (10YR 6/3)
Dry: light grey (dull yellow orange) (10YR 7/2)

MOTTLES:
Dominant Mottles: Type: unspecified Colour: orange Contrast: prominent Abundance: 10% - 20%

FIELD CHEMICAL TESTS:
pH: 5 (Raupach)

STRUCTURE:
Grade of Pedality: massive Fabric: sandy
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:
Type: sedimentary Amount: very few (< 2%) Distribution: dispersed Orientation: reoriented Weathering: weakly weathered
Shape: sub-rounded
Size: fine gravel (2-6 mm),gravel (6-20 mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

CRACKS AND MACROPORES:
Cracks
<5 mm width: evident 5-10 mm width: 10-20 mm width: 20-50 mm width: >50 mm width:
Macropores
<1 mm size: 1-2 mm size: 2-5 mm size: >5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	
Texture Modifier:	no change	Disruptive Test:	moderately weak force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

Water Table: none

BOUNDARY:

Distinctiveness:	abrupt (5-20 mm)	Shape:	wavy

LAYER 3 B2 horizon

Depth: 00.35 - 00.70

TEXTURE: medium clay

COLOUR:

Moist: brownish yellow (bright yellowish brown) (10YR 6/6)

Dry:

FIELD CHEMICAL TESTS:

pH: 4.5 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	rough-faced peds
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:		Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded								
Size:	gravel (6-20 mm),coarse gravel (20-60 mm)								

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks									
<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	
Macropores									
<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	
Texture Modifier:	no change	Disruptive Test:	moderately strong force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: low

LAYER NOTES: B horizon slakes.

Ped Porosity: porous

Water Table: none

BOUNDARY:
Distinctiveness: gradual (50-100 mm) Shape:

LAYER 4 C horizon
Depth: 00.70 - 01.20

TEXTURE: medium clay

COLOUR:
Moist: light brownish grey (greyish yellow brown) (10YR 6/2)
Dry:

MOTTLES:

	Type:		Colour:		Contrast:		Abundance:
Dominant Mottles:	Type:	unspecified	Colour:		Contrast:	prominent	Abundance: 10% - 20%
Subdominant Mottles:	Type:	unspecified	Colour:	red	Contrast:	prominent	Abundance: 2% - 10%

STRUCTURE:
Grade of Pedality: massive Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:
Type: sedimentary Amount: Distribution: Orientation: Weathering: weakly weathered
Shape: sub-rounded
Size: gravel (6-20 mm),coarse gravel (20-60 mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

CRACKS AND MACROPORES:
Cracks
<5 mm width: evident 5-10 mm width: 10-20 mm width: 20-50 mm width: >50 mm width:
Macropores
<1 mm size: 1-2 mm size: 2-5 mm size: >5 mm size:

CONSISTENCE:
Degree of Plasticity: Stickiness:
Texture Modifier: increase < 2 Grades Disruptive Test:
Shearing Test: Toughness:

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: low

LAYER NOTES: Horizon also given as B3, probably C; nostructure, sugary texture. This horizon like B3 in profile 19.
Water Table: none

LAYER 99 R horizon
Depth: 01.20 -

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

(4)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: PAST COTTSLOE RD AND OVERHEAD WIRES

SURVEY: LANDSCAPE MODELLING - DOORALONG (1000696)

PROFILE: 12

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	350205	MGA Northing:	6323290

SITE DETAILS:

Described by:	Rachel Dewar	Profile Date:	June 02, 1995
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	
Aust. Soil Classification:	Kandosol, Yellow, Mottled, Mottled, clay loamy		
Great Soil Group:	Yellow Earth	Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	4%, estimated		
Elevation:	20 m	Aspect:	west

LANDFORM:

Site Morphology:	lower slope	Site Process:	20 m
Slope Morphology:		Local Relief:	extremely low (< 9m)
Landform Pattern:	rises	Landform Element:	footslope
Microrelief			
Pos in LF Element:		Plan Curvature:	

VEGETATION:

Vegetation Community:	woodland shrub u'storey
Growth Form(s):	tree,fern/cycad,heath shrub,sod grass
Crown Separation Ratio:	
Upper Stratum Height:	12 - < 20 m

SITE CONDITION:

Ground Cover %:		Site Disturbance:	extensive clearing
Current Condition (s):	firm	Expected Dry Condition:	hardsetting

LAND USE:

Site:	timber/scrub/unused	General Area:	National/State Parks,timber/scrub/unused,improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	very high	Run-off:	low
Permeability:	moderately permeable	Profile Drainage:	poorly drained
Free Water pH:		Free Water Salinity:	

EROSION:
Sheet Erosion: moderate, partly stabilised

EROSION HAZARD: high

SALINITY: no salting evident

FIELD NOTES: Er unit.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 Surf. horizon
Depth: 00.00 - 00.00

LAYER 1 A2 horizon
Depth: 00.00 - 00.19

TEXTURE: light sandy clay loam

COLOUR:
Moist: brown (dull yellowish brown) (10YR 4/3)
Dry: brown (dull yellowish brown) (10YR 4/3)

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	yellow	Contrast:	distinct	Abundance:	10% - 20%

STRUCTURE:

Grade of Pedality:	massive	Fabric:	earthy
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not identified	Amount:	common (10-20%)	Distribution:		Orientation:		Weathering:	
Shape:	sub-angular								
Size:	fine gravel (2-6 mm)								

SOIL FAUNA:

Activity:	moderate (10 - 50%)	Type:	ant channelling

CONSISTENCE:

Degree of Plasticity:	non plastic	Stickiness:	slightly sticky		
Texture Modifier:		Disruptive Test:	very weak force		
Shearing Test:	crumbly	Toughness:			

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	aggregates slake	Bolus Formation:		Field Dilatency:	

SAMPLE TAKEN: disturbed

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	wavy

LAYER 2 B2 horizon
Depth: 00.19 - 00.50

TEXTURE: light medium sandy clay

COLOUR:

Moist: dark yellowish brown (brown) (10YR 4/4)
Dry: dark yellowish brown (brown) (10YR 4/4)

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	yellow	Contrast:	distinct	Abundance:	20% - 50%

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm,lenticular		
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not identified	Amount:	common (10-20%)	Distribution:		Orientation:		Weathering:
Shape:	sub-angular							
Size:	fine gravel (2-6 mm)							

CONSISTENCE:

Degree of Plasticity:		Stickiness:	
Texture Modifier:		Disruptive Test:	moderately weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	aggregates slake	Bolus Formation:		Field Dilatency:	

SAMPLE TAKEN: disturbed

LAYER NOTES: Layer continues.

LABORATORY TESTS:
Sample No:
Depth: 00.19 - 00.19 m
Test Results:

N518.99 [Volume expansion]:	6.0
N517.99_GR [PSA gravel - SDS]:	7
N513.98 [Emerson aggregate test SCS method]:	2(1)
N504.02_FC [Field Capacity, SWC pressure plate]:	27.8
N515.99 [Wind erodible aggregate percentage]:	86
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	9.1
N6A1 [Organic carbon - Walkley & Black]:	.37
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	3.9
N4A1 [pH of 1:5 soil/water suspension]:	5.3
N3A1 [EC of 1:5 soil/water extract]:	0.03
N550.02 [USCS - field]:	CL
N514.99 [Dispersion percentage]:	43
N517.99_CS [PSA coarse sand - SDS]:	6
N517.99_CL [PSA clay - SDS]:	22
N517.99_FS [PSA fine sand - SDS]:	46
N517.99_SI [PSA silt - SDS]:	19

Sample No:
Depth: 00.00 - 00.00 m
Test Results:

N518.99 [Volume expansion]:	2.0
N514.99 [Dispersion percentage]:	40
N550.02 [USCS - field]:	ML
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	6.9
N504.02_FC [Field Capacity, SWC pressure plate]:	23.8
N6A1 [Organic carbon - Walkley & Black]:	1.22
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	3.8
N4A1 [pH of 1:5 soil/water suspension]:	5.1
N3A1 [EC of 1:5 soil/water extract]:	0.03
N515.99 [Wind erodible aggregate percentage]:	56
N513.98 [Emerson aggregate test SCS method]:	8
N517.99_GR [PSA gravel - SDS]:	11
N517.99_SI [PSA silt - SDS]:	13
N517.99_FS [PSA fine sand - SDS]:	54
N517.99_CS [PSA coarse sand - SDS]:	9
N517.99_CL [PSA clay - SDS]:	13

For information on laboratory test data and units of measure, please see the SPADE Help page

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5

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: Unknown

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 15

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	350005	MGA Northing:	6323190

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 08, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:	Rnu	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:	Grey-brown Podzolic Soil	Northcote PPF:	Db2.21
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	10%, measured		
Elevation:	15 m	Aspect:	north west

LANDFORM:

Site Morphology:	lower slope	Site Process:	15 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-lithic	Substrate:	sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	dry sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:	90	Site Disturbance:	
Current Condition (s):		Expected Dry Condition:	hardsetting

LAND USE:

Site:	logged native forest	General Area:	improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	moderate	Run-off:	moderate
Permeability:		Profile Drainage:	imperfectly drained
Free Water pH:		Free Water Salinity:	

EROSION:

Wind Erosion: none,
Sheet Erosion: minor, partly stabilised

EROSION HAZARD: moderate

FIELD NOTES: Close to boundary with Rnp (near vertic al). A1 horizon SL is absent from batterFactual key just off Dy. Sand fraction is medium.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	many (20-50%)	Distribution:		Orientation:	Weathering:	weakly weathered
Shape:	angular,sub-angular							
Size:	fine gravel (2-6 mm),gravel (6-20 mm)							

LAYER 1 A2 horizon
Depth: 00.00 - 00.21

TEXTURE: coarse sandy loam

COLOUR:

Moist: brown (dull yellowish brown) (10YR 4/3)
Dry: pale brown (dull yellow orange) (10YR 6/3)

STRUCTURE:

Grade of Pedality:	massive	Fabric:	earthy
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	common (10-20%)	Distribution:		Orientation:	Weathering:	weakly weathered
Shape:	angular,sub-angular							
Size:	fine gravel (2-6 mm),gravel (6-20 mm)							

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately firm force
Shearing Test:		Toughness:	

SOIL WATER STATUS: dry

SOIL ERODIBILTY: moderate

LAYER NOTES: Hardsetting.

Water Table: none

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	wavy

LAYER 2 B horizon
Depth: 00.21 - 00.60

TEXTURE: fine medium sandy clay

COLOUR:

Moist: dark yellowish brown (brown) (10YR 4/6)

Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	brown	Contrast:	prominent	Abundance:	20% - 50%
Subdominant Mottles:	Type:	unspecified	Colour:	grey	Contrast:	prominent	Abundance:	2% - 10%

STRUCTURE:

Grade of Pedality:		Fabric:	rough-faced peds
Dominant Peds:	20 - 50 mm		
Subdominant Peds:			
Artificial Aggregates:			

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks									
<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	
Macropores									
<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately firm force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

LAYER NOTES: Top of B earthy but majority pedal.

Ped Porosity: porous
Water Table: none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

6

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: 4KM FR. DICKSON & MANDALONG RD INT.SEC

SURVEY: LANDSCAPE MODELLING - DOORALONG (1000696)

PROFILE: 11

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	350480	MGA Northing:	6324690

SITE DETAILS:

Described by:	Rachel Dewar	Profile Date:	June 02, 1995
Nature of Exposure:	other	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	
Aust. Soil Classification:	Kandosol, Yellow, Mottled, Mottled, clay loamy		
Great Soil Group:	Yellow Earth	Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	5%, estimated		
Elevation:	20 m	Aspect:	west

LANDFORM:

Site Morphology:	lower slope	Site Process:	20 m
Slope Morphology:		Local Relief:	very low (9-30 m)
Landform Pattern:	rises	Landform Element:	footslope
Microrelief			
Pos in LF Element:		Plan Curvature:	

VEGETATION:

Vegetation Community:	woodland shrub u'storey
Growth Form(s):	tree,shrub,sod grass
Crown Separation Ratio:	
Upper Stratum Height:	12 - < 20 m

SITE CONDITION:

Ground Cover %:		Site Disturbance:	limited clearing
Current Condition (s):	soft	Expected Dry Condition:	hardsetting

LAND USE:

Site:	timber/scrub/unused	General Area:	National/State Parks,timber/scrub/unused,improved

pasture

HYDROLOGY:

Presence of Free Water:	below soil surface	Free Water Depth:	.8
Run-on:	high	Run-off:	low
Permeability:	moderately permeable	Profile Drainage:	poorly drained
Free Water pH:		Free Water Salinity:	

EROSION HAZARD: high

SALINITY: no salting evident

FIELD NOTES: Er unit. Tiling spade west to road.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 Surf. horizon
Depth: 00.00 - 00.00

LAYER 1 A2 horizon
Depth: 00.00 - 00.30

TEXTURE: light sandy clay loam

COLOUR:
Moist: dark greyish brown (greyish yellow brown) (10YR 4/2)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	yellow	Contrast:	distinct	Abundance:	20% - 50%

STRUCTURE:

Grade of Pedality:	massive	Fabric:	earthy
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:		Distribution:	Orientation:	Weathering:	
Shape:							
Size:							

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:		Disruptive Test:	very weak force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moist

ERODIBILITY TESTS:

Crumb Test:	aggregates disperse	Bolus Formation:		Field Dilatency:	

SAMPLE TAKEN: disturbed

BOUNDARY:
Distinctiveness: abrupt (5-20 mm) Shape: smooth

LAYER 2 B horizon
Depth: 00.30 - 00.50

TEXTURE: light medium sandy clay

COLOUR:
Moist: yellowish brown (10YR 5/6)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	grey	Contrast:	prominent	Abundance:	20% - 50%
Subdominant Mottles:	Type:	unspecified	Colour:	red	Contrast:	prominent	Abundance:	10% - 20%

STRUCTURE:
Grade of Pedality: weak pedality Fabric: rough-faced peds
Dominant Peds: ,sub-angular blocky
Subdominant Peds: 2 - 5 mm
Artificial Aggregates:

COARSE FRAGMENTS:
Type: not evident Amount: Distribution: Orientation: Weathering:
Shape:
Size:

CONSISTENCE:
Degree of Plasticity: very plastic Stickiness: moderately sticky
Texture Modifier: Disruptive Test: moderately firm force
Shearing Test: labile Toughness:

SOIL WATER STATUS: moist

ERODIBILITY TESTS:
Crumb Test: aggregates slake Bolus Formation: Field Dilatency:

SAMPLE TAKEN: disturbed

LAYER NOTES: Layer continues.

LABORATORY TESTS:
Sample No:
Depth: 00.30 - 00.30 m
Test Results:

N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	20.1
N3A1 [EC of 1:5 soil/water extract]:	0.11
N504.02_FC [Field Capacity, SWC pressure plate]:	44.4
N550.02 [USCS - field]:	CH
N513.98 [Emerson aggregate test SCS method]:	3(2)
N514.99 [Dispersion percentage]:	58
N517.99_CS [PSA coarse sand - SDS]:	4

N517.99_FS [PSA fine sand - SDS]:	33
N517.99_SI [PSA silt - SDS]:	15
N517.99_CL [PSA clay - SDS]:	48
N518.01 [Linear shrinkage]:	13.0
N518.99 [Volume expansion]:	12.0
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	3.8
N6A1 [Organic carbon - Walkley & Black]:	.37
N4A1 [pH of 1:5 soil/water suspension]:	5.2
N515.99 [Wind erodible aggregate percentage]:	99
Sample No:	
Depth:	00.00 - 00.00 m
Test Results:	
N518.99 [Volume expansion]:	10.0
N6A1 [Organic carbon - Walkley & Black]:	.56
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	4.2
N4A1 [pH of 1:5 soil/water suspension]:	5.3
N3A1 [EC of 1:5 soil/water extract]:	0.11
N515.99 [Wind erodible aggregate percentage]:	71
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	4.6
N504.02_FC [Field Capacity, SWC pressure plate]:	23.1
N550.02 [USCS - field]:	ML
N513.98 [Emerson aggregate test SCS method]:	2(1)
N517.99_CL [PSA clay - SDS]:	9
N517.99_SI [PSA silt - SDS]:	14
N517.99_FS [PSA fine sand - SDS]:	59
N514.99 [Dispersion percentage]:	50
N517.99_CS [PSA coarse sand - SDS]:	18
N518.01 [Linear shrinkage]:	.5

For information on laboratory test data and units of measure, please see the SPADE Help page

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: DURREN RD NEAR MT YAMBO

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 50

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	350405	MGA Northing:	6324990

SITE DETAILS:

Described by:	Peter Tille	Profile Date:	January 18, 1984
Nature of Exposure:		Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:	Rnp	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:		Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	%, estimated		
Elevation:	m	Aspect:	

VEGETATION:

Vegetation Community:
Growth Form(s):
Crown Separation Ratio:
Upper Stratum Height:

SITE CONDITION:

Ground Cover %:		Site Disturbance:	
Current Condition (s):		Expected Dry Condition:	hardsetting

FIELD NOTES: Geology map code may be Rnu Tuggerah. Peter Tille old site 92 observation.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 1 A2 horizon
Depth: 00.00 - 00.30

TEXTURE: fine sandy clay loam

STRUCTURE:
Grade of Pedality: weak pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

LAYER NOTES: Apedal massive to weakly pedal structure

LAYER 2 B horizon
Depth: 00.30 - 00.40

TEXTURE: medium clay

COLOUR:
Moist: light yellowish brown (dull yellow orange) (10YR 6/4)
Dry:

MOTTLES:

Dominant Mottles:	Type: unspecified	Colour: red	Contrast: prominent	Abundance: < 2%
Subdominant Mottles:	Type: unspecified	Colour: orange	Contrast: distinct	Abundance: < 2%

STRUCTURE:
Grade of Pedality: Fabric:
Dominant Peds: 20 - 50 mm
Subdominant Peds:
Artificial Aggregates:

LAYER NOTES: *** Layer depth not given. Lower depth printed here is nominal. Dominant ped 10-50mm in size and also subangular blocky.

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

(8)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: 2KM PAST COTTESLOE RD, LHS GOING SOUTH

SURVEY: LANDSCAPE MODELLING - DOORALONG (1000696)

PROFILE: 13

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	350355	MGA Northing:	6321115

SITE DETAILS:

Described by:	Rachel Dewar	Profile Date:	June 02, 1995
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:		Soil Map Code:	
Aust. Soil Classification:	Kandosol, Yellow, Mottled, Mottled, clay loamy		
Great Soil Group:		Northcote PPF:	
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	5%, estimated		
Elevation:	20 m	Aspect:	west

LANDFORM:

Site Morphology:	lower slope	Site Process:	20 m
Slope Morphology:		Local Relief:	very low (9-30 m)
Landform Pattern:	rises	Landform Element:	footslope
Microrelief			
Pos in LF Element:		Plan Curvature:	

VEGETATION:

Vegetation Community:	woodland shrub u'storey
Growth Form(s):	tree,sod grass
Crown Separation Ratio:	
Upper Stratum Height:	12 - < 20 m

SITE CONDITION:

Ground Cover %:		Site Disturbance:	limited clearing
Current Condition (s):	firm	Expected Dry Condition:	hardsetting

LAND USE:

Site:	timber/scrub/unused	General Area:	National/State Parks,timber/scrub/unused,cropping

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	high	Run-off:	low
Permeability:	moderately permeable	Profile Drainage:	poorly drained
Free Water pH:		Free Water Salinity:	

EROSION:
Sheet Erosion: none, partly stabilised

EROSION HAZARD: high

SALINITY: no salting evident

FIELD NOTES: er unit.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 Surf. horizon
Depth: 00.00 - 00.00

LAYER 1 A2 horizon
Depth: 00.00 - 00.30

TEXTURE: light silty clay loam

COLOUR:
Moist: brown (dull yellowish brown) (10YR 4/3)
Dry: brown (dull yellowish brown) (10YR 4/3)

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	grey	Contrast:	faint	Abundance:	10% - 20%

STRUCTURE:

Grade of Pedality:	massive	Fabric:	earthy
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not identified	Amount:	common (10-20%)	Distribution:		Orientation:		Weathering:
Shape:	sub-rounded							
Size:	fine gravel (2-6 mm),gravel (6-20 mm)							

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:		Disruptive Test:	moderately weak force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	no change	Bolus Formation:		Field Dilatency:	

SAMPLE TAKEN: disturbed

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

LAYER 2 B2 horizon
Depth: 00.30 - 00.60

TEXTURE: medium sandy clay

COLOUR:
Moist: brown (7.5YR 4/4)
Dry: brown (7.5YR 4/4)

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	red	Contrast:	distinct	Abundance:	2% - 10%

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	
Dominant Peds:			
Subdominant Peds:	2 - 5 mm,polyhedral		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:	Distribution:	Orientation:	Weathering:
Shape:					
Size:					

CONSISTENCE:

Degree of Plasticity:	very plastic	Stickiness:	moderately sticky
Texture Modifier:		Disruptive Test:	moderately firm force
Shearing Test:	labile	Toughness:	

SOIL WATER STATUS: moderately moist

ERODIBILITY TESTS:

Crumb Test:	no change	Bolus Formation:		Field Dilatency:	

SAMPLE TAKEN: disturbed

LAYER NOTES: Layer continues.

LABORATORY TESTS:
Sample No:
Depth: 00.30 - 00.30 m
Test Results:

N518.99 [Volume expansion]:	5.0
N517.99_FS [PSA fine sand - SDS]:	37
N514.99 [Dispersion percentage]:	58
N550.02 [USCS - field]:	CL
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	13.8
N3A1 [EC of 1:5 soil/water extract]:	0.1

N515.99 [Wind erodible aggregate percentage]:	93
N6A1 [Organic carbon - Walkley & Black]:	.35
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	3.8
N4A1 [pH of 1:5 soil/water suspension]:	5
N504.02_FC [Field Capacity, SWC pressure plate]:	32.9
N513.98 [Emerson aggregate test SCS method]:	2(2)
N517.99_CS [PSA coarse sand - SDS]:	13
N517.99_SI [PSA silt - SDS]:	15
N518.01 [Linear shrinkage]:	13.0
N517.99_CL [PSA clay - SDS]:	35

Sample No:
Depth: 00.00 - 00.00 m
Test Results:

N518.99 [Volume expansion]:	1.0
N517.99_FS [PSA fine sand - SDS]:	45
N517.99_GR [PSA gravel - SDS]:	11
N513.98 [Emerson aggregate test SCS method]:	3(2)
N504.02_FC [Field Capacity, SWC pressure plate]:	22.6
N515.99 [Wind erodible aggregate percentage]:	65
N504.02_PWP [Permanent Wilt Point, SWC pressure plate]:	5.5
N6A1 [Organic carbon - Walkley & Black]:	.48
N4B1 [pH of 1:5 soil/0.01M CaCl2 extract - direct, no stir]:	3.9
N4A1 [pH of 1:5 soil/water suspension]:	4.8
N3A1 [EC of 1:5 soil/water extract]:	0.07
N550.02 [USCS - field]:	SM
N514.99 [Dispersion percentage]:	71
N517.99_CS [PSA coarse sand - SDS]:	20
N517.99_SI [PSA silt - SDS]:	15
N518.01 [Linear shrinkage]:	1.5
N517.99_CL [PSA clay - SDS]:	9

For information on laboratory test data and units of measure, please see the SPADE Help page

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(9)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION:	Unknown		
SURVEY:	TUGGERAH LAKES SOIL LANDSCAPES (1000384)		
PROFILE:	14		

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	350175	MGA Northing:	6321490

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 08, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	4		

SOIL AND MAP CODES:

Geology Map Code:	Rnu	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:	Yellow Earth	Northcote PPF:	Gn2.34
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	8%, measured		
Elevation:	20 m	Aspect:	south west

LANDFORM:

Site Morphology:	lower slope	Site Process:	20 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-lithic	Substrate:	sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	wet sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:		Site Disturbance:	limited clearing
Current Condition (s):	loose	Expected Dry Condition:	

LAND USE:

Site:	timber/scrub/unused	General Area:	improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	high	Run-off:	moderate
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: slight

SALINITY: no salting evident

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded						
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)						

LAYER 1 A1 horizon
Depth: 00.00 - 00.08

TEXTURE: coarse loamy sand

COLOUR:
Moist: brown (7.5YR 4/4)
Dry:

FIELD CHEMICAL TESTS:
pH: 6 (Raupach)

STRUCTURE:
Grade of Pedality: weak pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded						
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)						

PANS:
Type: not evident Cementation: Continuity: Structure:

CRACKS AND MACROPORES:
Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	moderately weak force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate
Ped Porosity: porous
Water Table: none

BOUNDARY:

Distinctiveness:	clear (20-50 mm)	Shape:	smooth

LAYER 2 A2 horizon
Depth: 00.08 - 00.30

TEXTURE: coarse sandy loam

COLOUR:
Moist: brown (dull orange) (7.5YR 5/4)
Dry: pinkish grey (light brownish grey) (7.5YR 7/2)

FIELD CHEMICAL TESTS:
pH: 6 (Raupach)

STRUCTURE:

Grade of Pedality:	massive	Fabric:
Dominant Peds:		
Subdominant Peds:		
Artificial Aggregates:		

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered

Shape: sub-rounded
Size: fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

LAYER NOTES: Hardsetting.
Ped Porosity: porous
Water Table: none

BOUNDARY:
Distinctiveness: gradual (50-100 mm) Shape:

LAYER 3 B2 horizon
Depth: 00.30 - 00.60

TEXTURE: fine sandy clay loam

COLOUR:
Moist: yellowish brown (10YR 5/8)
Dry:

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:
Grade of Pedality: massive Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:
Type: sedimentary Amount: very few (< 2%) Distribution: Orientation: Weathering: weakly weathered
Shape: sub-rounded
Size: fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

CRACKS AND MACROPORES:
Cracks
<5 mm width: evident 5-10 mm width: 10-20 mm width: 20-50 mm width: >50 mm width:
Macropores
<1 mm size: 1-2 mm size: 2-5 mm size: >5 mm size:

CONSISTENCE:
Degree of Plasticity: Stickiness: slightly sticky
Texture Modifier: no change Disruptive Test: moderately firm force
Shearing Test: Toughness:

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate

LAYER NOTES: Light sandy clay loam at top, Fine sandyclay loam at bottom.
Ped Porosity: porous
Water Table: none

LAYER 4 B3 horizon
Depth: 00.60 - 01.30

TEXTURE: medium clay

COLOUR:
Moist: pale brown (dull yellow orange)

Dry: (10YR 6/3)

MOTTLES:

Dominant Mottles: Type: unspecified Colour: orange Contrast: prominent Abundance: 10% - 20%

FIELD CHEMICAL TESTS:

pH: 4.5 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	rough-faced peds
Dominant Peds:	20 - 50 mm		
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not identified	Amount:	very few (< 2%)	Distribution:		Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded								
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)								

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate

LAYER NOTES: Dominant peds 10-50mm in size.

Ped Porosity: porous

Water Table: none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:25:05 EST 2012

10

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: MYRTLE CK

SURVEY: Soil Landscapes of the Gosford 1:100 000 Sheet (1000133)

PROFILE: 50

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	349005	MGA Northing:	6321290

SITE DETAILS:

Described by:	Peter Tille	Profile Date:	January 17, 1984
Nature of Exposure:	gully	Photo Taken:	
No of Layers:	2		

SOIL AND MAP CODES:

Geology Map Code:	Qa	Soil Map Code:	af
Aust. Soil Classification:			
Great Soil Group:		Northcote PPF:	Um6.23
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	1%, measured		
Elevation:	m	Aspect:	

LANDFORM:

Site Morphology:		Site Process:	m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	backplain
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	alluvium	Substrate:	alluvium m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation	wet sclerophyll forest

Community:
Growth Form(s):
Crown Separation Ratio:
Upper Stratum Height:

SITE CONDITION:

Ground Cover %:	95	Site Disturbance:	extensive clearing
Current Condition (s):	soft	Expected Dry Condition:	

LAND USE:

Site:	improved pasture	General Area:	improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	4
Run-on:	very high	Run-off:	low
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,
Streambank Erosion: evident,

EROSION HAZARD: very high

SALINITY: no salting evident

FIELD NOTES: GSG given as AS.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:
Type: not evident Amount: Distribution: Orientation: Weathering:
Shape:
Size:

LAYER 1 horizon
Depth: 00.00 - 00.80

TEXTURE: silty loam

COLOUR:
Moist: strong brown (brown) (7.5YR 4/6)

Dry:

FIELD CHEMICAL TESTS:

pH:	5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	5 - 10 mm		
Subdominant Peds:	< 2 mm,crumb		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:		Distribution:	Orientation:	Weathering:
Shape:						
Size:						

PANS:

Type:	not evident	Cementation:		Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:		1-2 mm size:	2-5 mm size:	>5 mm size:	

SOIL WATER STATUS:	moderately moist
SOIL ERODIBILTY:	high

LAYER NOTES:

Root Distribution:	in ped

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 2	horizon
Depth:	00.80 - 04.00

TEXTURE:	silty clay loam

FIELD CHEMICAL TESTS:

pH:	6 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm		
Subdominant Peds:	5 - 10 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:	Distribution:	Orientation:	Weathering:
Shape:					
Size:					

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:	Stickiness:	slightly sticky
Texture Modifier:	Disruptive Test:	
Shearing Test:	Toughness:	

SOIL WATER STATUS: moderately moist

LAYER NOTES: *** Layer moist munsell reported as 7.5YR 4/8!

Root Distribution: in ped

LAYER 99 R horizon
Depth: 04.00 -

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:25:36 EST 2012

(11)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: JILIBY RD

SURVEY: Soil Landscapes of the Gosford 1:100 000 Sheet (1000133)

PROFILE: 49

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	349405	MGA Northing:	6319690

SITE DETAILS:

Described by:	Peter Tille	Profile Date:	January 17, 1984
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnp	Soil Map Code:	ns/f
Aust. Soil Classification:			
Great Soil Group:	Soloth (Solod)	Northcote PPF:	Dy3.21
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	15%, measured		
Elevation:	m	Aspect:	

LANDFORM:

Site Morphology:	lower slope	Site Process:	m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:		Substrate:	sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	wet sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	extensive clearing
Current Condition (s):		Expected Dry Condition:	hardsetting

LAND USE:

Site:	improved pasture	General Area:	improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	high	Run-off:	high
Permeability:		Profile Drainage:	imperfectly drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: very high

SALINITY: no salting evident

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	strongly weathered
Shape:	sub-rounded						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

LAYER 1 A1 horizon
Depth: 00.00 - 00.13

TEXTURE: fine sandy loam

COLOUR:
Moist: dark brown (10YR 3/3)
Dry:

FIELD CHEMICAL TESTS:
pH: 6 (Raupach)

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	rough-faced peds
Dominant Peds:	5 - 10 mm		
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	strongly weathered
Shape:	sub-rounded						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:		1-2 mm size:	2-5 mm	>5 mm	

			size:	size:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate

LAYER NOTES:
Water Table: none

BOUNDARY:
Distinctiveness: clear (20-50 mm) Shape: wavy

LAYER 2 A2 horizon
Depth: 00.13 - 00.27

TEXTURE: fine sandy clay loam

COLOUR:
Moist: dark yellowish brown (brown) (10YR 4/4)
Dry: pale brown (dull yellow orange) (10YR 6/3)

FIELD CHEMICAL TESTS:
pH: 6 (Raupach)

STRUCTURE:
Grade of Pedality: moderate pedality Fabric: rough-faced peds
Dominant Peds: 10 - 20 mm
Subdominant Peds: 2 - 5 mm
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:		Orientation:		Weathering:	strongly weathered

Shape: sub-rounded
Size: fine gravel (2-6 mm),gravel (6-20 mm)

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:
Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

LAYER NOTES:
Water Table: none

BOUNDARY:
Distinctiveness: clear (20-50 Shape: wavy

mm)

LAYER 3 B horizon
Depth: 00.27 - 00.37

TEXTURE: medium clay

COLOUR:
Moist: yellowish brown (10YR 5/6)
Dry:

MOTTLES:

Dominant Mottles:		Type:	unspecified	Colour:	grey	Contrast:	faint	Abundance:	20% - 50%

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	smooth-faced peds
Dominant Peds:	10 - 20 mm		
Subdominant Peds:	5 - 10 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:		Orientation:		Weathering:	strongly weathered
Shape:	sub-rounded								
Size:	fine gravel (2-6 mm),gravel (6-20 mm)								

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks									
<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	
Macropores									
<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:			

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	increase >= 2 Grades	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: high

LAYER NOTES: B harsh. Fine sand present. *** Layer depth was not given. Lower depth printed here is nominal.
Water Table: none

LAYER 99 R horizon
Depth: 01.50 -

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:26:04 EST 2012

12

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: DUNKS LANE OFF JILLIBY RD

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 99

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	348905	MGA Northing:	6318590

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 24, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnu	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:		Northcote PPF:	Dy3.21
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	7%, measured		
Elevation:	20 m	Aspect:	north east

LANDFORM:

Site Morphology:	mid-slope	Site Process:	20 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	not identified	Substrate:	not identified m
Rock Outcrop:		Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	dry sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	
Species:	Eucalyptus baxteri (brown stringybark)

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	extensive clearing
Current Condition (s):		Expected Dry Condition:	hardsetting

LAND USE:

Site:	improved pasture	General Area:	improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	moderate	Run-off:	moderate
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: slight

SALINITY: no salting evident

FIELD NOTES: Under forest good sandy loam topsoil A1,but where cleared often have A2 exposed:hardsetting at surface. Brown ped coatings.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	ironstone	Amount:		Distribution:		Orientation:		Weathering:	
Shape:									
Size:									
Type:	sedimentary	Amount:	few (2-10%)	Distribution:	dispersed	Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm)								

LAYER 1 A2 horizon
Depth: 00.00 - 00.35

TEXTURE: fine light sandy clay loam

COLOUR:
Moist: dark brown (10YR 3/3)
Dry: light brownish grey (greyish yellow brown) (10YR 6/2)

FIELD CHEMICAL TESTS:
pH: 5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	20 - 50 mm		
Subdominant Peds:	5 - 10 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	ironstone	Amount:		Distribution:		Orientation:		Weathering:	
Shape:									

Size:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:	dispersed	Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm)								

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL ERODIBILTY: moderate

LAYER NOTES: Bleached?

Root Distribution: in ped

Water Table: none

BOUNDARY:

Distinctiveness: clear (20-50 mm) Shape: wavy

LAYER 2 B2 horizon

Depth: 00.35 - 00.50

TEXTURE: medium clay

COLOUR:

Moist: brownish yellow (bright yellowish brown) (10YR 6/6)

Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	grey	Contrast:	distinct	Abundance:	2% - 10%

FIELD CHEMICAL TESTS:

pH: 4.5 (Raupach)

STRUCTURE:

Grade of Pedality:		Fabric:	rough-faced peds

Dominant Peds:

Subdominant Peds:

Artificial Aggregates:

COARSE FRAGMENTS:

Type:	ironstone	Amount:	Distribution:		Orientation:		Weathering:	

Shape:

Size:

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

LAYER NOTES: Hardly any sand.

Root Distribution: in ped

Water Table: none

LAYER 3 B3 horizon

Depth: 00.50 - 01.00

TEXTURE: light medium clay

COLOUR:

Moist: light brownish grey (greyish yellow brown) (10YR 6/2)

Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	orange	Contrast:	distinct	Abundance:	20% - 50%

FIELD CHEMICAL TESTS:

pH: 5 (Raupach)

STRUCTURE:

Grade of Pedality:		Fabric:	rough-faced peds
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL ERODIBILTY: low

LAYER NOTES:	*** Layer depth given as +1.00m. Fine sand present.
Root Distribution:	in ped
Water Table:	none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

13

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: WATAGAN FOREST RD

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 101

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	347305	MGA Northing:	6319390

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 24, 1989
Nature of Exposure:		Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnt	Soil Map Code:	wn
Aust. Soil Classification:			
Great Soil Group:	Yellow Podzolic Soil	Northcote PPF:	Dy3.11
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	15%, measured		
Elevation:	260 m	Aspect:	

LANDFORM:

Site Morphology:	mid-slope	Site Process:	260 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	shale,sandstone-lithic	Substrate:	shale m
Rock Outcrop:		Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %: Site Disturbance:

Current Condition (s): Expected Dry Condition: hardsetting

LAND USE:

Site: logged native forest General Area: logged native forest

FIELD NOTES: Sandstone boulders upslope. Peter Tille's site 42. Crest on ridge. Subsoil shale. C horizon present below B.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type: not identified Amount: very few (< 2%) Distribution: Orientation: Weathering:

Shape:
Size:

LAYER 1 A1 horizon
Depth: 00.00 - 00.25

TEXTURE: fine light sandy clay loam

COLOUR:

Moist: dark brown (10YR 3/3)
Dry:

FIELD CHEMICAL TESTS:

pH: 4.5 (Raupach)

STRUCTURE:

Grade of Pedality: weak pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type: not identified Amount: very few (< 2%) Distribution: Orientation: Weathering:

Shape:
Size:

SOIL ERODIBILTY: moderate

LAYER NOTES: Structure massive and weak pedality.

LAYER 2 A1 horizon
Depth: 00.25 - 00.60

TEXTURE: fine light sandy clay loam

COLOUR:
Moist: dark yellowish brown (dark brown) (10YR 3/4)
Dry:

FIELD CHEMICAL TESTS:
pH: 5 (Raupach)

STRUCTURE:
Grade of Pedality: massive Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	not identified	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:

Shape:
Size:

LAYER 3 B horizon
Depth: 00.60 - 01.00

TEXTURE: heavy clay

COLOUR:
Moist: very pale brown (dull yellow orange) (10YR 7/3)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	yellow	Contrast:	prominent	Abundance:	10% - 20%

FIELD CHEMICAL TESTS:
pH: 4.5 (Raupach)

STRUCTURE:
Grade of Pedality: strong pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	not evident	Amount:	Distribution:	Orientation:	Weathering:

Shape:
Size:

SOIL ERODIBILTY: low

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: WATAGAN FOREST RD

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 100

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	346605	MGA Northing:	6319490

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 24, 1989
Nature of Exposure:		Photo Taken:	
No of Layers:	1		

SOIL AND MAP CODES:

Geology Map Code:	Rnt	Soil Map Code:	wn
Aust. Soil Classification:			
Great Soil Group:	No suitable group	Northcote PPF:	Uc6.12
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

LANDFORM:

Site Morphology:	upper slope	Site Process:	m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-lithic	Substrate:	sandstone-lithic m
Rock Outcrop:		Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	
Growth Form(s):	
Crown Separation Ratio:	

Upper Stratum Height:

LAND USE:
Site: logged native forest General Area: logged native forest

FIELD NOTES: Topsoil where sst boulders present,whereshales occur topsoil is loam, fine sandy (like Cumberland loam) over heavy grey clay. Yellow mottles. Lots of boulders. Structured Sandy Loam. D hor below A.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	common (10-20%)	Distribution:	dispersed	Orientation:	Weathering:
Shape:							
Size:							
Type:	ironstone	Amount:		Distribution:		Orientation:	Weathering:
Shape:							
Size:							
Type:	as parent material	Amount:		Distribution:		Orientation:	Weathering:
Shape:							
Size:							

LAYER 1 A horizon
Depth: 00.00 - 00.70

TEXTURE: fine sandy loam

COLOUR:
Moist: dark brown (10YR 3/3)
Dry:

STRUCTURE:
Grade of Pedality: weak pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	common (10-20%)	Distribution:	dispersed	Orientation:	Weathering:
Shape:							
Size:							
Type:	as parent material	Amount:		Distribution:		Orientation:	Weathering:
Shape:							
Size:							

Type:	ironstone	Amount:	Distribution:	Orientation: Weathering:
Shape:				
Size:				

LAYER NOTES: Sturcture massive and weak pedality. Peter Tille's site 43.

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:30:55 EST 2012

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: GOLDSMITH RIDGE, WATAGAN FOREST RD

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 178

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	345855	MGA Northing:	6320440

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	February 22, 1990
Nature of Exposure:	auger	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnt	Soil Map Code:	ol
Aust. Soil Classification:			
Great Soil Group:		Northcote PPF:	Dy4.61
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	2%, estimated		
Elevation:	200 m	Aspect:	

LANDFORM:

Site Morphology:	crest	Site Process:	200 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	sandstone-lithic	Substrate:	sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	weak		
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation	wet sclerophyll forest

Community:
Growth Form(s):
Crown Separation Ratio:
Upper Stratum Height:

Species: Acacia sp. (wattles)

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	
Current Condition (s):	soft	Expected Dry Condition:	

LAND USE:

Site:	logged native forest	General Area:	logged native forest

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	none	Run-off:	high
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION HAZARD: slight

SALINITY: no salting evident

FIELD NOTES: Sandstone-earth capping could be quite common on ol unit crests. Internal drainage mod-rapid. Other veget'n: some Iron-bark Stringybark. C hor pres ent below B. Sand fraction is medium.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

LAYER 1 A1 horizon
Depth: 00.00 - 00.10

TEXTURE: coarse sandy loam

COLOUR:

Moist:	very dark greyish brown (brownish black) (10YR 3/2)
Dry:	

FIELD CHEMICAL TESTS:

pH:	5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	5 - 10 mm		
Subdominant Peds:	20 - 50 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:		1-2 mm size:	2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL ERODIBILTY: low

LAYER NOTES:	Friable topsoil Subdominant peds 10-50mm. Platy fragments
Ped Porosity:	porous
Water Table:	none

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:

LAYER 2 A2 horizon

Depth: 00.10 - 00.15

TEXTURE: coarse sandy loam

COLOUR:
Moist: brown (7.5YR 4/3)
Dry:

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	massive	Fabric:	earthy
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

PANS:

Type:	not evident	Cementation:		Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks						
<5 mm width:	evident	5-10 mm width:		10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores						
<1 mm size:		1-2 mm size:		2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

LAYER NOTES: Platy fragments
Water Table: none

BOUNDARY:
Distinctiveness: clear (20-50 mm) Shape:

LAYER 3 B horizon
Depth: 00.15 - 00.90

TEXTURE: light medium clay

COLOUR:

Moist:	strong brown (bright brown) (7.5YR 5/8)
Dry:	

FIELD CHEMICAL TESTS:

pH:	5 (Raupach)

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	slightly sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL ERODIBILTY:	low
LAYER NOTES:	Can't tell structure of B from auger. Medium sand present. Soft yellow medium lithic sandstone. Platy fragments
Water Table:	none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION:	WATAGAN FOREST RD, HARRIS POINT RD
SURVEY:	TUGGERAH LAKES SOIL LANDSCAPES (1000384)
PROFILE:	106

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	345205	MGA Northing:	6320290

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	November 24, 1989
Nature of Exposure:		Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnt	Soil Map Code:	wnc
Aust. Soil Classification:			
Great Soil Group:	Yellow Podzolic Soil	Northcote PPF:	Dy3.21
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	?%, estimated		
Elevation:	m	Aspect:	

LANDFORM:

Site Morphology:	upper slope	Site Process:	m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

VEGETATION:

Vegetation Community:
Growth Form(s):
Crown Separation Ratio:
Upper Stratum Height:

SITE CONDITION:

Ground Cover %:		Site Disturbance:	
Current Condition (s):		Expected Dry Condition:	hardsetting

FIELD NOTES: Peter Tille's site 45. Lithic sandstone ridge. Profile described in 1985. Deep loamy leaf layer on top.

PROFILE ADDENDUM:

SOIL

DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:	Orientation:		Weathering:	
Shape:								
Size:								
Type:	sedimentary	Amount:	many (20-50%)	Distribution:	Orientation:		Weathering:	weakly weathered
Shape:								
Size:								

LAYER 1 A1 horizon
Depth: 00.00 - 00.30

TEXTURE: fine sandy loam

COLOUR:
Moist: (brownish black) (10YR 2/3)
Dry:

STRUCTURE:
Grade of Pedality: moderate pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:	Orientation:		Weathering:	
Shape:								
Size:								
Type:	sedimentary	Amount:	many (20-50%)	Distribution:	Orientation:		Weathering:	weakly weathered
Shape:								
Size:								

LAYER NOTES: Moderate pedality to apedal massive withdepth.

LAYER 2 A2 horizon
Depth: 00.30 - 00.60

TEXTURE: fine sandy clay loam

COLOUR:
Moist: brown (dull yellowish brown) (10YR 5/3)
Dry: pale brown (dull yellow orange) (10YR 6/3)

STRUCTURE:
Grade of Pedality: weak pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:		Orientation:	Weathering:	
Shape:								
Size:								
Type:	sedimentary	Amount:	few (2-10%)	Distribution:		Orientation:	Weathering:	weakly weathered
Shape:								
Size:								

LAYER NOTES: Hardsetting but A1 is very deep. Some bleached A2. Weak pedality to apedal massive with depth.

LAYER 3 B horizon
Depth: 00.60 - 01.30

TEXTURE: light medium clay

COLOUR:
Moist: brownish yellow (bright yellowish brown) (10YR 6/8)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	red	Contrast:	prominent	Abundance:	2% - 10%
Subdominant Mottles:	Type:	unspecified	Colour:	brown	Contrast:	prominent	Abundance:	2% - 10%

STRUCTURE:
Grade of Pedality: moderate pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:		Orientation:	Weathering:	
Shape:								
Size:								
Type:	sedimentary	Amount:	many (20-50%)	Distribution:		Orientation:	Weathering:	weakly weathered
Shape:								
Size:								

LAYER NOTES: Medium sand present.

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:31:46 EST 2012

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION:	WATAGAN RD
SURVEY:	Soil Landscapes of the Gosford 1:100 000 Sheet (1000133)
PROFILE:	13

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	345105	MGA Northing:	6320490

SITE DETAILS:

Described by:	Peter Tille	Profile Date:	December 13, 1983
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnt	Soil Map Code:	ns
Aust. Soil Classification:			
Great Soil Group:	Xanthozem	Northcote PPF:	Gn3.74
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	25%, measured		
Elevation:	m	Aspect:	

LANDFORM:

Site Morphology:	upper slope	Site Process:	m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:		Substrate:	sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	weak		
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	wet sclerophyll forest
Growth Form(s):	

Crown Separation Ratio:
Upper Stratum Height:

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	no effective disturbance
Current Condition (s):	gravelly,soft	Expected Dry Condition:	

LAND USE:

Site:	hardwood plantation	General Area:	hardwood plantation

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	moderate	Run-off:	high
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: high

SALINITY: no salting evident

FIELD NOTES: Vegetation regenerating. Fine sand present in all layers. Soil below layer 3 is reported as super plastic.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	many (20-50%)	Distribution:	dispersed	Orientation:		Weathering:	weakly weathered

Shape: sub-rounded
Size: gravel (6-20 mm),coarse gravel (20-60 mm),cobbles (60-200 mm)

LAYER 1 A1 horizon
Depth: 00.00 - 00.15

TEXTURE: clay loam,clay loam

COLOUR:
Moist: brown (7.5YR 4/3)

Dry:

FIELD CHEMICAL TESTS:

pH:	5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	5 - 10 mm		
Subdominant Peds:	20 - 50 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	many (20-50%)	Distribution:	dispersed	Orientation:	Weathering: weakly weathered
Shape:	sub-rounded						
Size:	gravel (6-20 mm),coarse gravel (20-60 mm),cobbles (60-200 mm)						

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:		1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	non-sticky
Texture Modifier:		Disruptive Test:	moderately weak force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY:	low
Root Distribution:	in ped
Water Table:	none

BOUNDARY:

Distinctiveness:	gradual (50-100 mm)	Shape:	smooth

LAYER 2	A2 horizon
Depth:	00.15 - 00.25

TEXTURE: sandy clay

COLOUR:

Moist:	brown (dull orange) (7.5YR 5/4)

Dry: light brown (dull brown) (7.5YR 6/3)

FIELD CHEMICAL TESTS:

pH: 5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	10 - 20 mm		
Subdominant Peds:	50 - 100 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	many (20-50%)	Distribution:	dispersed	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded							
Size:	gravel (6-20 mm),coarse gravel (20-60 mm),cobbles (60-200 mm)							

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:	

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	non-sticky
Texture Modifier:		Disruptive Test:	moderately firm force
Shearing Test:	crumbly	Toughness:	

SOIL WATER STATUS: moderately moist

LAYER NOTES: *** Layer depth was not reported, lower depth printed here is nominal.

Root Distribution: in ped

Water Table: none

BOUNDARY:

Distinctiveness: gradual (50-100 mm) Shape: smooth

LAYER 3 B horizon

Depth: 00.25 - 00.35

TEXTURE: light clay

COLOUR:

Moist: yellowish red (bright reddish brown) (5YR 5/6)

Dry:

FIELD CHEMICAL TESTS:

pH: 4 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	20 - 50 mm		
Subdominant Peds:	50 - 100 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	many (20-50%)	Distribution:	dispersed	Orientation:		Weathering:	weakly weathered
Shape:	sub-rounded								
Size:	gravel (6-20 mm),coarse gravel (20-60 mm),cobbles (60-200 mm)								

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:	

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:		>50 mm width:	

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	non-sticky
Texture Modifier:	decrease >= 1 Grade	Disruptive Test:	moderately strong force
Shearing Test:	brittle	Toughness:	

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate

LAYER NOTES: *** Layer depth was not reported, lower depth printed here is nominal. Coarse fragments range in size 6-600mm.

Root Distribution: in ped

Water Table: none

LAYER 99 R horizon

Depth: 01.00 -

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: WATAGAN FOREST ROAD

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 177

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	343705	MGA Northing:	6321590

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	February 22, 1990
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	4		

SOIL AND MAP CODES:

Geology Map Code:	Rnt	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:		Northcote PPF:	Dy5.11
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	11%,		
Elevation:	210 m	Aspect:	north east

LANDFORM:

Site Morphology:	upper slope	Site Process:	210 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	siltstone/mudstone,sandstone-lithic	Substrate:	siltstone/mudstone,sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	dry sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	
Species:	Eucalyptus baxteri (brown stringybark)
Species:	Eucalyptus punctata (grey gum)

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	

Current Condition (s): soft
Expected Dry Condition:

LAND USE:
Site: logged native forest
General Area: logged native forest

HYDROLOGY:
Presence of Free Water:
Free Water Depth:
Run-on: low
Run-off: high
Permeability:
Profile Drainage: mod. well drained
Free Water pH:
Free Water Salinity:

EROSION HAZARD: slight

SALINITY: no salting evident

FIELD NOTES: A lot of faunal mixing. Additional veg.: bloodwood.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:		Orientation:	reoriented	Weathering:	weakly weathered
Shape:	sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)								

LAYER 1 A1 horizon
Depth: 00.00 - 00.30

TEXTURE: fine sandy loam

COLOUR:
Moist: dark yellowish brown (brown) (10YR 4/4)
Dry:

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:
Grade of Pedality: weak pedality
Fabric: rough-faced peds
Dominant Peds: 10 - 20 mm
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	very few (< 2%)	Distribution:		Orientation:	reoriented	Weathering:	weakly weathered
Shape:	angular,sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)								

PANS:
Type: not evident
Cementation:
Continuity:
Structure:

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate

LAYER NOTES: Few to common roots.
Ped Porosity: porous

BOUNDARY:
Distinctiveness: gradual (50-100 mm) Shape: smooth

LAYER 2 A horizon
Depth: 00.30 - 00.55

TEXTURE: fine sandy clay loam

COLOUR:
Moist: dark yellowish brown (dark brown) (10YR 3/4)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	brown	Contrast:	distinct	Abundance:	20% - 50%

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:
Grade of Pedality: massive Fabric: earthy
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:
Type: sedimentary Amount: few (2-10%) Distribution: Orientation: reoriented Weathering: weakly weathered
Shape: angular,sub-angular
Size: fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)

PANS:
Type: not evident Cementation: Continuity: Structure:

SOIL WATER STATUS: moderately moist

LAYER NOTES: Few to common roots.
Ped Porosity: porous

BOUNDARY:
Distinctiveness: abrupt (5-20 mm) Shape: wavy

LAYER 3 B2 horizon
Depth: 00.55 - 01.00

TEXTURE: medium clay

COLOUR:
Moist: brownish yellow (bright yellowish brown) (10YR 6/8)
Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	grey	Contrast:	faint	Abundance:	20% - 50%
Subdominant Mottles:	Type:	unspecified	Colour:	orange	Contrast:	distinct	Abundance:	10% - 20%

FIELD CHEMICAL TESTS:
pH: 5 (Raupach)

STRUCTURE:
Grade of Pedality: strong pedality Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	common (10-20%)	Distribution:	stratified	Orientation:		Weathering:	weakly weathered
Shape:	angular,sub-angular								
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)								
Type:	sedimentary	Amount:		Distribution:		Orientation:		Weathering:	
Shape:									
Size:	cobbles (60-200 mm)								

PANS:
Type: not evident Cementation: Continuity: Structure:

SOIL WATER STATUS: moderately moist

SOIL ERODIBILTY: moderate

LAYER NOTES: Some fine sand present. Angular blocky peds evident.
Ped Porosity: dense
Root Distribution: in ped & ex ped

BOUNDARY:
Distinctiveness: gradual (50-100 mm) Shape:

LAYER 4 B3 horizon
Depth: 01.00 - 01.10

TEXTURE: medium clay

COLOUR:
Moist: light grey (10YR 7/1)
Dry:

MOTTLES:
Dominant Mottles: Type: unspecified Colour: yellow Contrast: distinct Abundance: 20% - 50%

FIELD CHEMICAL TESTS:
pH: 4.5 (Raupach)

STRUCTURE:
Grade of Pedality: massive Fabric:
Dominant Peds:
Subdominant Peds:
Artificial Aggregates:

COARSE FRAGMENTS:

Type:	not identified	Amount:	very few (< 2%)	Distribution:	stratified	Orientation:		Weathering:	
Shape:	angular,sub-angular								
Size:									

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:

SOIL WATER STATUS: moist

SOIL ERODIBILTY: moderate

Ped Porosity: dense

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:32:53 EST 2012

(19)

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: DURREN RD JILLIBY CK

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 12

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	348605	MGA Northing:	6322990

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	October 20, 1989
Nature of Exposure:	auger	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Qa	Soil Map Code:	ya
Aust. Soil Classification:			
Great Soil Group:	Soloth (Solod)	Northcote PPF:	Dy3.41
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	%, estimated		
Elevation:	m	Aspect:	

LANDFORM:

Site Morphology:	flat	Site Process:	m
Slope Morphology:		Local Relief:	
Landform Pattern:	floodplain	Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	alluvium	Substrate:	m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:			
Weathering & Alteration:	m		
Discontinuities:			
Fragment Amount:			

VEGETATION:

Vegetation Community:	wet sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	
Current Condition (s):		Expected Dry Condition:	hardsetting

LAND USE:

Site:	improved pasture	General Area:	improved pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	high	Run-off:	low
Permeability:		Profile Drainage:	imperfectly drained
Free Water pH:		Free Water Salinity:	

EROSION:
Wind Erosion: none,

EROSION HAZARD: slight

SALINITY: no salting evident

FIELD NOTES: Gets boggy - deep hoof inprints. Middle floodplain. Open depression. Hardsetting A2.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	not evident	Amount:	Distribution:	Orientation:	Weathering:
Shape:					
Size:					

LAYER 1 A1 horizon
Depth: 00.00 - 00.20

TEXTURE: silty clay loam

COLOUR:
Moist: brown (dull yellowish brown) (10YR 4/3)
Dry: light brownish grey (greyish yellow brown) (10YR 6/2)

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:			
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	not evident	Amount:	Distribution:	Orientation:	Weathering:
Shape:					
Size:					

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:
Cracks

<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores			
<1 mm size:	1-2 mm size:	2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	moderately sticky
Texture Modifier:	no change	Disruptive Test:	
Shearing Test:		Toughness:	

SOIL WATER STATUS: dry

SOIL ERODIBILTY: moderate

Water Table: none

BOUNDARY:

Distinctiveness: clear (20-50 mm) Shape:

LAYER 2 B horizon

Depth: 00.20 - 00.65

TEXTURE: medium clay

COLOUR:

Moist: yellowish brown (dull yellowish brown) (10YR 5/4)

Dry:

FIELD CHEMICAL TESTS:

pH: 5.5 (Raupach)

COARSE FRAGMENTS:

Type:	not evident	Amount:	Distribution:	Orientation:	Weathering:
Shape:					
Size:					

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:		1-2 mm size:	2-5 mm size:	>5 mm size:	

SOIL WATER STATUS: dry

LAYER NOTES: Spongy.

Water Table: none

BOUNDARY:

Distinctiveness: clear (20-50 mm) Shape:

LAYER 3 horizon

Depth: 00.65 - 00.80

TEXTURE: medium clay

COLOUR:

Moist: light brownish grey (greyish yellow brown) (10YR 6/2)

Dry:

MOTTLES:

Dominant Mottles:	Type:	unspecified	Colour:	yellow	Contrast:	prominent	Abundance: 20% - 50%

FIELD CHEMICAL TESTS:

pH: 5 (Raupach)

PANS:

Type:	not evident	Cementation:		Continuity:		Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:	evident	5-10 mm width:		10-20 mm width:		20-50 mm width:	>50 mm width:

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:		>5 mm size:

SOIL WATER STATUS: moist

SOIL ERODIBILTY: low

LAYER NOTES: *** Layer depth given as +0.80m Second layer B goes spongy in water, lowwet strength. Silty.

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:33:21 EST 2012

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NSW SOIL AND LAND INFORMATION SYSTEM

Soil Technical Report

LOCATION: JILLIBY RD

SURVEY: TUGGERAH LAKES SOIL LANDSCAPES (1000384)

PROFILE: 11

PROFILE MAP DETAILS:

1:100,000 Mapsheet:	GOSFORD (9131)	Scale of Mapping:	other
MGA Easting:	348005	MGA Northing:	6324290

SITE DETAILS:

Described by:	Casey Murphy	Profile Date:	October 20, 1989
Nature of Exposure:	batter	Photo Taken:	
No of Layers:	3		

SOIL AND MAP CODES:

Geology Map Code:	Rnp	Soil Map Code:	
Aust. Soil Classification:			
Great Soil Group:	Soloth (Solod)	Northcote PPF:	Dr2.41
Soil Taxonomy:		Atlas (Northcote) Code:	
Atlas (A&M) Code:			

TOPOGRAPHY:

Slope:	15%,		
Elevation:	30 m	Aspect:	north

LANDFORM:

Site Morphology:	mid-slope	Site Process:	30 m
Slope Morphology:		Local Relief:	
Landform Pattern:		Landform Element:	
Microrelief			
Pos in LF Element:		Plan Curvature:	

LITHOLOGY:

Solum PM:	siltstone/mudstone,sandstone-lithic	Substrate:	siltstone/mudstone,sandstone-lithic m
Rock Outcrop:	nil	Outcrop Same As:	
Substrate Strength:	weak		
Weathering & Alteration:	m		
Discontinuities:			

Fragment Amount:

VEGETATION:

Vegetation Community:	dry sclerophyll forest
Growth Form(s):	
Crown Separation Ratio:	
Upper Stratum Height:	

Species:	Eucalyptus maculata (spotted gum)
Species:	Eucalyptus punctata (grey gum)

SITE CONDITION:

Ground Cover %:	100	Site Disturbance:	extensive clearing
Current Condition (s):	soft	Expected Dry Condition:	hardsetting

LAND USE:

Site:	volun./native pasture	General Area:	volun./native pasture

HYDROLOGY:

Presence of Free Water:		Free Water Depth:	
Run-on:	moderate	Run-off:	high
Permeability:		Profile Drainage:	mod. well drained
Free Water pH:		Free Water Salinity:	

EROSION:

Wind Erosion:	none,
Sheet Erosion:	minor, active

EROSION HAZARD: high

SALINITY: no salting evident

FIELD NOTES: Large cracks in soil, deep A2. Large prismatic breaking down to some lenticular. Batter collapsing.

PROFILE ADDENDUM:

SOIL DESCRIPTION:

LAYER 0 horizon
Depth: 00.00 - 00.00

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:	Orientation:	Weathering:	
Shape:							
Size:							
Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)						

LAYER 1 A1 horizon
Depth: 00.00 - 00.02

TEXTURE: silty loam

COLOUR:
Moist: dark brown (brownish black) (7.5YR 3/2)
Dry:

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	moderate pedality	Fabric:	rough-faced peds
Dominant Peds:	5 - 10 mm		
Subdominant Peds:	2 - 5 mm,crumb		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)						
Type:	as parent material	Amount:		Distribution:	Orientation:	Weathering:	
Shape:							
Size:							

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:	

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:		1-2 mm size:	2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	
Texture Modifier:	no change	Disruptive	moderately

		Test:	weak force
Shearing Test:		Toughness:	

SOIL WATER STATUS: dry

SOIL ERODIBILTY: moderate
Water Table: none

BOUNDARY:
Distinctiveness: clear (20-50 mm) Shape: smooth

LAYER 2 A2 horizon
Depth: 00.02 - 00.30

TEXTURE: silty clay loam

COLOUR:
Moist: dark yellowish brown (dark brown) (10YR 3/4)
Dry: light grey (dull yellow orange) (10YR 7/2)

FIELD CHEMICAL TESTS:
pH: 5.5 (Raupach)

STRUCTURE:

Grade of Pedality:	weak pedality	Fabric:	earthy
Dominant Peds:	50 - 100 mm		
Subdominant Peds:			
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm),coarse gravel (20-60 mm)						
Type:	as parent material	Amount:		Distribution:	Orientation:	Weathering:	
Shape:							
Size:							

PANS:

Type:	not evident	Cementation:	Continuity:	Structure:	

CRACKS AND MACROPORES:

Cracks					
<5 mm width:	evident	5-10 mm width:	10-20 mm width:	20-50 mm width:	>50 mm width:
Macropores					
<1 mm size:		1-2 mm size:	2-5 mm size:	>5 mm size:	

CONSISTENCE:

Degree of Plasticity:		Stickiness:	
Texture Modifier:	no change	Disruptive Test:	very firm force
Shearing Test:		Toughness:	

SOIL WATER STATUS: dry

LAYER NOTES: Large peds in A2 are probable due to cracking from B below. Fine sand present. Apedal massive to weak structure.

Water Table: none

BOUNDARY:

Distinctiveness:	abrupt (5-20 mm)	Shape:	wavy

LAYER 3 B horizon
Depth: 00.30 - 00.80

TEXTURE: medium clay

COLOUR:

Moist: yellowish red (reddish brown) (5YR 4/6)

Dry:

FIELD CHEMICAL TESTS:

pH: 5 (Raupach)

STRUCTURE:

Grade of Pedality:	strong pedality	Fabric:	smooth-faced peds
Dominant Peds:	50 - 100 mm		
Subdominant Peds:	20 - 50 mm		
Artificial Aggregates:			

COARSE FRAGMENTS:

Type:	as parent material	Amount:		Distribution:	Orientation:	Weathering:	
Shape:							
Size:							
Type:	sedimentary	Amount:	few (2-10%)	Distribution:	Orientation:	Weathering:	weakly weathered
Shape:	sub-rounded,sub-angular						
Size:	fine gravel (2-6 mm),gravel (6-20 mm)						

PANS:

Type:	not evident	Cementation:		Continuity:	Structure:

CRACKS AND MACROPORES:

Cracks

<5 mm width:		5-10 mm width:	evident	10-20 mm width:	20-50 mm width:	>50 mm width:

Macropores

<1 mm size:		1-2 mm size:		2-5 mm size:	>5 mm size:

CONSISTENCE:

Degree of Plasticity:		Stickiness:	
Texture Modifier:	no change	Disruptive Test:	moderately strong force
Shearing Test:		Toughness:	

SOIL WATER STATUS: dry

SOIL ERODIBILTY: high

LAYER NOTES: *** Layer depth given as +0.80m. B is a mixture of large prismatic and large lenticular, some break down to smaller lenticular. When wet goes to crumb.

Water Table: none

LABORATORY TESTS:

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Technical Report To contact us email:soils@dnr.nsw.gov.au Tue Apr 03 11:33:58 EST 2012

Geological Borelog

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION		Borehole Log: WEST SHAFT	Logged by NC
SURFACE ELEVATION	JOB NUMBER 612017		
GROUNDWATER	DATUM	PROJECT: WALLARAH	Proj. Manager JH
DRILL METHOD road cutting	DATE 26/3/12		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES TYPE	Undisturbed	Disturbed	Lost	Duplicate	Moisture content %	PID/FID Background	PID/FID Reading	CHEMICAL DATA pH - soil	H2O	CONSTRUCTION DETAILS COMMENTS
	A1 10YR 3/2 clay loam sandy, moderate ang. block, w/ OM (root)		0.1									4.5		photo 4702
	B2 10YR 4/6 medium clay, moderate, angular blocky peds, dry, strong.		0.3									4.5		
			0.5											
			0.7											
			0.9											
			1.1											
			1.3											
	end @ road/track level		1.5											

Geological Borelog

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION		Borehole Log: BUTTONDERRY - 2	Logged by NC
SURFACE ELEVATION	JOB NUMBER 612017		
GROUNDWATER	DATUM	PROJECT: WALLARAH	Proj. Manager JH
DRILL METHOD road cutting	DATE 26/3/12		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: TYPE	Undisturbed	Disturbed	Lost	Duplicate	Moisture content %	PID/FID Background	PID/FID Reading	CHEMICAL DATA: pH - soil	H2O	CONSTRUCTION DETAILS / COMMENTS
	A1 10YR 3/2 clay loam sandy, moderate angular blocky with OM (rootlets and cinders).											4.5		grass @ surface.
	B2 5YR 4/6 light medium clay, moderate angular blocky peds, dry, strong.		0.1									5		photo 4707
			0.2											
	end @ road/track level		0.3											

S2

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Geological Borelog

LOCATION		Borehole Log: TOOHEYS - DAM	Logged by NC
SURFACE ELEVATION	JOB NUMBER 612017		
GROUNDWATER	DATUM	PROJECT: WALLARAH	Proj. Manager JH
DRILL METHOD dam wall	DATE 26/3/12		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES TYPE	Undisturbed	Disturbed	Lost	Duplicate	Moisture content %	PID/FID Background	PID/FID Reading	CHEMICAL DATA pH - soil	H2O	CONSTRUCTION DETAILS / COMMENTS
	A1 10YR 5/3 loamy sand apedal massive, moist, very weak. containing OM (rootlets 10% and cinders 5%). with angular ironstone and sandstone gravel (<20mm) throughout.		0.1, 0.2, 0.3, 0.4, 0.5									5		grass @ surface. photo 4724
	end @ dam floor.													

ALLBorelog BW(1)1

Geological Borelog

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LOCATION		Borehole Log: SPARKS ROAD.	Logged by NC
SURFACE ELEVATION	JOB NUMBER 612017		
GROUNDWATER	DATUM	PROJECT: WALLARAH	Proj. Manager JH
DRILL METHOD road cutting	DATE 26/3/12		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES: TYPE	Undisturbed	Disturbed	Lost	Duplicate	Moisture content %	PID/FID Background	PID/FID Reading	CHEMICAL DATA: pH - soil	H2O	CONSTRUCTION DETAILS / COMMENTS
	A1 7.5YR 4/4 Clay loam, weak subangular blocky peds, dry, firm. containing OM (rootlets 5%) with angular ironstone gravel (<10mm)		0.2									5		photo: 4742 33° 13.591 ±6m. 151° 24.947
			0.4											
	B2 5YR 4/6 light medium clay, moderate angular blocky peds, dry, strong. with angular ironstone gravel (10 - 50mm) and siltstone gravel (50 ~~mm~~ mm)		0.6 0.8 1.0 1.2 1.4 1.6 1.8									4		grass and bark/leaves @ surface
	C weathered ironstone with interbedded claystone.		2.0 2.2 2.4 2.6 2.8 3.0											
	end @ roadway.		3.2											

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 14.591
151° 22.013 ±10m

Site location W.SHAFT Job No. 612017 Date: 26/3/12

Observation Point #: 1. Assessor NC Client: HANSON BAILEY

Photograph Numbers: SW-4698 N-4699 NW-4700 (off track).

Landform assessment

Slope (tangent (%) or degrees): 0° Symbol: LE

Morphological Type (code): M (name): ______

Landform Element Type (code): HSL (name): ______

Mode of activity: ERODED (name): sheet water, gravity

Geomorphological agent: GR | SH (name): ______

(status) C

Vegetation (plus boundaries).

Growth form (code): T / Z (name): spotted gum, terpintine, lantana.

Height (Class): 6 (name): ______

Foliage cover (%): 80 (name): D

Land surface

Aspect: S

Elevation (code): ______ (name): ______

Drainage height (metres) ______

Drainage Suitability (any waterlogged zones in top 300mm?): none.

Site disturbance (No.): 3 (type): unoperational state forest.

Microrelief (code): ______ (name): ______

Erosion status (code): P (type): water - 1

Extent/depth: 100-300mm Aggradation? (Y/N): Y

Coarse fragments (%): 20% (size): CG ironstone / sandstone

(shape): angular

Outcropping bedrock (code): R (name): sandstone boulders.

LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 13.378
151° 25.009 ± 5m

Site location BUTTON Job No. 612017 Date: 26/3/12

Observation Point #: 2 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N-4703 E-4704 S-4705 W-4706

Landform assessment

Slope (tangent (%) or degrees): 10° Symbol: MO

Morphological Type (code): C (name):

Landform Element Type (code): SUS (name):

Mode of activity: ERODED (name): sheet water, wind

Geomorphological agent: SH / WI (name):

(status) B

Vegetation (plus boundaries).

Growth form (code): M/D (name): spotted gum, ironbark, tussock grass.

Height (Class): 6 (name):

Foliage cover (%): 60 (name): M (grass 80%)

Land surface

Aspect: N

Elevation (code): (name):

Drainage height (metres)

Drainage Suitability (any waterlogged zones in top 300mm?): none - small dam.

Site disturbance (No.): 3 (type): slashing / cattle.

Microrelief (code): BIOTIC (name): ants. GILGAI: contours.

Erosion status (code): S (type):

Extent/depth: Aggradation? (Y/N): N

Coarse fragments (%): 30 % (size): CG ironstone / sandstone

(shape): angular

Outcropping bedrock (code): — (name):

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 13.336 ± 6m
151° 24.843

Site location BUTTON Job No. 612017 Date: 26/3/12

Observation Point #: 3 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N-4708 E-4709 S-4710 W-4711

Landform assessment

Slope (tangent (%) or degrees): 30° Symbol: ST

Morphological Type (code): S (name):

Landform Element Type (code): HSL (name):

Mode of activity: ERODED (name):

Geomorphological agent: SH (name):

(status) F

Vegetation (plus boundaries).

Growth form (code): M/D (name): spotted gum, ironbark, tussock grass.

Height (Class): 6 (name):

Foliage cover (%): 50% (name): M

Land surface

Aspect: NW

Elevation (code): (name):

Drainage height (metres)

Drainage Suitability (any waterlogged zones in top 300mm?): none

Site disturbance (No.): 3 (type): slashing / cattle

Microrelief (code): BIOTIC (name): ants

Erosion status (code): P (type): wind - 1 water - rill - 1

Extent/depth: Aggradation? (Y/N):

Coarse fragments (%): 50 % (size): CG ironstone / sandstone.

(shape): angular

Outcropping bedrock (code): — (name):

LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 13.265
151° 24.803

Site location BUTTON Job No. 612017 Date: 26/3/12

Observation Point #: 4 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N-4712 E-4713 S-4714 W-4715

Landform assessment

Slope (tangent (%) or degrees): 20° Symbol: MO

Morphological Type (code): L (name): ______

Landform Element Type (code): HSL (name): ______

Mode of activity: ERODED (name): ______

Geomorphological agent: SH (name): ______

(status) F

Vegetation (plus boundaries).

Growth form (code): M (name): spotted gum, ironbark, tussock/sedge

Height (Class): 6 (name): ______

Foliage cover (%): 60% (name): M (grass 60%)

Land surface

Aspect: NW

Elevation (code): ______ (name): ______

Drainage height (metres) ______

Drainage Suitability (any waterlogged zones in top 300mm?): none

Site disturbance (No.): 3 (type): slashing / cattle

Microrelief (code): BIOTIC (name): ants GILGAI : contour.

Erosion status (code): P (type): water - 1

Extent/depth: 100mm Aggradation? (Y/N): ______

Coarse fragments (%): 50% (size): CG ironstone / sandstone

(shape): angular

Outcropping bedrock (code): / (name): ______

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LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 13.247 151° 25.031 ± 6m

Site location BUTTON Job No. 612017 Date: 26/3/12

Observation Point #: 5 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N - 4716 E - 4717 S- 4718 W- 4719

Landform assessment

Slope (tangent (%) or degrees): 0° Symbol: ≷

Morphological Type (code): L (name): ______

Landform Element Type (code): HSL (name): ______

Mode of activity: ERODED (name): ______

Geomorphological agent: SH (name): ______

(status) B

Vegetation (plus boundaries).

Growth form (code): M (name): ironbark, spotted gum, grasses

Height (Class): 6 (name): ______

Foliage cover (%): 30% (name): S (grass 100%)

Land surface

Aspect: N

Elevation (code): ______ (name): ______

Drainage height (metres) ______

Drainage Suitability (any waterlogged zones in top 300mm?): yes (boggy when wet).

Site disturbance (No.): 3 (type): slashing / cattle.

Microrelief (code): GILGAI (name): contours BIOTIC: ants.

Erosion status (code): S (type): ______

Extent/depth: ______ Aggradation? (Y/N): ______

Coarse fragments (%): 10% (size): CG ironstone

(shape): angular

Outcropping bedrock (code): — (name): ______

Glaeba (02) Pty Ltd trading as Environmental Earth Sciences NSW
7 - 9 George Place, Artarmon, NSW. 2064 PO Box 380, North Sydney, NSW. 2059
P. 61 2 9922 1777 F. 61 2 9922 1010 E. eesnsw@environmentalearthsciences.com
www.environmentalearthsciences.com

LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 12.865 151° 27.238 ± 4m

Site location TOOHEY Job No. 612017 Date: 26/3/12

Observation Point #: 6 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N-4720 E-4721 S-4722 W-4723

Landform assessment

Slope (tangent (%) or degrees): 0° Symbol: L

Morphological Type (code): S (name): ______

Landform Element Type (code): HSL (name): ______

Mode of activity: ERODED (name): ______

Geomorphological agent: SH / GR (name): ______

(status) B

Vegetation (plus boundaries).

Growth form (code): M/V (name): spotted gum, ironbark, sedge grasses

Height (Class): 6 (name): ______

Foliage cover (%): 10% (name): S (grass 100%)

Land surface

Aspect: N

Elevation (code): ______ (name): ______

Drainage height (metres) ______

Drainage Suitability (any waterlogged zones in top 300mm?): none.

Site disturbance (No.): 3 (type): slashed.

Microrelief (code): GILGAI (name): contours

Erosion status (code): S (type): ______

Extent/depth: ______ Aggradation? (Y/N): N

Coarse fragments (%): — (size): ______

______ (shape): ______

Outcropping bedrock (code): — (name): ______

ENVIRONMENTAL EARTH SCIENCES
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LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 12.656 ±6m
151° 27.382

Site location TOOHEY Job No. 612017 Date: 26/3/12

Observation Point #: 7 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N-4728 E-4729 S-4730 W-4731

Landform assessment

Slope (tangent (%) or degrees): 20° Symbol: MO

Morphological Type (code): S (name): ______

Landform Element Type (code): HSL (name): ______

Mode of activity: ERODED (name): ______

Geomorphological agent: SH / GR (name): ______

(status) B

Vegetation (plus boundaries).

Growth form (code): M/V (name): ironbark, sedge

Height (Class): 6 (name): ______

Foliage cover (%): <10% (name): V (grass 100%)

Land surface

Aspect: S

Elevation (code): ______ (name): ______

Drainage height (metres) ______

Drainage Suitability (any waterlogged zones in top 300mm?): none.

Site disturbance (No.): 3 (type): slashed

Microrelief (code): GILGAI (name): contours.

______

Erosion status (code): S (type): ______

Extent/depth: ______ Aggradation? (Y/N): N

Coarse fragments (%): / (size): ______

______ (shape): ______

Outcropping bedrock (code): / (name): ______

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LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 12.584 151° 27.662 ±7m

Site location TOOHEY Job No. 612017 Date: 26/3/12

Observation Point #: 8 Assessor NC Client: HANSON BAILEY

Photograph Numbers: W – 4733 N – 4734 E – 4735 S – 4736

Landform assessment

Slope (tangent (%) or degrees): 10° Symbol: MO

Morphological Type (code): S (name):

Landform Element Type (code): HSL (name):

Mode of activity: ERODED (name):

Geomorphological agent: SH / GR / WI (name):

(status) S

Vegetation (plus boundaries).

Growth form (code): M (name): ironbark, banksia, sedge, native grass.

Height (Class): 6 (name):

Foliage cover (%): 40% (name): M (grass 100%)

Land surface

Aspect: S

Elevation (code): (name):

Drainage height (metres)

Drainage Suitability (any waterlogged zones in top 300mm?): none.

Site disturbance (No.): 3 (type): slashed.

Microrelief (code): U (name):

GILGAI: contour.

Erosion status (code): 3 (type):

Extent/depth: Aggradation? (Y/N): N

Coarse fragments (%): / (size):

(shape):

Outcropping bedrock (code): / (name):

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LAND CAPABILITY OBSERVATION SHEET

GPS: 33° 12.496 151° 27.961 ±7m

Site location TOOHEY Job No. 612017 Date: 26/3/12

Observation Point #: 9 Assessor NC Client: HANSON BAILEY

Photograph Numbers: N - 4737 E - 4738 S - 4740 W - 4739

Landform assessment

Slope (tangent (%) or degrees): 0° Symbol: L

Morphological Type (code): C (name):

Landform Element Type (code): SUS (name):

Mode of activity: ERODED (name):

Geomorphological agent: SH / WI (name):

(status) U

Vegetation (plus boundaries).

Growth form (code): D / V (name): grasses

Height (Class): 1-3 (name):

Foliage cover (%): D (name): 100% grasses.

Land surface

Aspect: ridge ?

Elevation (code): (name):

Drainage height (metres)

Drainage Suitability (any waterlogged zones in top 300mm?): none.

Site disturbance (No.): 5 (type): PASTURE

Microrelief (code): U (name):

Erosion status (code): S (type):

Extent/depth: Aggradation? (Y/N): N

Coarse fragments (%): / (size):

(shape):

Outcropping bedrock (code): / (name):

Wallarah 2
COAL PROJECT

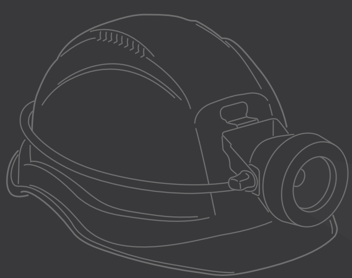
Wallarah 2 Coal Project

Response to Submissions

September 2013

Appendix I

Peer Review of Geology Report



Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Report

Peer Review of Structural Interpretation

Company	KORES
Site	Wallarah 2 Coal Project
Date	May 2013
Doc No	KORES1623-02

palaris

palaris

Report To	John Edwards		
Project No	KORES1623		
Doc No	KORES1623-022		
	Name	**Date**	**Version**
Author	Grahame Lindsay	Apr 2013	1
Peer Review By	John Bamberry	Apr 2013	1
Draft Issued To	John Edwards	Apr 2013	1
Final Review By	John Bamberry	May 2013	2
Final Issued To	John Edwards	May 2013	2

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- Plant and equipment constraints
- The capability and availability of management and employees (of Palaris, the Client and relevant third parties)
- Workplace health & safety issues
- Availability of funding to the operation
- Availability and reliability of supporting infrastructure and services
- Efficiency considerations
- Variations in cost elements
- Market conditions and global demand
- Industry development
- Regulatory and policy changes

Contents

Executive Summary

Palaris Mining was engaged to peer review a component of work in an Environmental Impact Statement for the Wallarah 2 Coal Project. Specifically, a section of a chapter of supplementary information (*Section 7.3 Faulting*) was reviewed.

The finding of this review indicated that:-

- the Wallarah 2 Coal Project is supported by a first rate dataset of boreholes and geophysical surveys
- the interpretation of the datasets is supported by relevant facts and figures
- no major structural features have been identified to date

This peer review of the Chapter concludes that the arguments presented by the authors are valid. Palaris consider that the strength of the structural geology data and interpretations lie in discussion of the high standard dataset and the various syntheses of these that have been collated over the years. The risk of encountering significant structures that may impact on the mine plan or cause some perceived interference with surface aquifers is considered low.

The authors specifically addressed a feature known as the Coastal Lineament (Mauger et al. 1984) and discussed a fault interpreted by Jones (2005). Personnel working on the Wallarah 2 Coal Project have undertaken analysis of multiple datasets, including LIDAR, ground and airborne magnetics surveys, drilling and seismic surveys. This work has conclusively demonstrated that in the project area, no significant faulting exists in association with the Coastal Lineament and that there is no evidence to support the faults interpreted by Jones (2005).

1 Introduction

The Wallarah 2 Coal Project (the Project) is located on the east coast of NSW approximately 70 km south of the Port of Newcastle. The Project is located in the north-eastern part of the Sydney Basin and in the southern part of the Newcastle Coalfield. The location of the project and associated exploration tenements are shown in Figure 1.1.

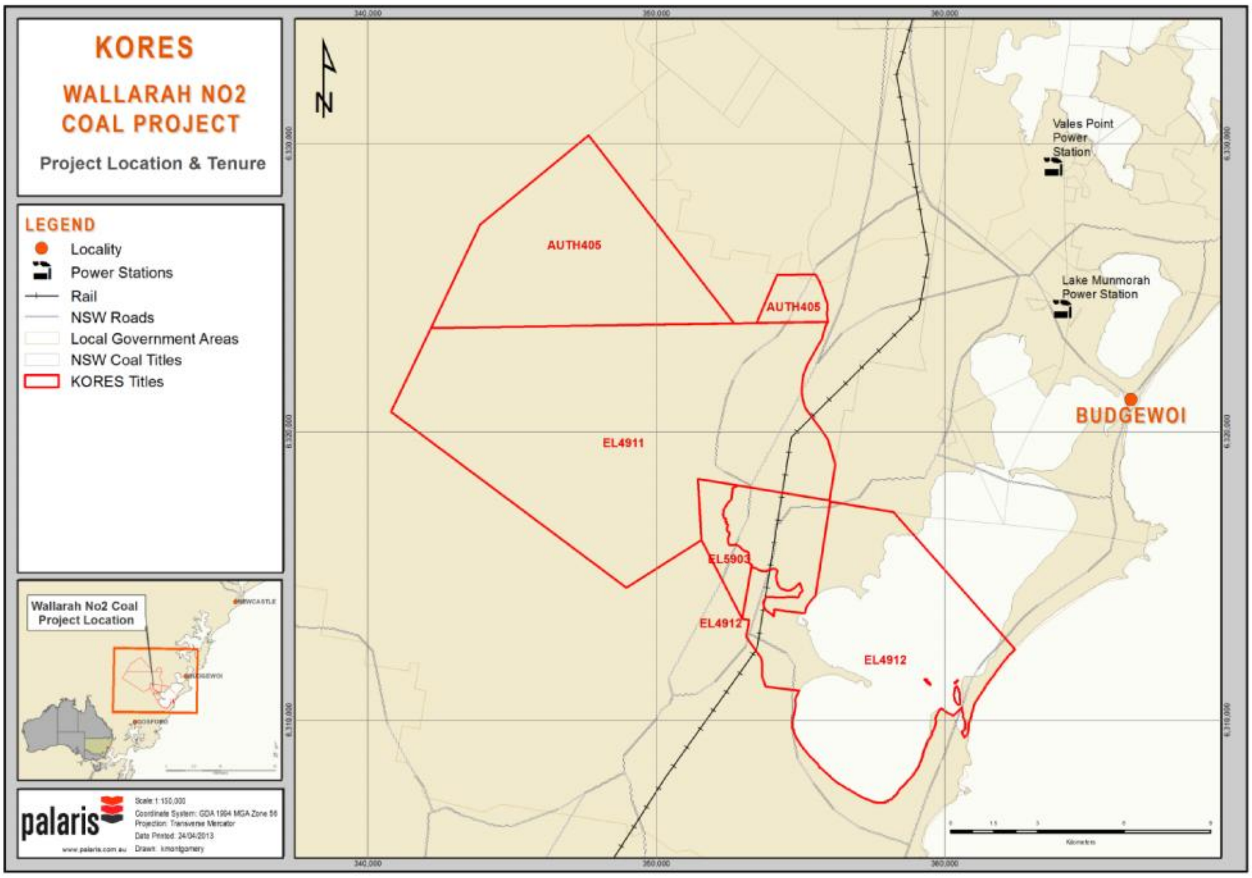

Figure 1.1 Locality Plan

The target coal seams occur in the upper part of the Late Permian Newcastle Coal Measures and in the project area, these seams occur at depths ranging from 200 metres to greater than 600 metres. The seams dip gently to the south west. The project proposal is for the development of an underground longwall mine working the uppermost seams in the Newcastle Coal Measures, being the Wallarah - Great Northern seams. Underground mines around the Lake Macquarie area have worked these seams by underground methods for many years.

Kores Australia Pty Ltd (Kores) holds several tenements over the area; the larger exploration tenements cover a total area of approximately 189 km^2 (Table 1.1). MLA342 covers the area of the proposed longwall development and covers an area of 40.53 km^2.

Kores requested that Palaris undertake a peer review of the interpretation of the structural geology presented in the supplementary addition to the Wallarah 2 Coal Project Environmental Impact Statement (EIS).

The scope of work is to:-

- describe the current structural interpretation, and the development of the rationale
- briefly critique methods used in the interpretation, such as seismic surveys
- review the specific interpretations outlined in *Section 7.3 Faulting* of the EIS Supplementary Geology Chapter
- draw conclusions and recommendations (if any)

The scope does not include interpretation of data and is limited to the proposed mine area.

Tenement	Area (ha)	Purpose
EL4911	5700	Exploration
EL4912	9200	Exploration
A405	4000	Exploration
EL5903	427	Exploration
MLA342	4053	Mine development
MLA343	154	Drift
MLA346	194	Pit top
MLA350	40.14	Rail corridor

Table 1.1 Tenement summary

2 Structural Interpretation

2.1 Background

Exploration of the Wyong area has a long history that extends back to the 1880's. Significant components of drilling were undertaken by the Electricity Commission (Elecom) in the 1960's and 1980's, and by the Department of Mineral Resources in the 1970's and 1980's. The exploration was aimed at establishing potential coal resources for planned additional power stations.

In 1995, Coal Operations Australia Limited was granted the right to explore three leases that made up the Wyong Coal Development Area and included the western area, covering the Dooralong and Yarramalong Valleys (now A405 and EL4911) and the eastern area over Tuggerah Lake (EL4912). Following successive ownership changes, Kores acquired the project in 2005.

Exploration since 1996 has resulted in the acquisition of a large volume of modern data, including a substantial number of boreholes and various aerial and ground geophysical surveys. The data are stored securely, including all cores stored at a central facility. The data relevant to a structural geological interpretation of the target area are outlined below.

2.2 Data

The data collected for this project is of high geological standards and is summarised below. This data forms the basis for most of the structural interpretation outlined in the EIS.

(i) Regional Geology

The surface geology of the Wyong area and the geology of the region are well understood. In 1995, the NSW Government published the 1:100,000 scale Newcastle Coalfield Regional Geology map. The map shows that in the vicinity of the project area, the only major structures identified are the Lake Macquarie and Yarramalong Synclines (Figure 2.1). Both of these features trend southwest to northeast and the project is located between the two synclines.

The regional geology does not show any other structural features within the project area, including the "*Coastal Lineament*" (Mauger et al., 1984) or other faults supposed to exist in the area (such as one along *Jilliby Creek* [*sic*], (Jones, 2005)).

The map highlights the dominant northwest to southeast strike of faults and dykes, particularly in the Lake Macquarie area, with lesser frequency of structures orientated northeast-southwest.

The surface geology is dominated by the Narrabeen Group. This consists of in ascending order, Dooralong Shale, Munmorah Conglomerate, Tuggerah Formation, Patonga Claystone and Terrigal Formation. In the subsurface, the Dooralong Shale and overlying Munmorah Conglomerate are developed above the Newcastle Coal Measures and crop out to the north, in the Lake Macquarie area. The Tuggerah Formation, Patonga Claystone and Terrigal Formation (parts of the Narrabeen Group) crop out in the western exploration tenements.

(ii) Borehole Data

Since the 1980's, 453 boreholes have been drilled in tenements currently (and previously) held for the Wyong Project (Figure 2.2). The data from these holes is of a high standard and includes logging and photographs of all cores, and geophysical logging of all holes. The borehole data has indicated the presence of dykes, sills and faults (Wyong Areas Coal Joint Venture, 2003).

The borehole data has been used to highlight areas of structural disturbance by detailed examination of drill core and down-hole geophysics to record fracturing and possible faulting. This data highlighted zones of disturbance but generally is of limited use for determining the magnitude of faulting and in the absence of acoustic scanner logs, the orientation of features cannot be directly determined.

The borehole data were also used to develop detailed correlations of the geology and allow the modelling of the coal seam surfaces to aid in the understanding of the structuring of the seam.

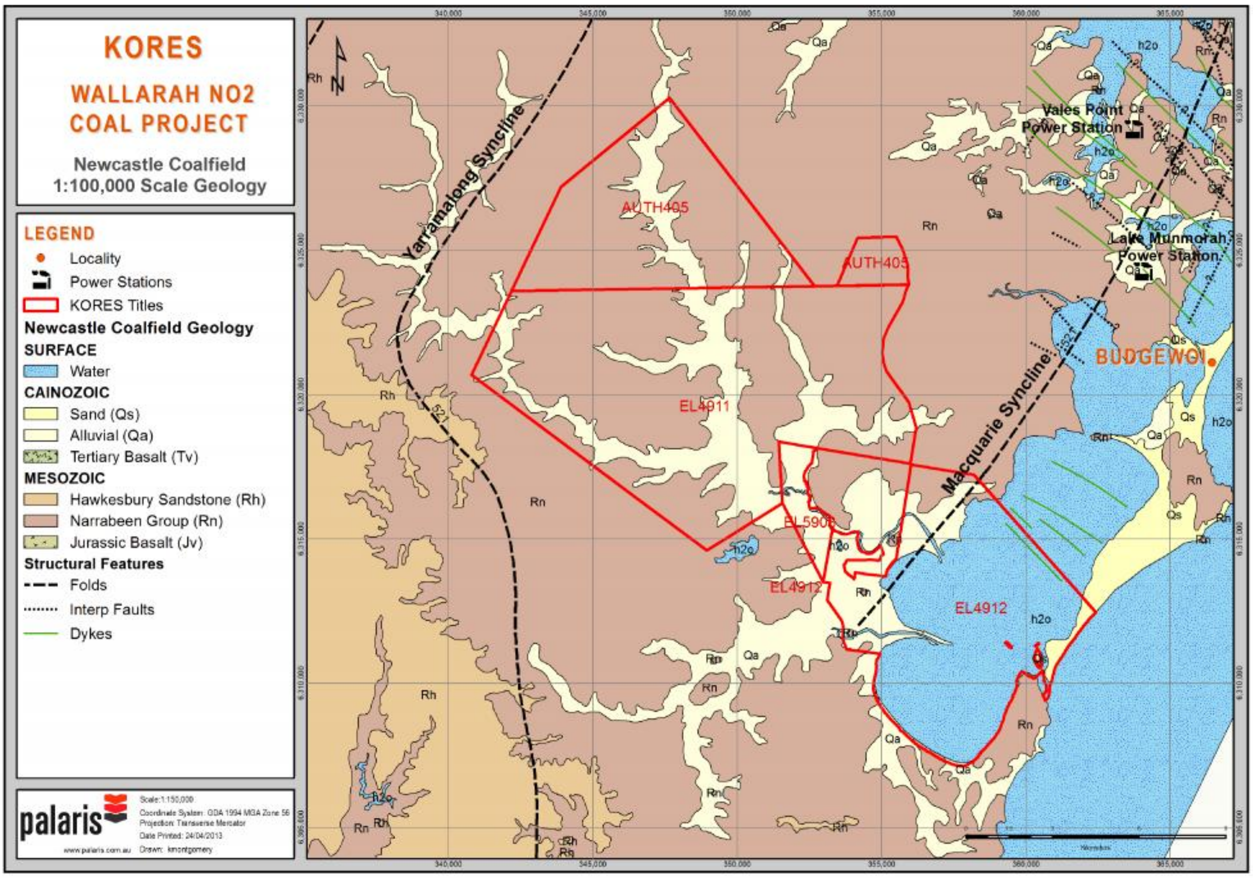

Figure 2.1 Regional Geology

(iii) Geophysical Surveys

Magnetometer surveys measure the magnetism of the earth's crust, essentially measuring the abundance of magnetite. In coal exploration, magnetometer surveys are mainly used to identify igneous rocks, such as sills and dykes, and have a limited use in identifying significant faults. However, since the faults are commonly intruded by dykes, the absence of dykes in the project area may reflect an absence of faulting.

The lower the altitude of the survey, the greater the precision is in locating igneous rocks at the surface. Ground magnetometer surveys can identify dykes as thin as one metre and in ideal conditions, even thinner ones.

The presence of the widespread and continuous dykes through the project area, provide a strong linear feature to highlight any lateral displacement that may indicate large scale, cross cutting faults.

Aerial Magnetics

A high resolution aerial magnetic survey was acquired over the entire area in 1996. The survey was conducted by helicopter from an altitude of 60m.

Ground Magnetics

A number of high resolution ground-based magnetic surveys were conducted over selected areas at various times (Figure 2.3, Figure 2.4).

2D Seismic

Approximately 30 km of Mini SOSIE seismic were acquired forming an approximate 1 km grid over the eastern half of the target area (Figure 2.4). Seismic surveys map surfaces within the earth by propagating sound waves through the rocks and capturing the reflections from surfaces with contrasting densities. Identifying faults using seismic survey results depends on a variety of factors including target depth, rock characteristics, signal source type and data processing parameters. Generally a high resolution seismic survey within coal measures should be capable of identifying faults with a displacement of 5 metres and greater with some confidence. Under ideal conditions it may be possible to identify smaller faults. The seismic acquired for this project is considered to be exceptional quality.

3D Seismic

An area of 2km by 1km of 3D Mini Sosie seismic was acquired in the area of proposed initial development. A 3D survey allows a greater level of confidence on fault interpretations because of the greater volume of data allowing better processing of the raw data. A 3D seismic survey also allows details of fault orientation and continuity to be determined with greater confidence.

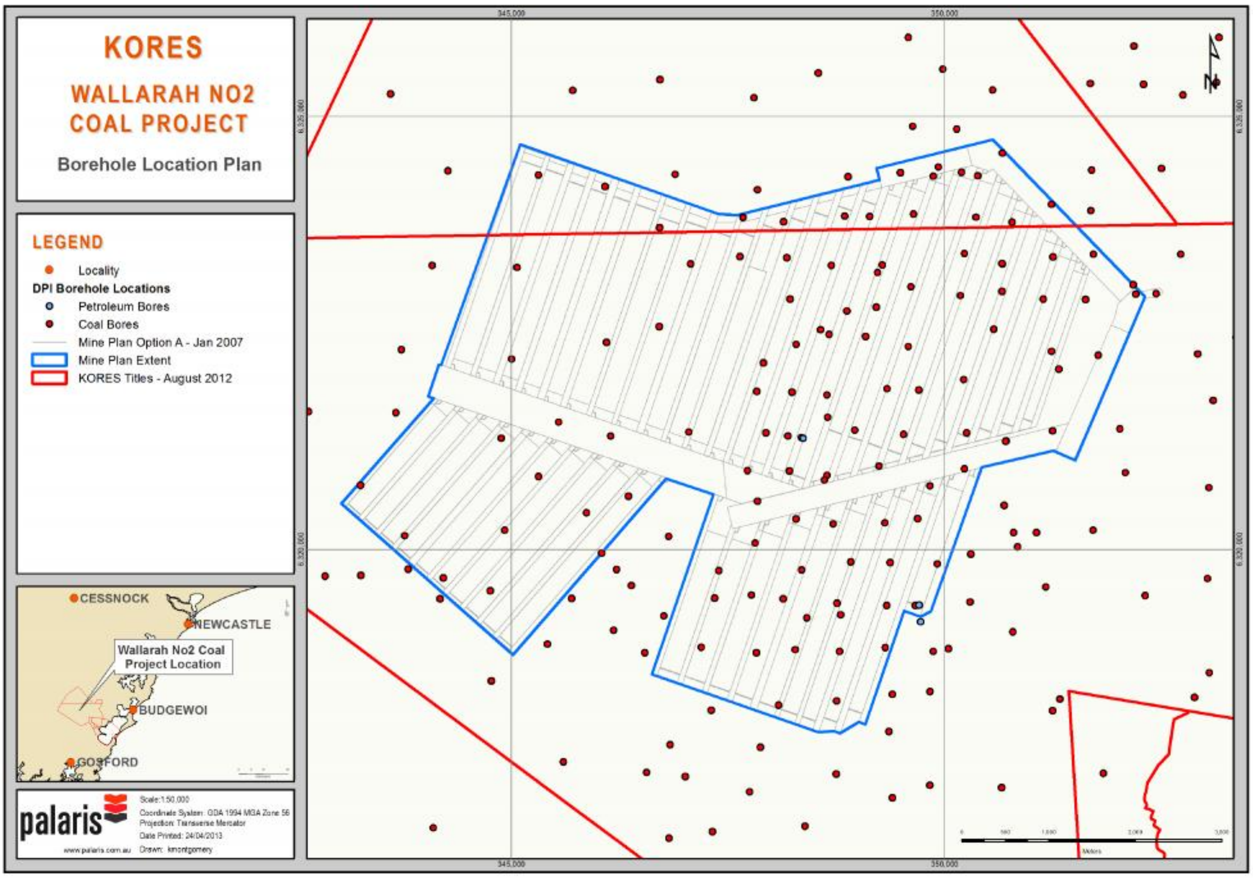

Figure 2.2 Target Area and Borehole Distribution

(iv) Aerial Photography

High resolution aerial photography was acquired over the project area in 1996 and again in 2006. High resolution aerial photographs can be used for lineament studies and will show subtle variations in erosion and vegetation patterns, both of which may be related to geological features such as igneous dykes and flows, faults, changes in fracture density and changes in lithological character.

(v) LIDAR Survey

A high resolution aerial laser (LIDAR) survey was conducted in 2006 (Figure 2.5). LIDAR is used for the very precise mapping of the earth's surface using airborne lasers, allowing the development of a high resolution digital terrain model.

The data from a LIDAR survey can be used to generate a very detailed model of the ground surface, excluding vegetation, and allows for the identification of very subtle variations that may be related to the underlying geology. The topographic variations reflect subtle changes in weathering and erosion or by faulting of the surface. LIDAR will often clearly display the surface expression of igneous dykes and large faults.

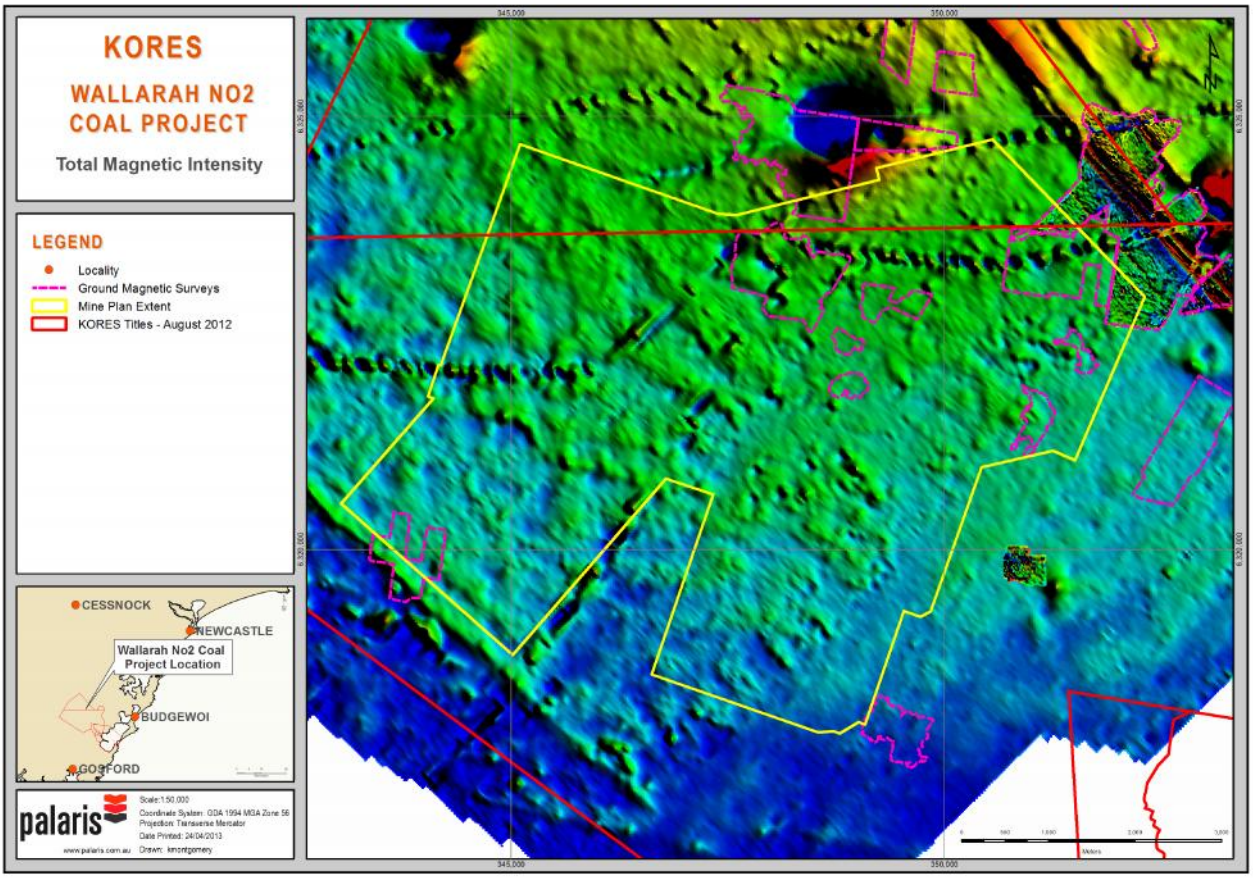

Figure 2.3 Total Magnetic Intensity

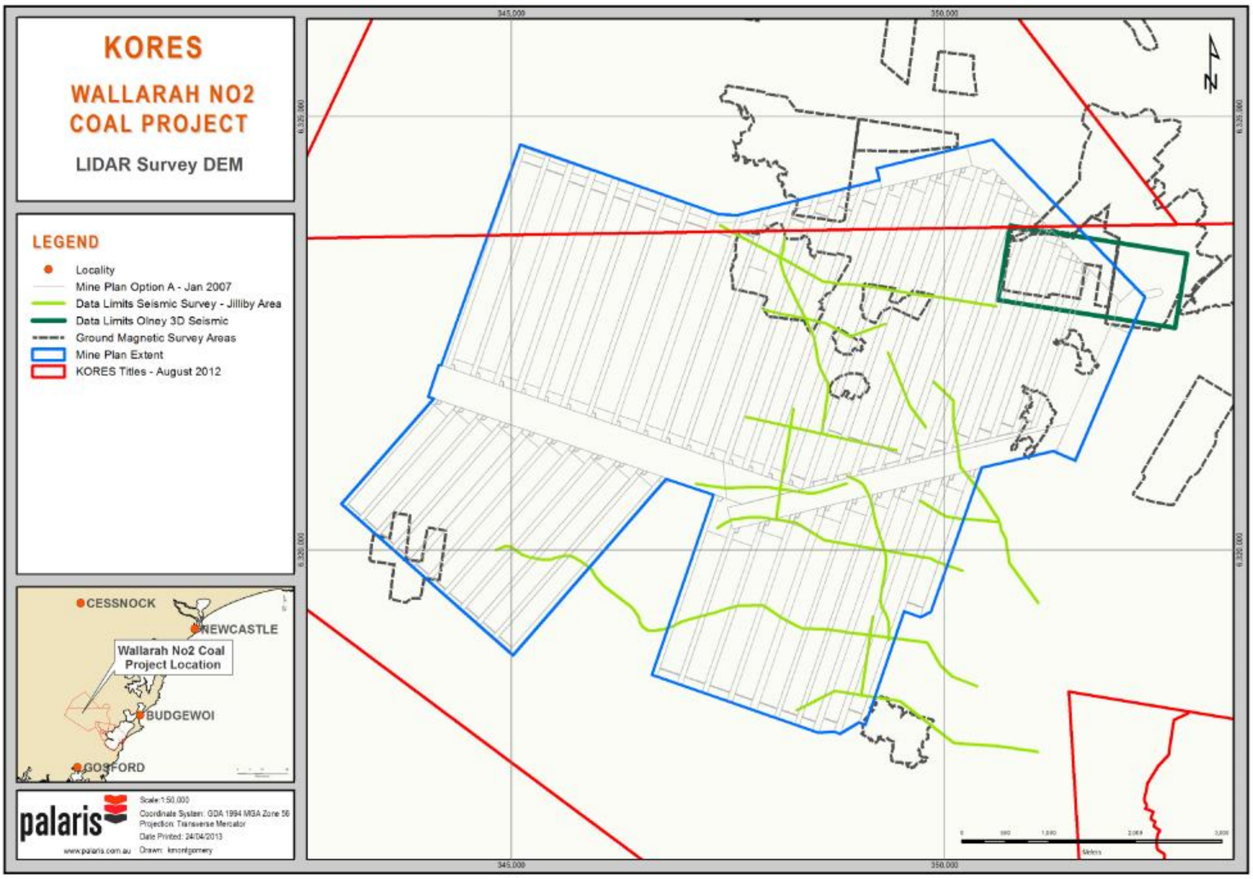

Figure 2.4 Seismic Surveys and Ground Magnetic Locations

2.3 Studies

(i) Lineament Analysis

CSIRO (Mauger et al., 1984) conducted a large scale basin wide lineament study reported in 1984 with the aim to *"…provide a framework on which further detailed structural geology studies at the mine lease scale could be conducted*."

The resultant 1:100,000 maps were derived from a synthesis of aerial photography and Landsat interpretation, and limited geological investigations and bedrock sampling. Figure 2.6 illustrates the lineaments within the area identified by the CSIRO Study.

At a later stage, staff consulting to the project conducted their own lineament study. This study used a combination of magnetic surveys (ground/airborne), LIDAR imaging and local geological knowledge to investigate geological structures. ERDAS ERMapper, an advanced image processing tool, was used to visualise and enhance geological structures, such as the surface expression of dykes. By overlying the position of the Coastal Lineament, the study demonstrated that no expression in these datasets of the Coastal Lineament exists. Equally, no surface expression of faults aligned with Jilliby Creek [*sic*] (Jones, 2005) was identified.

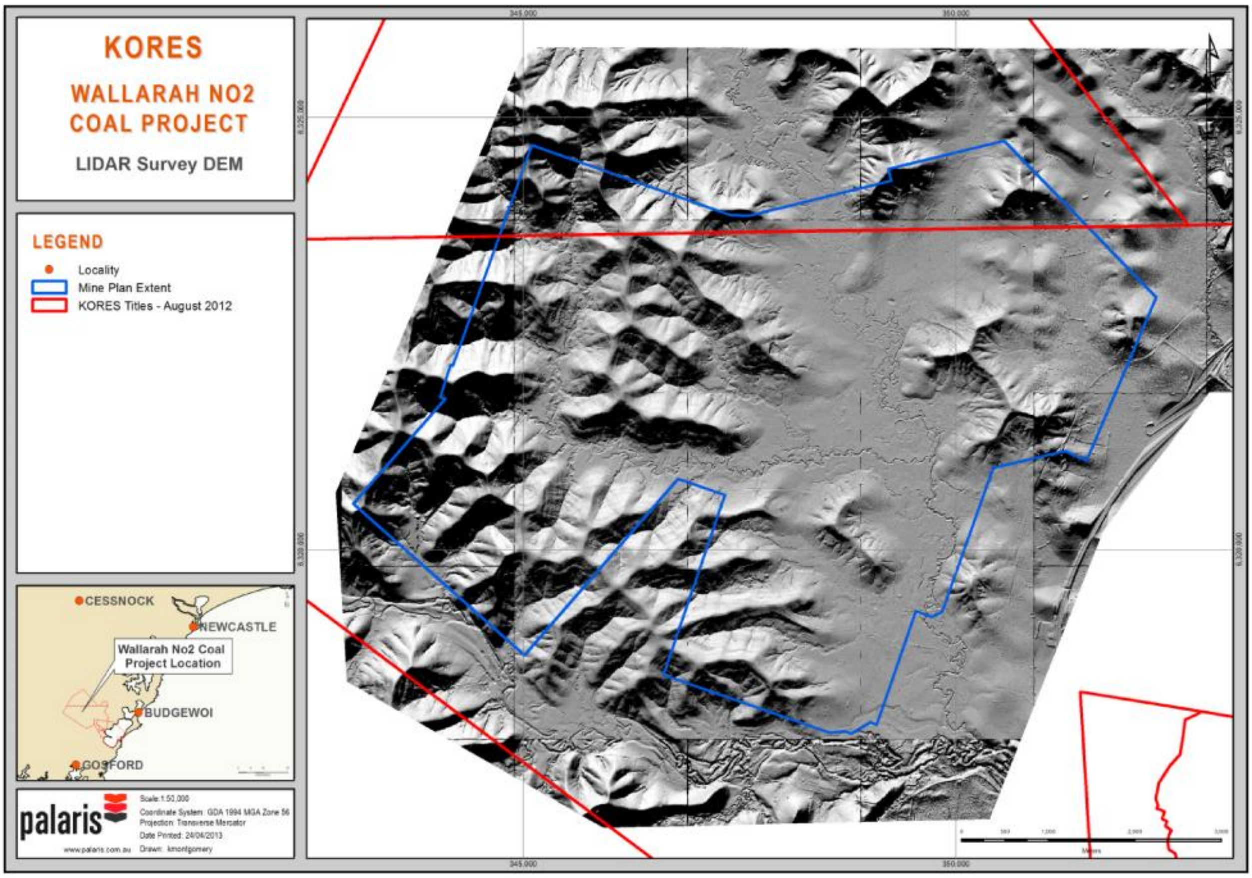

Figure 2.5 LIDAR Survey DEM

(ii) Tunnel Data

In 1990 the excavation of a tunnel located to the immediate west of the project, as part of the Gosford Wyong Water Supply infrastructure, was completed. The tunnel was excavated for a total of 10.8 km using a tunnel boring machine with a diameter of 3.1 metres. Detailed geotechnical logging provides a continuous rock intersection of over 10 km through the Terrigal Formation, which occurs in the Triassic Narrabeen Group, overlying the Newcastle Coal Measures.

(iii) Assessment of Adjacent Areas

The Wallarah 2 Coal Project team has conducted a study of historic geological data from adjacent underground mines to develop an understanding of the structural geology of the area and the magnitude and frequency of faulting.

Detailed plans of historic mining from areas to the north east were analysed to develop an understanding of the general characteristics of the faulting and igneous intrusions in the region. The investigation allowed the development of an understanding of the frequency, magnitude and orientation of faulting encountered in the mines, which was then used to develop probable structural characteristics within the target area.

A large database of drillholes, high resolution and high quality 3D seismic and aerial and ground magnetics exists for the Tuggerah Lakes area to the immediate south-east of the target area. This data was used to characterise the local geology. Additionally the continuity of some features, notably a zone of northwest trending dykes, could also be demonstrated.

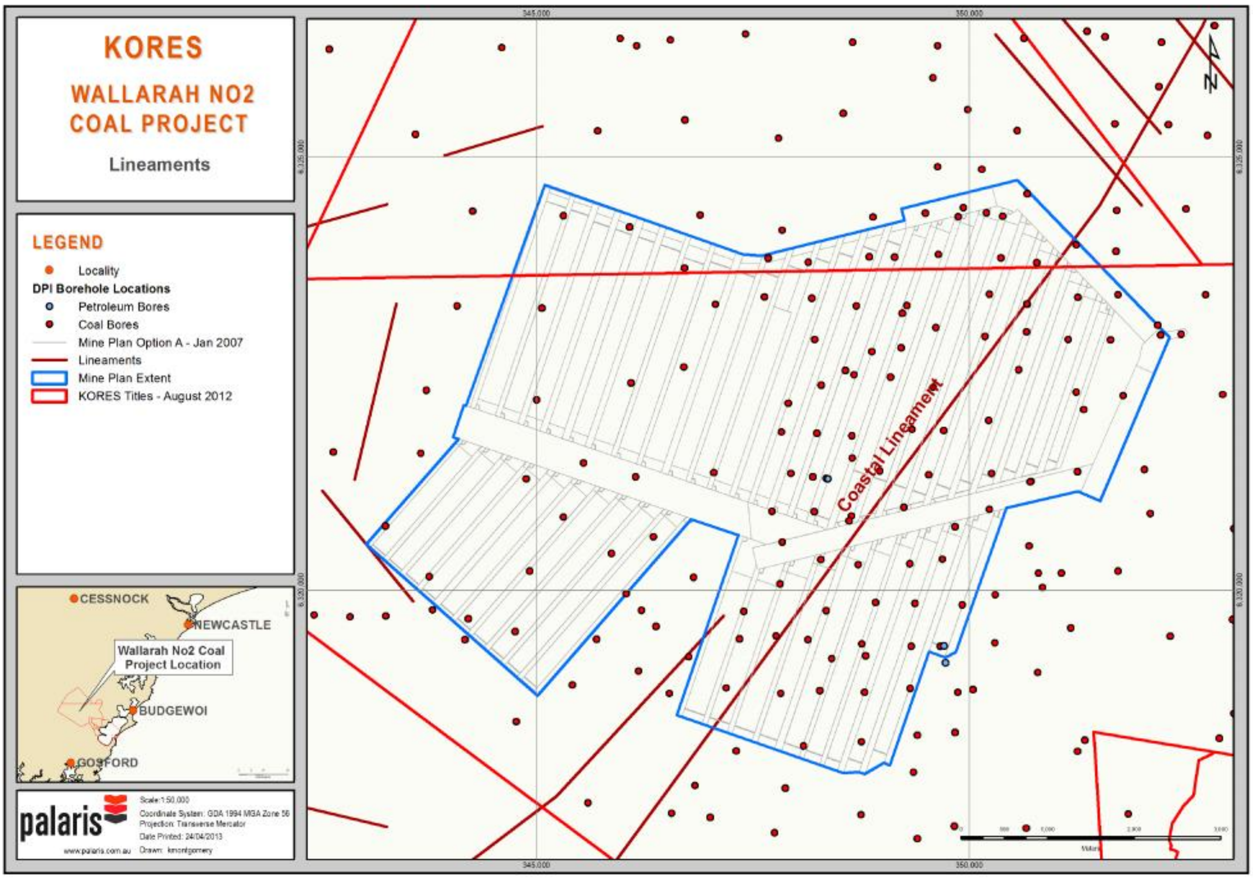

Figure 2.6 Lineaments from CSIRO Study

3 Peer Review of Structural Interpretations

3.1 Introduction

Wyong Areas Coal Joint Venture (2013) provides supplementary information for the EIS, Section 5 on Geology and Resources. Specific to this exercise, KORES requested that Palaris provide a peer review of *Section 7.3 Faulting*. The previous chapter of this report demonstrates that there is a large dataset of high quality data covering the project area that supports the development of the interpretations made for the project. The dataset for this project is particularly comprehensive reflecting the maturity of the exploration.

3.2 Summary of EIS Supplement

Section 7.3 Faulting presents an interpretation of the faulting within the target area based on the available data.

The chapter discusses the following:-

- principal fault directions of the Newcastle Coalfield
- lineament analysis by Mauger et al. (1984)
- the "Coastal Lineament"
- faults identified by seismic
- a "hydrogeology" report by Jones (2005)
- structure control on surface geology

The discussion is supported by appropriate figures.

3.3 Review of EIS Supplement

(i) Principal Fault Directions

Discussion in the EIS Supplement on principal fault directions is concise.

During discussions between Palaris and Project personnel, very valid comments were made with respect to the regional geology (1:100,000 Newcastle Coalfield Regional Geology) and information collected from many years of mining to the north, and what this data shows with respect to regional structural fabric. In addition, work such as the structural synthesis of the Newcastle Coalfield (such as Crapp and Nolan, 1975; Lohe and McLennan, 1991) demonstrates that it is unusual to observe significant structures in departures from the primary and secondary fault and dyke orientations.

(ii) Lineament Analysis

The EIS Supplement discusses the results of the 1984 CSIRO Lineament analysis (Mauger et al., 1984) and a hydrogeology report by a company called '*Northern Geosciences*' (Jones, 2005).

The 1984 CSIRO study was a synthesis of aerial photo and Landsat interpretation with limited geological investigations and bedrock sampling. The output was a series of 1:100,000 maps intended to provide a "*broad framework of features that would require additional investigation*".

The Coastal Lineament

From the CSIRO study the Wyong target area was generally found to be lineament free apart from a poorly defined lineament running northeast to southwest through the centre of the area named the "*Coastal Lineament*". A number of other lineaments around the Project area are clearly related to igneous dykes.

The Coastal Lineament was first defined by Scheibner (1973) as part of a preliminary study of linear features for the whole of New South Wales using ERTS-1 (Landsat)[1] and photographic imagery. Scheibner (1973) defined the lineament as a zone 5 to 15 km wide.

Mauger et al (1984) suggested that the Coastal Lineament was best developed on the imagery from the Heat Capacity Mapping Mission (HCMM). The report describes the quality of the HCMM data as; "*On the*

[1] The scene size produced by Landsat imagery was 170 km x 185 km.

HCMM the lineaments recognised either define general geometry of the Basin or were more in the class of broad spectral alignments." It is worthy to note that the HCMM was an experimental satellite program directed at observing thermal conditions on the Earth's surface during the day and at night. The satellite was operational from April 1978 to September 1980; many of the images produced from this survey have been scanned by NASA, but are of very low resolution.

The Coastal Lineament is displayed on the CSIRO maps as having a "*3rd order*" classification in the Wyong area, which is assumed to be low quality. In the Hawkesbury River area a study by Norman et al in 1985 suggested that the lineament to consist of *"…closely spaced (0.5m to 1.0m) master joints. The width of the lineament is not well defined and may be as wide as 1 km*." Mauger et al. (1984) stated that… "*The lineament is thought to parallel the opening of the Tasman Sea and the orientation appears to have controlled the geomorphology of the coast itself*."

The Coastal Lineament, thus, appears to be a broad, diffuse lineament reflecting deep seated basement structuring. It may be possible for this type of structuring (if it exists) to have influenced sedimentation patterns during the Permian without the presence of faulting at the level of the coal measures.

The EIS Supplement (Wyong Areas Coal Joint Venture, 2013) suggests that the Coastal Lineament may coincide with the western flank of the Central Channel Zone that defines the eastern limit of the extraction area. Palaris note that the borehole data and seismic surveys surrounding the area where the Coastal Lineament is supposed to be developed shows no evidence for the presence of a fault structure. This observation is highlighted in the EIS Supplement.

In addition to the exploration data, LIDAR and more recently acquired data was reviewed in conjunction with other datasets to determine if the Coastal Lineament is present. No evidence for the existence of the Coastal Lineament being a major fracture exists within the project area.

- **Kooree Creek Lineament**

The Kooree Creek Lineament is another feature identified by Mauger et al. (1984). The Boomerang Creek Tunnel was geotechnically logged in considerable detail and the orientations of all fractures and faults recorded. The tunnel is understood to have passed through the Kooree Creek Lineament. Intersected structure in the tunnel comprises a number of small faults over a zone of about a kilometre defining a small graben structure. However, most of the joints were in the northwest-southeast direction, hence at right angles to the Kooree lineament with only some on the northeast southwest orientation.

Numerous small faults and fracture zones were intersected and recorded in detail throughout the tunnel but no large scale features were intersected. Details of water inflows along fractures and faults were also documented, and although some high initial flows were recorded, measurements over time showed that they declined rapidly.

Although the tunnel is outside the target area it provides very useful data on the general geological characteristics and behaviour of the strata in the area. It also provides evidence that the interpretation of a lineament, such as the Koree Creek Lineament, does not translate to a major fault. The authors of the EIS Supplement make appropriate comments on water flow from structures, and the dissipation of flow over a short period. Further support for the lack of connectivity between surface fractures and coal seams could be gleaned from reference to experiences in underground mines beneath Lake Macquarie.

- **Hydrogeology Report**

The EIS Supplement makes reference to a report commissioned by Tony Davis and Associates of the former Australian Gas Alliance, who opposed coal seam gas projects. The *Northern Geosciences* report titled *"(Draft) Report on Hydrogeological Investigations Dooralong & Yarramalong Valleys Wyong, Central Coast, NSW*" is authored by Tim Jones (MSc) AIEH. The study proposed the possibility of major faulting in the area.

From a geological perspective the hydrogeology report is poorly presented showing a lack of fundamental geological knowledge of the area and contains numerous errors of fact. This report highlights that Jones (2005) has a very poor understanding of the geology, including:-

- incorrect reference to the stratigraphy of the area and misquoting the stratigraphic status, whether intentionally or by incompetence (eg "Narrabeen Sandstone", instead of the correct terminology "Narrabeen Group"); this misleads the reader into thinking that the sequence is sandstone, and hence a possible aquifer

- inclusion of pictures captioned with incorrect stratigraphy (e.g., p23, picture of "Gosford and Hawkesbury Formations" overlying the Great Northern Seam at Catherine Hill Bay, when this is the Munmorah Conglomerate)

Palaris could not locate or identify the company "*Northern Geosciences*", whose reports do not carry an ABN reference, address or contact details. Palaris could also not locate any information about the author, hydrogeologist, Tim Jones (MSc) AIEH. The competence and transparency of this author and report are questionable. Material issues, such as a picture of a "*crushed and sheared Gosford Sandstone*" (sic.) (p12), supposedly taken in the Dooralong Valley is not referenced by location, and would not be able to be independently validated. No substantive evidence is presented in the Northern Geosciences report to support the geological interpretations, particularly in relation to the use of lineaments to infer faulting.

The AIEH appears to be the "*Australian Institute of Environmental Health*" or now called "*Environmental Health Australia*" and its relevance to hydrogeology is not clear.

The work produced by Jones (2005) is full of incorrect assumptions and fairly vague statements relating to the geology, the location of aquifers, the supposed connectivity of groundwater and references to previous works. The work discusses investigations with no reference, for example on p15, Jones mentions "*The geophysical study was undertaken to provide information on the subsurface conditions and any structures that may influence groundwater in the area*" with no mention of who did this work, or what techniques were used. The work has little substance and has already been critiqued by Barry (2005).

The authors of the EIS Supplement have discussed the "*Northern Geosciences*" report findings and presented arguments refuting the findings of this report. The discussion of the work of Jones (2005) by the authors of the EIS Supplement is sound and logical. The presentation of the structural orientations clearly shows the anomalous nature of Jones' assertion that the Jilliby Creek follows a "conjugate fault zone".

4 Conclusions and Recommendations

The Wallarah 2 Coal Project has available a sufficiently large body of high quality data to allow the delineation and understanding of large scale structural features within the target area and surrounds. This includes a large dataset of cored boreholes, samples from which are well preserved in the Joint Venture core shed, geophysical surveys including airborne and ground magnetic surveys, and 2D and 3D seismic surveys.

The authors discuss the early works of Mauger et al. (1984) and the hydrogeological report of Jones (2005). Palaris consider that the EIS Supplement *Section 7.3 Faulting* contains relevant arguments and discussion that are logical and backed up by data.

The data presented in the EIS demonstrates that:-

- no evidence for a significant structure associated with the Coastal Lineament exists in the project area
- no evidence exists for the existence of the fault interpreted by Jones (2005)

Lineament analysis (Scheibner, 1973; Mauger et al., 1984), undertaken in the early 1970's and 1980's, was at a time when the resolution of imagery was low and remote sensing processing techniques were in their infancy. Interpretation using modern imaging technology undertaken by site personnel, combined with a comprehensive geological dataset refutes the existence of major faulting within the project area.

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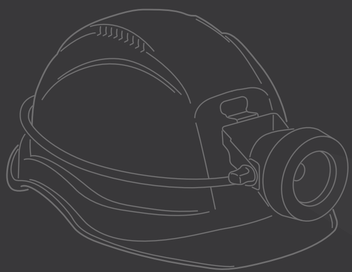
Wallarah 2
COAL PROJECT

Wallarah 2 Coal Project

Response to Submissions

September 2013



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