BULLI SEAM OPERATIONS

APPENDIX L

SOCIO-ECONOMIC ASSESSMENT

ILLAWARRA COAL
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Bulli Seam Operations
Socio-Economic Assessment

Prepared for

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EXECUTIVE SUMMARY

The Bulli Seam Operations (the Project) involves the continuation of longwall mining at the Appin Mine and West Cliff Colliery, located approximately 25 kilometres north-west of Wollongong in New South Wales (NSW), for 30 years, including the production of up to 10.5 million tonnes per annum (Mtpa) of run-of-mine coal and up to 9.3 Mtpa of product coal.

The Project requires the preparation of an Environmental Assessment (EA) in accordance with the requirements of the NSW *Environmental Planning and Assessment Act, 1979*. A socio-economic assessment is required as part of the EA.

From a socio-economic perspective there are three important aspects of the Project that can be considered:

- its economic efficiency (i.e. consideration of the economic costs and benefits of the Project);
- its regional economic impacts (i.e. the economic stimulus that the Project would provide to the regional economy); and
- the distribution of impacts between stakeholder groups (i.e. the equity or social impact considerations) often considered in terms of the impacts on employment, population and community infrastructure.

A Benefit Cost Analysis identified a range of potential economic costs and benefits of the Project and initially placed values on the production costs and benefits. Possible environmental externalities of the Project were then also quantified based on a range of replacement/repair cost values and the results of a choice modelling study.

The analysis indicated that the total net quantified production benefit of the Project is likely to be in the order of $10,310 million (M). The net production benefit is distributed amongst a range of stakeholders including:

- Illawarra Coal Holdings Pty Ltd (ICHPL) shareholders;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of company tax.

The NSW Government receives additional benefits in the form of payroll tax and local councils may also benefit through community infrastructure contributions (if applicable).

The Project also has a range of external economic costs and benefits. External costs associated with surface infrastructure, road transport and mine subsidence have been estimated at $2,898M, the majority relating to greenhouse gas generation. External benefits associated with employment provided by the Project have been estimated at $870M.

Overall the Project is estimated to have net benefits to society of $8,282M and hence is desirable and justified from an economic efficiency perspective.

An economic impact analysis, using input-output analysis, estimated that, in total, the Project would contribute the following to the Illawarra and Outer South Western Sydney (OSWS) economy:

- $2,074M in annual direct and indirect regional output or business turnover;
- $1,197M in annual direct and indirect regional value-added;
- $298M in annual household income; and
- 3,296 direct and indirect jobs.

At the State level, the Project would make the following contribution to the economy:

- $2,822M in annual direct and indirect output or business turnover;
- $1,615M in annual direct and indirect value-added;
- $516M in annual household income; and
- 5,791 direct and indirect jobs.

The sectors most impacted by output, value-added and income flow-ons are likely to be the services to mining sector, other property services sector, legal, accounting, marketing and business sector, road transport sector, wholesale and retail trade sector, scientific research, technical and computer services sector, other business services sector and accommodation, cafes and restaurants sector.

Employment impacts are also likely to be felt across a number of sectors including the mining sectors, transport sectors, manufacturing sectors, wholesale and retail trade sectors, accommodation, cafes and restaurants sectors and services sectors (education, health, community services and personal services).

The Project would also have forward linkages to BlueScope Steel in Wollongong, OneSteel at Whyalla in South Australia, Berrima Cement Works and Port Kembla.

Any changes in the workforce and populations of regions and towns may have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities. This may include the number of services that are available to be used and the accessibility of these services.

During the initial development of the Project (including upgrades of existing surface and underground infrastructure), an additional 100 people would be required in the short-term (for up to one year). However, this workforce is likely to be sourced locally or commute to the region on a daily basis from Sydney. Consequently, little if any population change as a result of the construction workforce is envisaged.

The additional direct operational workforce associated with the Project is estimated at 295. Additional flow-on employment is estimated at 339 production-induced flow-on jobs and 273 consumption induced flow-on jobs.

However, to estimate the likely population change to the region as a result of the Project it is necessary to consider the extent to which this incremental direct and indirect employment generated by the Project would be met from within the local labour force, in-migration or commuters from outside the region. Only in-migration is likely to result in increased demand for community infrastructure.

Factors influencing the level of in-migration include the size and nature of the regional economy and its ability to supply the additional labour and required skill mix and the proximity to other regions that may be able to provide commuter labour.

Based on a consideration of these factors it is considered that only a small proportion, 20 percent (%), of the incremental direct workforce (employees) and indirect jobs generated by the Project is likely to come from in-migration and add to the demand for community infrastructure. The potential increase in population would therefore be in the order of 399 for Illawarra and 65 for OSWS.

This potential influx in population is small in the context of annual population growth of the regions and is considered likely to have negligible impacts on housing, schools, health or community infrastructure.

Cessation of the Project after 30 years of operation may lead to a reduction in economic activity. The significance of these Project cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Given these uncertainties it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project brings to the region, to strengthen and broaden the region's economic base.

1 INTRODUCTION

Illawarra Coal Holdings Pty Ltd (ICHPL) owns and operates the Bulli Seam longwall mining operations at the Appin Mine and West Cliff Colliery which are located approximately 25 kilometres (km) north-west of Wollongong in New South Wales (NSW). The Appin Mine produces up to 4 million tonnes per annum (Mtpa) of run-of-mine (ROM) coking coal and the West Cliff Colliery produces up to 3.5 Mtpa of ROM coking coal. This high-value coking coal is produced for the Australian steel industry and for export to overseas customers. ICHPL is seeking approval for the continuation of longwall mining for 30 years, including production of up to 10.5 Mtpa of ROM coal and up to 9.3 Mtpa of product coal.

Resource Strategies has been commissioned by ICHPL to prepare an Environmental Assessment (EA) for the Bulli Seam Operations (the Project) in accordance with the requirements of the NSW *Environmental Planning and Assessment Act, 1979* (EP& A Act). The Department of Planning (DoP) Environmental Assessment Requirements for the Project indicate that a socio-economic assessment is required as part of the EA. In this respect, consideration was given to the relevant aspects of the Planning NSW's (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* and the Office of Social Policy's (1995) *Techniques for Effective Social Impact Assessment: A Practical Guide*.

From a socio-economic perspective there are three important aspects of the Project that can be considered:

- the economic efficiency of the Project (i.e. consideration of economic costs and benefits);
- the regional economic impacts of the Project (i.e. the economic stimulus that the Project would provide to the regional economy); and
- the distribution of impacts between stakeholder groups (i.e. the equity or social impact considerations).

Planning NSW (James and Gillespie, 2002) draft *Guideline for Economic Effects and Evaluation in EIA* identified economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guidelines identified BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The above draft guideline indicates that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the local economy can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

The draft guidelines also identify the need to consider the distribution of benefits and costs in terms of:

- intra-generational equity effects – the incidence of benefits and costs within the present generation; and
- inter-generational equity effects – the distribution of benefits and cost between present and future generations.

These social impacts are often considered in terms of the impacts on employment, population and community infrastructure. This study relates to the preparation of each of the following types of analyses:

- a BCA of the Project;
- a regional economic impact assessment of the Project; and
- an Employment, Population and Community Infrastructure Assessment (EPCIA).

An extensive consultation programme for the EA was undertaken by ICHPL and is provided in Section 3 in the Main Report of the EA.

As an adjunct to the BCA, a non-market valuation study (Choice Modelling [CM]) was conducted to obtain estimates of NSW community values for key potential environmental impacts of the Project. This study is reported in Attachment A and, where relevant, implicit values determined in this study have been utilised in the BCA.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the Project to be economically desirable from an Australian community perspective, it must be economically efficient. Technically, a project is economically efficient and desirable on economic grounds if the benefits to society exceed the costs (James and Gillespie, 2002). For mining projects, the main economic benefit is the producer surplus generated by the mine and the employment benefits it provides, while the main economic costs relate to environmental costs. The main technique that is used to weigh up these benefits and costs is BCA.

BCA involves the following key steps:

- identification of the base case;
- identification of the Project and its implications;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- sensitivity testing;
- application of decision criteria; and
- consideration of non-quantified benefits and costs.

What follows is a BCA of the Project based on financial, technical and environmental advice provided by ICHPL and its specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND PROJECT

Identification of the "base case" or "without" option is required in order to facilitate the identification and measurement of the incremental economic benefits and costs of the Project.

In this study, the base case or "without" option involves:

- cessation of mining activity at the Appin Mine and West Cliff Colliery in 2010 with associated decommissioning and rehabilitation;
- relinquishment of the mining tenements to the Department of Primary Industries (DPI);
- sale of capital equipment;
- surplus land allocated to its next best use; and
- subsidence effects and environmental impacts arising from previous mining.

In contrast to the "base case", the Project involves:

- continued development of underground mining operations within existing coal leases and new mining leases to facilitate a total ROM coal production rate of up to 10.5 Mtpa;
- on-going exploration activities within existing exploration tenements;
- upgrade of the existing West Cliff Washery to support the increased ROM coal production;
- continued mine gas drainage and capture for beneficial utilisation at the West Cliff Ventilation Air Methane Project (WestVAMP) and Appin-Tower Power Project;

- continued generation of electricity by the existing Appin-Tower Power Project (owned and operated by Energy Development Limited [EDL]) utilising coal bed methane drained from the Bulli Seam;
- upgrade of existing surface facilities and supporting infrastructure (e.g. service boreholes, ventilation shafts, gas drainage equipment, waste water treatment and waste water disposal);
- continued and expanded placement of coal wash at the West Cliff Coal Wash Emplacement;
- continued road transport of ROM coal from the Appin East pit top to the West Cliff Washery;
- continued road transport of ROM coal from Appin East pit top and West Cliff pit top via the public road network to the Dendrobium Washery at Port Kembla;
- continued road transport of product coal from the West Cliff Washery via the public road network to BlueScope Steelworks, Port Kembla Coal Terminal (PKCT), Corrimal and Coalcliff coke works and other customers;
- on-going surface monitoring and rehabilitation (including rehabilitation of mine related infrastructure areas that are no longer required) and remediation of subsidence effects; and
- other associated infrastructure, plant, equipment and activities.

At the end of the Project it is assumed that capital equipment would be sold and the mining tenements would be relinquished to the DPI and the Appin Mine and West Cliff Colliery surface facilities would be allocated to their next best use.

ICHPL has also considered a number of alternatives to the Project. These involve various levels of restriction on mining activities to examine the relative costs and environmental benefits of avoiding or minimising subsidence effects on key surface features. The analysis of these alternatives is presented in Section 2.7.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or “without” scenario of mining cessation, the Project may have the potential incremental economic benefits and costs shown in Table 2.1.

It should be noted that the potential external costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community wellbeing through direct use of resources by individuals or non-use. If the potential impacts are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

Table 2.1
Economic Benefits and Costs of the Project

Category	Costs	Benefits
Production	• Opportunity cost of land • Opportunity cost of capital • Capital costs of establishment and construction including ancillary works and sustaining capital • Operating costs, including administration, mining, processing and transportation	• Sale value of export and domestic coal • Residual value of capital and land at the cessation of the Project • Delayed decommissioning and rehabilitation costs of surface facilities areas in 2010
Production Externalities	-	• Economic and social benefits of employment
Surface Operations Externalities	• Operational noise • Air quality emissions • Non-Aboriginal heritage impacts • Aboriginal heritage impacts • Surface water release/runoff • Visual impacts • Greenhouse gas generation • Flora and fauna impacts of extensions	-
Transport Externalities	• Road transport noise • Road transport vibration	-
Project Underground Mining Externalities	• Stream impacts • Groundwater impacts • Upland swamp impacts • Aboriginal heritage impacts • Non-Aboriginal heritage impacts • Infrastructure, roads and buildings impacts • Subsidence damage to houses and other properties • Flora and fauna impacts • Greenhouse gas generation • Visual impacts	-

Note: All external impacts need to be relative to the base case which is cessation -of mining after 2010.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

In accordance with the NSW *Treasury Guidelines for Economic Appraisal* (NSW Treasury, 2007), where competitive market prices are available, they have generally been used as an indicator of economic values. Non-market values have been estimated using CM (Attachment A).

2.4.1 Production Costs and Benefits[1]

Economic Costs

Opportunity Cost of Land

There is an opportunity cost associated with using land for the surface facilities at Appin Mine and West Cliff Colliery instead of its next best use. An indication of the opportunity cost of the land can be gained from the market value of this land following decommissioning and rehabilitation. Land at Appin East and Appin West is assumed to have a market value of $3.1M while land at West Cliff is assumed to have lesser market value as its alternative use is likely to be bushland.

Opportunity Cost of Plant

Where the mining and coal processing activity would utilise plant and machinery already owned by ICHPL, there is an opportunity cost associated with utilising this plant rather than selling it or using it elsewhere. An indication of its opportunity cost can be gained from its current book value (although this is likely to overstate the market value) which is estimated at $393M.

Capital Cost of the Project

Capital costs of the Project are associated with replacement of longwall machines and continuous miners, ramping up ROM production and sustaining capital. These capital costs over the life of the Project are estimated at approximately $2 billion. These costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Mine

The annual operating costs of the Project include those associated with mining, environmental management and monitoring, operation of the West Cliff Coal Preparation Plant and handling, administration, marketing, rail freight, port costs and sampling costs. Average annual operating costs of the mine are estimated at $535M.

While royalties and levies are a cost to ICHPL they are part of the overall producer surplus benefit of the mining and processing activity that is redistributed by government. Royalties and levies are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project would generate total royalties and levies in the order of $127M per annum (pa) with total royalties and levies over the life of the Project in the order of $3.8B.

Decommissioning and Rehabilitation Costs of Surface Facilities

With the Project, the Appin Mine and West Cliff Colliery surface facilities would be decommissioned and rehabilitated at cessation of Project mining at a cost in the order of $25M.

Economic Benefits

Sale Value of Coal

The provisional production schedule is provided in Table 2.2.

[1] All values reported in this section are undiscounted unless specified.

Table 2.2
Provisional Production Schedule

Year	Total ROM Coal (Mtpa)*	Project Coal Wash Production (Mtpa)	Total Product Coal (Mtpa)
1	7.5	1.2	6.3
2	10.5	1.2	9.3
3	10.5	1.3	9.2
4	10.5	1.4	9.1
5	10.5	1.4	9.1
6	10.5	1.4	9.1
7	10.5	1.5	9.0
8	10.5	1.6	8.9
9	10.5	1.6	8.9
10	10.5	1.6	8.9
11	10.5	1.5	9.0
12	10.5	1.7	8.8
13	10.5	1.7	8.8
14	10.5	1.7	8.8
15	10.5	1.9	8.6
16	10.5	1.9	8.6
17	10.5	1.5	9.0
18	10.5	1.4	9.1
19	10.5	1.6	8.9
20	10.5	1.8	8.7
21	10.5	1.9	8.6
22	10.5	1.6	8.9
23	10.5	1.7	8.8
24	10.5	1.6	8.9
25	10.5	1.5	9.0
26	10.5	1.5	9.0
27	10.5	1.6	8.9
28	10.5	1.5	9.0
29	10.5	1.5	9.0
30	4.9	0.7	4.2
Total	306.4	46.0	260.4

Source: ICHPL (2009).
* The total ROM coal quantities include ROM coal associated with development works and accounts for sterilisation of the coal resource (based on historic coal sterilisation analysis).

Both demand and supply for coal influences current and projected prices.

Demand for coal is derived demand, i.e. dependent on demand for the end products within which the coal resource is used. For coking coal the end product is steel production while for thermal coal it is electricity. Demand for coal therefore fluctuates considerably based on numerous market factors including the demand for steel and electricity, the prices of related end products, income of consumers, expected future prices, population, preferences, etc.

World supply of coal also fluctuates depending on numerous factors including the price of steel and electricity, prices of factors of production, prices of related goods, expected future prices, the number of suppliers, technology, greenhouse gas emission policy, etc.

Coal prices fluctuate considerably and are expected to continue to do so.

The global financial crisis led to a reduction in steel demand in the last quarter of 2008 which resulted in cutbacks in steel production and depressed the market for metallurgical coal. Prior to the onset of the financial crisis it was generally expected metallurgical coal prices would remain very high throughout 2009 and 2010 before slowly decreasing to long-term levels generally 20 to 40 percent (%) higher than the pre "China Boom" levels in 2007.

By year end 2008, the near term forecasts for premium hard coking coal had basically halved to between United States (US) $125 to $200 per tonne (/t) free-on-board (FOB), but the long-term expectations have increased slightly over the pre-financial crisis levels to between US$120 to $150. The 2009 price of semi-soft coking coal, the lowest coking coal category and the highest quality thermal coal, is now expected to be slightly less than half the 2008 price of US$240, and then to drift down to between US$90 and US$100 until at least 2015.

Demand for thermal coal in 2009 will be driven by industrialisation and urbanisation in China and India which will account for half of the new coal plants.

Commonwealth Securities expects: "thermal demand to hold up better than coking coal demand. The majority of Australia's thermal coal exports are some of the highest quality available in the seaborne market, with high energy content, low sulphur, moisture and impurities. These qualities will shield demand somewhat as certain power stations require high quality inputs for effective operation."

Thermal or steam coal is expected to fall from the 2008 level of US$125/t FOB to between US$75 and $105 in 2009 and by 2015 to be between US$70 and $80/t, approximately 50 percent above the 2007 level (Barnett, 2009).

Having regard to the above forecasts, an average of Australian Dollar (AUD) $180 for coking coal and AUD$97 for thermal coal was used in this analysis.

There is obviously considerable uncertainty around future coal prices and hence coal prices have been subjected to sensitivity analysis (Section 2.6).

Residual Value at End of the Evaluation Period

At the end of the Project, purchased capital equipment may have some residual value that could be realised by sale. On decommissioning of the Project, the existing pit tops and surface facilities would also have some value, estimated by their market value. The residual value of capital equipment and land are estimated at $15M and $3M, respectively.

Decommissioning and Rehabilitation Costs of Surface Facilities

Under the base case the Appin and West Cliff surface facilities would be decommissioned and rehabilitated in 2010 at a cost in the order of $25M. With the Project, this decommissioning cost would not occur until approximately 2041. The cost of decommissioning in 2010 under the "without" scenario is therefore avoided and hence is a benefit of the Project.

2.4.2 External Costs and Benefits

The environmental and social impacts or externalities of the Project can be considered within four main contexts:

- continuation (and where relevant) extension of existing environmental impacts associated with the Appin Mine and West Cliff Colliery surface facilities;
- environmental externalities associated with road transport – including increased delivery of coal on the public road network, and additional general traffic movements associated with increased Appin Mine and West Cliff Colliery delivery, visitor and workforce traffic;
- subsidence effects and associated environmental impacts on the natural and built environment above the Project extent of longwall mining area; and
- the social and economic benefits of employment provided by the Project.

Appin Mine and West Cliff Colliery Surface Facilities

Potential externalities of the Project arise from continued operation of the existing Appin Mine and West Cliff Colliery facilities at the surface.

These are described further below.

Operational Noise

As described in Appendix I of the EA, the existing Appin East facilities contribute to the existing noise environment in Appin. The approved Stage 3 Coal Wash Emplacement and the proposed Stage 4 Coal Wash Emplacement would also contribute to the noise environment in Appin.

Although operational noise emissions would not increase significantly as a result of the Project (Appendix I of the EA), residences in close proximity to the existing facilities would continue to experience noise levels in excess of project specific noise criteria until Project cessation. Without the Project, ambient noise levels at these properties would return to baseline sub-urban levels within approximately one year (assuming future use of the Appin East site for non-industrial purposes). Hence, while noise emissions would not be significantly increased by the Project, the continued noise emissions of the Appin Mine and West Cliff Colliery would continue to be reflected in the property values of nearby properties.

Air Quality

As described in Appendix J of the EA, the existing Appin Mine and West Cliff Colliery contribute to existing air quality conditions in the Appin area. Current dust and particulate monitoring at locations in close proximity to these facilities indicates compliance with applicable air quality criteria at the nearest residences, and this compliance is predicted to continue for the Project (Appendix J of the EA). Hence, no economic effects have been identified with respect to the predicted air quality emissions of the Project.

Non-Aboriginal Heritage

The Bulli Shafts No. 1 and No. 2 are listed in the Wollongong Local Environmental Plan (LEP) and Illawarra Regional Environmental Plan (REP) as registered heritage sites. A description of the heritage items and their location is provided in Appendix H of the EA.

Potential impacts to items of heritage at the Bulli Shafts No. 1 and No. 2 include impacts associated with the rehabilitation of these closed sites. The sites would either be managed in accordance with a management plan to be developed in consultation with the Sydney Catchment Authority, or if un-resolvable public liability issues dictate their removal, they would be documented to a suitable level of detail prior to demolition.

The rehabilitation of the closed Bulli Shafts No. 1 and No. 2 would occur regardless of the Project and so cannot be considered to be an incremental effect of the Project. Consequently, no externality cost item has been included in the BCA.

Aboriginal Heritage

The proposed Stage 4 Coal Wash Emplacement Area has the potential to impact Aboriginal heritage sites either through burial of the sites under the coal wash emplacement, through direct impact by associated works supporting the Stage 4 emplacement area (such as channel diversion drains, settling dams and haul roads) or through secondary impacts (such as dust settling on art panels). The Project's contribution to the Stage 3 and Stage 4 Coal Wash Emplacements has been conservatively estimated as disturbance of eight known Aboriginal heritage sites.

Surface disturbance works associated with supporting infrastructure for the Project are described in Section 2 in the Main Report of the EA. As part of the Project detailed design phase, the final location of some of the ancillary infrastructure and surface works (e.g. exploration works, access tracks, subsidence monitoring, subsidence restoration works and surface rehabilitation works) would be determined. If required, surface goaf gas drainage boreholes and associated surface infrastructure would be subject to preparation of supplementary specialist environmental assessment studies to the satisfaction of the Director-General of the DoP.

Surface development activities would be on-going throughout the life of the Project and their planning would be subject to on-going considerations for their placement and exact nature. This being the case, specific assessment of the potential impacts on individual Aboriginal heritage sites cannot be made at this time. Nevertheless, given the anticipated small scale of the surface works across the entire study area and the flexibility of precise locations for these works, the surface works do not pose the risk of a significant impact to the Aboriginal cultural heritage of the study area (Appendix G of the EA).

The community values associated with impacted Aboriginal sites have been estimated from the CM study at $6M per site and have been included in the BCA.

Surface Water Management

Water management and mitigation measures at the pit top facilities include:

- the diversion of runoff from undisturbed areas around areas of disturbance;
- the containment, and treatment where necessary, of runoff from areas of disturbance; and
- water conservation via maximising re-use.

Further summary of water management at each pit top is provided below. Additional detail is provided in Section 2 in the Main Report of the EA and Appendix C of the EA.

West Cliff

The West Cliff pit top area is contained within the catchment of Brennans Creek, a tributary of the Georges River. The Brennans Creek Dam is the main storage for the West Cliff Colliery underground mining operations, with water utilised for equipment cooling and dust suppression.

The West Cliff pit top has three Department of Environment and Climate Change (DECC) licensed discharge points under Environment Protection Licence (EPL) 2504 for discharge of excess water from the site, being discharge through the spillway of Brennans Creek Dam, at the outlet from the Reclaim Dam and for irrigation of treated effluent.

Overall, the West Cliff pit top site water management system relies largely on harvesting water from Brennans Creek Dam and efficiently reusing, treating and re-circulating this water on-site.

Appin East

Appin East surface water runoff reports to settling and stormwater dams where the water is treated by filtration and then released to the nearby Georges River in accordance with EPL 758. Water harvested from the stormwater dam is used on-site for truck wash and dust suppression. Sydney Water provides the remainder of the Appin East pit top site water requirements.

Treated site effluent at Appin East is disposed of by either irrigation in a dedicated area in accordance with the EPL or is trucked off-site by a licensed contractor.

Appin West

Water supplied to the Appin Mine underground mining operations is used for equipment cooling and dust suppression. Underground mine water make/inflow is pumped to an underground storage. Water is then pumped to the Mine Water Lagoons at the Appin West pit top and the water is treated in the Appin West Water Treatment Plant for re-use or discharge to Sandy Gully in accordance with EPL 398. Sandy Gully is a tributary of Allens Creek which in turn flows into the Nepean River. Treated product water from the Appin West Water Treatment Plant is also piped to the Appin East pit top as required.

Water supply to the Appin Mine underground mining operations is supplemented by Sydney Water as required.

Existing water management measures would be maintained and/or improved as a result of the Project. Water quality issues can be effectively managed on-site such that there are no unlicensed water quality impacts occurring off-site (Appendix C of the EA). Consequently, it is assumed that there are no external economic impacts associated with surface water release/runoff from facilities at the surface.

Visual Impacts

Surface facility elements of the Project considered to have the potential to impact on the visual landscape include:

- the West Cliff Coal Wash Emplacement;
- the continuation of the operation of the West Cliff, Appin West and Appin East pit tops, surface facilities and supporting infrastructure, including the use of night lighting; and
- surface goaf gas drainage (subject to separate site specific environmental assessment).

These are described briefly below, further detail is provided in Section 5 in the Main Report of the EA.

West Cliff Coal Wash Emplacement

Stage 4 of the West Cliff Coal Wash Emplacement may be visible on the south-eastern outskirts of the Appin township along George Street, however views are likely to be partially screened by intervening vegetation.

Views of the West Cliff Coal Wash Emplacement may be available along Appin Road, however views would be restricted by the mature remnant vegetation along the road reserve. If bushfire impacts vegetation located along the road reserve, potential visual impacts would increase in the short-term, however, visibility would decrease as natural regeneration occurs.

Cataract Scout Park is located on a ridge at approximately 370 metres (m) Australian Height Datum (AHD) to the south of the West Cliff Coal Wash Emplacement, and has high viewer sensitivity. The visual modification at this location is expected to be very low, given the intervening vegetation and existing occasional, distant views of the approved West Cliff Coal Wash Emplacement. With progressive rehabilitation of the emplacement, the long-term visual impact would be reduced to very low.

Views of the West Cliff Coal Wash Emplacement from the Dharawal State Conservation Area are expected to be very limited due to intervening topography and vegetation. Progressive rehabilitation of the West Cliff Coal Wash Emplacement would reduce these potential visual impacts over time.

The visual impact on views from areas beyond the sub-regional setting are considered to be very low given the reduction in clarity of viewing that occurs with distance, the level of visual modification compared to the overall view, and the presence of the existing West Cliff Coal Wash Emplacement.

Continued Use and Extension of other Surface Infrastructure

Upgrades to the surface installations of the Appin Mine and West Cliff Colliery would generally be within the current disturbance footprint of existing facilities as they would involve replacement, upgrade or addition to existing components. Given the mass and scale of the existing buildings, structures (e.g. conveyors) and stockpiles, the potential visual modification as a result of Project alterations to the West Cliff, Appin West and Appin East pit tops, surface facilities and supporting infrastructure is considered to be very low.

Night lighting would continue to be used at the West Cliff pit top, Appin East pit top, Appin West pit top and West Cliff Washery as part of the Project. The use of night lighting may increase with extensions and upgrades to existing surface facilities. Night lighting on the West Cliff Coal Wash Emplacement would also move closer to Appin as emplacement of coal wash progresses.

Surface Goaf Gas Drainage

As described in Section 4.4.3 in the Main Report of the EA, there may be advantages in implementing surface goaf gas drainage facilities above the extent of longwall mining area over the life of the Project. Such works would be subject to separate environmental assessment and approval via a Surface Goaf Gas Drainage Management Plan. Notwithstanding the fact that the locations of this temporary infrastructure are not currently known, potential impacts are likely to be variable according to the presence of vegetation and the proximity of public vantage points or dwellings to the drainage facilities. Due to the short-term nature of these installations (i.e. individual drainage boreholes typically operate for less than three months), no significant long-term effects are anticipated.

Overall there are considered to be no visual impacts that are sufficiently significant that they would warrant for inclusion in the BCA.

Flora and Fauna

Development of surface extensions would result in 115 ha of vegetation clearance associated with the Project's contribution to Stage 3 and Stage 4 of the Coal Wash Emplacement and other ancillary activities.

A number of threatened flora and fauna species and endangered ecological ecosystems were identified in the Project area and surrounds as described in Appendices D, E and F of the EA. Assessment of the impacts of the Project indicated that none of the populations, threatened species or endangered ecological ecosystems would be significantly impacted by the Project.

The community values associated with impacts to flora (and associated fauna) have been estimated from the CM study at $1M per hectare (ha) and have been included in the BCA. Consideration of ecological impacts associated with subsidence effects on streams were also included in the potential impacts on streams (described above).

Road Transport Externalities

Transport Noise

As described in Appendix I of the EA, the existing Appin Mine and West Cliff Colliery contribute to off-site road transport noise effects along coal delivery routes and local roads associated with workforce, visitor movements and deliveries.

With the Project, coal deliveries, consumable deliveries and workforce and visitor movements would increase. However, without the Project, existing Appin Mine ROM coal truck movements along Appin Road, Appin Mine, West Cliff Colliery and coal deliveries to PKCT and customers in the region would cease in 2010. Consequently, the Project may result in some continuing (and in some cases increased) amenity impacts to houses located adjacent to transport routes, relative to without the Project.

Analysis of road transport noise changes as a result of the Project indicates increased traffic on major haulage routes would not result in any significant change in traffic noise. However, some transport noise effects can be expected as a result of workforce movements potentially being concentrated at Appin West (Appendix I of the EA).

Transport Vibration

As described in Appendix I of the EA, existing heavy vehicle movements on the public road network would generate some ground vibration effects at locations in very close proximity to these roads. However for the purpose of this analysis, it is assumed that the variation in ground vibration effects associated with cessation of the Project in 2010 or development of the Project would not be of sufficient magnitude to alter land valuations along the key road transport routes.

Project Underground Mining Externalities

As described in Appendix A of the EA, underground longwall mining results in mine subsidence effects occurring at the surface. These effects include shifting of the ground surface (generically referred to as subsidence). Subsidence effects can result in some impacts on natural features including streams, upland swamps, and heritage sites.

Surface Water

Mine subsidence can result in surface cracking of some sections of the stream bed. This cracking can result in the diversion of surface flows in the following ways:

- Diversion underground and resurfacing further downstream.
- Leakage through rock bars, where water held in ponds and pools may leak through fractures and joints in rock bars and resurface further downstream.

Re-emerging water can have elevated levels of iron, manganese, aluminium and electrical conductivity, and results in red staining of the water or rock surfaces. Consequently, during periods of low flows, subsidence cracking can:

- reduce water levels in natural weirs that pond water;
- reduce surface water flows in the sections of the stream where cracking occurs (i.e. diversion of a portion of the surface flow to the sub-surface);
- result in staining of the water downstream of where the water re-merges;
- cause localised changes to water quality and aquatic habitats; and
- cause localised effects on riparian vegetation (e.g. loss of vigour or localised dieback).

These impacts are particularly evident during periods of low flow. During periods of moderate to high flow, sections of the streams affected by subsidence function normally (i.e. pool water levels persist, rock bars experience over flow and significant surface flows occur).

Although mine subsidence effects can result in isolated, episodic pulses in iron, manganese, aluminium and electrical conductivity, these pulses have not had any measurable effect on water quality on downstream reservoirs. The Project would not impact on the performance of Woronora Reservoir or Cataract Reservoir and is unlikely to affect water reporting to the Upper Canal from Broughtons Pass Weir (Appendix C of the EA). In addition, compensatory measures to further offset the effects of the Project on local water quality are proposed (Section 8 in the Main Report of the EA).

Subsidence impacts have been observed along previously undermined sections of streams in the previous mine development area. If the Project were approved it is predicted that subsidence effects would be experienced along an additional 72 km of (3^{rd} order and above) streams located above the Project extent of longwall mining area.

The community values associated with these impacts on streams have been estimated from the CM study at $5.46M/km and have been included in the BCA.

Groundwater

Analysis of groundwater data indicates that there are three separate groundwater systems:

- Perched Groundwater System associated with swamps, shallow sandstone and shale;
- Shallow Groundwater System; and
- Deep Groundwater System.

Hydrogeological studies indicate that there is very little effective groundwater flow between the Deep Groundwater System and the Shallow Groundwater System due to the presence of aquitards and the inherent low permeability of the geological strata.

The coal seam that is extracted during underground coal mining is generally located at depths of more than 400 m below the ground surface in the Deep Groundwater System. As a result, there is no potential for the loss of shallow water to the mine because there is no continuity of fractures from the surface to the mine. This means that there would be (Appendix B of the EA):

- Negligible reduction in baseflows in the Cataract River, Nepean River, Georges River, Woronora River and O'Hares Creek and associated tributaries.
- Negligible reduction in cumulative average inflows to the Cataract Reservoir, Broughtons Pass Weir and Woronora Reservoir.
- No effect to vegetation or swamps as a result of groundwater pressure change in the Deep Groundwater System.

Consequently there are considered to be no significant environmental groundwater impacts for inclusion in the BCA.

Notwithstanding the predicted limited environmental consequences of mining groundwater effects, there would potentially be some impacts on domestic, agricultural and/or commercial groundwater bores that have been developed in the middle Hawkesbury Sandstone formation or lower formations (e.g. Bulgo Sandstone). The Groundwater Assessment (Appendix B of the EA) has identified some 44 registered bores that may potentially be impacted by mining related groundwater drawdown at depth (however not all of these bores may be utilised for water production). Consideration of the potential costs of lowering or otherwise altering these bores and/or providing an alternative water supply for a period prior to the bore being re-commissioned (nominal cost $2M over 30 years) has been included in the BCA.

Upland Swamps

Upland swamps may occur in gently sloping valleys, on steep slopes, benches on valley sides or extend to the valley floor. They are considered to be species rich and provide habitat for a range of fauna including birds and frogs. Subsidence may lead to cracking in upland swamps in the Project extent of longwall mining area.

Monitoring to date indicates that there have been no significant adverse impacts on upland swamps of the nature found in the Project extent of longwall mining area. However, for the purpose of the analysis, it is conservatively assumed that a proportion of swamps predicted to experience greater than 200 millimetres (mm) of closure due to mine subsidence would be adversely affected by cracking, erosion and changes in the types of vegetation present. Some 57 ha of swamp has conservatively been assumed to be impacted.

The community values associated with impacted swamps have been estimated from the Metropolitan Coal Project CM study together with the respondent private discount rates determined from Bulli Seam Operations CM study (Attachment A) at $2M per ha and included in the BCA.

Aboriginal Heritage

The landscape of the Southern Coalfield is characterised by sandstone ridges, steep slopes, valleys, rocky outcrops and cliff formations typical of the Sydney basin. Weathering of the Hawkesbury sandstone forms a range of features including scooped-out ledges with overhangs and large boulders. Some sandstone features contain known Aboriginal heritage sites e.g. grinding sites, engraving sites, sandstone overhangs with art, sandstone overhangs with artefacts and/or archaeological deposits. Instabilities occur naturally, particularly in cliff lines and overhangs, however, subsidence movements have the potential to further reduce the stability of these features. Sandstone overhangs and open sites such as engravings on rock platforms are the Aboriginal site types most likely to experience subsidence related impacts (i.e. cracking of rock platforms or instability of overhangs). Open sites in the western part of the Project extent of longwall mining area (e.g. artefact scatters) are less sensitive to potential subsidence effects. If the Project were approved it is estimated that a small proportion of the total number of Aboriginal sites in the vicinity of the Project extent of longwall mining area would be adversely affected.

The community values associated with the assumed 26 impacted Aboriginal sites have been estimated from the CM study at $6M per site and included in the BCA.

Non-Aboriginal Heritage

Some 49 listed non-Aboriginal heritage items have been identified in the Project extent of longwall mining area and surrounds (Appendix H of the EA). Identified items include a range of houses, public infrastructure (e.g. heritage listed bridges and water supply infrastructure) and community buildings (e.g. churches).

Descriptions of the listed heritage items and their locations relative to the Project are provided in Appendix H of the EA. Potential impacts to items of heritage in the vicinity of the Project extent of longwall mining area relate to the potential effects of subsidence on the buildings or infrastructure (e.g. cracking or damage). The heritage values of the Bulli Shaft No. 1 and Bulli Shaft No. 2 (closed but not completely decommissioned) would also potentially be affected by rehabilitation works.

As a component of the Extraction Plan process, detailed subsidence assessments, structural assessments, monitoring and investigations would be undertaken as required for sites potentially impacted by mine subsidence.

It is ICHPL's general subsidence management philosophy that all occupied buildings are maintained in a safe condition during subsidence. Subject to the outcomes of site-specific subsidence and structural assessments, mitigation or management measures would be applied to minimise damage to occupied heritage buildings to ensure the safety and serviceability of the structures is not compromised. The implementation of on-going subsidence monitoring and management/mitigation measures to maintain occupant safety would also limit the potential for significant damage to occupied heritage buildings.

In order to minimise potential impacts to buildings of higher heritage significance in the Project extent of longwall mining area, subject to the outcomes of site-specific subsidence and structural assessments, mitigation or management measures would be applied. Appendix H of the EA provides initial recommendations for the management of the more significant heritage listed buildings of relevance to the Project, which would be reviewed and, where required, amended following the completion of structural assessments and individual statements of heritage impact for these items as a component of the Extraction Plan process.

In the case of major infrastructure heritage items that provide services to the wider community there is an obligation to maintain public safety and infrastructure serviceability. Protection of the heritage values of these infrastructure items would be an issue integrated into the subsidence management and response planning process (Appendix H of the EA).

With the implementation of pre-mining mitigation by ICHPL where required and the conduct of repairs to any damaged buildings funded by the Mine Subsidence Board (MSB), it is not anticipated that the Project would result in any significant adverse impacts on heritage values.

ICHPL Mine Subsidence Fund contributions have been included in the Project BCA.

Infrastructure, Roads and Buildings

There is a wide range of infrastructure located above or in close proximity to the Project extent of longwall mining area that may potentially be adversely affected by subsidence effects. These include features such as:

- optical fibre cables;
- electrical transmission lines;
- water pipelines;
- large scale industrial and agribusiness facilities;
- major bridges, water supply infrastructure and the Nepean Tunnel/Upper Canal; and
- local roads, main roads and freeways.

Potential impacts on these items of infrastructure would be managed through the Extraction Plan process post-Project Approval. Management measures would be implemented by ICHPL where required and remediation of subsidence damage would be facilitated and funded by the MSB, as required.

Allowance for suitable pre-mining infrastructure management and mitigation costs by ICHPL is included where relevant in the Project operating cost profile in the BCA.

ICHPL Mine Subsidence Fund contributions have been included in the Project BCA.

Subsidence Damage to Houses and Other Property Improvements

In the Project extent of longwall mining area and surrounds, there are over 3,000 houses, buildings, sheds, fences, dams and other improvements that would potentially be affected by mine subsidence. The process for management and repair of subsidence damage to improvements (repairs funded by the MSB) is provided in Appendix A of the EA.

In summary, damage would be expected to occur to a small proportion of houses and other improvements at the surface that would warrant some repair. The cost of compensation or repair of damage from mine subsidence would be met by the MSB in accordance with the requirements of the *Mine Subsidence Compensation Act, 1961*.

ICHPL Mine Subsidence Fund contributions have been included in the Project BCA.

Flora and Fauna

Areas of native vegetation overlying the Project underground mining would not be significantly impacted by subsidence effects. A number of threatened flora and fauna species and endangered ecological communities were identified in the Project area and surrounds as described in Appendices D, E and F of the EA. Assessment of the impacts of the Project indicated that none of the populations of these species or endangered ecological communities would be significantly impacted by the Project.

Greenhouse Gas Generation

The Project would generate in the order of 185 million tonnes (Mt) of greenhouse gas emissions associated with mining and transport of product coal by rail to the port[2]. To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions. There is great uncertainty around the social cost of carbon with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. Again, however, there is a wide range of permit prices. For this analysis a shadow price of carbon of AUS$30/t CO_2-e was used, with sensitivity testing from AUS$8/t CO_2-e to AUS$40/t CO_2-e. Attachment B provides a summary of these issues and explains how these values were derived.

Visual Impacts

The Project would have limited potential for visual impacts as the Project mining would be underground. Visual aspects of the key surface features of the mining operations are described above.

Potential subsidence related impacts on watercourses may result in the following aesthetic impacts:

- visible surface cracking of exposed sandstone stream beds and at some rock bars;
- reduced water levels in some pools and drying out of some sections of some streams during times of low flows; and
- localised iron precipitation causing localised discolouration of stream waters and stream beds to an orange/brown colour.

Visual impacts may also occur where isolated cliff collapse or blockfall occurs as a result of mine subsidence. Such falls also occur naturally and the fresh exposed rock surfaces at these locations would become weathered and would be less visually prominent over time.

Viewer sensitivity in areas that are restricted to the public is expected to be low (i.e. Holsworthy Military Reserve, Woronora and Metropolitan Special Areas and parts of O'Hares Creek Special Area). Similarly in agricultural areas where a high degree of visual modification has already occurred, sensitivity to additional changes would also be lower. There would be higher viewer sensitivity within the Dharawal State Conservation Area, given the potential value of scenic quality to visitors in the Conservation area.

[2] It should be noted that greenhouse gas generation associated with sea transport and usage of the product coal is considered to be outside of the scope of the BCA of the Project.

Any impact on visitors to Dharawal State Conservation Area could potentially affect the consumer surplus of these visitors. Consumer surplus values for visits to NSW National Parks have been estimated in a range of studies and vary from $19 per visit for Gibraltar Range National Park (Bennett, 1995), to $33 per visit for Dorrigo National Park (Bennett, 1995) and between $28 and $44 per visit for Minnamurra Rainforest Centre, Budderoo National Park (Gillespie, 1997). Using a consumer surplus figure of $30 per visitor, a conservative 5,000 visitors per year would be associated with $150,000 per year of recreation values. However, all these values would not be lost in the presence of cracking of streams. The Plan of Management for Dharawal State Conservation Area already acknowledges (NSW National Parks and Wildlife Service, 2006) the presence of some stream cracking. Additional cracking may however reduce the consumer surplus associated with visitation.

There are no published reports on how stream cracking may impact demand for passive recreation. However, recreation values may be quite resilient to changes. A study by Crase and Gillespie (2008) found that a 50% reduction in water levels reduced annual recreation values by 38%. A 90% reduction in water levels reduced annual recreation values by 50%. If additional cracking at Dharawal State Conservation Area reduced the abovementioned assumed annual values for passive recreation by 10%, the annual impact would be $15,000. Over a 30 year period using a 7% discount rate, this amounts to $0.2M present value and would have no effect on the BCA.

Any localised visual impacts associated with isolated cliff collapse or blockfall and/or temporary closure of a portion of a river gorge or cliff locality for public safety purposes while mining is conducted would also not be of sufficient monetary magnitude as to warrant inclusion in the BCA.

Social and Economic Value of Employment

Following the construction of the Project over a period of one year (workforce 975), the Project would generate an on-site workforce of 1,170 for a period of 29 years. Historically employment benefits of projects has tended to be omitted from BCA on the implicit assumption that labour resources used in a Project would otherwise be employed elsewhere. Where this is not the case and labour resources would otherwise be unemployed for some period of time, Streeting and Hamilton (1991) and Bennett (1996) outline that otherwise unemployed labour resources utilised in a project should be valued in a BCA at their opportunity cost (wages less social security payments and income tax) rather than the wage rate which has the effect of increasing the net production benefits of the Project. In addition, there may be social costs of unemployment that require the estimation of people's willingness to pay to avoid the trauma created by unemployment. These are non-market values.

More recently, it has been recognised that the broader community may hold non-environmental, non-market values (Portney, 1994) for social outcomes such as employment (Johnson and Desvouges, 1997) and the viability of rural communities (Bennett *et al*., 2004).

The community values associated with the employment provided by the Project have been estimated from the CM study at an average of $31M per year that the Project provides 1,170 jobs and have been included in the BCA.

2.5 CONSOLIDATION OF VALUE ESTIMATES

The present value of costs and benefits, using a 7% discount rate, is provided in Table 2.3.

Table 2.3
Benefit Cost Analysis Results of the Project (Present Values)

	COSTS	$ Million (M)*	BENEFITS	$M*
Production	Opportunity cost of land	$3M	Sale value of export and domestic coal	$18,205M
	Opportunity cost of capital	$367M	Residual value of capital and land at the cessation of the Project	$2M
	Capital costs of establishment and construction including ancillary works and sustaining capital	$1,008M	Delayed decommissioning and rehabilitation costs of surface facilities areas in 2010	$24M
	Operating costs, including administration, mining, processing and transportation	$6,542M	-	-
	Production Sub-total	**$7,920M**	-	**$18,230M**
	Net Production Benefits	**-**	-	**$10,310M**
Production externalities	-	-	Economic and social benefits of employment	$870M
Surface Operations Externalities	Operational noise	$3M	-	-
	Air quality	Negligible	-	-
	Non-Aboriginal heritage impacts	Negligible	-	-
	Aboriginal heritage impacts	$44M	-	-
	Surface water release/runoff	Negligible	-	-
	Visual impacts	Negligible	-	-
	Flora and fauna impacts of extensions	$112M	-	-
Road Transport Externalities	Road transport noise	$1M	-	-
	Road transport vibration	Negligible	-	-
Project Underground Mining Externalities	Stream impacts	$368M	-	-
	Groundwater impacts	Included in operating costs	-	-
	Upland swamp impacts	$95M	-	-
	Aboriginal heritage impacts	$144M	-	-
	Non-Aboriginal heritage impacts	Included in operating costs	-	-
	Infrastructure, roads and buildings impacts	Included in operating costs	-	-
	Subsidence damage to houses and other properties	Included in operating costs	-	-
	Flora and fauna impacts	Negligible	--	-
	Greenhouse gas generation	$2,131M	-	-
	Visual (recreation) impacts	Negligible	-	-
	Externalities Sub-total	**$2,898M**	-	**$870M**
	Net Externality Impacts	**$2,028M**	-	-
	TOTAL	**$10,819M**	-	**$19,101M**
NET BENEFITS		-	-	**$8,282M**

* Cost and benefits over time have been discounted at 7%. Lump sum values from the CM study have been inserted into the first year of the analysis and discounted. Totals may have minor discrepancies due to rounding.

The main decision criterion for assessing the economic desirability of a project to society is its Net Present Value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the Project, because the community as a whole would obtain net benefits from the Project.

Table 2.3 indicates that the Project would have net production benefits of $10,310M. The net production benefit is distributed amongst a range of stakeholders including:

- ICHPL shareholders;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of Company tax.

The NSW Government receives additional benefits in the form of payroll tax and local councils may also benefit through community infrastructure contributions required under the EP&A Act (if applicable).

The Project also has a range of external economic costs and benefits. External costs associated with environmental costs arising from Project related surface infrastructure, road transport and mine subsidence, have been estimated at $2,898M. The majority of this cost relates to greenhouse gas generation. External benefits associated with employment provided by the Project have been estimated at $870M.

Overall the Project is estimated to have net benefits of $8,282M and hence is desirable and justified from an economic efficiency perspective.

The external economic costs of the Project would be borne by residents of the Appin area and the general community who value the environment of the Southern Coalfields. The external benefits would accrue to broader community who value the employment provided by the Project.

ICHPL is undertaking measures to minimise external environmental costs, including:

- progressively reducing noise emissions at the Appin Mine surface facilities as a component of the Project upgrades;
- implementing stream restoration works over the Project life; and
- implementing swamp restoration works over the Project life.

Furthermore, the major environmental externality (greenhouse gas emissions) that has been included in Table 2.3 above would be internalised through the purchase of required carbon pollution permits once the Commonwealth Government's proposed Carbon Pollution Reduction Scheme is implemented.

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.3 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result was tested for changes to the following variables:

- opportunity cost of land;
- opportunity cost of capital;
- capital costs;
- operating costs;
- revenue from sale of coal;
- residual value of capital and land;
- operational noise impacts;
- transport noise impacts;
- greenhouse gas impacts;
- visual impacts (on recreational use of the Dharawal State Conservation Area);
- Aboriginal heritage impacts;
- flora and fauna impacts;
- upland swamp impacts;
- stream impacts; and
- social and economic value of employment.

This analysis indicated (Attachment C) that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables. In particular, significant increases in the values used for external impact such as greenhouse gas costs or environmental impacts had little impact on the overall economic desirability of the Project.

The results were most sensitive to decreases in the sale value of coal, although substantial (45%) and sustained reductions in assumed coal prices would be required to make the Project undesirable from an economic efficiency perspective.

Consideration was also given to the potential for uncertainty regarding the implicit prices derived from the CM study. In order to consider the potential for variability in these values, confidence intervals were generated (Attachment A). It is considered that there is a 95% probability that the mean implicit price of the NSW population for each of the environmental and social attributes determined in the CM study lies within the 95% confidence intervals described in Attachment A.

Varying the implicit prices derived from the CM study to upper and lower 95% confidence limit values in the BCA only has a moderate impact, and the net benefits of the Project would remain strongly positive (Attachment C).

2.7 CONSIDERATION OF ALTERNATIVES

An assessment has also been completed of a range of alternatives to the EA Base Plan Longwalls, to examine the relative costs and benefits of reducing the extent of the mining area to achieve various environmental impact reduction outcomes.

These analyses are based on estimation of the:

- incremental production costs and revenues of alternatives relative to the EA Base Plan Longwalls using estimates of the tonnage of ROM coal sterilised, foregone revenue, capital and operating cost savings and the additional capital and operating costs to maintain Project ROM coal production rates; and
- incremental environmental and social costs and benefits based on the CM study.

These alternatives have been evaluated in terms of impact on the net benefits of the Project by altering aspects of the EA Base Plan Longwall layout (e.g. by setting back relevant longwalls from certain streams). Other alternative mine layouts could also potentially be designed to achieve similar environmental outcomes. It is anticipated that development of suitable final mine layouts to achieve the environmental outcomes authorised by the Project Approval would be undertaken as a component of the Extraction Plan process, if the Project is approved.

Table 2.4 summarises the alternatives considered in this process. Each of these is based on some reduction in the recovery of ROM coal in comparison to the EA Base Plan Longwalls. Consideration of the significant reduction in the mining reserve as a result of ICHPL adopting the EA Base Plan Longwalls is summarised in Section 2.7.2.

Table 2.4
Project Environmental Impact Reduction Alternatives Considered

Code	Summary Description
A1	Altering the North Cliff domain mine layout to utilise 163 m wide longwalls.
A2	Altering the Appin Area 2/3 Extended domain mine layout to utilise 163 m wide longwalls.
A3	*Combination of A1 and A2*.
B1	Longwall setbacks from the North Cliff domain swamps predicted to experience more than 200 mm closure.
B2	Longwall setbacks from the Appin Area 2/3 Extended domain swamps predicted to experience more than 200 mm closure.
B3	*Combination of B1 and B2.*
B4	Longwall setbacks from eight swamps in the North Cliff and Appin Area 2/3 Extended domains that are predicted to experience more than 200 mm closure and have a high erosion index.
C1	Longwall setbacks from additional North Cliff domain streams 3rd order and above.
C3	Longwall setbacks from additional Appin Area 2/3 Extended domain streams 3rd order and above.
C4	*Combination of C1 and C3*.
C9	Longwall setbacks from additional West Cliff Area 5 (C5), Appin Area 7 (C6), Appin Area 9 (C7) and Appin Area 8 (C8) streams 3rd order and above.
C10	*Combination of C4 and C9.*

Diagrams showing indicative longwall panel setbacks for alternatives B1, B2, B4, C1, C3 and C9 (combination of C5, C6, C7 and C8 sub-alternatives) are provided in Attachment D.

2.7.1 Environmental Impact/Benefit Assumptions for Alternatives

In estimating the potential environmental and social costs and benefits for the EA Base Plan Longwalls and for alternatives, some assumptions are required.

Externalities have been valued using the CM results as follows.

Streams

- Impacts costed per kilometre for streams 3rd order and above and predicted to be subject to >200 mm of valley closure.
- Impacts costed per kilometre for named rivers (that may be <3rd order) and predicted to be subject to >200 mm of valley closure.
- No costing of impacts in the flooded section of the Nepean River as typical related subsidence impacts (e.g. localised flow diversion) would not arise in the flooded section (Appendix A of the EA).

Vegetation

- Vegetation clearance has been assumed to arise from the Project coal wash contribution to Stages 3 and 4 of the Coal Wash Emplacement, plus incidental clearance for surface activities associated with the EA Base Plan Longwalls.
- For alternatives to the EA Base Plan Longwalls, it has been assumed that the same clearance area would be required for coal wash emplacement. Proportional reductions in incidental clearing for other surface activities have been calculated (proportioned as per total ROM coal reduction).

Swamps

- Impacts are assumed to occur in swamps where valley closure is predicted to exceed 200 mm.
- The proportion of swamp assumed impacted has been estimated based on the proportion of swamp long section predicted to experience >200 mm closure, multiplied by the area of swamp (ha), multiplied by a 50% factor to recognise that impacts are likely to be largely concentrated either side of and along the swamp invert/valley floor[3].
- Swamps that overlie sterilised coal as a result of an impact reduction alternative have been assumed not to be impacted.

Aboriginal Heritage Sites

- 5% of hard rock sites that are within 600 m of the Project extent of longwall mining area are assumed to be impacted under the EA Base Plan Longwalls (i.e. artefact scatters, trees and open potential archaeological deposits [PADs] are assumed not to be materially impacted by subsidence). A proportion of Aboriginal heritage sites that would be affected by the Project's contribution to the development of Stages 3 and 4 of the Coal Wash Emplacement have also been included.
- 5% of any Aboriginal heritage sites that directly overly the EA Base Case Longwalls and for an alternative would overly sterilised coal, have been assumed not to be impacted.

Greenhouse Gases

- greenhouse gas emissions have been calculated for the Project by PAE Holmes (Appendix J of the EA).
- greenhouse gas emissions have been attributed a shadow price[4] of AUD$30/t CO_2e.
- greenhouse gas emissions are assumed to be reduced in proportion with the ROM coal reductions for alternatives to the EA Base Plan Longwalls.

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3 Valuation of the impact of swamps is taken from Gillespie Economics (2008) and discounted according to the results of the Project CM study.

4 Shadow price is the true social value of good or service.

Life of Mine

- From Year 2, the Project ROM coal production rate would be 10.5 Mtpa. Where alternatives involve a reduction in the total ROM coal extracted, a reduction in the mine life has been calculated based on the total quantity of ROM sterilised divided by 10.5 Mtpa.

Subsidence Infrastructure Management Costs

- Annual Project subsidence infrastructure management costs have been estimated for the EA Base Plan Longwalls.
- Where alternatives involve a reduction in the estimated infrastructure management costs, these savings have been estimated and incorporated in the economic analysis.

Stream and Swamp Restoration Costs

- Annual Project stream and swamp restoration costs have been estimated for the EA Base Plan Longwalls.
- Where alternatives involve a reduction in potential impacts (i.e. a reduction in the length of stream or swamp where the predicted closure is >200 mm) savings in restoration costs have been estimated and included in the economic analysis.

It is considered that the above assumptions are generally conservative and are likely to generally overstate both the potential impacts of the Project and the potential environmental benefits and social costs of the various environmental impact reduction alternatives.

In addition it is noteworthy that the valuations obtained by the CM study did not include any consideration of ICHPL restoration activities and hence the environmental impacts on streams and swamps have been costed as if no remediation would be undertaken. As discussed in Section 5 in the Main Report of the EA, extensive stream and swamp restoration is proposed for the Project. Savings associated with reduced operational expenditure on these activities have been included for alternatives where remediation budgets are likely to be reduced due to the adoption of an alternative. This is considered to be conservative as it effectively double counts stream impact-remediation related costs.

2.7.2 Consideration of the Maximum Case

ICHPL has already made significant reductions in the potential Project mining reserve within its mining tenements in developing the EA Base Plan Longwalls.

The EA Base Plan Longwalls incorporate an estimated reduction of the mining reserve by approximately 72.5Mt of ROM coal and a reduction in the Project life by approximately seven years as a result of changes to the mine plan that have been adopted for the EA. It is estimated that the undiscounted value of 72.5 Mt of ROM coal is approximately $9.8 billion.

These changes have resulted from adopting the stream design criteria described in Section 2 in the Main Report of the EA (e.g. not undermining the Georges and Nepean Rivers and adopting the stream impact minimisation criteria described in Section 2.5.2 in the Main Report of the EA) and by adopting setbacks from some key major infrastructure.

In order to put this into perspective, an estimate of the environmental benefits and economic costs of this voluntary reduction in the Project extent of longwall mining area has been simply estimated by extending the economic modelling of the Project for an extra seven years using consistent operating and capital cost profiles.

The results of this can be summarised as follows:

- An estimated reduction of some 30 km of stream length (of 3rd order and above) subject to >200 mm of valley closure.
- An estimated reduction in vegetation clearance of some 25 ha associated with general surface disturbance and reduced need for further extension of the West Cliff Coal Wash Emplacement.
- Reduction in potential impacts to Aboriginal heritage sites and upland swamps.
- Reductions in greenhouse gas emissions associated with reducing the total ROM coal quantity.
- A reduction of the net production benefits of the Project by $580M.
- A reduction in environmental impact costs of the Project by $378M.
- A reduction in the social benefits associated with the length of Project life of $57M.

Summing the three values above indicates there is a reduction in the net benefits of the Project to the community of $259M as a result of the adoption of the EA Base Case Longwalls (over the maximum case).

Whilst this very significant reduction in the mining reserve would not be considered economically efficient, the EA Base Plan Longwalls have been adopted as a result of ICHPL's internal policies and consideration of the views of stakeholders.

2.7.3 Potential Environmental Benefits Associated With the Alternatives

The following summarises the environmental benefits of the alternative environmental impact reduction alternatives.

Case A – Narrow Longwalls

The Case A alternatives were included for the North Cliff and Appin Area 2/3 Extended domains. These Project domains include the majority of water supply catchment and conservation areas, and associated streams and upland swamps.

Narrowing of longwall panels generally reduces systematic strains at the surface. However, non-systematic movements, such as valley closure, are considered to be the key driver of impacts on streams and swamps (Appendix A of the EA), and therefore are the focus of the discussion below.

MSEC compared the subsidence, upsidence and closure profiles obtained using the 163 m wide longwall panel voids against the subsidence, upsidence and closure profiles obtained for the EA Base Plan Longwalls for a number of streams in the North Cliff domain.

The analysis is summarised in Appendix P of the EA, which indicates that use of the 163 m wide longwall panel voids would not significantly alter the environmental consequences expected to be experienced (i.e. there would not be a material reduction in the length of stream predicted to experience >200 mm closure):

Based on the above, it is considered that there would be only limited alteration of the environmental consequences for upland swamps and streams associated with the 163 m panel voids, as valley closure effects of >200 mm would still occur and only marginal reductions in subsidence effects would be observed at the surface. No material change in environmental consequences have been assumed for streams and upland swamps for the Case A alternatives.

It would be expected that mine related compressive and tensile strains at the surface would be reduced to some extent by these alternatives. This could result in some marginal reduction in the potential for damage to individual overlying Aboriginal heritage sites, however the likelihood of damage to any individual site is already small (Appendix A of the EA). Therefore no reduction of potential impact to any Aboriginal heritage sites was assumed for these alternatives.

Some greenhouse gas and vegetation clearance savings would occur for the Case A alternatives as the amount of ROM coal mined in the subject domains would be reduced.

Case B – Setbacks to Achieve <200 mm of Valley Closure at Upland Swamps

For the purposes of the benefit cost analysis it has been conservatively assumed that impacts would occur in upland swamps where valley closure is predicted to exceed 200 mm (Section 2.7.1).

MSEC has designed the Case B alternative mine layouts to achieve <200 mm closure in all upland swamps in the North Cliff and Appin Area 2/3 Extended domains. Therefore, where these setbacks are implemented in a domain, no environmental impacts have been assumed on upland swamps in that domain.

These upland swamp impact reduction alternatives are also expected to have some marginal benefits associated with a reduction in environmental impacts on streams and a proportion of Aboriginal heritage sites that overly sterilised coal, and these reductions have been estimated.

Some greenhouse gas and vegetation clearance savings would also occur for the Case B alternatives as the amount of ROM coal mined in the subject domains would be reduced.

Case C – Setbacks to Achieve <200 mm Closure at Streams 3rd Order and Above

Impacts are assumed to occur in streams 3rd order and above, where valley closure is predicted to exceed 200 mm (Section 2.7.1).

MSEC has designed the Case C mine layouts to achieve <200 mm closure in all streams 3rd order and above, therefore where these setbacks are implemented in a domain, no environmental impact costs have been assumed on streams in that domain.

The Case C stream impact reduction alternatives would also have some marginal benefits associated with reductions in environmental impacts on some upland swamps in the North Cliff and Appin Area 2/3 Extended domains that were predicted to experience >200 mm closure under the EA Base Plan Longwalls.

A proportion of Aboriginal heritage sites were assumed to be protected by these alternatives where they overlie sterilised coal.

Some greenhouse gas and vegetation clearance savings would occur for the Case C alternatives as the amount of ROM coal mined in the subject domains would be reduced.

2.7.4 Economic Analysis of Environmental Impact Reduction Alternatives

The environmental benefits of the Case A, Case B and Case C alternatives with respect to reduced environmental impacts on streams, upland swamps, vegetation clearance, Aboriginal heritage sites and greenhouse gas emissions due to reduced Project life were estimated using the results of the CM study and a carbon price. The estimates of environmental benefits in comparison to the EA Base Plan Longwalls were conservative, as they assumed that no stream restoration is implemented for the EA Base Plan Longwalls, however, as described in Section 5 in the Main Report of the EA significant stream restoration works are proposed for the Project.

The estimated incremental costs and benefits of the impact reduction alternatives were calculated and indicate that the alternatives are not economically efficient and all result in a net cost to society. Testing of the sensitivity of these results to variations in the implicit prices derived from the CM study was also completed and indicated that all of the alternatives remain economically inefficient with implicit prices at the upper and lower 95% confidence limits.

3 REGIONAL ECONOMIC IMPACT ASSESSMENT

3.1 INPUT-OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

Regional economic impact assessment is primarily concerned with the effect of an impacting agent on an economy in terms of a number of specific indicators, such as gross regional output, value-added, income and employment.

These indicators can be defined as follows:

- ***Gross regional output*** – the gross value of business turnover.
- ***Value-added*** – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output.
- ***Income*** – the wages paid to employees including imputed wages for self employed and business owners.
- ***Employment*** – the number of people employed (including full-time and part-time).

An impacting agent may be an existing activity within an economy or may be a change to a local economy (Powell *et al.,* 1985; Jensen and West, 1986). This assessment is concerned with the impact of continued development of underground mining operations within existing coal leases and new mining leases to facilitate a total ROM coal production rate of up to 10.5 Mtpa at the Appin Mine and West Cliff Colliery.

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.,* 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the Project but not making the economy so large that the impact of the proposal becomes trivial (Powell and Chalmers, 1995). Data on the residential location of current employees at Appin Mine and West Cliff Colliery (Table 3.1) indicates that approximately 88% live in the Illawarra Statistical Division (SD) while the remaining 12% live in the Outer South Western Sydney (OSWS) Statistical Subdivision (SSD). Consequently, for this study, the impacts of the Project have been estimated for the combined region of the Illawarra SD and the OSWS SSD.

Table 3.1
Residential Location of Workforce

Statistical Divisions/Subdivisions	Statistical Local Areas	%*
Illawarra SD	Wollongong	65%
	Shellharbour	16%
	Kiama	4%
	Wingecarribee	2%
	Shoalhaven	2%
	Nowra - Bomaderry	0%
	Sub-total	**88%**
OSWS SSD	Campbelltown	4%
	Camden	1%
	Wollondilly	7%
	Sub-total	**12%**
Total		**100%**

Source: ICHPL (2009).

* Totals may have minor discrepancies due to rounding.

A range of methods that can be used to examine the regional economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.,* 1985). This study uses input-output analysis.

Input-output analysis essentially involves two steps:

- construction of an appropriate input-output table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- identification of the initial impact or stimulus of the Project (construction and/or operation) in a form that is compatible with the input-output equations so that the input-output multipliers and flow-on effects can then be estimated (West, 1993).

A 2005-06 input-output table of the regional economy (Illawarra SD and OSWS SSD) was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment E) using a 2005-06 NSW input-output table (developed by Monash University) as the parent table. The 109 sector input-output table of the regional economy was aggregated to 30 sectors and 6 sectors for the purpose of describing the economy.

A highly aggregated 2005-06 input-output table for the regional economy is provided in Table 3.2. The rows of the table indicate how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD - which includes stock changes, capital expenditure and government expenditure). The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA - which includes gross operating surplus and depreciation and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Table 3.2
Aggregated Transactions Table: Regional Economy 2005-06 ($'000)

	Ag, forestry, fishing	**Mining**	**Manuf.**	**Utilities**	**Building**	**Services**	**TOTAL**	**Household Expenditure**	**OFD**	**Exports**	**Total**
Ag, forestry, fishing	9,829	99	87,072	14	961	30,255	128,231	79,401	61,831	155,598	**425,062**
Mining	35	54,205	126,053	48,136	6,018	6,455	240,902	2,818	-40,080	1,251,395	**1,455,034**
Manuf.	29,534	37,092	1,834,898	13,497	438,902	1,060,036	3,413,959	1,096,507	441,297	4,921,715	**9,873,478**
Utilities	3,164	6,220	114,808	244,684	10,316	138,036	517,228	138,383	6,053	255,253	**916,916**
Building	2,202	11,123	21,652	14,821	769,394	260,062	1,079,255	0	2,035,007	191,582	**3,305,845**
Services	41,429	77,948	1,210,496	34,295	345,263	4,281,639	5,991,070	5,773,692	5,133,298	7,687,227	**24,585,287**
TOTAL	**86,194**	**186,686**	**3,394,979**	**355,448**	**1,570,855**	**5,776,483**	**11,370,644**	**7,090,801**	**7,637,406**	**14,462,771**	**40,561,623**
Household Income	107,032	188,805	1,719,097	78,213	888,335	8,881,074	11,862,555	0	0	0	**11,862,555**
OVA	83,661	899,463	1,087,908	197,482	256,166	4,217,209	6,741,889	900,102	270,046	25,995	**7,938,032**
Imports	148,175	180,080	3,671,495	285,773	590,489	5,710,521	10,586,534	8,322,350	1,450,901	1,025,318	**21,385,103**
TOTAL	**425,062**	**1,455,034**	**9,873,478**	**916,916**	**3,305,845**	**24,585,287**	**40,561,623**	**16,313,254**	**9,358,353**	**15,514,083**	**81,747,313**
Employment	2,659	2,808	25,851	1,191	12,755	143,920	189,184				

Gross regional product (GRP) for the regional economy is estimated at $19,801M, comprising $11,863M to households as wages and salaries (including payments to self employed persons and employers) and $7,938M in OVA.

The employment total in the Illawarra/OSWS region in 2006 was 189,184 people.

The economic structure of the regional economy can be compared with that of NSW through a comparison of results from the input-output model (Figures 3.1 and 3.2). This reveals that the economic structures are reasonably similar although in the Illawarra/OSWS region the mining (household income, GRP and output only) and manufacturing sectors in the regional economy are of greater relative importance than they are in the NSW economy, while the agricultural/forestry/fishing sectors, utilities sectors (GRP and output), building sectors (household income and output) and service sectors are of less relative importance than they are to the NSW economy.

Figure 3.1
Summary of Aggregated Sectors: Regional Economy (2005-06)

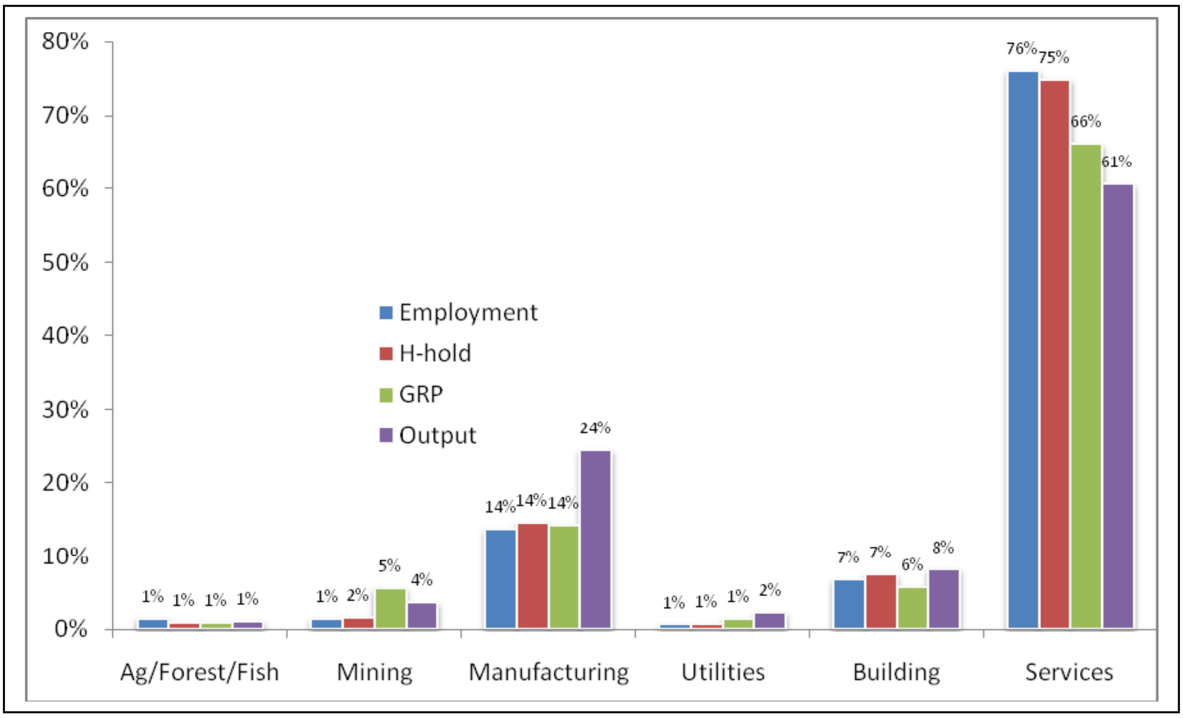
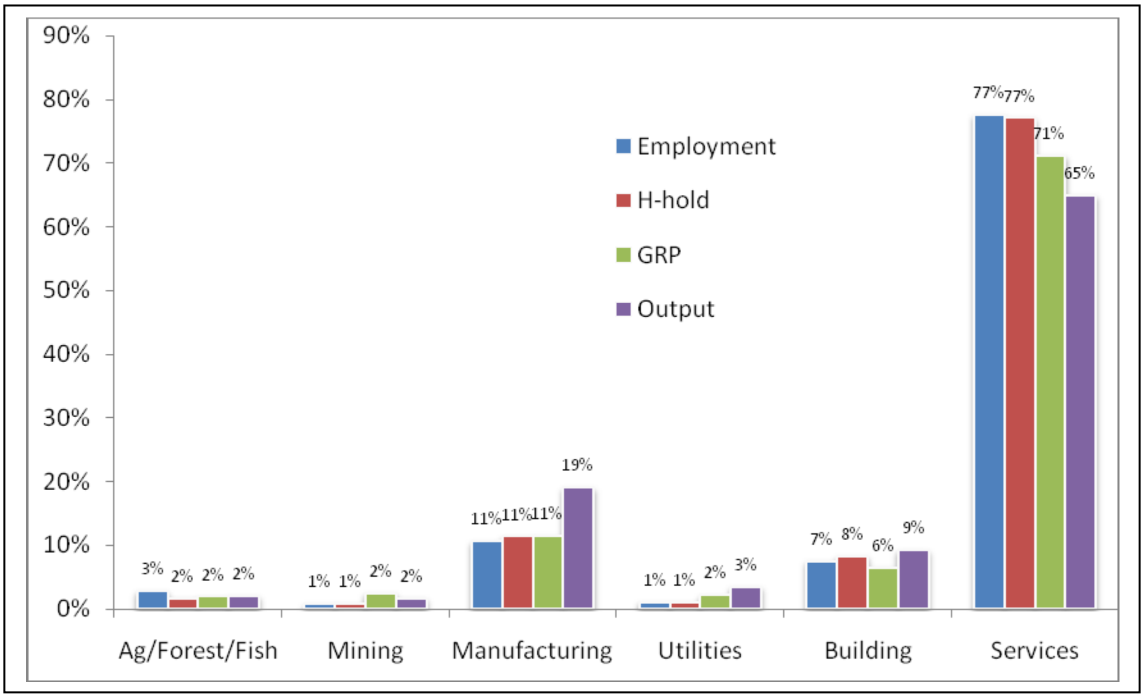


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2005-06)

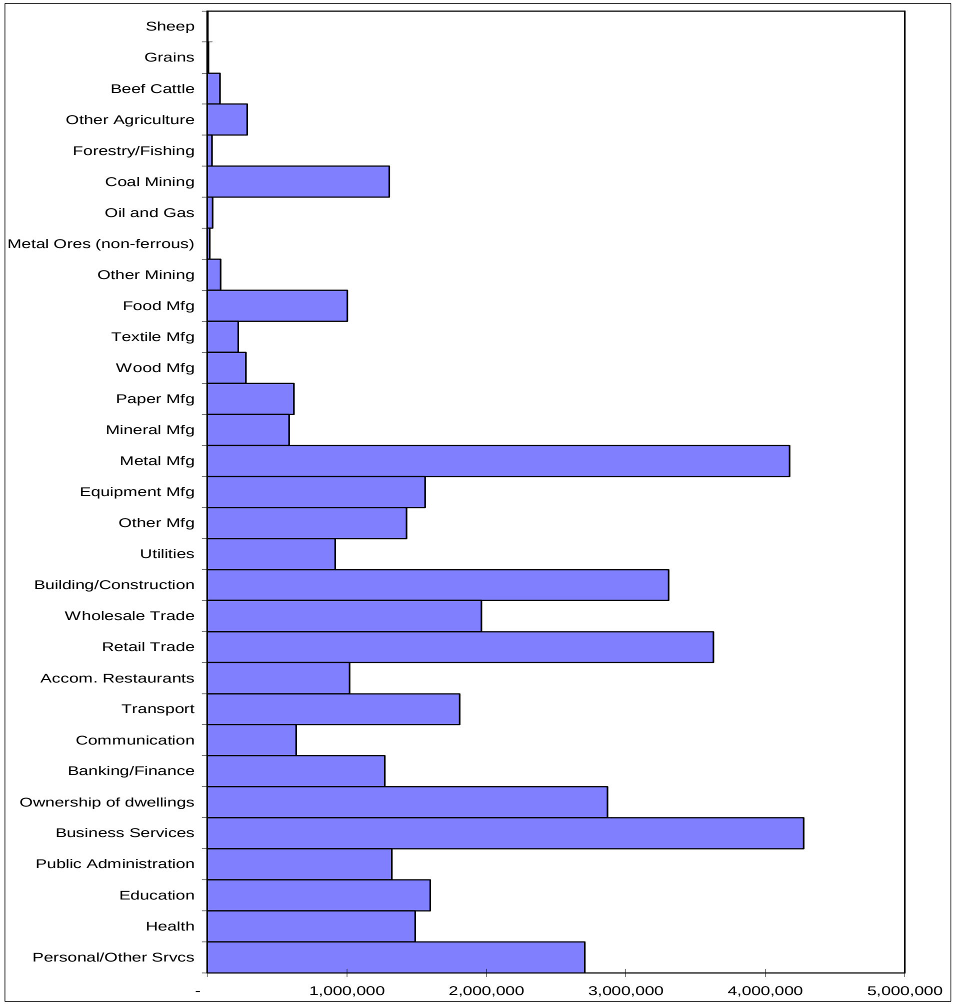


Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, gross value-added, gross regional income, employment, imports and exports, and can be used to provide some more detail in the description of the economic structure of the economy.

In terms of gross regional output, the business services sector is the most significant sector of the regional economy followed by the metal manufacturing sector, retail trade and building/construction. For gross value-added, ownership of dwellings, business services and retail trade are the most significant sectors. The retail trade sector is the greatest employer in the region followed by the services sectors (predominantly education, health, personal/other services and business services). However, in terms of income paid to employment, the business services sectors is the most significant, reflecting the high wages in this sector. Metal manufacturing is the major sector responsible for imports to and exports from the region.

Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added ($'000)

Gross Regional Output



Gross Value-Added

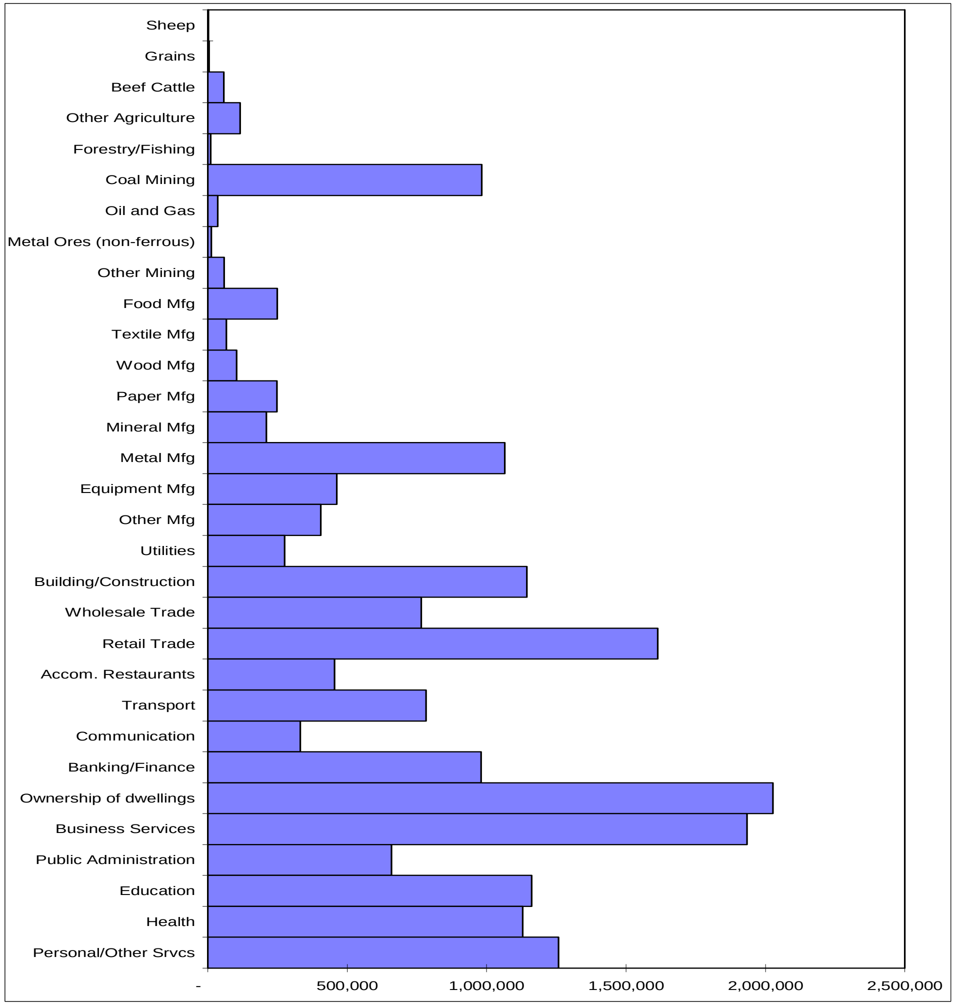
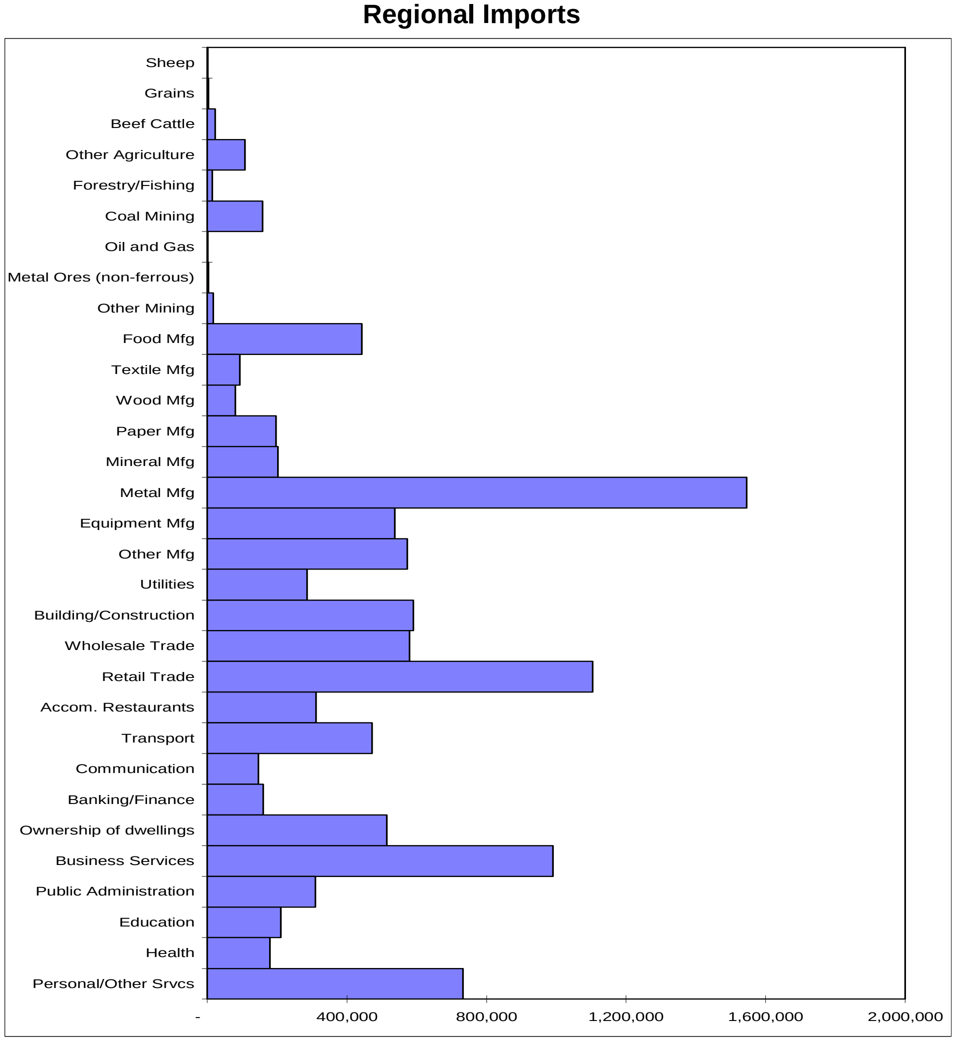
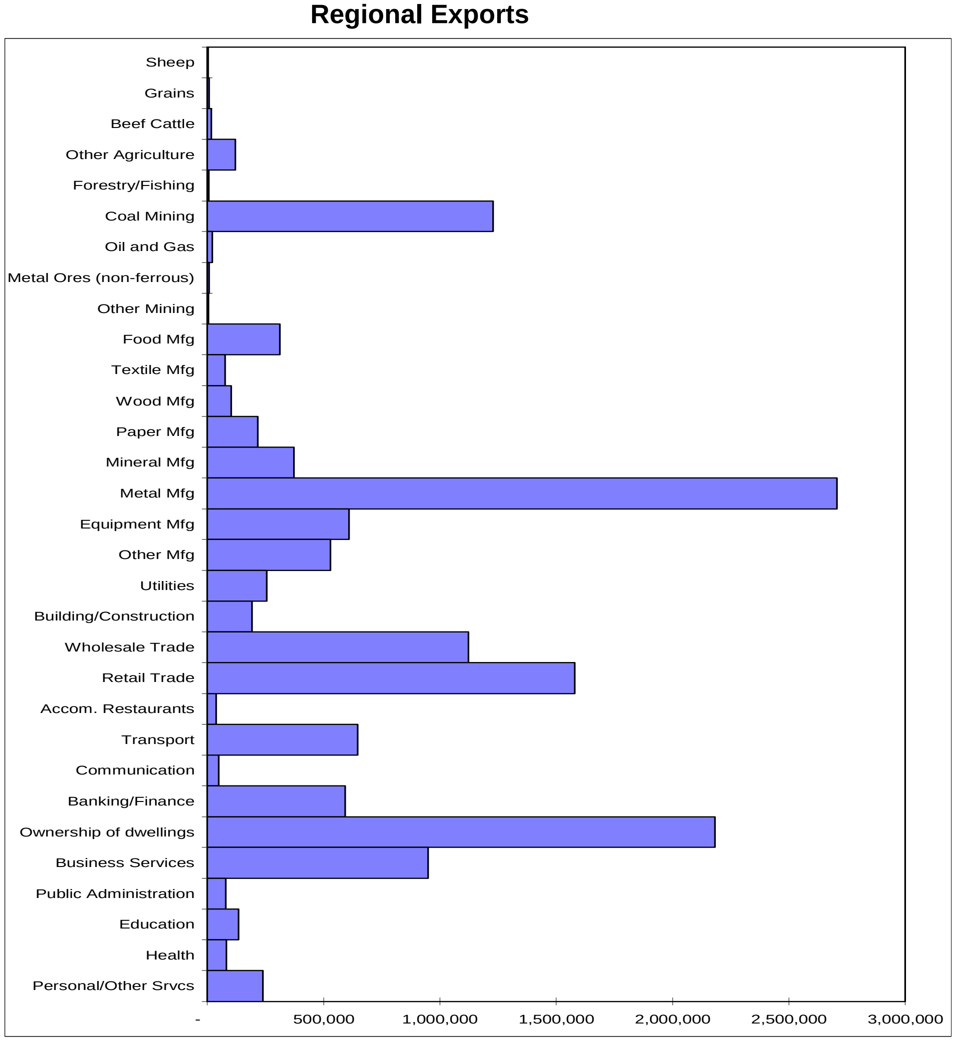


Figure 3.4 Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

Figure 3.5 Sectoral Distribution of Imports and Exports ($'000)





3.2 REGIONAL ECONOMIC IMPACT OF THE PROJECT

3.2.1 Introduction

The main regional economic impact of the Project is associated with the continued operation of the Appin Mine and West Cliff Colliery, albeit at higher than historical production levels. For the analysis of the Project, an Appin/West Cliff sector was inserted into the input-output table. For this sector:

- the estimated average annual gross revenue over the life of the Project was estimated from data provided by ICHPL and allocated to the *Output* row;
- the estimated average annual expenditure over the life of the Project was estimated from data provided by ICHPL;
- a detailed expenditure break down (labour and non-labour costs) for one typical historical year was provided by ICHPL and this was pro-rated up to the estimated average annual labour and non-labour expenditure estimate for 10.5 Mtpa ROM production;
- detailed information from ICHPL on expenditure within the region was used to allocate expenditure between local expenditure and *imports*;
- local expenditure was allocated to appropriate *intermediate sectors*, the *household wages* row, the o*ther value-added* row;
- local expenditure on primary and secondary goods were further allocated between local expenditure and *imports* based on the location quotient for each relevant sector;
- purchase prices for each sector were adjusted to basic values and margins and taxes allocated to appropriate sectors using relationships in the latest (2001-02) National Input-Output Tables;
- the difference between total revenue and total costs was allocated to the *other value-added* row*;* and
- direct employment by ICHPL (not including contractors) that reside in the region was allocated to the *employment* row.

To facilitate the later EPCIA, the regional economic impact of the existing levels of operation of the Appin Mine and West Cliff Colliery were also estimated and are reported first.

3.2.2 Impacts of the Existing Operation of the Appin Mine and West Cliff Colliery

The total and disaggregated annual impacts of the existing operation of the Appin Mine and West Cliff Colliery at 7.5Mtpa ROM on the regional economy in terms of output, value-added, income and employment (in 2009 dollars) are shown in Table 3.3.

Table 3.3
Annual Regional Economic Impacts of the Existing Operation of the Appin Mine and West Cliff Colliery

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	1,024,286	332,169	127,054	459,222	1,483,508
Type 11A Ratio	*1.00*	*0.32*	*0.12*	*0.45*	*1.45*
VALUE-ADDED ($'000)	653,992	159,769	59,430	219,199	873,191
Type 11A Ratio	*1.00*	*0.24*	*0.09*	*0.34*	*1.34*
INCOME ($'000)	70,589	100,595	45,552	146,146	216,735
Type 11A Ratio	*1.00*	*1.43*	*0.65*	*2.07*	*3.07*
EMPLOYMENT (No.)	472	1,190	727	1,917	2,389
Type 11A Ratio	*1.00*	*2.52*	*1.54*	*4.06*	*5.06*

In total, the existing operation of the Appin Mine and West Cliff Colliery is estimated to make the following contribution to the regional economy:

- $1,484M in annual direct and indirect regional output or business turnover;
- $873M in annual direct and indirect regional value-added;
- $217M in annual household income; and
- 2,389 direct and indirect jobs.

3.2.3 Impacts of the Project

The total and disaggregated annual impacts of the operation of the Project on the regional economy in terms of output, value-added, income and employment (in 2009 dollars) are shown in Table 3.4.

Table 3.4
Annual Regional Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	1,434,000	465,049	174,586	639,634	2,073,634
Type 11A Ratio	*1.00*	*0.32*	*0.12*	*0.45*	*1.45*
VALUE-ADDED ($'000)	891,828	223,680	81,664	305,344	1,197,172
Type 11A Ratio	*1.00*	*0.25*	*0.09*	*0.34*	*1.34*
INCOME ($'000)	94,387	140,837	62,593	203,429	297,817
Type 11A Ratio	*1.00*	*1.49*	*0.66*	*2.16*	*3.16*
EMPLOYMENT (No.)	631	1,665	1,000	2,665	3,296
Type 11A Ratio	*1.00*	*2.64*	*1.58*	*4.22*	*5.22*

In total, the Project is estimated to make the following contribution to the regional economy:

- $2,074M in annual direct and indirect regional output or business turnover;
- $1,197M in annual direct and indirect regional value-added;
- $298M in annual household income; and
- 3,296 direct and indirect jobs.

While the Project would provide 1,170 jobs, 631 of these are estimated to be direct ICHPL employees and 539 are estimated to be on-site contractors, all residing in the region. The 539 contractors are included in the production-induced flow-on employment in Table 3.4.

3.2.4 Multipliers

The Type 11A ratio multipliers for the Project range from 1.34 for output up to 5.22 for employment.

Capital intensive industries tend to have a high level of linkages with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to relatively high ratio multipliers for employment. A lower ratio multiplier for income (compared to employment) also generally occurs as a result of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the Project. Capital intensive mining projects also typically have a relatively low ratio multiplier for value-added, reflecting the relatively high direct value-added for the Project compared to that in flow-on sectors. The low output ratio multiplier for output largely reflects the high direct output value of the Project compared to the sectors that experience flow-on effects from the Project.

3.2.5 Main Sectors Affected

Flow-on impacts from the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- services to mining sector;
- other property services sector;
- legal, accounting, marketing and business management sector;
- road transport sector;
- wholesale trade sector;
- scientific research, technical and computer services sector;
- retail trade sector;
- other business services sector; and
- accommodation, cafes and restaurant sector.

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment would potentially be generated (Table 3.5).

Table 3.5
Sectoral Distribution of Total Regional Employment Impacts

Sector	Average Direct Effects	Production Induced	Consumption Induced	Total
Primary	0	1	14	**15**
Mining	631	341	1	**973**
Manufacturing	0	248	76	**324**
Utilities	0	18	7	**25**
Wholesale/Retail	0	135	217	**352**
Accommodation, cafes, restaurants	0	21	148	**169**
Building/Construction	0	121	8	**129**
Transport	0	389	34	**423**
Services	0	391	494	**885**
Total	**631**	**1,665**	**1,000**	**3,296**

Note: Totals may have minor discrepancies due to rounding.

Table 3.5 indicates that direct, production-induced and consumption-induced employment impacts of the Project on the regional economy are likely to have different distributions across sectors.

The Project would provide direct employment for 1,170 people (631 employees and 539 on-site contractors) who are expected to all reside in the region. Production-induced employment impacts would mainly occur in the services sectors, transport sectors, mining sectors, manufacturing sectors, building construction sectors and wholesale/retail trade sectors. Consumption-induced employment flow-ons would mainly occur in the services sectors, wholesale/retail trade sectors and accommodation/cafes/restaurants sectors.

Businesses that can provide the inputs to the production process required by ICHPL and/or the products and services required by employees would directly benefit from the Project by way of an increase in economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

3.2.6 Forward Linkages

The above analysis captures backward linkages from Project. However, there are also a number of significant forward linkages from coal mining in the Southern Coalfield including to BlueScope Steel in Wollongong, OneSteel at Whyalla in South Australia, Berrima Cement works and Port Kembla.

BlueScope steel at Port Kembla sources a considerable component of its coal requirements from the Appin Mine and West Cliff Colliery. The coal is used for the production of coke which feeds the blast furnaces. Consequently a consistent supply of coking coal which meets specifications of the Steelworks is essential for their continued operation. The Steelworks coal blend has been optimised around the specific properties of the high grade coking coal sourced from the two seams in the Southern Coalfield, the Bulli Seam (No. 1 Seam) and the Wongawilli Seam (No. 3 Seam). Based on 2006 census data, Iron and Steel manufacturing in the Illawarra and OSWS region directly employs 7,278 people (3.8% of the workforce in the Illawarra and OSWS region) and is the third most significant single sector in the Illawarra and OSWS economy for business turnover, 7th most important for value-added, 7th most important for household income and 6th most important in terms of direct employment.

The PKCT is a key coal exporting facility. It services the Southern and Western coalfields of NSW, exporting high quality coking and steaming coal to customers around the world (PKCT, 2008). The Port relies on coal throughput for its financial viability. Based on ABS data it is estimated that the Port directly employs 58 people.

Together direct coal mining employment associated with the Project together with forward and backward linkages in the region are estimated at 10,632. In 2006 this represents 5.6% of the Illawarra and OSWS workforce.

3.3 STATE ECONOMIC IMPACTS OF THE PROJECT

3.3.1 *Introduction*

The State economic impacts of the Project operation were assessed in the same manner as for estimation of the regional impacts. A new Appin/West Cliff sector was inserted into a 2008 NSW input-output table in the same manner described in Section 3.2.1. The primary difference from the sector identified for the regional economy was that all direct employment and contractors employed were assumed to reside in NSW and a greater level of expenditure was captured by the NSW economy compared to the regional economy.

3.3.2 Impacts of the Project on NSW

The total and disaggregated annual impacts of the Project on the NSW economy in terms of output, value-added, income and employment (in 2009 dollars) are shown in Table 3.6.

Table 3.6
Annual State Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	1,434,000	790,213	598,736	1,388,950	2,822,950
Type 11A Ratio	*1.00*	*0.55*	*0.42*	*0.97*	*1.97*
VALUE-ADDED ($'000)	933,990	376,467	304,970	681,437	1,615,427
Type 11A Ratio	*1.00*	*0.40*	*0.33*	*0.73*	*1.73*
INCOME ($'000)	94,388	247,328	174,524	421,853	516,241
Type 11A Ratio	*1.00*	*2.62*	*1.85*	*4.47*	*5.47*
EMPLOYMENT (No.)	631	2,704	2,456	5,160	5,791
Type 11A Ratio	*1.00*	*4.29*	*3.89*	*8.18*	*9.18*

In total, the Project is estimated to make the following contribution to the NSW economy:

- $2,822 M in annual direct and indirect output or business turnover;
- $1,615 M in annual direct and indirect value-added;
- $516 M in annual household income; and
- 5,791 direct and indirect jobs.

While the Project would provide 1,170 jobs, 631 of these are estimated to be direct ICHPL employees and 539 are estimated to be on-site contractors, all residing in the region. The 539 contractors are included in the production-induced flow-on employment in Table 3.6.

The impacts on the NSW economy are substantially greater than for the regional economy, as the NSW economy is able to capture more mine and household expenditure, and there is a greater level of intersectoral linkages in the larger NSW economy.

3.4 PROJECT CESSATION

The establishment and operation of the Project would stimulate demand in the regional and NSW economy leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, cessation of the mining operations would result in a contraction in regional economic activity.

The magnitude of the regional economic impacts of cessation of the Project would depend on a number of interrelated factors at the time, including:

- the movements of workers and their families;
- alternative development opportunities; and
- economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of Project cessation would depend on whether the workers and their families affected would leave the region. If it is assumed that some or all of the workers remain in the region, then the impacts of Project cessation would not be as severe compared to a greater proportion of employees leaving the region. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption the regional economic impacts of Project cessation would approximate the direct and production-induced effects in Table 3.4. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.4.

The decision by workers, on cessation of the Project, to move or stay would be affected by a number of factors including the prospects of gaining employment in the local region compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the local region (Economic and Planning Impact Consultants, 1989).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with Project closure that arise through reduced production and employment expenditure can be substantially ameliorated and absorbed by the growth of the region. One key factor in the growth potential of a region is a region's capacity to expand its factors of productions by attracting investment and labour from outside the region (Bureau of Industry Economics, 1994). This in turn can depend on a region's natural endowments. The Illawarra/OSWS region is highly prospective with considerable coal resources (DPI, 2008).

It is therefore likely that over time, new mining developments would occur, offering potential to strengthen and broaden the economic base of the region and hence buffer against impacts of the cessation of individual activities.

Ultimately, the significance of the economic impacts of cessation of the Project would depend on the economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy, the impacts might be significant. Alternatively, if Project cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the Project may not be a cause for concern.

Nevertheless, given the uncertainty about the future complementary mining activity in the region it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project would maintain in the region.

4 EMPLOYMENT, POPULATION AND COMMUNITY INFRASTRUCTURE ASSESSMENT

4.1 INTRODUCTION

Changes in the workforce and populations of a region may well have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities. This may include the number of services that are available to be used and the accessibility of these services.

The objective of this EPCIA is to examine the potential impacts of the Project on the existing community infrastructure as a result of employment and population change associated with the Project.

The basic methodology for carrying out the EPCIA was to:

- analyse the existing socio-economic environment of the region potentially impacted by the Project;
- analyse the likely magnitude of the Project work force and associated population including estimated flow-on employment and population effects;
- consider the impacts of estimated employment and population change on community infrastructure based on Australian Bureau of Statistics (ABS) data; and
- recommend impact mitigation or management measures for any substantive impacts that are identified.

The geographic scope of the EPCIA was determined by the location of Project and the region that would potentially service the Project and its employees. The Project is located 25 km north-west of Wollongong in NSW. Current employees are located across the Illawarra SD as well as the OSWS SSD (Table 3.1). While these regions were combined for the purpose of the regional economic impact assessment for the EPCIA they are described separately below.

The assessment draws on a range of publications, press releases and reports as well as data provided by ICHPL, the ABS Census, and information from Section 3 on the potential regional economic impacts of the Project. While the Project would also be expected to have population and workforce effects at a state level, these effects would not be of sufficient magnitude to warrant consideration of potential adverse effects.

4.2 REGIONAL PROFILE

Population

The Illawarra region (Illawarra SD) comprises the Statistical Local Areas (SLAs) of Wollongong, Wingecarribee, Shellharbour, Kiama, Nowra - Bomaderry and Shoalhaven). In 2006, it had a population of 394,213, representing 6.0% of the NSW population (ABS Census).

The OSWS region (OSWS SSD) comprises the SLAs of Campbelltown South, Campbelltown North, Camden and Wollondilly. In 2006 it had a population of 233,066, representing 3.6% of the NSW population.

Consistent with the trend for NSW, the proportion of the Illawarra and OSWS populations under the age of 44 has been declining over time while the proportion of the population over the age of 44 has been increasing. Nevertheless, the proportion of the OSWS population aged 14 years and younger, and aged 15 to 44 years, is greater than that for NSW. Compared to NSW, the Illawarra region has a similar proportion of the population aged 14 years and younger and a smaller proportion of the population aged 15 to 44 years (Table 4.1).

Table 4.1
Distribution of the Illawarra, Outer South Western Sydney and NSW Population by Age Group

Proportion of Total Population	Illawarra			OSWS			NSW		
	1996	2001	2006	1996	2001	2006	1996	2001	2006
Aged 14 years and younger	22.4%	21.5%	20.0%	28.3%	26.1%	24.2%	21.4%	20.9%	19.8%
Aged 15 years to 44 years	42.2%	39.9%	37.6%	47.8%	45.7%	43.7%	44.7%	43.1%	41.5%
Aged 45 years to 64 years	21.5%	23.5%	25.7%	17.9%	21.4%	24.2%	21.1%	22.9%	24.8%
Aged 65 years and over	13.9%	15.1%	16.8%	6.0%	6.8%	7.9%	12.7%	13.1%	13.8%

Source: ABS Census Time Series Profile (place of residence).
Note: Percentages may not add to 100% due to rounding.

The populations of the Illawarra and OSWS regions both increased at a greater rate than for NSW between the 1996 and 2001 Censuses (Table 4.2). However, population growth for both regions has slowed since 2001 to a rate less than that for NSW (Table 4.2). The population of Illawarra is expected to continue to grow but at a declining rate similar to that for NSW as a whole. However, the growth rate for OSWS is expected to be considerably greater than both NSW and the Illawarra region (DoP, 2005) (Table 4.3).

Table 4.2
Illawarra, Outer South Western Sydney and NSW, Population and Growth Rates 1991 to 2006

	Year	1996	2001	2006
Illawarra SD	Population	362,616	380,687	394,213
	Annual Population Growth Rate	-	1.00%	0.71%
OSWS SSD	Population	209,971	226,811	233,066
	Annual Population Growth Rate	-	1.60%	0.55%
NSW	Population	6,006,206	6,270,781	6,549,179
	Annual Population Growth Rate	-	0.88%	0.89%

Source: ABS Census Time Series Profile (place of residence).

Table 4.3
Illawarra, Outer South Western Sydney and NSW Population Projections 2011 to 2031

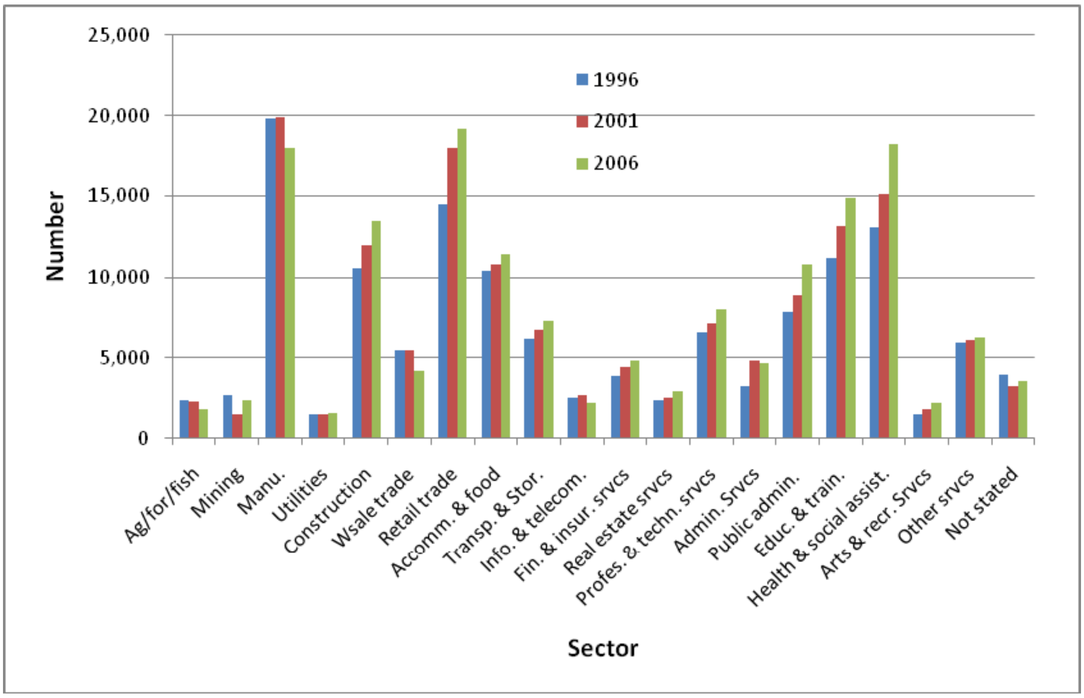
Region	2011	2016	2021	2026	2031
Illawarra SD	438,390	457,220	475,220	492,250	507,750
	-	0.86%	0.79%	0.72%	0.63%
OSWS SSD	269,480	296,950	339,250	375,550	408,940
	-	2.04%	2.85%	2.14%	1.78%
NSW	7,145,200	7,437,300	7,725,200	8,002,500	8,259,200
	-	0.82%	0.77%	0.72%	0.64%

Source: DoP (2005).

Employment

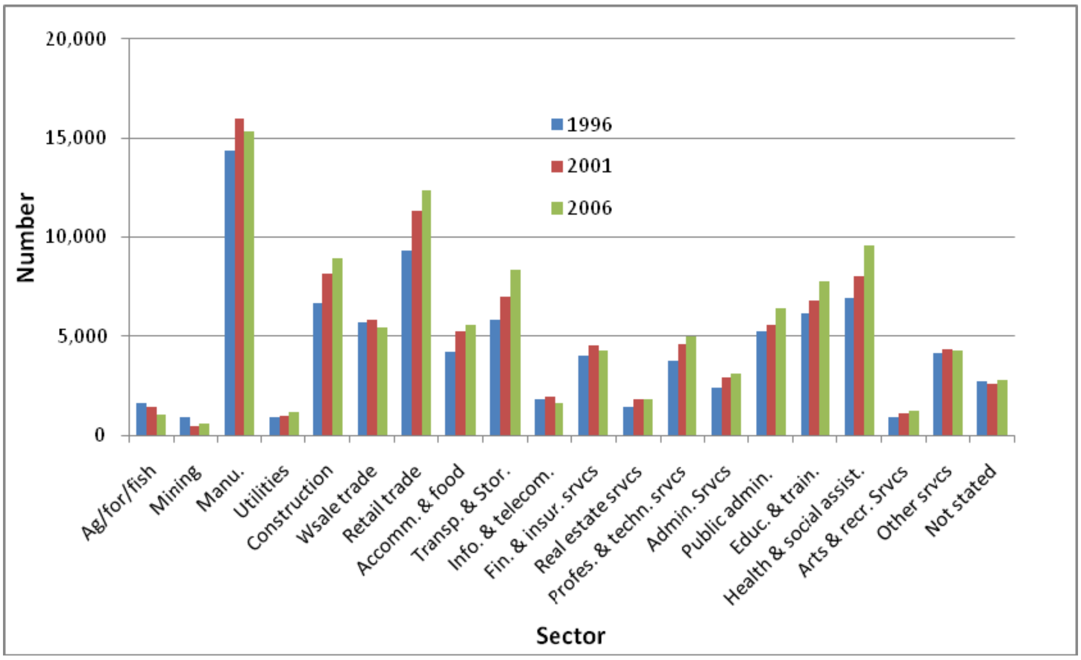
Detailed employment by industry data is presented on Figures 4.1 and 4.2. This clearly indicates the prominence of retail trade sector, the manufacturing sector and the health and social assistance sector to employment in both the Illawarra region and the OSWS region.

Figure 4.1
Employment by Industry in the Illawarra Region



Source: ABS Census Time Series Profile.

Figure 4.2
Employment by Industry in the Outer South Western Sydney Region

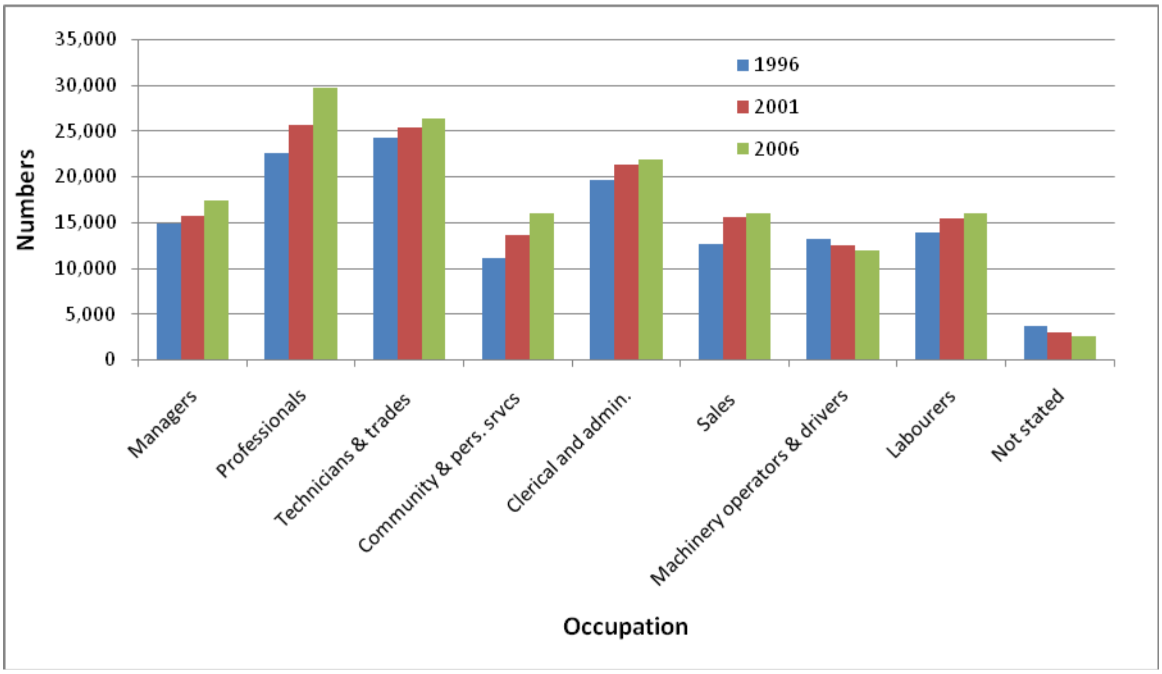


Source: ABS Census Time Series Profile.

Figures 4.1 and 4.2 also illustrate the increasing importance to both regions of the construction sector, retail trade sector, accommodation and food sector, transport and storage sector and the services sectors (financial and insurance services sectors, real estate services sector, professional and technical services sectors, administration services sectors, public administrations sectors, education and training sectors, health care and social assistance sectors, arts and recreation services sectors and other services sectors). The agriculture, forest and fishing sector, manufacturing sector, wholesale trade sector, information and telecommunications sector are the declining sectors in the Illawarra economy while for OSWS the mining sector and financial and insurance services sector have also declined.

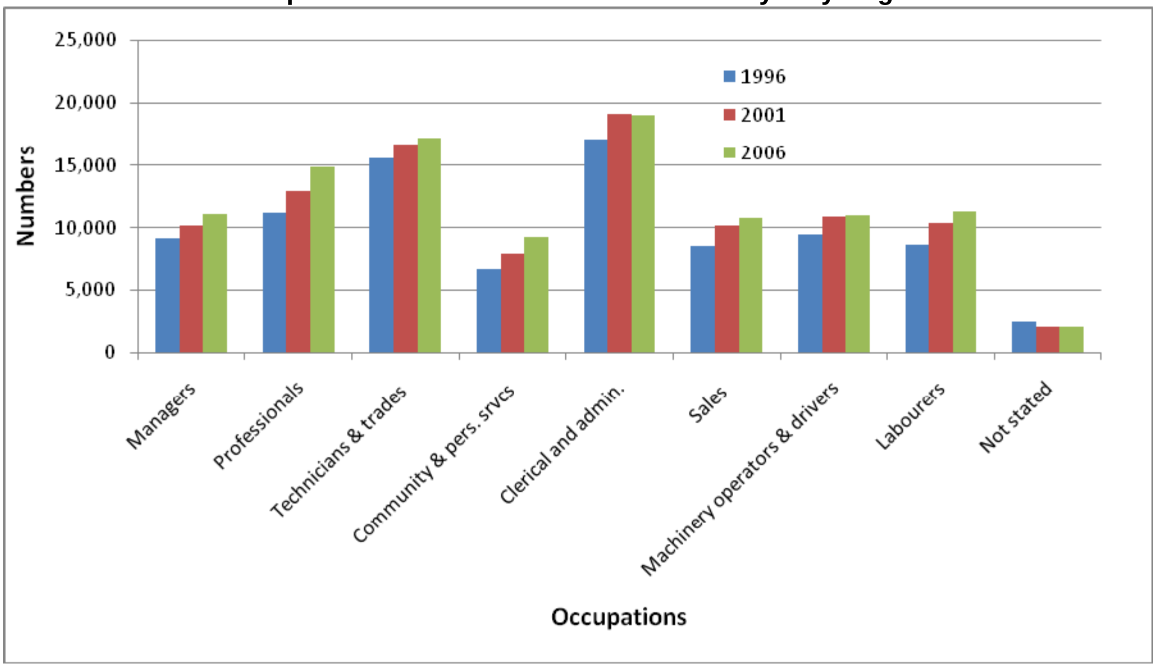
Supporting this sectoral change in employment is growth in managerial and professional occupations as well as technicians and trades, community and personal services, clerical and administrative workers (static in OSWS region), sales workers and labourers (Figures 4.3 and 4.4).

Figure 4.3
Occupations in the Illawarra Region



Source: ABS Census Time Series Profile.

Figure 4.4
Occupations in the Outer South Western Sydney Region



Source: ABS Census Time Series Profile.

The unemployment rate in the Illawarra region and OSWS region has been declining between censuses (Tables 4.4 and 4.5). However, the unemployment rate for the Illawarra region has been consistently higher than that for NSW while the unemployment rate for OSWS region has tended to be lower than for NSW up until the 2006 census when it was higher. Since the 2006 census the global financial crisis has resulted in a trend of rising unemployment levels, albeit from lower unemployment levels than those reported at the 2006 census. The level of unemployment in the December 2008 quarter is reported as 12,000 people (6.0%) for Illawarra region and 7,738 (5.9%) for OSWS region (Department of Education, Employment and Workplace Relations, 2009).

Table 4.4
Unemployment in the Illawarra Region

	1996	**2001**	**2006**
Total No. in Labour Force	154,008	162,947	170,670
As % of People over 15 Years	55.1%	54.7%	55.00%
Total Employment	135,966	148,402	158,028
Total Unemployment	18,042	14,545	12,642
Unemployment Rate	11.7%	8.9%	7.41%
NSW Unemployment Rate	**8.8%**	**7.2%**	**5.90%**

Source: ABS Census Time Series Profile.

Table 4.5
Unemployment in the Outer South Western Sydney Region

	1996	**2001**	**2006**
Total No. in Labour Force	97,139	107,985	113,527
As % of People over 15 Years	64.95%	64.66%	64.83%
Total Employment	88,978	100,447	106,537
Total Unemployment	8,161	7,538	6,990
Unemployment Rate	8.40%	6.98%	6.16%
NSW Unemployment Rate	**8.8%**	**7.2%**	**5.90%**

Source: ABS Census Time Series Profile.

Average individual taxable income in the Illawarra region was in the order of $43,798 in 2005 and for the OSWS region $42,228 in 2005 compared to $49,728 for NSW (ABS Regional Statistics, 2009a).

Housing

In 2006 there were approximately 151,616 private occupied dwellings in the Illawarra region and 77,443 in the OSWS region, about 6.1% and 3.1% of the State total, respectively. The Illawarra and OSWS regions had a higher proportion of separate houses than the State (approximately 80% and 86% respectively, compared with approximately 70% for NSW) and a lower proportion of townhouses/units/flats/apartments (approximately 19% and 14% respectively, compared with 29% in NSW) (Table 4.6).

Table 4.6
Housing Stock in the Illawarra, Outer South Western Sydney and NSW
(Occupied Dwellings Only)

Housing Stock	Illawarra SD			OSWS SSD			NSW
	1996	2001	2006	1996	2001	2006	2006
Total Private Dwellings	132,418	144,201	151,616	65,442	73,192	77,443	2,470,452
% Separate Houses	79.8%	79.8%	79.6%	81.35%	84.35%	85.98%	69.7%
% Townhouse, Flat, Unit, Apartment	16.7%	17.4%	18.8%	15.76%	14.53%	13.56%	28.8%
% Other	2.1%	2.1%	1.6%	0.62%	0.48%	0.43%	1.4%
% Not Stated	1.4%	0.6%	0.05%	2.27%	0.64%	0.03%	0.08%

Source: ABS Census Time Series Profile.

At the 2006 Census, there were 24,605 unoccupied dwellings in the Illawarra region and 4,035 unoccupied dwellings in the OSWS region (Table 4.7).

Table 4.7
Housing Stock in the Illawarra and Outer South Western Sydney Regions (All Dwellings)

Housing Stock	Illawarra (2006)			OSWS (2006)		
	Occupied Dwelling	Unoccupied dwelling	Total Dwelling	Occupied Dwelling	Unoccupied dwelling	Total Dwelling
Separate house	120,700	19,680	140,380	66,587	3,033	69,620
Semi-detached, row or terrace house, townhouse	12,214	1,795	14,009	8,713	744	9,457
Flat, unit or apartment	16,225	2,917	19,142	1,785	209	1,994
Other dwelling	2,400	200	2,600	332	42	374
Dwelling structure not stated	74	13	87	25	7	32
Total	**151,613**	**24,605**	**176,218**	**77,442**	**4,035**	**81,477**

Source: ABS Census Time Series Profile.

There is considerable short stay tourism accommodation available in the Illawarra and OSWS regions with 138 establishments in the Illawarra region providing 3,053 rooms and 8,242 beds and 15 establishments in the OSWS region providing 498 rooms and 1,391 beds (Table 4.8).

Table 4.8
Illawarra and Outer South Western Sydney Regions - Hotels, Motels and Serviced Apartments December Quarter 2008

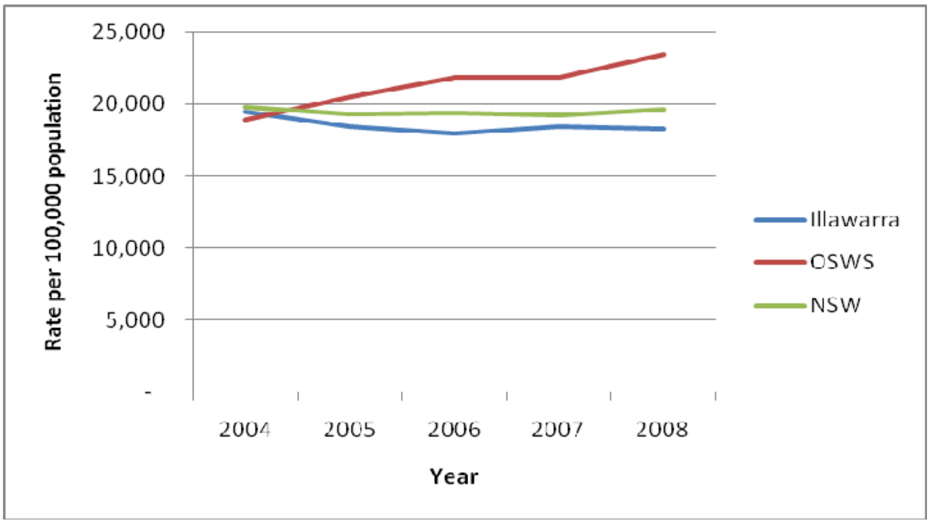
Short Stay Tourism Accommodation	Illawarra	OSWS
Establishments	138	15
Rooms	3,053	498
Beds	8,242	1,391
Guest Nights	244,436	46,506
Room Occupancy Rates	49%	56%
Bed Occupancy Rate	32%	36%
Accommodation Gross Takings ($)	19,135,656	3,368,528

Source: ABS 8635.1.55.001 - Tourist Accommodation, Small Area Data, NSW, December 2008.

Crime and Safety

NSW Bureau of Crime Statistics and Research indicates that the incidence of crime in the Illawarra region per 100,000 head of population is following the general decreasing trend being experienced in NSW as a whole. However, the incidence of crime per 100,000 head of population in the OSWS region is higher than for NSW and the Illawarra region and has been increasing over time (Figure 4.5 and Table 4.9).

Figure 4.5
Illawarra SD, Outer South Western Sydney SSD and NSW Incidence of Crime per 100,000 Head of Population Over Time



Source: NSW Bureau of Crime Statistics and Research (2009).

Table 4.9
Illawarra SD, Outer South Western Sydney and NSW Incidence of Crime per 100,000 Head of Population, 2008

	Illawarra SD	OSWS SSD	NSW
Homicide	3	2	4
Assault	1,041	1,325	1,046
Sexual offences	130	154	137
Abduction and kidnapping	4	6	6
Robbery	52	121	100
Blackmail and extortion	-	1	1
Harassment, threatening behaviour and private nuisance	396	720	361
Other offences against the person	19	23	22
Theft	3,587	3,694	4,132
Arson	121	249	105
Malicious damage to property	1,730	2,108	1,589
Drug offences	343	313	419
Prohibited and regulated weapons offences	128	140	125
Disorderly conduct	322	343	379
Betting and gaming offences	3	2	5
Liquor offences	271	148	260
Pornography offences	1	1	2

Table 4.9 (Continued)
Illawarra, Outer South Western Sydney and NSW Incidence of Crime per 100,000 Head of Population, 2008

	Illawarra SD	OSWS SSD	NSW
Prostitution offences	5	2	3
Against justice procedures	884	963	649
Driving offences	7,823	11,788	9,500
Transport regulatory offences	1,209	1,160	573
Other offences	194	199	226
Total	**18,267**	**23,461**	**19,643**

Source: NSW Bureau of Crime Statistics and Research (2009).

While the overall incidence of crime per capita was lower in the Illawarra region and higher in the OSWS region than for NSW, the per capita incidence of crimes varied between regions (Table 4.9).

It is difficult to specify reasons for the higher overall incidence of crime in OSWS and a higher incidence of some categories of crime in the Illawarra region than in the State since causal factors that lead to criminal activity are complex and include many and varied social and economic circumstances and conditions. However, socio-economic characteristics of the OSWS and Illawarra region that may be relevant include relatively lower income levels and higher unemployment rates. For the OSWS region the high proportion of the population under 44 years of age may also be relevant.

Community Infrastructure

Education

The NSW Department of Education and Training (DET) is the main provider of primary and secondary education in the Illawarra and OSWS region, accounting for 71% and 69% of primary and secondary school enrolments, respectively. In both regions there has been declining total enrolments at infants/primary schools with an increasing proportion of enrolments being in private schools (Table 4.10).

Secondary public school enrolments in OSWS have declined over time with private school enrolments increasing over time (Table 4.10). Secondary public school enrolments in the Illawarra region also declined between 2001 and 2006. It is therefore reasonable to assume that both regions are likely to have some excess capacity in the public school system.

Health, Arts and Recreation

According to the 2006 population census there were 16,372 people employed in the health care and social assistance industries in the Illawarra SD (Table 4.11) and 6,115 employed in these industries in the OSWS region. The proportion of employment in these health care and social assistance sectors in Illawarra was higher than in NSW while the proportion in these sectors in OSWS was lower than for NSW (Table 4.11).

The proportion of employment in OSWS in arts and recreation services was lower than for NSW while the proportion of employment in Illawarra in these sectors was the same as NSW (Table 4.11).

Table 4.10
Education in the Illawarra and Outer South Western Sydney Regions

	Illawarra			OSWS		
	1996	**2001**	**2006**	**1996**	**2001**	**2006**
Preschool	6,937	7,016	7,657	4,249	4,226	4,786
Infants/Primary	37,065	37,996	34,253	26,794	26,617	23,822
Public	*79%*	*77%*	*74%*	*83%*	*78%*	*74%*
Private	*21%*	*23%*	*26%*	*17%*	*22%*	*26%*
Secondary	25,578	27,414	27,666	18,435	19,597	18,710
Public	*73%*	*70%*	*67%*	*72%*	*67%*	*64%*
Private	*27%*	*30%*	*33%*	*28%*	*33%*	*36%*
TAFE	11,248	11,978	9,834	5,766	6,618	5,994
University	10,645	11,954	11,621	4,484	5,320	5,464
Other	1,444	2,126	1,852	874	1,304	1,190
Not Stated	16,999	17,432	30,038	9,711	11,646	18,839
Total	**109,916**	**115,916**	**122,921**	**70,313**	**75,328**	**78,805**

Source: ABS Time Series Profile.

Table 4.11
Employment in Health, Arts and Recreation Services

	Illawarra		OSWS		NSW	
Health care and social assistance						
Health care and social assistance	451	0.4%	156	0.3%	9,400	0.3%
Hospitals	4,803	3.7%	1,506	2.5%	94,187	3.4%
Medical and other health care services	4,766	3.7%	1,831	3.0%	85,108	3.1%
Residential care services	2,829	2.2%	947	1.5%	44,648	1.6%
Social assistance services	3,523	2.7%	1,675	2.7%	59,618	2.2%
Total	***16,372***	***12.8%***	***6,115***	***10.0%***	***292,961***	***10.7%***
Arts and recreation services	-					
Arts and recreation services	67	0.1%	26	0.0%	1,740	0.1%
Heritage activities	195	0.2%	66	0.1%	4,424	0.2%
Creative and performing arts activities	265	0.2%	57	0.1%	8,122	0.3%
Sports and recreation activities	1,188	0.9%	460	0.8%	18,873	0.7%
Gambling activities	59	0.0%	34	0.1%	4,799	0.2%
Total	***1,774***	***1.4%***	***643***	***1.0%***	***37,958***	***1.4%***
TOTAL	**18,146**	**14.1%**	**6,758**	**11.0%**	**330,919**	**12.0%**
TOTAL EMPLOYMENT	**128,320**	**100.0%**	**61,322**	**100.0%**	**2,748,394**	**100.0%**

Source: ABS (2009b) 4 Digit Employment by Industry Data for SLA of Workplace.

The South East Sydney and Illawarra Area Health Service (SESIAHS) administers the following health and community services in the Illawarra region:

- one principal hospital – Wollongong Hospital;
- two major district hospitals – Shoalhaven Hospital and Shellharbour Hospital;
- two small district hospitals – Bulli Hospital and Milton-Ulladulla Hospital;
- four sub-acute facilities – Coledale Hospital, Pt Kembla Hospital, Kiama Hospital, David Berry Hospital and Garrawarra Centre;
- 12 community health centres;
- eight dental clinics;
- 22 early childhood centres; and
- 10 mental health centres.

The Sydney South West Area Heath Service administers the following health and community services in the OSWS SSD:

- three public hospitals – Campbelltown, Carrington Centennial Hospital for Convalescents and Queen Victoria Memorial Home;
- one private hospital – MacArthur Private Hospital;
- three mental health facilities;
- one sexual assault facility; and
- three nursing homes.

4.3 PROJECT WORKFORCE AND POPULATION CHANGE

The main drivers for impacts on community infrastructure are changes in employment and population and the spatial location of these changes in employment and population. Employment that is directly generated by the Project may be sourced from:

- the local region either from:
  - the unemployment pool;
  - workers from other industries;
- in-migration; or
- commuters.

Sourcing labour from the local region has minimal direct impact on local community infrastructure and services since it results in no changes to the regional population and hence demand for services. It may, however, have an indirect impact on some local community infrastructure and services where changes in employment status or income result in changes in demand for some particular services (e.g. health services).

Whether local labour is sourced from the unemployment pool or from other industries, it can reduce unemployment levels - directly in the case of employing unemployed people and indirectly via the filter effect[5] where labour is sourced from other industries.

The impact of commuter workers would depend on the extent to which they integrate into the regional communities, however, for a region like the Illawarra and outer south west Sydney where any commuter workers are likely to come from major centres such as Sydney, any impact is likely to be modest.

In-migration resulting in population change is likely to have the greatest potential impact on demand for community services and infrastructure with this impact dependent on the new residential location of the migrating workforce and their families.

As well as direct employment and population changes, mining projects may also generate indirect labour demand through expenditure by employees in the local region and mine operation expenditure in the local region on other inputs to production. This induced demand for labour may also have consequences for population change and demand for community infrastructure and services.

To facilitate consideration of potential community infrastructure impacts, this section explores the likely direct and indirect employment and population effects of the Project.

4.3.1 Construction Workforce and Population Change

It is anticipated that during the initial development of the Project (including upgrades of existing surface and underground infrastructure), an additional 100 people would be required in the short-term (for up to one year).

Construction activities generally require a labour force with highly specialised skills including specialised welders, fitters, electrical contractors, machinery mechanics and construction engineers (Centre for International Economics, 2001). These types of professions are located in the construction sector, wholesale trade sector (mechanics), and the professional/scientific/technical services sector. Examination of the employment by industry data in Section 4.2 indicates that the Illawarra region and OSWS region both have a large and strongly growing construction sector and profession and technical services sector and a declining wholesale trade sector.

It is envisaged that most of the required construction workforce would be contractor labour from existing contractor firms located within the region. Any construction workforce unable to be sourced locally would most likely be able to be sourced from Sydney and commute to the region daily.

Consequently, little, if any, population change as a result of the construction workforce is envisaged.

4.3.2 Operation Workforce and Population Change

The Project relates to the continuation of an existing activity, albeit at increased rates of ROM coal and product coal production. Currently, the total workforce at the Appin Mine and West Cliff Colliery is approximately 875 people (comprising some 472 employees and 403 on-site contractors).

5 The filter effect refers to the situation where labour is sourced from other industries in the region making jobs available in those industries which are subsequently filled by people either from the unemployment pool or other industries with the latter making jobs available in that industry etc.

The operational workforce associated with the Project is estimated at 1,170 (comprising 631 employees and 539 on-site contractors). Hence, the additional direct workforce associated with Project is estimated at 295 (comprising 159 direct employees and 136 contractors (with this contractor employment included in the regional impact assessment as part of the production-induced flow-on).

There would also be additional flow-on employment estimated at 339 production-induced flow-on jobs and 273 consumption induced flow-on jobs.

Where prospective direct employees already reside in the region some level of consumption-induced flow-on employment already occurs in the region as a result of their current level of spending. Given the generally high level of mining wages compared to other wages it is conservatively assumed here that the full level of incremental consumption induced flow-ons would result from the Project.

To estimate the likely population change to the region as a result of the Project it is necessary to consider the extent to which this incremental direct and indirect employment generated by the Project would be met from within the local labour force, in-migration or commuters from outside the region. Only in-migration is likely to result in increased demand for community infrastructure.

Factors influencing the level of in-migration include the size and nature of the regional economy, its ability to supply the additional labour and skill mix and the proximity to other regions that may be able to provide commuter labour.

The Illawarra and OSWS regions are relatively large containing populations of 394,213 and 233,066 people, respectively (Table 4.2) and workforces of 170,670 and 113,527, respectively (Tables 4.4. and 4.5). The long history of coal mining in the Illawarra region has resulted in a considerable workforce focused on servicing coal mining both directly and indirectly. Both the Illawarra region and OSWS region have experienced considerable growth over time in occupations from which prospective employees and contractors for the Project may come such as managers, professionals, technicians and trades, and labourers. A further potential source of labour, the unemployment pool, is also considerable with 12,642 people unemployed in the Illawarra region at the last census and 6,990 people unemployed in the OSWS Region (Tables 4.4 and 4.5). The proximity of the Project to the even larger labour market of the Greater Sydney region provides an additional potential source of non-migrating labour. Consequently, it is considered that only a small proportion, 20%, of the incremental direct workforce (employees) generated by the Project is likely to come from in-migration and add to the demand for community infrastructure. A similar percentage of in-migration is assumed for production-induced and consumption-induced employment, although the percentage of in-migration may be even smaller for production-induced employment if there is spare capacity in existing business and may be smaller for consumption-induced employment, much of which is in retail trade and service sectors where there may be greater potential to fill positions from the unemployment pool.

On the basis of an assumption of 20% in-migration, a split in residential location between Illawarra and OSWS (Table 3.1) in accordance with the existing direct workforce and an average household size of 2.5 for Illawarra and 3.0 for OSWS (ABS Census) the potential increase in population would be 399 people for the Illawarra and 65 people for the OSWS.

4.4 COMMUNITY INFRASTRUCTURE IMPACT ASSESSMENT

4.4.1 Construction

Because the modest level of construction workforce is likely to be contractor labour from existing contractor firms located in the region or sourced from Sydney, no community infrastructure impacts are envisaged as a result of Project construction.

4.4.2 Operation

A population influx to the Illawarra region of 399 and to the OSWS region of 65 is small in the context of annual population growth, representing in the order of 2 months average population growth between 2001 and 2006 for the Illawarra region and less than 1 months average population growth between 2001 and 2006 for the OSWS region.

As such the demand this population influx would create for housing is also modest (Table 4.12). In Illawarra it represents 0.1% of total occupied housing stock in 2006, 0.7% of unoccupied residential properties in 2006 and 7% of new dwelling approvals in 2006. In OSWS it represents 0.03% of total occupied housing stock in 2006, 0.5% of unoccupied residential properties in 2006 and 2% of new dwelling approvals in 2006. The Illawarra Regional Strategy (DoP, 2007) provides a strategy to accommodate a population increase of 47,600 over the next 25 years.

Table 4.12
Predicted Project-Related Demand for Additional Accommodation

Region	Demand for Housing	Housing Stock		
	Additional Workforce	New Dwellings Approved 2006	Total Occupied Housing Stock 2006	Unoccupied Residential Properties 2006
Illawarra	160	2,390	151,616	24,605
OSWS	22	950	77,443	4,035

During the operation of the Project, any incoming workers would be expected to exhibit average family structures and hence would be associated with some children creating some increased demand for education facilities within the region. Assuming that the incoming population exhibits the same characteristics as the Illawarra region working age population, Table 4.13 summarises the likely demand for pre-school, infants/primary and high school places.

Table 4.13
Predicted Project-Related Demand for Children's Schooling

Type	Demand	2006 Enrolment (No.)	Public School Change in Enrolment 2001-2006
Illawarra			
Pre-school	29	7,657	*
Infants/Primary	53	34,253	-3,808
High school	41	27,666	-723
OSWS			
Pre-school	5	4,786	*
Infants/Primary	9	23,822	-3,096
High school	7	18,710	-1,312

* Data not available

These demands can be compared to the total enrolments in 2006 and growth/decline in public school enrolments between 2001 and 2006 across the region (see Table 4.10). In this context, it is evident that the increased demand for schooling associated with incremental Project employment effects could be considered to be insignificant.

If demand for private schools occurs in the same proportions as indicated in Table 4.10, it would comprise less than a single year's recent growth in private school enrolments.

There is potential for the Project to increase the demand for public health facilities in the region such as for Hospitals, General Practitioners Medical Services, Dental, Physiotherapy, Chiropractors, Optometrists, etc. via the potential increase in population as a result of increased flow-on employment associated with the Project. However, the potential indirect population increase for the Project is very small compared to the total population.

The Project also has the potential to indirectly positively impact on public health through the provision of employment opportunities and the reduction in unemployment. Prolonged unemployment can generate a range of personal and social problems including increased drug and alcohol dependency and increased demand for health services (University of NSW, 2006). Providing opportunities to reduce unemployment can therefore be beneficial.

Demand for additional investment in community services such as child care, aged care and community care services, by Local, State and Commonwealth Governments can arise from increases in the population. However, as identified above the expected increases in population would be very small. No requirement for additional investment in community services and facilities infrastructure is therefore anticipated to result from the Project.

4.4.3 Cumulative Impacts

A range of other developments would be expected to occur over the 30 year life of the Project. Other major developments that may coincide with Project increases in regional population (expected in the early years of the Project) could potentially result in cumulative impacts on community infrastructure demand, as a result of rapid regional population growth.

Table 4.14 provides a summary of some recently approved major projects in the region (excluding West Cliff and Appin Mine approvals) that are currently listed by the DoP in the local government areas of Campbelltown, Wollongong and Wollondilly, and an indication of their potential workforce increases.

From Table 4.14 it is evident that most of the direct employment associated with these other major projects comprises construction jobs. It is envisaged that most of the required construction workforce will be contractor labour from existing regional contractor firms. Any construction workforce unable to be sourced locally would most likely be able to be sourced from Sydney and commute to the region daily. Consequently, the cumulative construction workforce demand is likely to have little, if any, impact on community infrastructure demand in the region.

The total operational workforce associated with these other major projects is also quite modest when compared to recent employment growth. Given that a considerable amount of the workforce demand from other major projects is likely to be filled from existing employees in the region, the considerable unemployment pool or from the Greater Sydney labour market, the actual population change associated with major project operational workforce requirements in the region is likely to be small. The subsequent cumulative community infrastructure demand in the region is therefore expected to be negligible.

Furthermore, the Illawarra Regional Strategy (Department of Planning, 2007) provides a strategy to accommodate a population increase of 47,600 over the next 25 years.

Table 4.14
Selected Regional Major Projects and Indicative Workforce Changes*

Project Name	Summary Description	Local Government Area	Date Approved	Indicative Workforce Change
Metropolitan Colliery: Metropolitan Coal Project	Augmentation and upgrade of the Metropolitan Coal Mine located near Wollongong.	Wollongong	22 June 2009	No change
PKCT: Port Kembla Coal Terminal Project	The Port Kembla Coal Terminal Project allows the delivery of up to 10 Mtpa of coal and bulk products to the PKCT by road 24 hours per day, seven days per week and continuation of the existing rail and road receival, stockpiling and shiploading operations.	Wollongong	12 June 2009	No change
Maltings Plant: Minto Maltings Project	Establishment of a new malting plant and grain packing facility at Minto.	Campbelltown	12 May 2009	20 operational jobs 50 construction jobs (average)
Port Kembla Biodiesel Facility: Soybean Processing and Biodiesel Facility	Establishment of a soybean processing and biodiesel plant at Port Kembla.	Wollongong	5 May 2009	235 jobs
06_0305 Princes Hwy, Helensburgh: Golf resort	Development for a golf resort at the Illawarra Country Golf Club, near Wollongong.	Wollongong	13 January 2009	426 construction jobs 80 operational jobs
Port Kembla Steelworks: BlueScope Steel Injection Station Project	Establishment of a new Steel Injection Station at the Port Kembla Steelworks.	Wollongong	15 December 2008	39 construction jobs
Port Kembla Steelworks: BlueScope Cogeneration Plant Project	Modification of BlueScope Steel Limited (AIS) Pty Ltd's Development Consent for a new 225 megawatt cogeneration plant and associated infrastructure at the Port Kembla Steelworks.	Wollongong	15 December 2008	300 construction jobs 30 operational jobs
Camden Gas Project – Stages 1, 2 and 3: Spring Farm and Menangle Park	Expansion of Stage 2 of the Camden Gas Project by the construction of additional gas wells and installation of gas gathering and water pipelines, and their operation within Spring Farm and Menangle Park.	Wollondilly, Campbelltown	4 September 2008	35 construction jobs 3 operational jobs
Camden Gas Project – Stages 1, 2 and 3: P 06_0138 – MOD 1	Expansion of the Camden Gas Project by the drilling and testing of 14 coal seam gas wells on the Elizabeth Macarthur Agricultural Institute property, and bringing these wells into production.	Wollondilly, Campbelltown	6 July 2007	20 construction jobs 3 operational jobs
Port Kembla Steelworks: Project Application – Ore Preparation Area Upgrade	Upgrade of Port Kembla Steelworks' Ore Preparation Area and an increase in the production capacity of the Sinter Plant.	Wollongong	3 July 2007	200 construction jobs
Southern Sydney Freight Line: Project Application – Freight Line	Construction, operation and maintenance of a dedicated freight line in south-western Sydney, to allow passenger and freight rail to operate independently.	Campbelltown	21 December 2006	300 construction jobs
Camden Gas Project – Stages 1, 2 and 3: P 06_0137 (Razorback)	Expansion of the Camden Gas Project by the drilling and testing of ten coal seam gas wells on the Razorback group of properties, and bringing these wells into production.	Wollondilly, Campbelltown	9 December 2006	6 construction jobs 3 operational jobs

Table 4.14 (Continued)
Selected Regional Major Projects and Indicative Workforce Changes

Project Name	Summary Description	Local Government Area	Date Approved	Indicative Workforce Change
Camden Gas Project – Stages 1, 2 and 3: P 06_01378 (EMAI)	Expansion of the Camden Gas Project by the drilling and testing of 14 coal seam gas wells on the Elizabeth Macarthur Agricultural Institute property, and bringing these wells into production.	Wollondilly, Campbelltown	9 December 2006	20 construction jobs 3 operational jobs
Advance Metals Plant P 05_0097	Construction and operation of a new metal manufacturing facility in the Ingleburn industrial area.	Campbelltown	5 September 2006	160 operational jobs
Port Kembla: Port Kembla General Cargo Handling Facility	Expansion of the cargo handling facility in the Inner Harbour of Port Kembla and diversification of the types of cargoes to be handled on the site.	Wollongong	6 April 2006	70 construction jobs 150 operational jobs

Source: DoP (2009).

* Does not include approved modifications or concept plan approvals for which employment details were not readily available.

5 CONCLUSION

A BCA identified a range of potential economic costs and benefits of the Project and quantified the production costs and benefits. Key environmental externalities of the Project were then also quantified based on a range of replacement/repair cost values and the results of a CM study.

The analysis indicated that the total net quantified production benefit of the Project is likely to be in the order of $10,310M. The net production benefit is distributed amongst a range of stakeholders including:

- ICHPL shareholders;
- the NSW Government via royalties; and
- the Commonwealth Government in the form of company tax.

The NSW Government receives additional benefits in the form of payroll tax and local councils may also benefit through community infrastructure contributions required under the EP&A Act (if applicable).

The Project also has a range of external economic costs and benefits. External costs associated with surface infrastructure, road transport and mine subsidence, have been estimated at $2,898M, the majority relating to greenhouse gas generation. External benefits associated with employment provided by the Project have been estimated at $870M.

Overall the Project is estimated to have net benefits to society of $8,282M and hence is desirable and justified from an economic efficiency perspective.

An economic impact analysis, using input-output analysis, estimated that in total, the Project would contribute the following to the Illawarra and OSWS economy:

- $2,074M in annual direct and indirect regional output or business turnover;
- $1,197M in annual direct and indirect regional value-added;
- $298M in annual household income; and
- 3,296 direct and indirect jobs.

At the State level the Project would make the following contribution to the economy:

- $2,822M in annual direct and indirect output or business turnover;
- $1,615M in annual direct and indirect value-added;
- $516M in annual household income; and
- 5,791 direct and indirect jobs.

The sectors most impacted by output, value-added and income flow-ons are likely to be the services to mining sector, other property services sector, legal, accounting, marketing and business sector, road transport sector, wholesale and retail trade sector, scientific research, technical and computer services sector, other business services sector and accommodation, cafes and restaurants sector.

Employment impacts are also likely to be felt across a number of sectors including the mining sectors, transport sectors, manufacturing sectors, wholesale and retail trade sectors, accommodation, cafes and restaurants sectors and services sectors (education, health, community services and personal services).

The Project would also have forward linkages to BlueScope Steel in Wollongong, OneSteel at Whyalla in South Australia, Berrima Cement Works and Port Kembla as provision of coal to these facilities is significant to their on-going operation.

Any changes in the workforce and populations of regions and towns may have implications in relation to access to community infrastructure and human services, which includes for example housing, health and education facilities. This may include the number of services that are available to be used and the accessibility of these services.

During the initial development of the Project (including upgrades of existing surface and underground infrastructure), an additional 100 people would be required in the short-term (for up to one year). However, this workforce is likely to be sourced locally or commute to the region on a daily basis from Sydney. Consequently, little if any population change as a result of the construction workforce is envisaged.

The additional direct operational workforce associated with the Project is estimated at 295. Additional flow-on employment is estimated at 339 production-induced flow-on jobs and 273 consumption induced flow-on jobs.

To estimate the likely population change to the region as a result of the Project it is necessary to consider the extent to which this incremental direct and indirect employment generated by the Project would be met from within the local labour force, in-migration or commuters from outside the region. Only in-migration is likely to result in increased demand for community infrastructure.

Factors influencing the level of in-migration include the size and nature of the regional economy and its' ability to supply the additional labour and required skill mix and the proximity to other regions that may be able to provide commuter labour.

Based on these factors it is considered that only a small proportion, 20%, of the incremental direct workforce (employees) and indirect jobs generated by the Project is likely to come from in-migration and add to the demand for community infrastructure. The potential increase in population would therefore be in the order of 399 for the Illawarra and 65 for the OSWS.

This potential influx in population is small in the context of annual population growth of the two regions and is considered likely to have negligible impacts on housing, schools, health or community infrastructure.

Cessation of the Project after 30 years of operation may lead to a reduction in economic activity. The significance of these Project cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand. The economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Given these uncertainties it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project brings to the region, to strengthen and broaden the region's economic base.

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ATTACHMENT A – CHOICE MODELLING STUDY REPORT

BULLI SEAM OPERATIONS

CHOICE MODELLING STUDY OF ENVIRONMENTAL AND SOCIAL IMPACTS

Prepared for

Illawarra Coal Holdings Pty Ltd

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EXECUTIVE SUMMARY

Illawarra Coal Holdings Pty Ltd (ICHPL) owns and operates the Bulli Seam longwall mining operations at the Appin Mine and West Cliff Colliery which are located approximately 25 kilometres (km) north-west of Wollongong in New South Wales (NSW). ICHPL also owns and operates the Dendrobium Mine located approximately 10 km north-west of Wollongong.

As part of ICHPL's application to Government to continue its Bulli Seam operations, a benefit cost analysis was undertaken for the Bulli Seam Operations Project (the Project). A subset analysis was also undertaken of alternative mine layouts to examine the potential costs and benefits of measures to reduce impacts to natural surface features.

As an adjunct to the benefit cost analysis, a non-market valuation study (choice modelling) was conducted to obtain estimates of NSW and Illawarra community values for key potential environmental and social impacts of the Project. Choice modelling involves the design and implementation of a questionnaire that contains a number of choice sets that describe the environmental outcomes of alternative policy scenarios in terms of changing levels of a set of environmental and social attributes. By observing and modelling how people choose their preferred policy scenario in response to the changes in the levels of the attributes, it is possible to determine how they trade-off between the attributes. That is, it is possible to determine the value that respondents hold for additional amounts of an attribute.

The choice modelling study for the Project involved:

- defining the key environmental and socio-economic attributes of relevance to the Project;
- designing the choice modelling questionnaire with the aid of focus groups, including alternative questionnaire designs to test the concerns raised in the Metropolitan Coal Project Planning and Assessment Commission (the Metropolitan PAC);
- compiling the choice modelling experimental design;
- sampling the views of 663 households in the Illawarra Region and 2,302 households in the rest of NSW via completion of the questionnaires;
- analysing the data collected using conditional logit and random parameter logit econometric techniques; and
- estimating implicit prices for the environmental and social attributes included in the study.

The choice modelling study found that respondents were on average willing to pay:

- $4.73 per km of stream protected;
- $0.90 per hectare of native vegetation protected;
- $5.15 per Aboriginal heritage site protected; and
- $26.90 per year that the mine provides 1,170 jobs.

The concerns raised in the NSW Planning Assessment Commission's *Metropolitan Coal Project Review Report* (May, 2009) (the Metropolitan PAC Report) that were directly tested in this study include:

- *… It is likely that .... a revised* (cumulative impact) *context would lead to higher environmental value estimates because marginal values of goods increase as their supply becomes relatively more limited*; and
- *… the social costs caused by a reduction in mine length from 25 to 23 years are likely to be smaller than the social costs associated with closure of the mine immediately.*

In this instance, the implicit prices obtained from a questionnaire containing a full cumulative impact context for all mines in the Southern Coalfield were not significantly different from implicit prices from a questionnaire containing no cumulative impact context for all mines in the Southern Coalfield. It is hypothesised that the reasons that the inclusion of the cumulative impact context for all mines across the Southern Coalfield may not have resulted in the expected higher values for the environmental attributes is that while the Project specific environmental impacts are small in the context of the entire environmental resource across the Southern Coalfield, the cumulative impacts of all the mines in the Southern Coalfield are also relatively modest, particularly when compared to other well-known coal mining regions such as the Hunter Valley.

While non-linear transformation of the Years variable did not improve the statistical fit in conditional logit models, it was found that a natural log transformation of the Years variable in the preferred linear random parameter model did improve the performance of the model indicating that there are significant value differences for larger amounts of the impact on Years attribute (i.e. declining marginal utility associated with the length of time that the mine provides 1,170 jobs). However, even a small reduction in mine life (e.g. from 31 years to 30 years[1]) still results in a significant implicit price of $7.71 per household.

[1] While the approval sought from the NSW Government is only for 30 years, the cumulative impact context of the choice modelling study included the total mine life from 2009 which is 31 years.

1 INTRODUCTION

Significant new mining projects in New South Wales (NSW) require Government approval under Part 3A of the *Environmental Planning and Assessment Act, 1979.* An Environmental Assessment (EA) accompanies the application. These EAs generally address the likely environmental impacts of a project and should also consider potential socio-economic impacts.

Assessing the economic impacts of a project or providing economic justification for a project is not simply a matter of providing disparate information on production, employment, taxes and royalties or statements on the importance of a mine for exports or for regional economies (James and Boer, 1988). Economics is concerned with the allocation of scarce resources in society (labour, capital and land) to maximise community well-being (Tisdell, 1991).

Consequently, to evaluate the economic impacts of a project it is necessary to consider the costs and benefits of it to the community, where the community comprises both producers (e.g. mining companies) and consumers (e.g. households).

To provide economic justification for a project or policy it is necessary to demonstrate that the aggregate benefits of a project or policy to society exceed the aggregate costs to society (i.e. that it will have net benefits to the community). The method used by economists to undertake this evaluation is benefit cost analysis (BCA) (James and Gillespie, 2002).

In a simplified BCA framework, there is often a trade-off between net production benefits of a mining project and environmental impacts. The former accrue to the mining company and its shareholders, as well as the government through payment of royalties and company tax, whereas any environmental impacts that remain after mitigation by the company accrue to society.

Net production benefits can be readily estimated from market data, including information on revenue, capital costs, operating costs, rehabilitation costs, opportunity cost of land and the residual value of land and capital. However, estimating the value of environmental impacts to the community is more problematic. It requires use of so-called non-market valuation methods. One of the key non-market valuation methods that can be used to estimate community values for a range of environmental impacts is Choice Modelling (CM).

As part of Illawarra Coal Holdings Pty Ltd's (ICHPL's) application to government to continue its underground coal mining operation at the Appin Mine and West Cliff Colliery, located approximately 25 kilometres (km) north-west of Wollongong in NSW, a BCA was undertaken of the Bulli Seam Operations Project (the Project). A subset analysis was also undertaken of alternative mine layouts comprising setbacks from primary streams and natural features located in the underground mining area. To examine the economic magnitude of environmental impacts, a CM survey was undertaken to directly elicit community values. This approach is consistent with the findings of the Southern Coalfield Panel Inquiry which found that CM studies (NSW Department of Planning [DoP], 2008):

> *… could play an important role in assisting communities and the Government in their consideration of economic trade-offs*.

Section 2 introduces the CM method while Section 3 discusses the questionnaire development including attribute selection, questionnaire design and focus group feedback. Questionnaire implementation is reported in Section 4. Econometric results and implicit price estimations are reported in Section 5. Guidance on how to use these values is provided in Section 6 and overall conclusions are presented in Section 7.

2 CHOICE MODELLING

The CM technique originates from the marketing and transport literature where it has been used to analyse consumers' choices of products and transport modes. CM is a non-market valuation technique that enables estimation of environmental changes that are outside the range of currently observed conditions.

CM uses questionnaires that describe a hypothetical policy or natural resource management scenario that will cause environmental changes. In a CM survey of a relevant population, respondents are presented with a series of questions (choice sets), where each question shows the outcome of alternative policy scenarios, including a 'status quo' or 'no policy change' scenario. These outcomes are described in terms of different levels of a monetary attribute (costs) and several non-marketed attributes. Respondents are asked to choose their preferred option from the array of alternatives. In choosing between alternative scenarios, respondents are expected to make a trade-off between the levels of the environmental attributes and associated costs. This allows the researcher to observe the relative importance of the different attributes (Bennett and Blamey, 2001). Indeed it facilitates identification of respondents' willingness to pay (WTP) to secure additional units of each of the environmental attributes, or to avoid loss of additional units of each of the environmental attributes.

Environmental attributes for inclusion in CM studies can vary significantly and can be tailored to specifically reflect the relevant environmental issues associated with any specific project or policy.

Designing the application of the CM methodology to the Project involved several tasks:

- identifying and defining the attributes considered to be of potential interest to the community, ICHPL and government (decision-makers);
- identifying the range of impact levels for the attributes;
- designing the questionnaire with the aid of focus groups;
- developing alternative questionnaire designs to examine issues raised in the NSW Planning Assessment Commission's (PAC's) *Metropolitan Coal Project Review Report* (May, 2009) (the Metropolitan PAC Report);
- compiling the experimental design; and
- identifying the sample to be surveyed.

Each of the tasks is considered in more detail in the following section.

3 QUESTIONNAIRE DEVELOPMENT

3.1 ATTRIBUTE SELECTION

Fundamental to the application of non-market valuation methods, such as CM, are projections of the biophysical condition of the environment under the current policy regime (in this case continued underground coal mining at the Project) and how the biophysical condition may change under alternative policies that will be considered by policy makers (e.g. prohibition or restriction to coal mining at the Project). The biophysical condition of the environment is described in terms of a change in level of different environmental attributes. These environmental attributes must be relevant from the operations/business, policy makers and scientific perspective (the ‘supply side’) but also relevant to the community (the 'demand side').

The first task in the study was to develop a set of attributes that could be used to describe the key potential non-market environmental impacts of mining at the Project. Mining in the Southern Coalfield is underground, and the potential impacts are largely linked to the effects of mine subsidence. Subsidence is the vertical and horizontal movement of the land surface as a result of the extraction of coal at depth.

Review of the literature on coal mining in the Southern Coalfield and meetings with ICHPL elicited the following potential environmental attributes from the supply side:

- cracking of stream beds in affected sections of streams;
- draining of pools in affected sections of streams;
- reduced water flow in sections of affected streams;
- iron staining in affected sections of streams;
- ecological impacts in affected sections of streams;
- loss of water from the catchment;
- impacts on upland swamps above the underground mining area;
- impacts on vegetation from clearing for surface infrastructure;
- impact on cultural heritage features such as overhangs containing Aboriginal art above the underground mining area and where surface infrastructure is proposed; and
- location of impacts – under water supply catchments, a State Conservation Area and rural lands.

An important requirement of attribute definition in CM is that the attributes utilised are independent.

The first five attributes listed above are all related to the cracking of stream beds as a result of mine subsidence. Consequently, these impacts were amalgamated into a single attribute, length of stream affected, with the nature of effects described as including cracking, draining of pools, reduced water flow in streams, iron staining and ecological impacts.

While loss of water from the catchment, via stream bed cracking, has repeatedly been raised in some policy documents and the media, in relation to the mining in the Southern Coalfield, scientific evidence suggests that there is negligible loss of water from catchments as a result of underground mining at moderate to high depths of cover such as experienced in the area of the Project.

This conclusion was supported by the Southern Coalfields Panel Inquiry (DoP, 2008), which concluded:

> *No evidence was presented to the Panel to support the view that subsidence impacts on rivers and significant streams, valley infill or headwater swamps, or shallow or deep aquifers have resulted in any measurable reduction in runoff to the **water supply system** operated by the Sydney Catchment Authority or to otherwise represent a threat to the water supply of Sydney or the Illawarra region.*

The findings of the groundwater specialist study conducted for the Project indicate that there would be negligible impacts on groundwater baseflow contributions to streams as a result of the Project (Appendix B to the EA). This conclusion is also supported by the surface water specialist study conducted for the Project (Appendix C to the EA).

Consequently, loss of water from catchments was not included as an attribute in the CM questionnaire. In addition, in the event that a material impact on catchment yield was identified, any water losses could be readily valued using market data, without the need to include this attribute in a CM study.

At the time of completion of the CM survey it was considered that the Project would not result in any significant impacts on upland swamps, and hence this potential attribute was not included in the CM.

While potential impacts on upland swamps have not been included as a key attribute in this CM study, such impacts were considered in a study for the nearby Metropolitan Coal Project (Gillespie Economics, 2008). The values reported in Gillespie Economics (2008) will be utilised to provide indicative community values in the Project BCA, if required.

Future expansion of the surface infrastructure associated with the Project involves the removal of native vegetation that includes threatened plant species and provides habitat for a range of animal species. Native vegetation cleared was therefore considered a valid attribute for inclusion in the CM.

Above the two mines there are rock formations such as sandstone ridges, steep slopes and rocky ledges and overhangs that contain Aboriginal heritage sites (e.g. grinding groove sites, engraving sites, rock art and artefacts). Mine subsidence may increase the incidence that some of these rock formations, especially rock overhangs, crack, have rock falls or collapse. Expansion of Project surface infrastructure could also directly impact Aboriginal heritage sites. Aboriginal heritage sites were therefore included in the CM.

Underground mining at the Project would be under a combination of natural areas of the water supply catchment, a State Conservation Area and rural (primarily cleared) agricultural lands. Specialist advice indicates that material subsidence impacts on streams would be largely restricted to the more incised valleys in Hawkesbury Sandstone geology. Consequently, a separate location attribute for impacts on agricultural streams in disturbed rural lands in Wianamatta Shale geology was not included in the CM.

It has been recognised that as well as valuing environmental outcomes, the community may hold non-environmental, non-market values (Portney, 1994). For instance, Johnson and Desvouges (1997) estimated the non-market value of employment effects of energy programmes and Morrison and Bennet (1999) performed a similar task in the context of wetland protection. More recently Bennett *et al.* (2004) estimated the values the community hold for the continued viability of rural communities. Gillespie Economics (2008) estimated the values the community hold for each year that the Metropolitan Coal Project provides 320 jobs.

The Appin Mine and West Cliff Colliery currently provide 875 direct jobs to the Illawarra and Outer South Western Sydney Region. If approved, the Project would provide 1,170 jobs for an additional 30 years. Reducing environmental impacts is likely, in many instances, to result in the sterilisation of coal reserves and therefore reduce the length of time that the Project would provide 1,170 jobs. Hence, it was considered reasonable to determine if the community holds non-market values for this attribute.

So the supply side attributes selected were:

- total length of stream affected;
- total area of native vegetation affected;
- total number of Aboriginal heritage sites affected; and
- period of time that the mine would provide 1,170 jobs[2].

However, it is also important that the identified environmental and socio-economic attributes are meaningful to the potential respondents of the CM questionnaire. Gillespie Economics undertook a number of focus group sessions to ascertain the relevance of the selected attributes to the community.

Gillespie Economics (2008) found no significant differences in responses between focus groups in the Illawarra region and those in the rest of NSW.

Four focus group sessions were held in Parramatta, Sydney including:

- two on 7 April 2009; and
- two on 9 April 2009.

For each day that focus groups were held, an early evening focus group session (6:00 pm) and a late evening session (8:00 pm) was undertaken. This was to facilitate attendance by a cross section of people, including those employed in daytime occupations.

Recruitment to the focus group sessions was undertaken by a professional firm, Analyse Recruitment.

In total, 35 people attended the focus groups sessions. The age and gender distribution of attendees is provided in Table 1.

Table 1
Age and Gender of Focus Group Attendees

Age	Male	Female	Total
<20	0	1	1
20-29	4	5	9
30-39	2	3	5
40-49	5	3	8
50-59	1	2	3
>59	7	2	9
Total	**19**	**16**	**35**

Average household size was 3.4. Twenty-one of the 35 attendees had children, with 25 children being under the age of 18.

[2] This attribute includes the full 1,170 jobs rather than just the difference between 1,170 jobs and the current level of jobs (i.e. 875), because if the Project is not approved, mining would cease.

The majority of attendees were diploma/certificate or tertiary degree qualified (Table 2).

Table 2
Education Levels of Focus Group Attendees

Schooling	Number
Never went to school	0
Primary only	0
Junior/Year 10	5
Secondary/Year 12	6
Diploma or certificate	14
Tertiary degree	5
Post-graduate degree	5
Other	0
Total	**35**

The distribution of household income of focus group attendees is provided in Table 3.

Table 3
Household Income of Focus Group Attendees

Income Level	No.	Income Level	No.
Under $7,799	0	$62,400 to $72,799	2
$7,800 to $12,999	0	$72,800 to $88,399	2
$13,000 to $18,199	1	$88,400 to $103,999	2
$18,200 to $25,999	1	$104,000 to $129,999	4
$26,000 to $33,799	3	$130,000 to $155,999	6
$33,800 to $41,599	0	$160,000 or more	4
$41,600 to $51,999	6	Don't know	2
$52,000 to $62,399	2	**Total**	**35**

The focus group sessions incorporated a number of stages, including consideration of the attributes identified earlier as being relevant from the operations/business, policy maker and scientific perspective (the supply side). Across all four focus groups sessions, the attributes identified as being relevant from the operations/business, policy maker and scientific perspective (the supply side) were also generally considered to be the attributes that were most relevant to the community (the demand side).

With respect to the socio-economic attribute that was included (number of years the mine provides 1,170 jobs), numerous respondents confirmed its relevance by highlighting the consideration they gave to this attribute when answering the draft questionnaire.

3.2 ATTRIBUTE DESCRIPTIONS AND LEVELS

The descriptor for each attribute and ranges over which the cumulative attribute levels could vary in the future, over the next 31 years, under current management strategies (mining continuing as currently planned), and with new government decisions for the mine, are identified in Table 4. It should be noted that the context for the attribute levels includes the levels of impacts that have occurred to date above the two mines. Consequently, even though the mine life may cease in 1 years' time, some non-zero level of impact to environmental attributes will still have occurred.

Table 4
Attributes and Their Descriptions and Levels

Attribute	Description	Levels*
Cost	Compulsory once-off payment ($)	0; 125; 300; 625
Total length of stream affected	Length in kilometres	40; 60; 80; 100
Total area of native vegetation cleared	Area in hectares	240; 290; 330; 380
Total number of Aboriginal sites affected	Number of Aboriginal sites	20; 30; 40; 50
Period of time that the mine would provide 1,170 jobs	Number of years	1; 11; 21; 31

* Cumulative of the existing Appin Mine and West Cliff Colliery and the Project.

In this context, it is important to understand that mine subsidence effects (i.e. the movement of the ground surface due to the extraction of underlying coal) occur over the general area that overlies the underground mine, however, the spatial expression of particular environmental impacts associated with these subsidence effects is highly variable (e.g. the location and nature of surface cracking of exposed sandstone stream beds would be highly dependent on local structural and topographical conditions).

While the descriptors for each attribute were relative straightforward (e.g. kilometres, hectares and number), the description of the potential impacts was more complex.

For streams, the impacts canvassed included cracking of the stream bed, water flow under the bed of the stream, reduction in surface flow in the stream, reduction in water levels in pools, staining of the water and stream bed downstream of where the water resurfaces and localised changes to the stream environment.

For native vegetation, impacts canvassed included clearing of vegetation and associated threatened plant species and habitat for a range of non-threatened and threatened animal species.

For Aboriginal heritage impacts canvassed included cracking and collapse of rock features containing grinding grooves, engraving sites, rock art and artefacts.

Photographs were provided of the attributes that would potentially be impacted and, for streams, a range of photographs from the existing Appin Mine and West Cliff Colliery were provided of cracking, reduced stream flow, reduced water level in pools and staining of stream beds. Photographs of stream flow and pool levels after rain in affected sections of streams were also provided (refer to the Example Questionnaire in Attachment 1).

While an upper level and a lower level for each attribute was set for the Project including the potential impacts of the Project with reference to opinion of environmental specialists, the two intermediate levels were established to provide coverage across the range. In general, it was considered appropriate that the upper levels of the attributes be conservative (i.e. overstate potential cumulative impacts) rather than to understate impacts, or to make the potential impacts appear trivial.

With four different levels for each of the five attributes there are 5^4 (i.e. five to the power of four) choices (full factorial) that could be provided to respondents. However, this would obviously be very onerous for a single respondent to consider.

To overcome this problem a main effects orthogonal experimental design was used to produce 25 choice sets, with five choice sets embedded into five different versions of the same questionnaire (i.e. there were five blocks per questionnaires – where the choice sets in the questionnaire were different, but the remainder of the questionnaire was unchanged).

3.3 QUESTIONNAIRE DESIGN

The draft questionnaire, within which the choice sets were embedded, contained the following elements:

- an introduction outlining the purpose of the survey and its importance to decision-making (so as to encourage participation);
- background information on mining in the Southern Coalfield and the particular mines that were the subject of the questionnaire;
- information (including photos) on how the two Project mines could potentially impact streams, native vegetation and Aboriginal heritage;
- discussion of how potential environmental impacts could be reduced by government decisions on the future of the two mines and that these decisions would also impact employment at the two mines;
- identification of the employment provided by the two mines;
- discussion about how reducing environmental impacts of the mines could affect the respondent, namely that the government would receive less royalties to fund public services. A once-off payment in the form of an environmental levy would be required from each household to keep the same level of public services provided by the State Government[3];
- a framing statement reminding respondents that their income is limited and that other areas of NSW may also need funding for environmental improvement;
- five choice sets providing respondents with a choice of varying environmental and social outcomes for different payment amounts including the environmental and social outcome if no payment is made and no alternate government decision for the mines are taken;
- debriefing questions to detect payment vehicle protests and that respondents understood the information, were happy with the quantity of information provided and whether they found the choice sets confusing;
- questions to establish the socio-economic characteristics of respondents; and
- questions relating to respondents' attitudes towards development and the environment, assistance to impacted mine workers and links to environmental organisations, or the mining industry.

The Metropolitan PAC Report made a number of comments in relation to the design of the CM study undertaken for the Metropolitan Coal Project that were considered relevant to the design of the CM for the Project. These comments particularly related to the context statements used in the CM questionnaire, *viz.*:

> *It is acknowledged that the context of the choices made by CM respondents has an effect on value estimate. For instance, if the context of the choice is described so the number of substitutes available for the environment being damaged is exaggerated, there is a potential for under-estimation of the associated costs. Specifically for the case at hand, the Panel was concerned that the CM estimates were based on the context of the environmental and social impacts of the Metropolitan Mine decision alone. The CM respondents were told in the questionnaire that:*
>
>> *If mining continues as currently planned, it is predicted that a total of 15km of streams (out of a total of 1,500km of streams in the Southern Coalfield) will be affected by subsidence above the mine in 20 years time.*

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3 Focus groups sessions included discussion of the payment vehicle. Participants generally believed that the government may impose an environmental levy.

Similar 'context statements' were provided for upland swamps and Aboriginal heritage attributes.

The Panel is of the view that the context decision made with regard to the Metropolitan Coal Project goes beyond the immediate geographical boundaries of the project site. The appropriate context for people considering their willingness to pay for avoiding environmental damage is the wider context of the Southern Coalfield. Hence, for example the stream damage in Waratah Rivulet should not be considered as being 15km out of 1,500km – that is, a small river in a large area – as the case in the context statement given in the CM questionnaire. Rather the damage to Waratah Rivulet should be considered to be part of the total 'package' of damage that is likely to be done to streams in the Southern Coalfield with other mines also being given approval. It is likely that such a revised context would lead to higher environmental value estimates because marginal values of goods increase as their supply becomes relatively more limited".

Similar comments were made in the Metropolitan PAC Report in relation to the social attribute included in the CM study, *viz.:*

Other concerns were focused on the incorporation of the social costs of early mine closure as benefits of continuing mining. In particular, the Panel was concerned regarding the accuracy of forecasts made by the Proponent of the consequences of premature mine closure. The attribute used in the CM exercise was "Period of time that the mine will provide 320 jobs". Any time less than 25 years (the forecast of the mine's life with full production) was viewed by respondents as having a negative impact on their well-being. They were found to be willing to pay to avoid reductions in mine life. The Panel was concerned that the forecast of mine length – and hence employment at the mine – did not take into account the prospects of technological change over the 25 years period of mining to considerably alter the pattern of employment both in the mine and in the region more broadly. Furthermore, trends in social mobility have indicated that the prospects for employment flexibility are likely to be much improved over time.

What these concerns regarding the estimation of the social costs of mine closure suggest is that the Choice Modelling analysis may have over-simplified the situation. There is little doubt that the general public would experience costs should the mine close in the immediate future, as would be the case if the proposal to expand the mine was rejected altogether. However, there are doubts that these same costs would be experienced of the mine's life was shortened by a couple of years. In other words, the validity of the linear relationship between social costs and mine life is queried. Specifically, the social costs caused by a reduction in mine length from 25 to 23 years are likely to be smaller than the social costs associated with closure of the mine immediately.

In addition, the Metropolitan PAC Report makes a specific recommendation with respect to CM (emphasis added):

Recommendation 28

The Panel recommends that a study be commissioned to establish clear guidelines for the conduct of CM studies to be used in the assessment of environmental values for significant natural features in the Southern Coalfield. Specifically the study should address the extent to which estimated values vary as the relative scarcity of the environmental assets under consideration increases. <u>This test would involve split samples of CM respondents being given different context description</u>.

A number of refinements were included to the design of the CM questionnaire for the Project to address the issues raised in the Metropolitan PAC Report:

- The estimated cumulative environmental impact of all mines in the Southern Coalfield was included in the context statement in the main CM questionnaire, e.g:

  If mining continues as currently planned, it is predicted that in 31 years time a total of 100km of streams (out of a total of 1,500 km of similar streams in the Southern Coalfield) will be impacted by mine subsidence effects above the two mines – 300 km of streams will be impacted by all eight mines in the Southern Coalfield in 31 years time.

- Additional contextual information on employment prospects in 31 years time was included.

  Re-employment prospects for those affected by a shortened mine life would depend on the economic conditions at the time.

  Those employees affected by a shortened mine life (e.g. in 10 or 20 years time) may not be those currently employed at the mine.

  Other coal resources (mining lease areas) may be available in the future if the current planned life of the mines is reduced, although this would be subject to future government approvals.

- Two versions of the questionnaire were developed, one with the cumulative impact context for all mines in the Southern Coalfield and one without it, to test the Metropolitan PAC Report assertion that the context CM results in the Southern Coalfield would be sensitive to this information. This approach is consistent with Recommendation 28 of the Metropolitan PAC Report (as provided above).

- Modelling of the CM results included investigation of the non-linearity of the Years (life-of-mine) attribute.

Additional design considerations included:

- Undertaking a split sample on the main questionnaire to test for the impact of different temporal payment structures i.e. lump sum payments versus annual payments for 20 years[4], in the questionnaire. This was undertaken because there is limited definitive data about the appropriate discount rate to apply to annual WTP levels for each attribute to determine present value. If respondents use different internal discount rates to that used by the analyst, then inaccuracies in value estimates can arise (Windle and Rolfe, unpublished).

The draft questionnaire, with full cumulative impact context statements, was tested on the focus groups by asking them to complete it and then talking through the elements of the questionnaire design and content.

The questionnaire was generally well received by respondents with verbal comments indicating that it was clear, easily understood and that most did not have any difficulty with responding to the choice questions.

This verbal response was supported by the focus groups participants' response to Question 7 of the questionnaire which sought to determine whether the information being provided to respondents was sufficient and whether respondents found the choice sets to be confusing (Table 5).

Table 5
Information in Questionnaire

	Strongly Disagree (Score 1)	Disagree (Score 2)	Neither Agree or Disagree (Score 3)	Agree (Score 4)	Strongly Agree (Score 5)	Average Likert Score
I understood all the information provided	2	3	9	13	7	3.6
I needed more information than was provided	1	9	9	13	2	3.2
I found answering Q1-5 confusing	8	9	7	8	2	2.6

[4] A 20 year payment schedule is consistent with the temporal payment structure used for the Metropolitan Coal Project CM study (Gillespie Economics, 2008).

The majority agreed that they understood all the information provided.

The focus group participants were split over whether more information was needed.

The majority disagreed that the choice sets were confusing.

The time taken to complete the questionnaire ranged from 15 minutes to 30 minutes with most participants completing it within 20 minutes.

A number of minor ways to improve the questionnaire design were raised in the focus groups including:

- clarification of the size of one hectare;
- clarification of what the reference to "mine surface infrastructure" means;
- inclusion of a lighter photograph showing mine surface infrastructure; and
- making it clear throughout the questionnaire that there are eight mines in the region.

It was clear from the focus group sessions that the social attribute (length of time that the mine provides 1,170 jobs) was an important attribute. While many participants identified that they were trying to choose some balance between environmental impacts, life of the mines and what they can afford to pay, others considered the length of the time that the mine provides 1,170 jobs as their over-riding concern. Furthermore, when directly questioned about the fact that in some options the shortening of the mine life would occur a long time into the future, people still considered it to be important. Some respondents identified that they did not want the life of the mines to be decreased and that jobs in the future were still important to them.

Minor adjustments were then made to the questionnaire on the basis of focus group comments, prior to its implementation.

4 QUESTIONNAIRE IMPLEMENTATION

4.1 SURVEY LOGISTICS

There are a range of methods of implementing CM surveys including mail-out surveys, face-to-face, drop-off and pick-up and on-line methods.

Experience in recent CM surveys has demonstrated that mail-out surveys are becoming increasingly difficult to manage, mainly because of privacy laws which restrict access to up-to-date databases of potential respondents. Face-to-face methods are also problematic due to the time required to complete CM questionnaire and hence drop-off and pick-up tends to be used more often. This approach, however, does not lend itself to sampling of a geographically disperse population (e.g. the State of NSW).

For this study, on-line surveying was used. With over 70% of the population now online, these types of surveys are practical and cost-effective. Online surveying involves sampling from an existing Panel of pre-stratified and registered respondents. For this study the Panel of the Market Research company, PureProfile, was used.

Previous CM research has found it appropriate to involve both the community within the affected region and the community outside the region potentially affected by a proposal. This is because differences in values between these two types of respondents have been found in earlier studies (e.g. Van Bueren and Bennett, 2004). Consequently, the sampling for the different versions of the questionnaire was as follows:

- Full context and lump sum payment version of the questionnaire (V1):
  - NSW population (V1a); and
  - Regional population (Illawarra and Outer South Western Sydney) (V1b)).
- Part impact context and lump sum payment version of the questionnaire (V2):
  - NSW population.
- Full impact context and annual payment version of the questionnaire (V3):
  - NSW population.

The aim was to draw a sample of 750 for each sample. This sample size would result in 150 completed questionnaires per block for each of the samples, which is considered sufficient for use of “large number” statistic tests such as the t tests of significance.

The CM questionnaires were implemented via online survey from 15 May to 17 June 2009 by PureProfile.

Twenty-four thousand, nine hundred and sixty-six emails were sent out across the whole on-line survey. There were 2,917 complete responses and 1,771 screened responses - giving a total response rate across the survey of 18.7%.

4.2 SAMPLE CHARACTERISTICS

The samples were obtained from a randomly allocated cross-section of respondents from NSW, with a targeted additional sample from an Illawarra and Outer South Western Sydney postcode range[5]. Samples for each questionnaire version were distributed in line with the general age/gender splits of the population. With the exception of the Illawarra sample, all samples achieved their targeted age and gender distributions. The Illawarra sample fell short of the targets for the over 65 years age group. This was a function of the smaller number of panel members located in the Illawarra Region.

In the Illawarra Region sample, over 53% of respondents were female, while in the NSW samples 52% of respondents were female. The average age of respondents from the Illawarra was 42, while the average for the NSW samples was 44. The comparative age and gender distribution of respondents is provided in Table 6.

Table 6
Age and Gender of Respondents

	V1a NSW			V1b Illawarra			V2 NSW			V3 NSW		
Age	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
18-24	51	52	13%	47	50	15%	50	51	13%	50	52	13%
25-34	65	77	18%	60	66	19%	65	77	19%	67	76	19%
35-44	70	83	20%	65	76	21%	74	82	21%	70	84	20%
45-54	71	77	19%	65	75	21%	65	76	19%	76	75	20%
55-64	51	50	13%	54	60	17%	51	50	13%	50	51	13%
65+	63	62	16%	19	26	7%	59	59	16%	60	60	16%
Total	371	401	100%	310	353	100%	364	395	100%	373	398	100%
%	48.1%	51.9%		46.8%	53.2%		48.0%	52.0%		48.4%	51.6%	
Average Age	**44**			**42**			**44**			**44**		

The respondents from the Illawarra Region sample had an average household size of 3.1 people while respondents from the NSW samples had an average household size of between 2.9 and 3.0 people. The average number of children living at home varied between 0.6 and 0.8 across samples (Table 7).

Table 7
Household Size and Number of Children

Number	**V1a NSW**		**V1b Illawarra**		**V2 NSW**		**V3 NSW**	
	HH size	**Children**	**HH size**	**Children**	**HH size**	**Children**	**HH size**	**Children**
0	0%	64%	0	388	0%	64%	0%	63%
1	11%	17%	56	113	11%	18%	10%	16%
2	38%	15%	227	103	37%	13%	36%	14%
3	19%	3%	133	47	21%	4%	18%	5%
4	22%	1%	141	9	19%	2%	23%	1%
5	7%	0%	74	2	8%	0%	10%	1%
6	2%	1%	24	0	2%	0%	3%	0%
7	0%	0%	4	0	1%	0%	1%	0%
8	1%	0%	2	0	0%	0%	1%	0%
9	0%	0%	1	0	0%	0%	0%	0%
Total	**772**	**772**	**663**	**663**	**759**	**759**	**771**	**771**
Average	**2.9**	**0.6**	**3.1**	**0.8**	**2.9**	**0.6**	**3.0**	**0.7**

5 For simplicity, this region is hereafter referred to as the Illawarra Region.

The majority of respondents across all samples were diploma/certificate or tertiary degree qualified (Table 8).

Table 8
Education Level of Respondents

Schooling	V1a NSW	V1b Illawarra	V2 NSW	V3 NSW
Never went to school	1%	0%	0%	1%
Primary School only	1%	1%	2%	1%
Junior/Year 10	10%	17%	14%	14%
Secondary/Year 12	20%	21%	19%	17%
Diploma or certificate	29%	30%	25%	26%
Tertiary degree	25%	19%	28%	27%
Post-graduate degree	13%	11%	12%	14%
Other	1%	0%	1%	0%
Total	**772**	**663**	**759**	**771**

The distribution of household income across respondents in each sample is provided in Table 9. The average household income was $79,759 for the Illawarra Region sample and between $79,555 and $82,652 for NSW samples (Table 9).

Table 9
Household Income of Respondents

Income Level	V1a NSW	V1b Illawarra	V2 NSW	V3 NSW
Under $7,799	1%	0%	1%	1%
$7,800 to $12,999	1%	2%	2%	2%
$13,000 to $18,199	3%	3%	3%	3%
$18,200 to $25,999	5%	3%	7%	5%
$26,000 to $33,799	4%	5%	5%	3%
$33,800 to $41,599	7%	5%	4%	5%
$41,600 to $51,999	5%	7%	7%	7%
$52,000 to $62,399	9%	8%	8%	8%
$62,400 to $72,799	8%	8%	8%	7%
$72,800 to $88,399	8%	11%	8%	9%
$88,400 to $103,999	10%	11%	11%	12%
$104,000 to $129,999	13%	12%	11%	11%
$130,000 to $155,999	7%	7%	7%	6%
$160,000 or more	7%	5%	8%	9%
Don’t know	13%	13%	11%	12%
Average Household Income	**$80,531**	**$79,759**	**$79,555**	**$82,652**

In all samples, more respondents favoured protection of the environment than development, although the majority favoured development and the environment about equally (Table 10).

Table 10
Favour Protection or the Environment

View	V1a NSW	V1b Illawarra	V2 NSW	V3 NSW
Favour protection of the environment	27%	30%	31%	31%
Favour development and environmental protection about equally	67%	65%	64%	64%
Favour development	6%	4%	6%	6%
Total	**772**	**663**	**759**	**771**

Questionnaire respondents from all samples tended to favour the Government providing assistance when those working in mining are made worse-off by decisions to reduce the environmental impacts of the Project (Table 11).

Table 11
Providing Assistance to Miners

View	V1a NSW	V1b Illawarra	V2 NSW	V3 NSW
Strongly Agree with providing assistance	8%	16%	10%	12%
Agree with providing assistance	40%	41%	41%	40%
Neither Agree nor Disagree with providing assistance	33%	29%	32%	33%
Disagree with providing assistance	13%	10%	13%	12%
Strongly Disagree with providing assistance	5%	4%	4%	3%
Total	**772**	**663**	**759**	**771**

The proportion of respondents associated with the mining industry or an environmental organisation was relatively low and relatively even across all samples (Table 12).

Table 12
Associated with an Environmental Organisation or the Mining Industry

	V1a NSW	V1b Illawarra	V2 NSW	V3 NSW
Member of environmental organisation	7%	6%	4%	6%
Associated with mining industry	6%	8%	5%	7%
Total	**772**	**663**	**759**	**771**

The majority of respondents agreed that they understood all the information provided. Most did not consider that more information was required and the majority did not find the choice sets confusing. This did not vary significantly between sub-samples (Table 13).

Table 13
Information in Questionnaire

	Strongly Disagree (Score 1)	Disagree (Score 2)	Neither Agree or Disagree (Score 3)	Agree (Score 4)	Strongly Agree (Score 5)	Average Likert Score
V1a NSW						
I understood all the information provided	2%	7%	21%	51%	19%	3.8
I needed more information than was provided	8%	33%	37%	19%	4%	2.8
I found answering Q1-5 confusing	19%	40%	28%	11%	2%	2.4
V1b Illawarra						
I understood all the information provided	2%	5%	18%	56%	19%	3.9
I needed more information than was provided	6%	35%	38%	16%	4%	2.8
I found answering Q1-5 confusing	17%	39%	29%	12%	3%	2.4
V2						
I understood all the information provided	2%	6%	19%	55%	18%	3.8
I needed more information than was provided	7%	30%	39%	19%	6%	2.9
I found answering Q1-5 confusing	16%	40%	31%	10%	3%	2.4
V3						
I understood all the information provided	2%	5%	18%	58%	18%	3.8
I needed more information than was provided	6%	32%	39%	19%	3%	2.8
I found answering Q1-5 confusing	17%	41%	29%	11%	2%	2.4

4.3 COMPARISONS WITH AUSTRALIAN BUREAU OF STATISTICS DATA

Several of the socio-economic characteristics of the sub-samples and total sample were compared with those from the Australian Bureau of Statistics (ABS) 2006 Census (Table 14). Two types of statistical test were used. For category data, a chi-squared test was used to determine whether the observed number of individuals in different categories varies significantly from what would be expected based on the population. For continuous data, a single sample t-test was use to determine if the sample mean differed significantly from the mean of the population from which the sample was drawn.

Table 14
Comparison of Sample to Population

	V1a NSW	V1b Region	V2 NSW	V3 NSW	Region ABS	NSW ABS
Gender (% male 18) X^2 (5% critical value =3.84)	48.1% 0.1	46.8% 0.8	48.6% 0.1	48.6% 0.0	48.5%	49%
Age by band X^2 (5% critical value =11.07)	4.39	49.6	5.59	6.01	-	-
% Tertiary qualification X^2 (5% critical value =3.84)	68% 192	60% 96	65% 151	67% 183	41%	43%
Proportion with income levels greater than the median household income for the population X^2 (5% critical value =3.84)	60% 25.07	54% 33.6	59% 21.6	61% 35.0	50% -	50% -

The gender and age distribution for all samples was not significantly different from the populations from which they were drawn – with the exception of Illawarra. However, the level of tertiary qualifications and the proportion of households with income levels greater than the median level were all greater than the populations from which they were drawn.

While not exactly representative of the populations in all aspects, the samples are considered a reasonable basis on which to draw inferences for the population. Given the higher income levels of respondents, implicit prices generated from these samples are likely to be conservatively high.

5 MODELLING RESULTS

5.1 INTRODUCTION

The survey data were analysed using conditional logit (CL) and random parameter (RP) models. The variables used in the choice models are shown in Table 15.

Table 15
Variables used in the Choice Models

Variable Code	Description
ASC	Alternative Specific Constant
Cost	Cost of choice alternative ($ lump sum for V1 and V2 and $ per annum over 20 years for V3)
Km	Total length of stream affected (km)
Ha	Total area of native vegetation affected (ha)
No	Total number of Aboriginal sites affected (number)
Yr	Period of time that the mine would provide 1,170 jobs (years)
ascvis	Visited the area (1= visited) × ASC
ascedu	Years of education × ASC
ascint	Interested in mining impacts in the Southern Coalfield (1= interested) × ASC
ascsex	Respondent gender (1= female) × ASC
ascinc	Respondent household income per year ($000) × ASC
Ascinc2	Respondent household income is greater than the median (1=yes) × ASC
ascage	Respondent age × ASC
ascchild	Respondent has children (1= children) × ASC
Aschhsiz	Number of people who live in respondents household × ASC
ascnukids	Number of people under 18 years of age that live in respondents household × ASC
ascdevenv	Attitude to development and environment (1= tend to favour environment, -1 tend to favour development, 0= favour development and the environment evenly) × ASC
ascenv	Respondent or close family associated with an environmental organisation (1= yes) × ASC
ascdev	Respondent or close family associated with an mining industry (1= yes) × ASC

5.2 CONDITIONAL LOGIT MODEL RESULTS

The choice attributes cost (Cost), kilometres of stream affected (Km), hectares of native vegetation affected (ha), number of Aboriginal sites affected (No) and period of time that the mine would provide 1,170 jobs (Yrs) were modelled as continuous variables. The once-off payment (Cost) in questionnaire versions V1a, V1b and V2 was zero for the base alternative and $125, $300 or $625 for the two alternative choice options. In questionnaire version V3 the annual payment for 20-years was zero for the base alternative and $20, $50 or $100 for the two alternative choice options. The environmental attributes were described as negative impacts, such that the attribute would decrease in the alternative choice options. The period of time that the mine would provide 1,170 jobs was shown as a decrease in the alternative choice options.

An alternative specific constant (ASC) was included to take up the effect of factors that were not measured in the course of the survey but have an impact on well-being. The ASC was normalised to one for alternatives 2 and 3 and was zero for the base alternative. It is important to note that in the CL models the socio-economic variables were introduced into the modelling as interactions with the ASC. Hence, the parameters of these interacted variables show the influence of the socio-economic variable on the probability of the respondent choosing the alternative compared to the current situation.

A number of different model results are reported in this section. The first is an attributes only CL model that confirms that the respondents' choices are significantly influenced by the level of the attributes (Table 16). For V1a, V2 and V3, all attributes are significant at the 1% level and have the expected sign. Respondents prefer the choice option with lower payments, lower impacts on the total length of streams, smaller area of native vegetation affected, a lower number of Aboriginal sites affected and a longer period of time that the mines would provide 1,170 jobs. The negative and significant parameter on the ASC for V2 shows that there is a systematic tendency to choose the current situation over the choice alternatives and that there are unobserved effects that explain individuals' choices. While the ASC for V1a, V1b and V3 is insignificant suggesting that there are no systematic unobserved components that influence individuals' choice. For V1b all attributes except hectares of native vegetation were significant with the same signs as in the models of other versions of the questionnaire.

Table 16
Results of Attributes Only Models

Variable	V1a NSW		V1b Illawarra		V2		V3	
	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
Cost	-0.00163712	0.0000	-0.00147832	0.0000	-0.00145615	0.0000	-0.00736959	0.0000
Km	-0.00917684	0.0000	-0.00844892	0.0000	-0.00861875	0.0000	-0.00922956	0.0000
ha	-0.00305555	0.0001	-0.00131305	0.1127	-0.00286451	0.0002	-0.00337739	0.0002
No	-0.01045426	0.0025	-0.00949717	0.0115	-0.01048818	0.0028	-0.00691245	0.0402
Years	0.04198112	0.0000	0.05453805	0.0000	0.03557041	0.0000	0.04879848	0.0000
ASC	-0.30560936	0.0599	0.07208046	0.6850	-0.49078140	0.0028	-0.06464847	0.6826
AIC	1.962		1.937		1.964		2.031	
BIC	1.972		1.948		1.973		2.040	
Pseudo R2	0.041		0.049		0.030		0.042	
Log likelihood	-3780.588		-3205.415		-3719.826		-3907.828	
Log likelihood base	-3942.381		-3369.011		-3835.570		-4078.330	
LLRatio	323.586		327.192		231.488		341.004	
Chi2 (5DF)	11.071		11.071		11.071		11.071	

To determine whether these models are statistically significant, the log likelihood of the estimated models is compared to the log likelihood of the base model (market shares between alternatives as they exist in the data) using the log likelihood ratio-test (LLRatio). In all cases, the LLRatio exceeds the critical Chi-squared value and hence the specified models are statistically superior to the constants only base models.

The Metropolitan PAC Report in relation to the social attribute included in the CM study for the Metropolitan Coal Project (period of time that the mine will provide 320 jobs) expressed concern about the linearity of the life of mine variable, *viz.:*

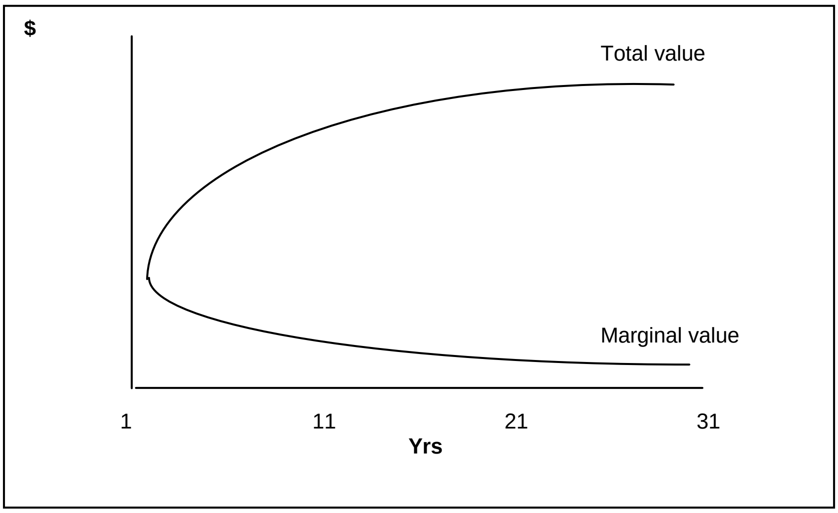
> *… the validity of the linear relationship between social costs and mine life is queried. Specifically, the social costs caused by a reduction in mine length from 25 to 23 years are likely to be smaller than the social costs associated with closure of the mine immediately.*

There are essentially two potential ways to test for non-linearity. The first is to effects code the alternative levels of the year attribute and then undertake a Wald test for linear restrictions. However, to undertake such a test for all alternative levels of the Yrs attribute it is necessary to use a different experimental design to that used in this study. That is, the experimental design must include the status quo level of attributes in the alternatives with a resulting increased number of blocks and hence surveying effort.

With the current experimental design, testing for non-linearities can be undertaken by including a transformation of the Yrs attribute in the models.

The Metropolitan PAC Report indicates that a non-linear transformation of the Yrs variable is likely to fit the data better. The hypothesis is essentially that the value of the Yrs attribute should increase at a declining rate as the life of mine becomes longer. This suggests that a log transformation of the Yrs variable would be appropriate[6] (Figure 1).

Figure 1
Log Transformation of the Yrs Attribute



A log transformation of the Yrs attribute was added to each of the attributes only models to examine whether this is likely to provide a superior explanation of respondent choices. The results are reported in Table 17.

Table 17
Results of Attributes Only Models with Log Transformation of the Yrs Attribute

Variable	V1a NSW		V1b Illawarra		V2		V3	
	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
Cost	-0.00165973	0.0000	-0.00150294	0.0000	-0.00144828	0.0000	-0.00740805	0.0000
Km	-0.00966931	0.0000	-0.00906107	0.0000	-0.00845040	0.0000	-0.00936629	0.0000
ha	-0.00309526	0.0000	-0.00136252	0.0993	-0.00284758	0.0002	-0.00338917	0.0000
No	-0.01159546	0.0010	-0.01080324	0.0047	-0.01008506	0.0046	-0.00718594	0.0353
Years	0.02403046	0.0213	0.03390986	0.0026	0.04201437	0.0001	0.04406535	0.0000
YrsLn	0.12339559	0.0696	0.14384865	0.0533	-0.04395342	0.5265	0.03270246	0.6201
ASC	-0.50541240	0.0099	-0.15753667	0.4601	-0.41898481	0.0360	-0.11682457	0.5383
AIC	1.962		1.937		1.964		2.031	
BIC	1.973		1.950		1.975		2.042	
Pseudo R2	0.041		0.049		0.030		0.042	
Log likelihood	-3778.950		-3203.289		-3719.625		-3907.705	
LLRatio	3.276		4.252		0.402		0.246	
Chi2 (1DF)	3.840		3.840		3.840		3.840	

[6] It should be noted that with non-linear transformations of attributes, the implicit price estimated at each level is essentially a total value with the marginal value estimated by looking at the difference between different years.

The YrsLn attribute was insignificant at the 5% level in all cases and only resulted in an improvement in model fit as indicated by the LLRatio for V1b[7]. Similarly, inclusion of YrsLn only in the models did not result in a better fit with a higher log likelihood in all cases with the exception of V1b.

Linear CL models were then run with attitudinal variables on:

- interest in the issue of mining under streams;
- whether the respondent favours development versus the environment;
- membership of an environmental organisation; and
- association with the mining industry (refer to Attachment 2).

Model results showed that interest and favouring the environment increased the probability of choosing one of the alternative options. This builds confidence in the data-set, as it shows that self-reported environmental disposition increases the likelihood of choosing alternatives that result in greater levels of environmental protection. The respondent or close family being associated with an environmental organisation increased the probability of choosing one of the alternative options. Where the attribute was significant (V3), the respondent or close family being associated with the mining industry reduced the probability of choosing one of the alternative options. These attitudinal variables were then excluded from further modelling.

More advanced model specification was then undertaken by incorporating socio-economic variables to estimate individual utility. These variables were introduced into the models via interactions with the ASC. Socio-demographic interactions that were found to be insignificant were systematically omitted from the final model. The preferred CL models are reported in Table 18.

Table 18
Results of Preferred Conditional Logit Models

Variable	V1a NSW		V1b Illawarra		V2		V3	
	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
Cost	-0.001657	0.0000	-0.00149686	0.0000	-0.001457	0.0000	-0.007444	0.0000
Km	-0.009379	0.0000	-0.00837799	0.0000	-0.008767	0.0000	-0.009319	0.0000
ha	-0.002997	0.0001	-0.00138151	0.0963	-0.002890	0.0002	-0.003442	0.0000
No	-0.010717	0.0020	-0.00937975	0.0129	-0.010797	0.0021	-0.007000	0.0385
Years	0.042229	0.0000	0.05531405	0.0000	0.036060	0.0000	0.049053	0.0000
ASC	-0.318076	0.1115	-0.41032655	0.0551	-0.324206	0.1458	0.109389	0.6092
ASCVis	0.269948	0.0001	0.27667999	0.0025	0.202158	0.0043	0.369557	0.000
ASCAge	-0.010961	0.0000	-	-	-0.007699	0.0016	-0.012073	0.000
ASCSex	0.244065	0.0002	-	-	0.210421	0.0020	0.342645	0.000
ASCChild	-	-	-	-	-0.231092	0.0022	-	-
ASCHHsize	-	-	0.05146237	0.0306	-	-	-	-
ASCEdu	0.294445	0.0001	0.46858105	0.0000	0.396436	0.0000	0.193684	0.0085
ASCInc	-	-	-0.203254D-05	0.0385	-0.238864D-05	0.0076	-0.215271D-05	0.0133

[7] It should be noted that other transformations of the Yrs attribute were also undertaken (e.g. yrs*yrs, 10/yrs etc), however, in all cases, the non-linear form of the Yrs attribute was insignificant.

Table 18 (Continued)
Results of Preferred Conditional Logit Models

Variable	V1a NSW		V1b Illawarra		V2		V3	
	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
AIC	1.945		1.923		1.947		2.009	
BIC	1.961		1.941		1.967		2.027	
Pseudo R2	0.050		0.057		0.040		0.053	
Log likelihood	-3743.719		-3177.276		-3682.257		-3860.834	
Log likelihood attributes only	-3780.588		-3205.415		-3719.826		-3907.828	
LLRatio	73.738		56.278		75.138		93.988	
Chi2	11.07 (5DF)		9.4877 (4DF)		12.59 (6DF)		11.07 (5DF)	
IIA Exclude Change1	0.100955		0.021319		0.000933		0.002940	
IIA Exclude Change 2	0.064286		0.223781		0.001430		0.037803	

For each of these models, all attributes and interactions are of statistical significance (apart from vegetation in V1b) and the ASC is not statistically significant, indicating that there are no systematic unobserved components that influence individuals' choices. The models offer an improved fit compared to the attributes only models as indicated by a significant LLRatio (relative to the attributes only model) for each model.

All significant socio-demographic interactions that are common between questionnaire versions have the same sign. Visitation, gender and education are positive and significant across V1a, V2 and V3 of the questionnaire indicating that respondents who have visited the region, are female or more highly educated are more likely to support alternate government decisions for the mines (i.e. mining restrictions). Age is negative and significant across V1a, V2 and V3 of the questionnaire indicating that older people are more likely to support continuation of the status quo over new government decisions for the mine. In models where income (V1b, V2 and V3) or having children (V2) were significant, these variables were negative indicating that respondents with children and higher incomes were more likely to support the status quo over alternate government decisions. V1b also had household size as a significant and positive attribute indicating that the larger the household size the more likely respondents are to support alternate government decisions for the mines (i.e. mining restrictions).

Respondents are assumed to make a trade-off between the levels of the non-market attributes and the associated lump sum or annual payments. The expressed trade-offs between attributes can be used to estimate the marginal utility of each attribute (Bateman *et al.*, 2006). If money is one of the attributes, this marginal utility is expressed as the 'marginal WTP' for each individual attribute.

The models reported in Table 19 have been used to estimate the marginal WTP (implicit prices) of the attributes Km, Ha, No and Yrs. Implicit prices are derived using the formula:

$$WTP = \frac{\beta_{attribute}}{\beta_{\cos ts}}$$

where $\beta_{attribute}$ is the estimated coefficient of the (non-market) attribute, and
B_{costs} is the estimated coefficient of the cost attribute.

Implicit Prices from these models and 95% confidence intervals (CI) are reported in Table 19. Graphical comparison of these CI is provided in Attachment 3.

Table 19
Implicit Prices from Preferred CL Models

	V1a		V1b		V2		V3	
Km	$5.66		$5.60		$6.01		$1.25	
95% CI	$3.46	$8.11	$3.01	$8.75	$3.80	$9.04	$0.78	$1.82
ha	$1.81		$0.00		$1.98		**$0.46**	
95% CI	$0.88	$2.81	$0.00	$0.00	$0.91	$3.25	$0.26	$0.73
No	$6.47		$6.27		$7.41		$0.94	
95% CI	$2.51	$10.77	$1.39	$11.54	$3.00	$12.37	$0.09	$1.91
Yrs	-$25.48		-$36.95		-$24.74		-$6.59	
95% CI	-$20.46	-$31.53	-$29.63	-$47.37	-$19.05	-$32.50	-$5.21	-$8.59

The Metropolitan PAC Report indicates that environmental and social impacts of mines should be considered to be part of the total 'package' of damage that is likely to be done in the Southern Coalfield with other mines also potentially being given approval. The Metropolitan PAC Report indicates that such a revised context would lead to higher environmental value estimates because marginal values of goods increase as their supply becomes relatively more limited.

This hypothesis suggests that the implicit prices obtained from V1a (which contains the cumulative impact context for all coal mining in the Southern Coalfield) should be significantly greater than those obtained from V2 which only contains the partial impact context (i.e. equivalent to that used for the Gillespie Economics, 2008).

Three approaches were used to test whether the implicit prices from V1a were significantly different from those obtained from V2. Firstly, observation of the substantially overlapping CI for the implicit prices for each attribute suggest that there is no significant difference (Attachment 3).

Secondly, a log-likelihood test was used to identify whether models were significantly different. This takes the following form:

$$LLRatio = -2(LogL_{v1/v2} - (LogL_{v1} + LogL_{v2}))$$

where $LogL_{v1/v2}$ is the log likelihood value attached to the CL model of the combined data set, and $LogL_{v1}$ and $LogL_{v2}$ are the log likelihoods of the CL models for the individual data sets.

The resulting likelihood ratio statistic follows an asymptotic chi-square distribution with (P + 1) degrees of freedom, where P is the number of parameters across the models involved.

Applying the information presented in Table 19 together with the log-likelihood of a combined model, a LLRatio statistic of 7.556 was calculated. This statistic is lower than the 1% chi-square statistic at 12 degrees of freedom (26.217), indicating that the models are equivalent. However, as identified by Windle and Rolfe (unpublished) this is a very general test and may hide some variations between attributes across the two models.

A more robust test was conducted that compared the differences in the part-worths for the different attributes using the procedures of Poe *et al*. (2005). The proportion of part-worth differences (V1a - V2) falling above zero are 61%, 62%, 61% and 55% for the Km, Ha, No and Yrs attributes, respectively. All proportions were well above the 5% level and below the 95% level and confirm that there was no significant difference between the V1a and V2 implicit prices.

The same test was undertaken to determine whether the implicit prices were different between V1a and V1b and between V1a and V3.

For the V1a and V1b comparison the proportion of part-worth differences (V1a – V1b) falling above zero are 48%, 100%, 48% and 0% for the Km, Ha, No and Yrs attributes, respectively. This indicates that the implicit price for the Ha and Yrs attributes in V1b were significantly different from those for V1a (lower and $0 for Ha and higher for Yrs).

For the V1a and V3 comparison the proportion of part-worth differences (V1a – V3) falling above zero are 0%, 0%, 0% and 100% for the Km, Ha, No and Yrs attributes respectively. This indicates that the implicit price for the V3 are significantly different from those for V1a, which would be expected given the different temporal payment structures.

One of the reasons that, in this instance, the inclusion of an indicative cumulative impact context for all mines across the Southern Coalfield may not have resulted in the Metropolitan PAC Report's expected higher values for the environmental attributes is that while the mine's specific environmental impacts are small in the context the entire resource across the Southern Coalfield, the cumulative impacts of all mines in the Southern Coalfield are also relatively modest. For instance:

- *If mining continues as currently planned, it is predicted that in 31 years time a total of 100 km of streams (out of a total of 1,500 km of similar streams in the Southern Coalfield) will be impacted by mine subsidence effects above the two mines – 300 km of streams will be impacted by <u>all</u> eight mines in the Southern Coalfield in 31 years time.*
- *If mining continues as currently planned, it is predicted that in 31 years time a total of 50 Aboriginal heritage sites (out of a total of up to 15,000 Aboriginal heritage sites in the Southern Coalfield) will experience some impact from subsidence or from surface infrastructure above the two mines – 300 Aboriginal sites will be impacted by <u>all</u> eight mines in the Southern Coalfield in 31 years time.*
- *If mining continues as currently planned, it is predicted that in 31 years time a total of approximately 380 ha of native vegetation (out of a total of up to 90,000 ha of similar native vegetation in the Southern Coalfield) will be affected by clearing for surface infrastructure of the two mines – 1,600 ha of native vegetation will be impacted by <u>all</u> eight mines in the Southern Coalfield in 31 years time.*

Perhaps if the cumulative impacts of all mines in the Southern Coalfield were a more significant proportion of the total resource then inclusion of the cumulative impact context may have had a more measurable effect on community valuations. Respondents may also be aware of the direct impacts of surface mining in other well-known NSW coal mining regions such as the Hunter Valley and responded accordingly.

With regard to the Yrs attribute, the additional context had no impact on the implicit prices, perhaps indicating that respondents were already incorporating the vagaries of future employment market and reemployment prospects into their choices.

An important assumption in CL models is the Independence-from-Irrelevant-Alternatives (IIA) property. The IIA assumption states that the relative probability of choosing one alternative over another (given that both alternatives have a non-zero probability of choice) is unaffected by the introduction or removal of additional alternatives in the choice set (Louviere *et al*., 2000). The IIA assumption implies that the error terms are independent across alternatives and provides a computationally convenient choice model. However, the IIA assumption is unlikely to hold if the preferences of respondents are heterogeneous (Louviere *et al*., 2000). In this situation, using a CL model can lead to biased estimators.

A Hausman specification test was used to determine whether the IIA assumption holds for each of the CL models reported in Table 18. It was found that the IIA assumption holds at the 5% confidence level for the CL model for V1a but not for the CL models for V1b, V2 and V3.

5.3 RANDOM PARAMETER MODEL RESULTS

Given the low McFaddens pseudo R-squared of the CL models and the results of the Hausman test on V1b,V2 and V3, additional RP model specifications were estimated that allow for a relaxation of the IIA assumption. This type of model increases the likelihood of revealing sources of preference heterogeneity associated with the mean. Therefore, this extended framework is able to capture a superior level of true behavioural variability in choice making (Hensher *et al*. 2005). However, with that comes increased complexity. Where the heterogeneity around RPs is explained by including interactions the variance becomes a function of those variables and makes welfare calculations considerably more complex. Since the focus in this study is estimation of the implicit prices of the environmental attributes, RP models have been kept simple without inclusion of interactions.

Four attributes (Km, Ha, No and Yrs) were included as random variables with a number of distributions imposed (i.e. normal, lognormal, uniform, triangular). A normal distribution was adopted as preferred across all models for the RPs. Results of the preferred RP models are reported in Table 20.

Table 20
Results of Preferred Random Parameters Logit Models

Variable	V1a NSW		V1b Illawarra		V2		V3	
RPs in Utility Functions	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
Km (n)	-0.013360	0.0001	-0.01393835	0.0000	-0.01438164	0.0000	-0.01812689	0.0000
ha (n)	-0.003723	0.0081	-	-	-0.00347845	0.0099	-0.00565116	0.0000
No (n)	-0.016477	0.0085	-	-	-	-	-	-
Years (n)	0.110875	0.0000	0.13324884	0.0000	0.11285081	0.0000	0.13492966	0.0000
Non RPs In Utility Functions								
Cost	-0.003252	0.0000	-0.00264598	0.0000	-0.00261077	0.0000	-0.01473238	0.0000
ha	-	-	-0.00301319	0.0054	-	-	-	-
No	-	-	-0.01621791	0.0012	-0.01882404	0.0000	-0.01625095	0.0011
ASC	0.6018517	0.065	0.76187252	0.0160	0.18210559	0.5674	1.13001427	0.0004
Standard Deviations of RPs								
Km	0.035641	0.0000	0.02141521	0.0002	0.02137462	0.0004	0.02407656	0.0000
ha	0.012805	0.0000	-	-	0.01131640	0.0000	0.00984482	0.0000
No	0.041530	0.0000	-	-	-	-	-	-
Years	0.112723	0.0001	0.12144749	0.0000	0.12940499	0.0000	0.14489722	0.0000
Standard Deviation of Latent Random Effects								
Sigma EO1	4.226305	0.0000	4.54160590	0.0000	4.34503828	0.0000	5.18764798	0.0000
Model Statistics								
AIC	1.438		1.410		1.432		1.463	
BIC	1.456		1.427		1.449		1.479	
Prob > chi2	0.000000		0.000000		0.00000		0.000000	
McFaddens R2	0.3481573		0.3607577		0.3504920		0.3366703	
Log likelihood	-2764.232		-2328.056		-2707.951		-2809.301	
Chi2	2952.822		2627.687		2922.566		2851.698	

Again the attributes have the expected sign in all models. Importantly, there is a significant improvement in the explanatory power of the RP models with significantly lower log likelihood statistics and McFadden Pseudo R-squared ranging from 0.34 to 0.36.

Implicit prices and 95% CI calculated from these models are reported in Table 21. Graphical comparison of these CI is provided in Attachment 4.

Table 21
Implicit Prices from RP Models

	V1a		V1b		V2		V3	
km implicit Price	$4.11		$5.27		$5.51		$1.23	
95% CI	$2.02	$6.05	$3.15	$7.52	$3.27	$7.79	$0.86	$1.61
ha Implicit Price	$1.14		$1.14		$1.33		$0.38	
95% CI	$0.30	$2.08	$0.37	$1.95	$0.39	$2.47	$0.23	$0.58
No Implicit Price	$5.07		$6.13		$7.21		$1.10	
95% CI	$1.48	$8.84	$2.61	$9.67	$3.90	$11.01	$0.51	$1.77
Yrs Implicit Price	-$34.09		-$50.36		-$43.23		-$9.16	
95% CI	-$28.05	-$41.48	-$41.08	-$60.84	$35.08	$52.38	$7.56	$11.11

Again comparison was made between implicit prices from each model using the Poe test. For the V1a V2 comparison the proportion of part-worth differences (V1a – V2) falling above zero are 81%, 61%, 79% and 6% for the Km, Ha, no and yrs attributes respectively, indicating that at the 5% level there is no differences in implicit prices between models. This supports the earlier finding that, in this instance, the cumulative impact context does not seem to be sufficiently different from the mine specific context to result in different implicit prices from different versions of the questionnaire.

For the V1a V1b comparison the proportion of part-worth differences (V1a – V1b) falling above zero are 77%, 49%, 63% and 0% for the Km, Ha, No and Yrs attributes respectively, indicating that at the 5% level the implicit price for the Yrs attribute for the Illawarra sample is significantly greater than that from V1a.

For the V1a V3 comparison the proportion of part-worth differences (V1a – V1b) falling above zero are 0%, 4%, 2% and 100% for the Km, Ha, No and Yrs attributes respectively, indicating that at the 5% level the implicit price for all attributes from the V1a sample are significantly different to those from the V3 sample.

Because of the differences in implicit prices between some version of the questionnaire and the only marginal similarity between the Yrs implicit price between V1a and V2, the different samples were not combined. The V1a model results were taken as the preferred linear RP model for this study.

This preferred model was then tested to determine whether some non-linear transformation of the Yrs attribute would be preferable to the linear specification in Table 20. Only a log transformation was statistically significant with this improving the overall fit of the model as indicated by a lower log likelihood statistic and higher McFadden pseudo R-squared (Table 22). This non-linear RP model was adopted as the preferred model with the implicit prices used in the BCA.

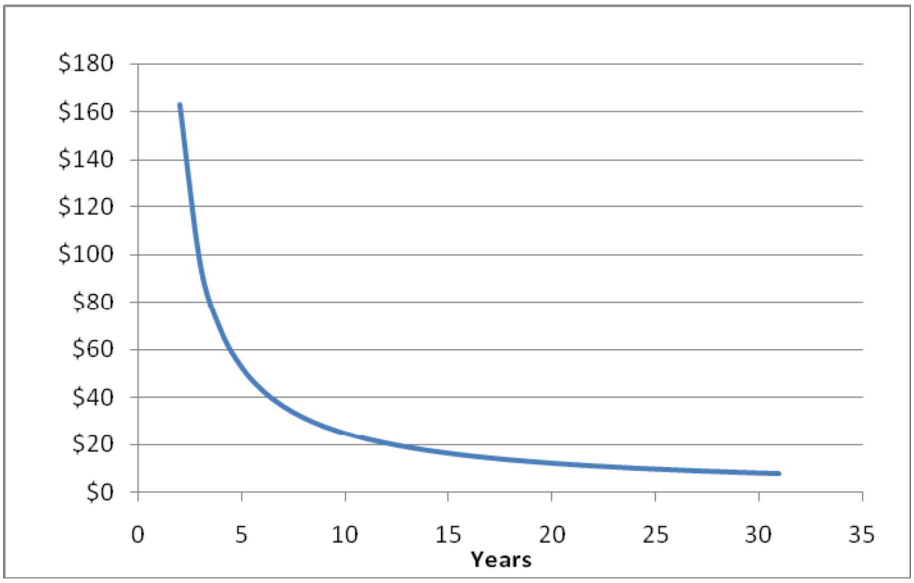
Table 22
Preferred RP Model with Non-Linear Yrs Attribute

Variable	V1a NSW		Implicit Price (95% CI)
RPs in Utility Functions	Coefficients	P-value	
Km (n)	-0.01695683	0.0000	$4.73 ($2.81 - $6.65)
ha (n)	-0.00320972	0.0413	$0.90 ($0.05 - $1.82)
No (n)	-0.01843505	0.0071	$5.15 ($1.52 - $8.84)
YrsLn (n)	0.84178652	0.0000	$26.90 average*
Non RPs In Utility Functions			
Cost	-0.00358220	0.0000	
ASC	-0.40512275	0.1961	
Standard Deviations of RPs			
Km	0.03479630	0.0000	
ha	0.01602200	0.0000	
No	0.05180295	0.0000	
YrsLn	0.95072020	0.0000	
Standard Deviation of Latent Random Effects			
Sigma EO1	4.26507015	0.0000	
Model Statistics			
AIC	1.430		
BIC	1.448		
Prob > chi2	0.000000		
McFaddens R2	0.3517823		
Log likelihood	-2748.860		
Chi2	2983.567		

* This is an average implicit price - a separate implicit price can be calculated for each one unit change in the YrsLn variable.

The declining marginal implicit price for the Yrs attribute is represented in Figure 2.

Figure 2
Diminishing Marginal Utility of Yrs Attribute
Dollars per Year Reduction in Mine Life



6 APPLICATION OF IMPLICIT PRICES

6.1 INTRODUCTION

The implicit prices estimated from the choice data are directly applicable to the consideration of alternative mine management options. Specifically, they are compatible, as welfare change measures, with the principles of BCA. The process of employing these implicit prices in BCAs involves three basic stages.

1. Predicting the physical impact of a management change on the attributes used in the CM exercise relative to the predicted continuation of the 'status quo'.
2. Multiplying the implicit prices by the respective predicted attribute change to estimate the per respondent household WTP for each attribute change.
3. Extrapolating across the relevant population, using the survey response rate, to estimate the societal WTP for the management change.

Section 6.2 provides some guidance on extrapolating the model results to the population. It also briefly examines the approach that can be used when implicit prices are expressed in annual terms rather than as a lump sum, as per V3.

6.2 ISSUES IN THE APPLICATION OF CM RESULTS

6.2.1 Extrapolating Across the Relevant Population

Implicit price results per household from CM studies are not normally aggregated to the entire population from which the sample is drawn. This is because it is unclear whether non-respondents hold the same values as those of respondents. Consequently, it has been normal practice in mailed or drop-off surveys to conservatively only aggregate WTP values to the proportion of the population given by the survey response rate. However, this is likely to understate community WTP as it assumes that all non-respondents have a zero WTP.

An alternative is to use the method suggested by Morrison (2000) and supported by the results of Van Bueren and Bennett (2000). In a study that involved the estimation of values derived from environmental improvements to wetlands, Morrison found that potentially, about one-third of non-respondents have value estimates similar to respondents. Similarly, Van Bueren and Bennett (2000) in a follow-up telephone interview with non-respondents in a CM application designed to estimate the non-marketed costs of land and water degradation found that about one third of non-respondents were highly likely to share the preferences of respondents.

Consequently, it is considered reasonable to aggregate values from the V1a questionnaire to the proportion of the NSW population indicated by the response rate plus one third of the non-response rate.

The estimated response rate for the current study is 18.7%. Applying the Morrison (2000) approach to the minimum estimate of a response rate from the online survey would give an adjusted response rate of 45.8%.

Based on this approach the aggregated value per unit of environmental impact is as follows:

- $5.46 Million (M) per km of stream impacted;
- $1.04M per ha of vegetation cleared; and
- $5.94M per Aboriginal site impacted.

The aggregated value per year that the mine provides 1,170 jobs per one year change in the mine life is provided in Table 23.

Table 23
Aggregated Value Per Year of Mine Life

Years	Implicit Price Per Year Reduction in Life of Mine	Aggregated Value Per Year Reduction in the Life of Mine
31	-	-
30	$7.71	$8.89M
29	$7.97	$9.19M
28	$8.25	$9.51M
27	$8.55	$9.86M
26	$8.87	$10.23M
25	$9.22	$10.63M
24	$9.59	$11.07M
23	$10.00	$11.54M
22	$10.45	$12.05M
21	$10.93	$12.61M
20	$11.47	$13.23M
19	$12.05	$13.91M
18	$12.71	$14.66M
17	$13.43	$15.50M
16	$14.25	$16.44M
15	$15.17	$17.50M
14	$16.21	$18.70M
13	$17.41	$20.09M
12	$18.81	$21.70M
11	$20.45	$23.59M
10	$22.40	$25.84M
9	$24.76	$28.56M
8	$27.68	$31.93M
7	$31.38	$36.20M
6	$36.22	$41.79M
5	$42.84	$49.43M
4	$52.44	$60.49M
3	$67.60	$77.99M
2	$95.28	$109.92M
1	$162.88	$187.91M
Average	**$26.90**	**$31.03M**

6.2.2 Converting the Annual Implicit Prices for 20 Years to a Present Value

The payment mechanism used in V1a, V1b and V2 were once-off payments and hence do not require discounting to be included in a BCA. However, V3 used an ongoing annual payment for 20 years as its payment mechanism.

Studies have shown that implicit price levels may differ significantly between different payment mechanisms. Windle and Rolfe (2004) examined WTP levels between lump sum payments and ongoing annual payments for a 20 year period. They found that there was a significant difference between annual and lump sum WTP amounts when lump sums were discounted at normal economic discount rates (e.g. 7%). It was only at very high discount rates of 30%, and above, that the part-worths of the different WTP models started to become equivalent, and only a rate of 37% ensured that all part-worths were equivalent (Windle and Rolfe 2004).

Further analysis by Windle and Rolfe (unpublished), using more sophisticated statistical methods, indicates that it is only at extremely high discount rates (between 45% and 59%) that CI for the amortised regular payment part-worth values overlap with the CI of the lump sum part-worths.

Because ultimately all values from CM studies must be expressed in present values or lump sum amounts, this suggests that the appropriate private discount rate to use for the CM results is up to 59%.

However, the Windle and Rolfe study is one of the few that have examined this issue empirically. Consequently, Gillespie Economics (2008) considered that until there is further evidence supporting these extremely high private discount rates, it is considered that a more conservative estimate of private discount rate should be used, such as the private borrowing rate for unsecured personal loans. Consequently, Gillespie Economics (2008) used a very conservative discount rate, relative to the results of the Rolfe and Windle studies, of 15%.

Comparison of V1a and V3 implicit prices from Table 21 gives some indication of the private discount rate that respondents use to equate annual payments to lump sum payments. The private discount rate equating mean implicit prices ranged from 21% to 34% (Table 24).

Table 24
Private Discount Rates that Equate Mean Implicit Prices between V1a and V3

Attribute	Discount Rate
Km	30%
Ha	34%
No	21%
Yrs	27%

6.2.3 Allowing for Remediation

The environmental implicit prices estimated in this study relate to community values for un-remediated environmental impacts. To the extent that remediation costs are included in any BCA, inclusion of these implicit prices will tend to overstate the magnitude of environmental impacts.

7 CONCLUSIONS

CM provides a way of estimating community values for environmental and socio-economic impacts of mines in dollar values so that they can be directly incorporated into BCA of projects. CM therefore enhances the role of BCA as a useful and practical aid to decision-makers, helping mining companies and decision-makers to directly examine the economic efficiency of projects and the economic efficiency of any proposed environmental restrictions on mining.

Because CM involves directly surveying representatives of the community it can provide clear guidance on community values, overcoming the often unsubstantiated qualitative statements from special interest groups about the general community acceptability or otherwise of environmental impacts.

This study demonstrates the application of CM to environmental and social attributes impacted by underground mining at the Project in the Southern Coalfield of NSW. The study found that the community value reducing impacts of mining on environmental attributes such as streams, vegetation and Aboriginal heritage sites. However, it was also found that the community values the employment that mining provides to the Illawarra Region. Values generated from the CM study were:

- $4.73 per km of stream protected;
- $0.90 per ha of native vegetation protected;
- $5.15 per Aboriginal heritage site protected; and
- Average of $26.90 per year that the mine provides 1,170 jobs ($234.99 per natural log of the change in the number of years that the mine provides 1,170 jobs).

A number of assertions from the Metropolitan PAC Report were directly tested, specifically that:

- *… It is likely that .... a revised* (cumulative impact) *context would lead to higher environmental value estimates because marginal values of goods increase as their supply becomes relatively more limited*; and
- *… the social costs caused by a reduction in mine length from 25 to 23 years are likely to be smaller than the social costs associated with closure of the mine immediately.*

In this instance, the implicit prices obtained from questionnaire V1a containing a full cumulative impact context for all mines in the Southern Coalfield were not significantly different from implicit prices from questionnaire V2 containing no cumulative impact context for all mines in the Southern Coalfield. It is hypothesised that the reasons that the inclusion of the cumulative impact context for all mines across the Southern Coalfield may not have resulted in the expected higher values for the environmental attributes is that while the mine specific environmental impacts are small in the context of the entire resource across the Southern Coalfield, the cumulative impacts of all the mines are also relatively modest. This is particularly the case when compared to other well-known coal mining regions in NSW such as the Hunter Valley.

While non-linear transformation of the Yrs variable did not improve the statistical fit of CL models, it was found that the a log transformation of the Yrs variable in the preferred linear RP model did improve the performance of the model and enable estimation of declining marginal utility associated with the length of time that the mine provides 1,170 jobs. However, even a small reduction in mine life e.g. from 31 years to 30 years[8] still results in a significant implicit price of $7.71 per household.

[8] While the approval sought from the NSW Government is only for 30 years, the cumulative impact context of the choice modelling study included the total mine life from 2009 which is 31 years.

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ATTACHMENT 1 – EXAMPLE QUESTIONNAIRE

MANAGING THE IMPACTS OF TWO MINES IN THE SOUTHERN COALFIELD

A SURVEY OF COMMUNITY ATTITUDES

Gillespie Economics
May 2009

INTRODUCTION

In the following questionnaire you are asked to give your views about the management of the impacts of two underground coal mines in the Southern Coalfield.

This survey is being undertaken to provide an input into decision-making on the future management of the mines.

Your answers are important to this process.

THE SOUTHERN COALFIELD

The Southern Coalfield extends from the south of Sydney, past Nowra on the NSW south coast, and east of Goulburn (Figure 1).

Figure 1- Location of the Southern Coalfield

MINING IN THE SOUTHERN COALFIED

Mining has been undertaken in the Southern Coalfield for over 100 years.

There are eight mines currently operating in the Southern Coalfield and these mines extract coal by underground mining methods.

The focus of this questionnaire is managing the impacts of two of these mines.

The two mines:

- are underground;
- are located:
  - partly under Sydney's drinking water catchment which:
    - provides drinking water for Sydney households;
    - is an area recognised for its conservation values;
    - has no public access because of Government regulations.
  - partly under a State Conservation Area that has restricted public access to it; and
  - partly under rural (primarily cleared) agricultural lands.
- have a number of existing above ground surface infrastructure areas containing buildings and coal stockpiles;
- produce coal primarily for making steel;
- pay royalties and taxes to the NSW State Government that are used to pay for public services such as schools, hospitals, parks and roads;
- directly provide jobs for approximately 875 people;
- contribute to the regional economy; and
- cause "subsidence" – where the ground surface above the mines shift downwards, and in some localised areas upwards, causing the cracking of the land surface.

Mine subsidence can result in impacts on streams and rock formations that contain Aboriginal heritage sites.

Mining can also result in the clearing of native vegetation and the loss of Aboriginal heritage sites from the construction of mine surface infrastructure i.e. buildings and coal stockpile areas.

MINE IMPACTS

Streams

Introduction

The mines can impact permanent and intermittent flowing streams in Sydney's drinking water catchment or a State Conservation Area.

Rocks under these streams can crack to a depth of up to 15 metres and a width of up to 15 cm as a result of mine subsidence (Figure 2).

Figures 2a and 2b – Cracking of Rocks Under A Stream Because of the Mines

During dry periods when the amount of water flowing in the streams is low:

- water flows underground through cracks in the rock and re-appears at the surface further downstream (Figure 3); and
- water flows through cracks in rockbars that usually hold water in pools (Figure 4).

Figure 3 –Flows underground Cracks in the Rock

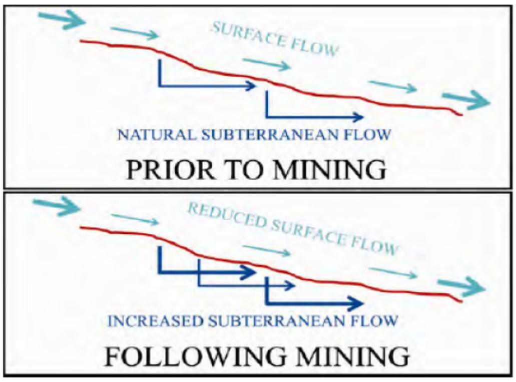
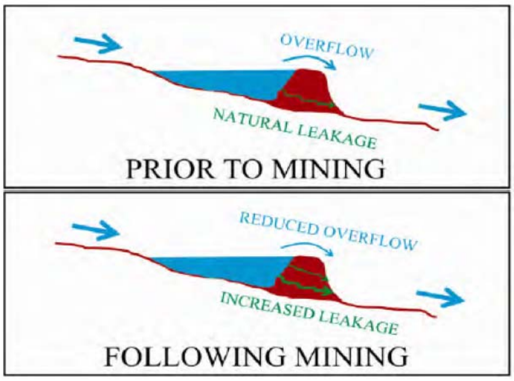


Figure 4 –Flows Through Rockbars that Usually Hold Water in Pools



When the water re-surfaces it can carry iron from the rock it has flowed through. The iron causes the water and stream bed to have an orange/red colour. This occurs naturally but is increased by cracking of the rock under the stream.

This means that during dry times there can be:

- reduced water levels in stream pools (Figure 5);
- reduced water flows in sections of the stream with cracking (Figure 6);
- staining of the water and rocks downstream of where the water re-surfaces (Figure 7); and
- localised changes to the stream ecology.

There is no loss of flow downstream of where the water re-surfaces. An independent Government inquiry found that there is no evidence that the quality and quantity of Sydney's water supply is changed by mine subsidence effects.

Figure 5 – Reduced Water Level in Stream Pools Due to Increased Rock Bar Leakage (in Low Flow Periods)

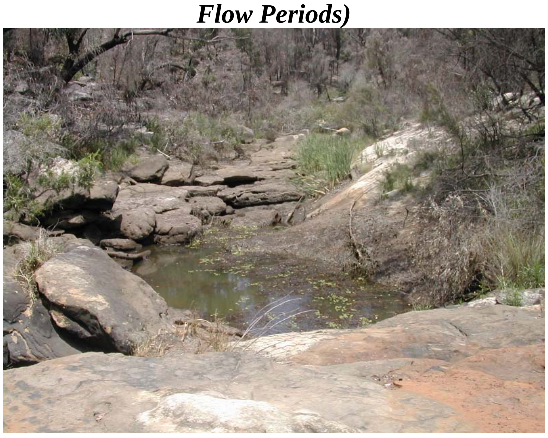


Figure 6 – Reduced Water Flows in Sections of Streams with Cracking (in Low Flow Periods)

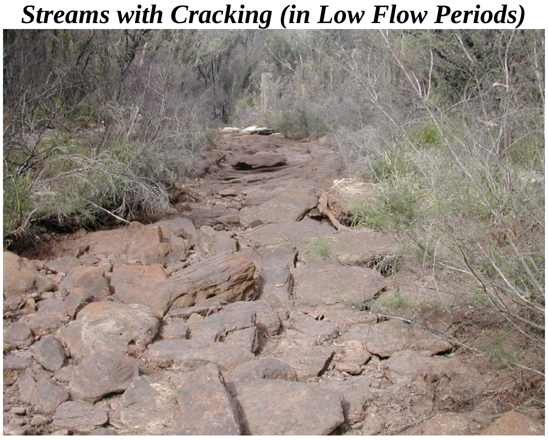


Figure 7 – Staining of the Stream Bed Downstream of Where the Water Resurfaces (Low Flow Periods)

During average flow conditions, extended periods occur where pool water levels stay high, water flows over rockbars and the appearance of staining is reduced (Figure 8).

Figure 8 – Stream Above the Mines After Rain

- 40 km of streams (out of a total of 1,500 km of similar streams in the Southern Coalfield) have been impacted by mine subsidence effects above the two mines – 150 km of streams have been impacted by <u>all</u> eight mines in the Southern Coalfield.
- If mining continues as currently planned, it is predicted that in 31 years time a total of 100 km of streams (out of a total of 1,500 km of similar streams in the Southern Coalfield) will be impacted by mine subsidence effects above the two mines – 300 km of streams will be impacted by <u>all</u> eight mines in the Southern Coalfield in 31 years time.

Aboriginal Heritage

- Above the two mines there are rock formations such as sandstone ridges, steep slopes, rocky ledges and overhangs (Figure 9).
- Some of these rock formations contain Aboriginal heritage sites (e.g. grinding groove sites, engraving sites, rock art and artefacts) (Figure 10).

Figure 9 – Sandstone Overhang

Figure 10 – Aboriginal Rock Art in Sandstone Overhang

- The mines' subsidence can increase the chance that these rock formations, especially rock overhangs, will crack, have rock falls or collapse.
- Expansion of surface infrastructure areas can also impact Aboriginal heritage sites.
- An estimated 20 Aboriginal heritage sites (out of a total of up to 15,000 Aboriginal heritage sites in the Southern Coalfield) have experienced some impact from subsidence or from surface infrastructure development above the two mines – 100 Aboriginal heritage sites have been impacted by <u>all</u> eight mines in the Southern Coalfield.
- If mining continues as currently planned, it is predicted that in 31 years time a total of 50 Aboriginal heritage sites (out of a total of up to 15,000 Aboriginal heritage sites in the Southern Coalfield) will experience some impact from subsidence or from surface infrastructure above the two mines – 300 Aboriginal sites will be impacted by <u>all</u> eight mines in the Southern Coalfield in 31 years time.

Native Vegetation

- Future expansion of the surface infrastructure of the two mines involves removal of native vegetation (Figure 11).
- This native vegetation (Figure 12) includes threatened plant species and provides habitat for a range of non-threatened and threatened animal species.

Figure 11 – Area Where Native Vegetation Has Been Cleared for Construction of Surface Infrastructure

Figure 12 – Native Vegetation

- Approximately 240 ha[1] of native vegetation (out of a total of up to 90,000 ha of similar native vegetation in the Southern Coalfield) has been affected by clearing for surface infrastructure of the two mines – 1,000 ha of native vegetation has been affected by <u>all</u> eight mines in the Southern Coalfield.
- If mining continues as currently planned, it is predicted that in 31 years time a total of approximately 380 ha of native vegetation (out of a total of up to 90,000 ha of similar native vegetation in the Southern Coalfield) will be affected by clearing for surface infrastructure of the two mines – 1,600 ha of native vegetation will be impacted by all eight mines in the Southern Coalfield in 31 years time.

[1] A single hectare (ha) is approximately 1.5 rugby fields in size.

REDUCING THE MINES' IMPACTS ON STREAMS, ABORIGINAL HERITAGE AND NATIVE VEGETATION

To reduce these mine impacts, the Government could:

- prevent some future coal mining activities;
- require a change in the extent of mining;
- require future mining to avoid areas that are located below or adjacent to streams and Aboriginal heritage sites; or
- require surface infrastructure to avoid areas of native vegetation and Aboriginal heritage sites.

Such Government decisions would affect employment at the two mines.

MINE EMPLOYMENT

- The two mines currently employ approximately 875 people (Figure 13).
- The mines also provide jobs indirectly to contractors and service providers.
- The mines contribute to the regional economy.
- If mining continues as currently planned, the two mines will provide approximately 1,170 jobs for the next 31 years.
- There are currently more than 2,500 direct mining jobs in the Southern Coalfield.
- Government decisions that reduce the effects of the two mines on streams, native vegetation and Aboriginal sites would reduce the planned life of the two mines and hence the length of time that the mines would provide 1,170 direct jobs.
- Re-employment prospects for those affected by a shortened mine life would depend on the economic conditions at the time.
- Those employees affected by a shortened mine life (e.g. in 10 or 20 years time) may not be those currently employed at the mine.
- Other coal resources (mining lease areas) may be available in the future if the current planned life of the mines is reduced, although this would also be subject to future government approvals.

Figure 13 - Mine Employment

HOW THIS COULD AFFECT YOU?

Government decisions to reduce the environmental impacts of the two mines (e.g. mine closure or changes to permitted impacts) would reduce coal production and less money would be received by the State Government from royalties and taxes. This could reduce the level of public services provided by Government for the households of NSW.

To reduce the environmental impacts of the two mines and keep the current level of public services that you receive from the State Government each year, every household in NSW would have higher costs (i.e. you would need to make an additional once-off payment to the State Government).

This payment would be to replace the royalties and taxes otherwise paid by the mines and would be in the form of an environmental levy.

The size of the once-off payment you would make, and the type and extent of reductions in environmental impacts, would depend on the government decisions made for the two mines.

WHAT DO YOU THINK?

Options

In Questions 1 to 5 below, we want you to make some choices between **different Government decisions** about how the two mines operate.

Option 1 shows the impacts that the two mines would have if the mining is permitted to continue as currently planned.

- Options 2 to 11 involve different Government decisions for the two mines.
- Each of the options is described by the:
  - predicted impacts of the two mines in 31 years time in terms of:
    - ❖ the total length of streams affected by subsidence;
    - ❖ the total number of Aboriginal heritage sites affected by subsidence or surface infrastructure expansion;
    - ❖ the total area of native vegetation cleared;
  - predicted impacts on the length of time that the two mines will provide 1,170 direct jobs; and
  - money it would cost you in the form of a once-off payment to achieve these outcomes.

When making your choices please consider:

- each question involves only three options – this is to make your choice easier;
- each option provides:
  - different impacts of the two mines over the next 31 years that would come from different Government decisions;
  - different once-off payments that you would be required to make to achieve these outcomes;
- your income is limited and you have other expenses; and
- other areas of NSW may also need funding for environmental management.

Note:

- ❖ Your answers are important to deciding the way that the environmental impacts of the two mines will be managed in the future.
- ❖ Some of the option outcomes may seem strange to you. This is because different combination of policies can lead to different outcomes.
- ❖ Each question should be considered **independently** of each other.

Question 1

Carefully consider each of the following three options for managing the environmental impacts of the two mines. Suppose options 1, 2 and 3 in the table below are the **ONLY ones available**. Which one would you choose?

Option	**Your once-off payment**	**Total impacts of the two mines in 31 years time**			**Length of time that the two mines will provide 1,170 jobs**
		Total length of streams affected	**Total number of Aboriginal sites affected**	**Total area of native vegetation cleared**	
Option 1 *Mining continues as currently planned*	$0	100 km	50 sites	380 ha	31 years
Option 2 *Different Government decisions for the two mines*	$125	60 km	40 sites	240 ha	11 years
Option 3 *Different Government decisions for the two mines*	$300	60 km	30 sites	330 ha	11 years

Which option would you choose? (Please tick)
Option 1 ☐
Option 2 ☐
Option 3 ☐
Not Sure ☐

Question 2

Carefully consider each of the following three options for managing the environmental impacts of the two mines. Suppose options 1, 4 and 5 in the table below are the **ONLY ones available**. Which one would you choose?

Option	**Your once-off payment**	**Total impacts of the two mines in 31 years time**			**Length of time that the two mines will provide 1,170 jobs**
		Total length of streams affected	**Total number of Aboriginal sites affected**	**Total area of native vegetation cleared**	
Option 1 *Mining continues as currently planned*	$0	100 km	50 sites	380 ha	31 years
Option 4 *Different Government decisions for the two mines*	$125	80 km	30 sites	330 ha	11 years
Option 5 *Different Government decisions for the two mines*	$125	40 km	20 sites	330 ha	21 years

Which option would you choose? (Please tick)
Option 1 ☐
Option 4 ☐
Option 5 ☐
Not Sure ☐

Question 3

Carefully consider each of the following three options for managing the environmental impacts of the mines. Suppose options 1, 6 and 7 in the table below are the **ONLY ones available**. Which one would you choose?

Option	**Your once-off payment**	**Total impacts of the two mines in 31 years time**			**Length of time that the two mines will provide 1,170 jobs**
		Total length of streams affected	**Total number of Aboriginal sites affected**	**Total area of native vegetation cleared**	
Option 1 *Mining continues as currently planned*	$0	100 km	50 sites	380 ha	31 years
Option 6 *Different Government decisions for the two mines*	$300	40 km	30 sites	330 ha	1 year
Option 7 *Different Government decisions for the two mines*	$625	80 km	20 sites	290 ha	11 years

Which option would you choose? (Please tick)
Option 1 ☐
Option 6 ☐
Option 7 ☐
Not Sure ☐

Question 4

Carefully consider each of the following three options for managing the environmental impacts of the two mines. Suppose options 1, 8 and 9 in the table below are the **ONLY ones available**. Which one would you choose?

Option	Your once-off payment	Total impacts of the two mines in 31 years time: Total length of streams affected	Total number of Aboriginal sites affected	Total area of native vegetation cleared	Length of time that the two mines will provide 1,170 jobs
Option 1 *Mining continues as currently planned*	$0	100 km	50 sites	380 ha	31 years
Option 8 *Different Government decisions for the two mines*	$300	60 km	20 sites	290 ha	1 year
Option 9 *Different Government decisions for the two mines*	$300	60 km	40 sites	290 ha	21 years

Which option would you choose? (Please tick)
Option 1 ☐
Option 8 ☐
Option 9 ☐
Not Sure ☐

Question 5

Carefully consider each of the following three options for managing the environmental impacts of the two mines. Suppose options 1, 10 and 11 in the table below are the **ONLY ones available**. Which one would you choose?

Option	**Your once-off payment**	**Total impacts of the two mines in 31 years time**			**Length of time that the two mines will provide 1,170 jobs**
		Total length of streams affected	**Total number of Aboriginal sites affected**	**Total area of native vegetation cleared**	
Option 1 *Mining continues as currently planned*	$0	100 km	50 sites	380 ha	31 years
Option 10 *Different Government decisions for the two mines*	$300	80 km	40 sites	240 ha	1 year
Option 11 *Different Government decisions for the two mines*	$125	40 km	30 sites	290 ha	1 year

Which option would you choose? (Please tick)
Option 1 ☐
Option 10 ☐
Option 11 ☐
Not Sure ☐

WE WOULD NOW LIKE TO ASK YOU SOME FURTHER QUESTIONS ABOUT THE DIFFERENT GOVERNMENT DECISIONS AND RESULTING MINE IMPACTS

Question 6

When answering Questions 1 to 5, did you always choose Option 1 (mining continues as currently planned)?

☐ Yes ☐ No ***Go to Question 7***

If you answered "yes", which of the following statements most closely describe your reason for doing so? Tick one box only.

- ☐ I support mining continuing as currently planned and the associated environmental impacts
- ☐ I support changing the mines' impacts, but could not afford a payment of any amount
- ☐ I support changing the mines' impacts but object to a payment of any amount
- ☐ I didn't know which option was best, so I stayed with the current management and mine impacts
- ☐ Some other reason. Please specify below:
  …………………………………

Go to Question 7

Question 7

Thinking about the information presented at the start of this survey on the impacts of the mines and the questions asked earlier, please indicate how strongly you agree or disagree with EACH of the following statements. Tick the option that is closest to your view.

I understood all the information provided

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree Nor Disagree
- ☐ Agree
- ☐ Strongly Agree

I needed more information than was provided

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree Nor Disagree
- ☐ Agree
- ☐ Strongly Agree

I found answering Questions 1 to 5 confusing

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree Nor Disagree
- ☐ Agree
- ☐ Strongly Agree

WE WOULD LIKE TO KNOW HOW FAMILIAR YOU ARE WITH THE NATURAL AREAS OF THE SOUTHERN COALFIELD

Question 8

Have you visited the natural areas of the Southern Coalfield (Illawarra, Wollongong, Wollondilly or Southern Highlands) in the last 10 years?

- ☐ Never visited ⟶ go to Q10
- ☐ Visited only once
- ☐ Visited between once and 10 times
- ☐ Visited more than 10 times

Question 9

When you visited the natural areas of the Southern Coalfield (Illawarra, Wollongong, Wollondilly or Southern Highlands), which of the following things did you do? (tick as many boxes as applies)

☐ Camping	☐ Visiting friends
☐ Bushwalking	☐ Fishing
☐ Sightseeing	☐ Picnicking
☐ Swimming	☐ Other (please specify) ………………..
☐ Birdwatching	………………..

Question 10

How interested are you in the environmental impacts of mining in the Southern Coalfield?

- ☐ Not interested at all
- ☐ Slightly interested
- ☐ Moderately interested
- ☐ Very interested

In this last section, we would like to ask you a few questions to help us understand why respondents' opinions may differ.

WE REALISE THAT SOME OF THESE QUESTIONS MAY BE SENSITIVE TO YOU BUT PLEASE BE ASSURED THAT THE INFORMATION IS CONFIDENTIAL

Question 11

What is your age? …………..

Question 12

What is your gender?

☐ Male	☐ Female

Question 13

Do you have any children?

☐ Yes	☐ No

Question 14

What is the postcode where you live? ……….

Question 15

What is the highest level of education you have obtained?

☐ Never went to school	☐ Diploma or certificate
☐ Primary only	☐ Tertiary degree
☐ Junior/Year 10	☐ Post-graduate degree
☐ Secondary/Year 12	☐ Other (please specify) ……………………….. ……………………….

Question 16

How many people live in your household?.............

Question 17

How many people in your household are under 18 years of age?

Question 18

Annual Household Income - Please indicate the approximate total household income (before taxes) earned last year. The ranges shown are consistent with those used in the 2006 Census.

As for all your answers, information provided here is **STRICTLY CONFIDENTIAL**.

☐ Under $7,799	☐ $62,400 to $72,799
☐ $7,800 to $12,999	☐ $72,800 to $88,399
☐ $13,000 to $18,199	☐ $88,400 to $103,999
☐ $18,200 to $25,999	☐ $104,000 to $129,999
☐ $26,000 to $33,799	☐ $130,000 to $155,999
☐ $33,800 to $41,599	☐ $160,000 or more
☐ $41,600 to $51,999	☐ Don’t know
☐ $52,000 to $62,399	

Question 19

When you have heard about proposed mining projects where there is a conflict between development and the environment, have you tended to:

- ☐ Favour protection of the environment
- ☐ Favour development and environmental protection about equally
- ☐ Favour development

Question 20

If people living in the Illawarra, Wollongong or Wollondilly and/or working in mining are made worse-off by changing the environmental impacts of the mines, the State Government may provide some assistance, at a cost to taxpayers.

Would you:

- ☐ Strongly Agree with providing assistance
- ☐ Agree with providing assistance
- ☐ Neither Agree nor Disagree with providing assistance
- ☐ Disagree with providing assistance
- ☐ Strongly Disagree with providing assistance

Question 21

Are you, or a member of your close family, a member of an organisation that is associated with environmental conservation or regularly contribute to this type of organisation?

☐ Yes	☐ No

Question 22

Are you, or a member of your close family, associated with the mining industry?

☐ Yes	☐ No

If you would like to make any other comments about managing the impacts of mines in the Southern Coalfield, or about this questionnaire, please make them in the following space.

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

Thank you for completing this questionnaire. We hope that you enjoyed taking part in the survey

ATTACHMENT 2 – CONDITIONAL LOGIT MODELS WITH ATTITUDINAL VARIABLES ONLY

Table A2
Results of Conditional Logit Models with Attitudinal Variables

Variable	V1a NSW		V1b Illawarra		V2		V3	
	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
Cost	-0.00169901	0.0000	-0.00152194	0.0000	-0.00149904	0.0000	-0.00772119	0.0000
Km	-0.00948237	0.0000	-0.00880143	0.0000	-0.00899913	0.0000	-0.00944095	0.0000
Ha	-0.00330108	0.0000	-0.00134896	0.0000	-0.00289474	0.0002	-0.00353454	0.0000
No	-0.01112319	0.0016	-0.01009164	0.1063	-0.01097576	0.0020	-0.00707116	0.0387
Years	0.04400526	0.0000	0.05620376	0.0080	0.03713951	0.0000	0.05009240	0.0000
ASC	-1.42895494	0.0000	-0.93139300	0.0001	-1.57736385	0.0000	-1.28848390	0.0000
ASCINT	0.95418500	0.0000	0.82259277	0.0000	0.94192452	0.0000	1.11257967	0.0000
ASCDEVEN	0.91217122	0.0000	0.74790744	0.0000	0.75358282	0.0000	0.43978070	0.0000
ASCENV	0.99737114	0.0000	0.76229524	0.0000	0.91063421	0.0000	0.43978070	0.0051
ASCDEV	0.01516058	0.9219	-0.15330948	0.2383	-0.18009646	0.2611	-0.29689446	0.0352
AIC	1.871		1.884		1.900		1.955	
BIC	1.887		1.903		1.916		1.972	
Pseudo R2	0.087		0.076		0.063		0.078	
Log likelihood	-3600.725		-3113.182		-3595.280		-3759.069	
LLRatio (base of attributes only)	359.726		184.466		249.092		297.518	
Chi2 (4DF)	9.49		9.49		9.49		9.49	

ATTACHMENT 3 – GRAPHICAL REPRESENTATION OF CONDITIONAL LOGIT MODEL IMPLICIT PRICE 95% CONFIDENCE INTERVALS

Figure A3.1 – Km Implicit Price Confidence Intervals

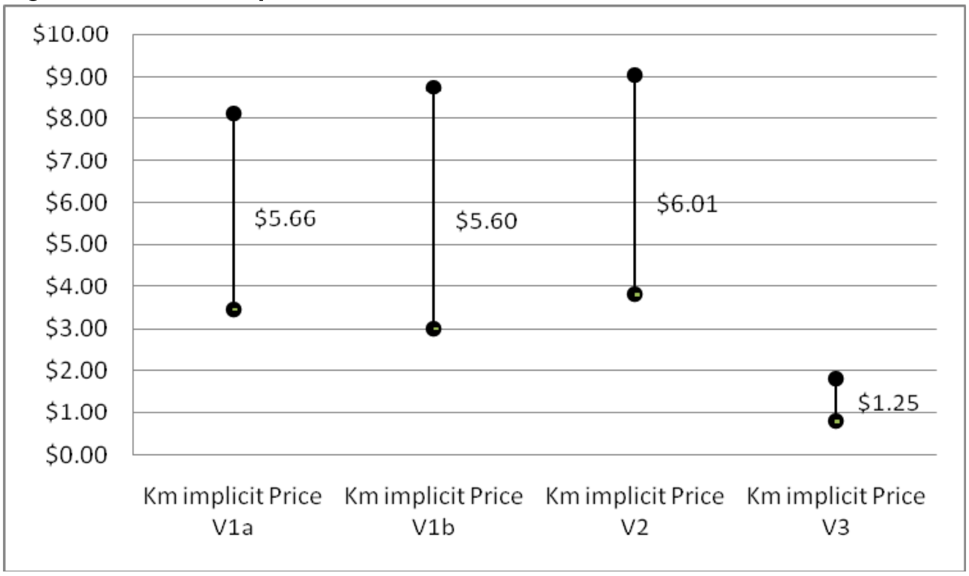


Figure A3.2 – Ha Implicit Price Confidence Intervals

Figure A3.3 – No Implicit Price Confidence Intervals

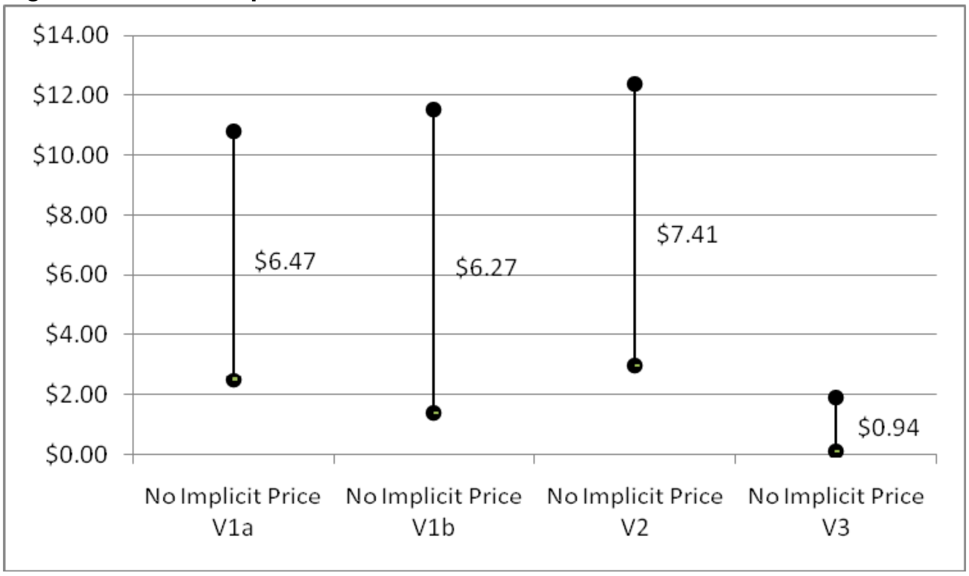
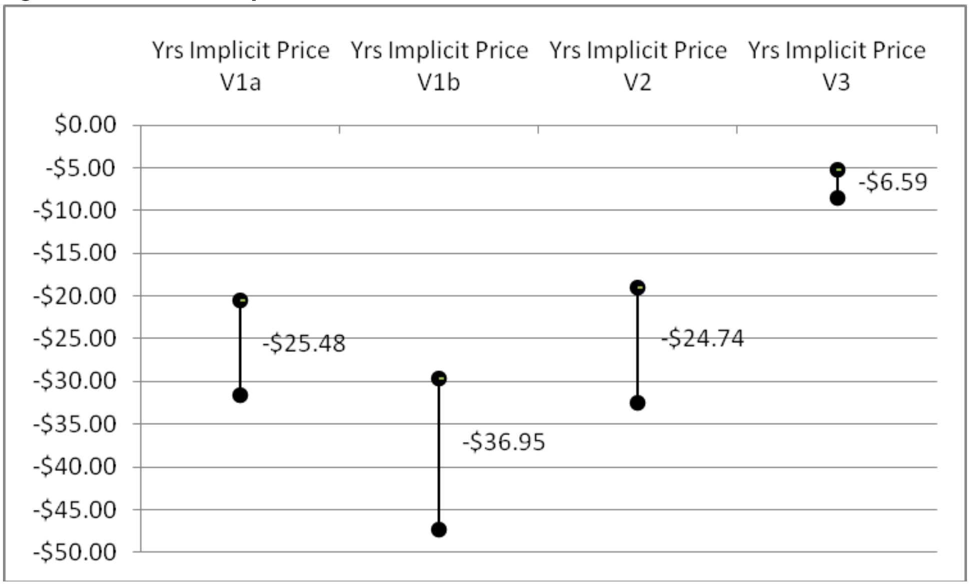


Figure A3.4 – Yrs Implicit Price Confidence Intervals



ATTACHMENT 4 – GRAPHICAL REPRESENTATION OF RANDOM PARAMETER MODEL IMPLICIT PRICE 95% CONFIDENCE INTERVALS

Figure A4.1 – Km Implicit Price Confidence Intervals

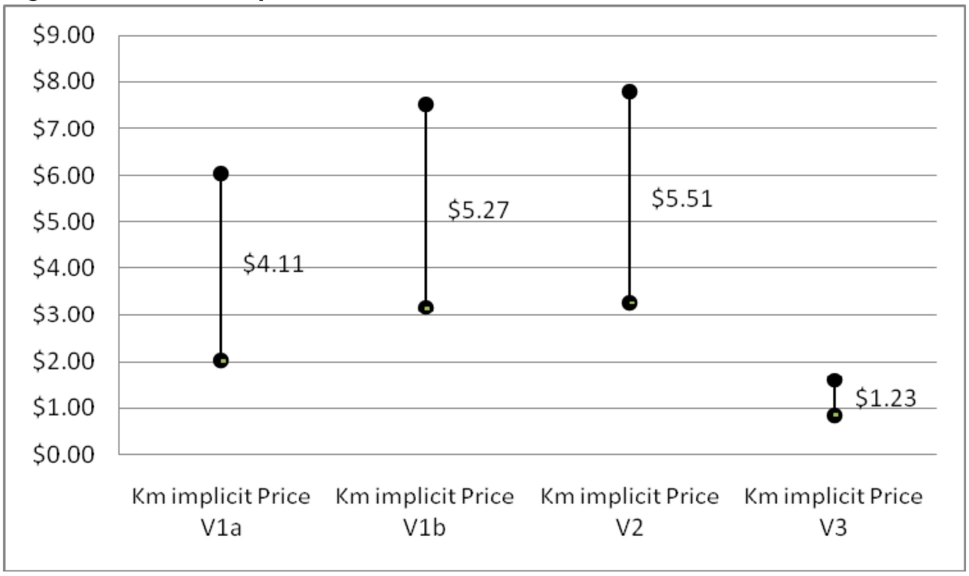


Figure A4.2 – Ha Implicit Price Confidence Intervals

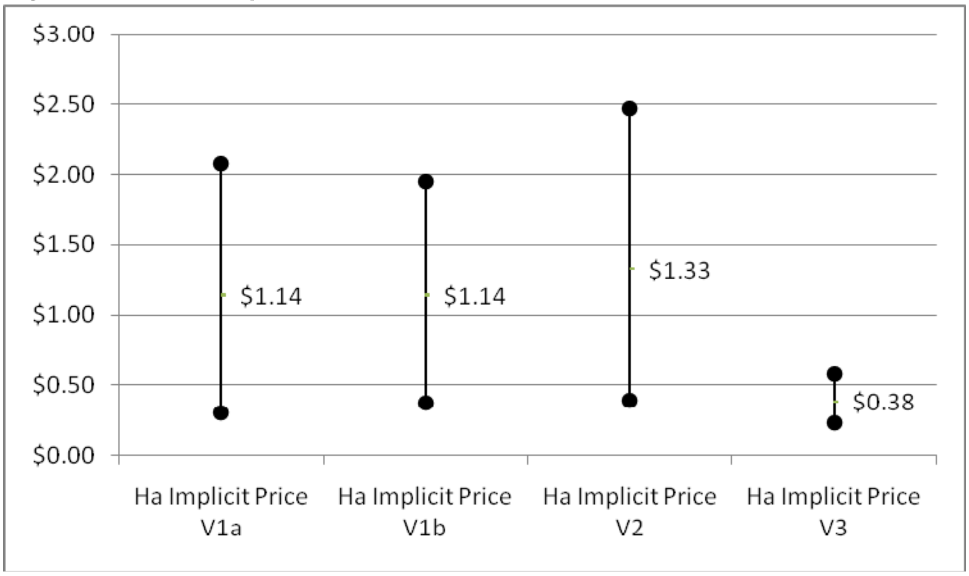


Figure A4.3 – No Implicit Price Confidence Intervals

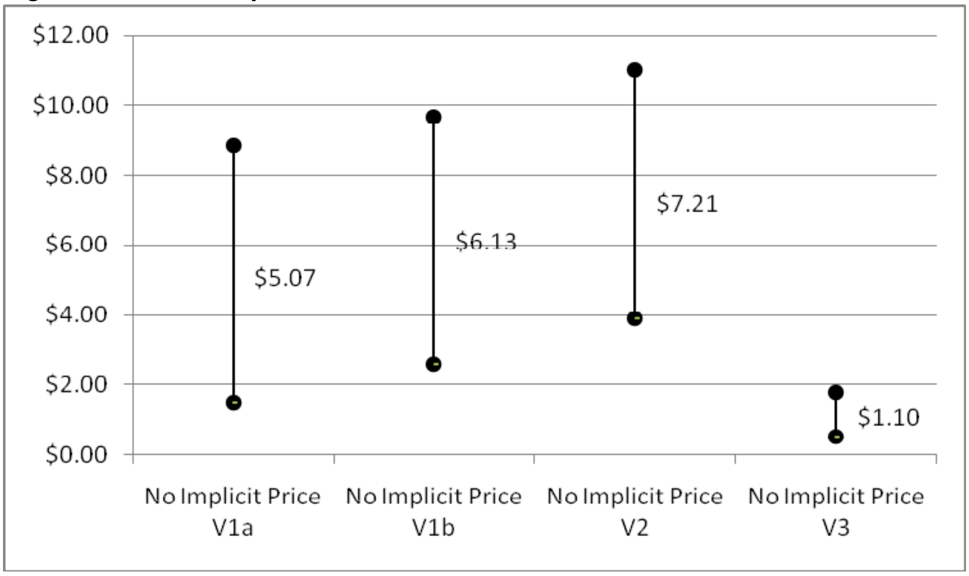
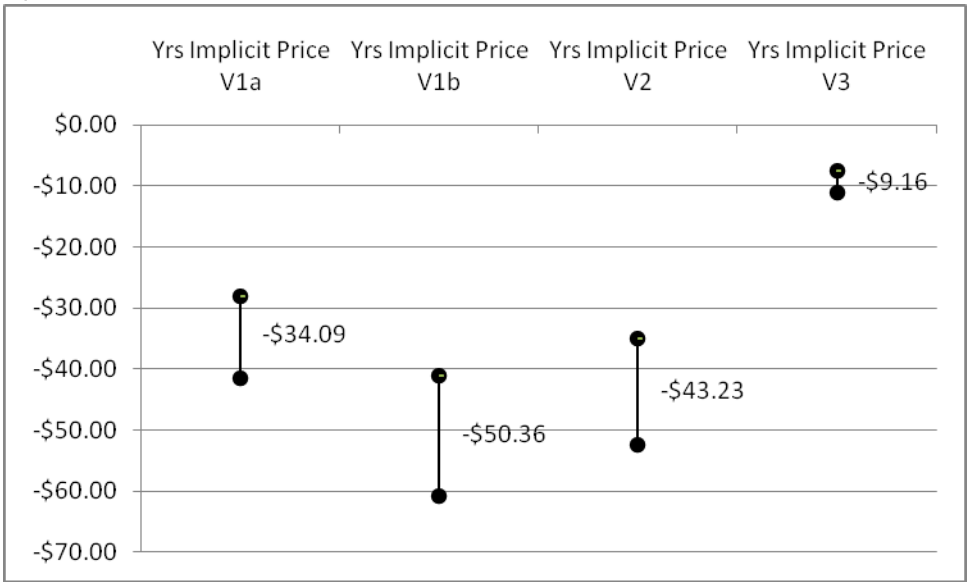


Figure A4.4 – Yrs Implicit Price Confidence Intervals



ATACHMENT B – VALUING GREENHOUSE GAS EMISSIONS

To place an economic value on carbon dioxide equivalent (CO_2-e) emissions a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions.

A prerequisite to valuing this environmental damage is scientific dose-response functions identifying how incremental emissions of CO_2-e would impact climate change and subsequently impact human activities, health and the environment on a spatial basis. Only once these physical linkages are identified is it possible to begin to place economic values on the physical changes using a range of market and non market valuation methods. Neither the identification of the physical impacts of additional greenhouse gas nor valuation of these impacts is an easy task, although various attempts have been made using different climate and economic modelling tools. The result is a great range in the estimated damage costs of greenhouse gas.

The Stern Review: Economics of Climate Change (Stern, 2006) acknowledged that the academic literature provides a wide range of estimates of the social cost of carbon. It adopted an estimate of United States (US) $85 per tonne (/t) of carbon dioxide (CO_2) for the "business as usual" case, i.e. an environment in which there is an annually increasing concentration of greenhouse gas in the atmosphere.

Tol (2006) highlights some significant concerns with Stern's damage cost estimates including:

- that in estimating the damage of climate change Stern has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's estimate of the social cost of carbon is based on a single integrated assessment model, PAGE2002, which assumes all climate change impacts are necessarily negative and that vulnerability to climate change is independent of development; and
- Stern uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world.

All these have the effect of magnifying the social cost of carbon estimate, providing what Tol (2006) considers to be an outlier in the marginal damage cost literature.

Tol (2005) in a review of 103 estimates of the social cost of carbon from 28 published studies found that the range of estimates was right-skewed: the mode was US$0.55/t CO_2 (in 1995 US$), the median was US$3.82/t CO_2, the mean US$25.34/t CO_2 and the 95^{th} percentile US$95.37/t CO_2. He also found that studies that used a lower discount rate and those that used equity weighting across regions with different average incomes per head, generated higher estimates and larger uncertainties. The studies did not use a standard reference scenario, but in general considered 'business as usual' trajectories.

Tol (2005) concluded that "it is unlikely that the marginal damage costs of carbon dioxide emissions exceed US$14/t CO_2 and are likely to be substantially smaller than that". Nordhaus's (2008) modelling using the DICE-2007 Model suggests a social cost of carbon with no emissions limitations of US$30 per tonne of carbon (/tC) (US$8/t CO_2).

An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO_2 resulting in climate change damage costs or may purchase credits that offset their CO_2 impacts, internalising the cost of the externality at the price of the carbon credit. The price of carbon credits therefore provides an alternative estimate of the economic cost of greenhouse gas. However, the price is ultimately a function of the characteristics of the scheme and the scarcity of permits etc and hence may or may not reflect the actual social cost of carbon.

The price of carbon credits under the European Union Emissions Trading Scheme are currently around Pounds (£) 24/t CO_2, the equivalent of about US$38/t CO_2 while spot prices in the Chicago Climate Exchange are in the order of US$3.95/t CO_2.

More recent information on the cost of carbon credits can be obtained from the carbon reduction schemes in Australia. As of July 2008 the spot price under the NSW Government Greenhouse Gas Reduction Scheme was Australian Dollars (AUD) $7.25/t CO_2. Prices under the Commonwealth Governments Greenhouse Friendly Voluntary Scheme were AUD$8.30/t CO_2 and Australian Emissions Trading Unit (in advance of the Australian Governments Emissions Trading Scheme) was priced at AUD$21/t CO_2-e (Next Generation Energy Solutions, pers. comms., 24 July 2008).

A National Emissions Trading Scheme is foreshadowed in Australia by 2010. While the ultimate design and hence liabilities under the scheme are still a work in progress, the National Emissions Trading Taskforce cited a carbon permit price of around AUD$35/t CO_2.

The *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future White Paper* (Australian Government, 2008) cited a carbon permit price of AUD$23/t CO_2-e in 2010 and AUD$35/t CO_2-e in 2020 (in 2005) dollars for a 5% reduction in carbon pollution below 2000 levels by 2020.

Given the above information and the great uncertainty around damage cost estimates, a range for the social cost of greenhouse gas emissions from AUD$8/t CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.6 of the Socio-Economic Assesssment, with a conservatively high central value of AUD$30/t CO_2-e.

REFERENCES

Stern, N. (2006) *Stern Review: The Economics of Climate Change – Executive Summary*, Cabinet Office – HM Treasury.
Website: www.hm-treasury.gov.uk/media/8AC/F7/Executive_Summary.pdf.

Tol, R. (2005) *The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties*, Energy Policy 33 (2005) p. 2064-2074.

Tol, R. (2006) *The Stern Review of the Economics of Climate Change: A Comment.* Economic and Social Research Institute, Hamburg, Vrije and Carnegie Mellon Universities.

ATTACHMENT C – BCA SENSITIVITY TESTING

Benefit Cost Analysis Sensitivity Testing ($Millions)

INCREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
Opportunity cost of land	$11,858	$8,281	$6,068
Opportunity cost of capital	$11,783	$8,208	$5,997
Capital costs	$11,599	$8,080	$5,904
Operating costs	$9,974	$6,973	$5,106
Revenue	$17,035	$11,923	$8,772
Residual value of capital	$11,858	$8,282	$6,069
Residual value of land	$11,858	$8,282	$6,069
Operational noise impacts	$11,858	$8,281	$6,068
Transport noise impacts	$11,858	$8,282	$6,069
Visual impacts on recreation values	$11,858	$8,282	$6,069
UPPER 95% CONFIDENCE LIMIT			
Stream impacts	$11,704	$8,132	$5,923
Aboriginal site impacts	$11,719	$8,147	$5,937
Vegetation impacts	$11,741	$8,168	$5,958
Swamp impacts	$11,822	$8,247	$6,035
Value of employment	$12,044	$8,462	$6,244
Upper 95% Confidence Limit All	$11,597	$8,028	$5,822
GREENHOUSE COSTS @ $40/TONNE (T)	$10,838	$7,572	$5,546

DECREASE 20%	4% Discount Rate	7% Discount Rate	10% Discount Rate
Opportunity cost of land	$11,859	$8,282	$6,069
Opportunity cost of capital	$11,934	$8,355	$6,140
Capital costs	$12,118	$8,483	$6,234
Operating costs	$13,743	$9,590	$7,032
Revenue	$6,681	$4,641	$3,366
Residual value of capital	$11,858	$8,282	$6,069
Residual value of land	$11,858	$8,282	$6,069
Operational noise impacts	$11,859	$8,282	$6,069
Transport noise impacts	$11,858	$8,282	$6,069
Visual impacts on recreation values	$11,858	$8,282	$6,069
LOWER 95% CONFIDENCE LIMIT			
Stream impacts	$12,012	$8,432	$6,214
Aboriginal site impacts	$11,995	$8,415	$6,198
Vegetation impacts	$11,967	$8,387	$6,171
Swamp impacts	$11,895	$8,318	$6,104
Value of employment	$11,696	$8,124	$5,915
Lower 95% Confidence Limit All	$12,132	$8,548	$6,328
GREENHOUSE COSTS @ $8/T	$14,102	$9,845	$7,220

ATTACHMENT D

MSEC DIAGRAMS OF ALTERNATIVES INVOLVING PANEL SETBACKS

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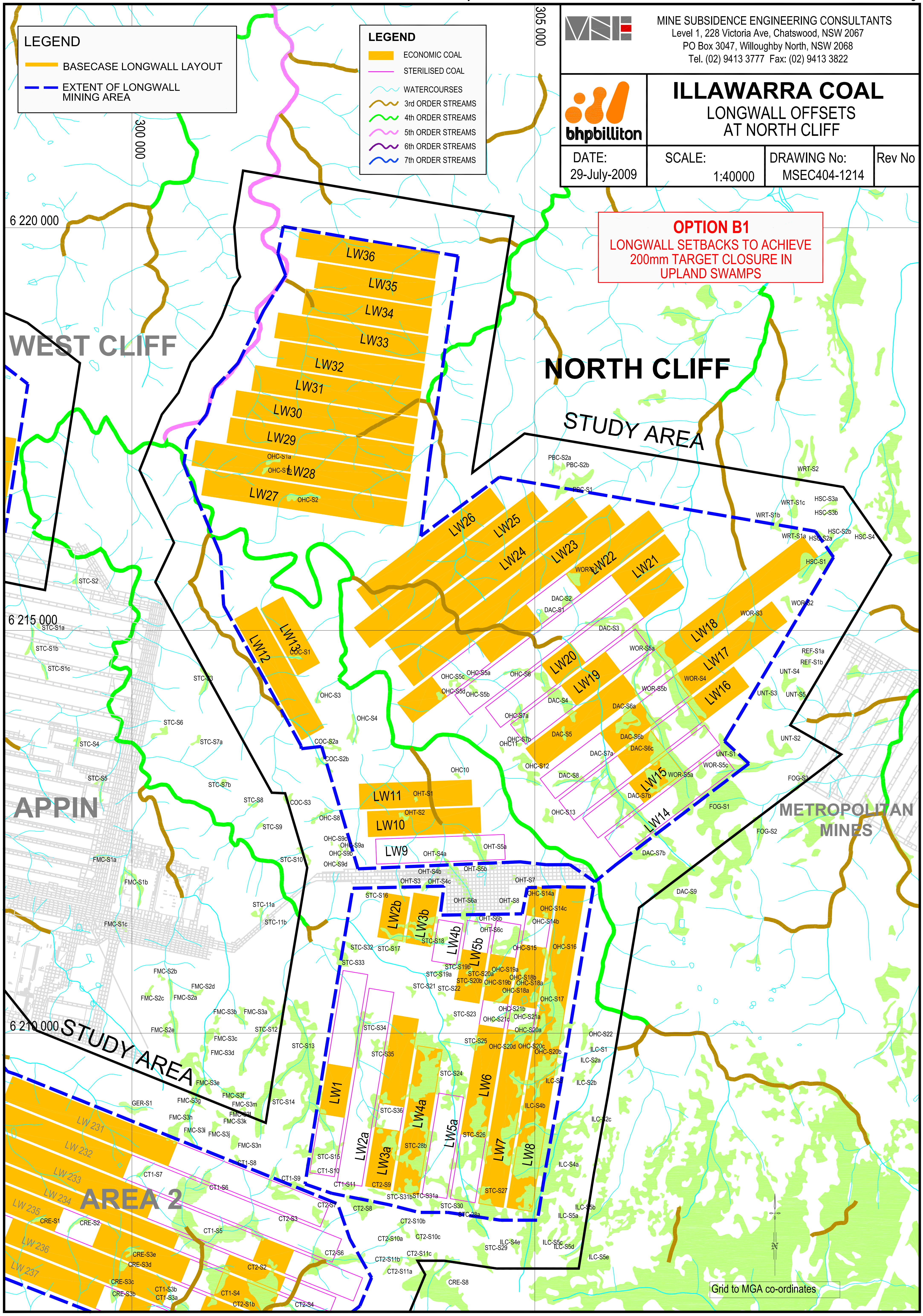

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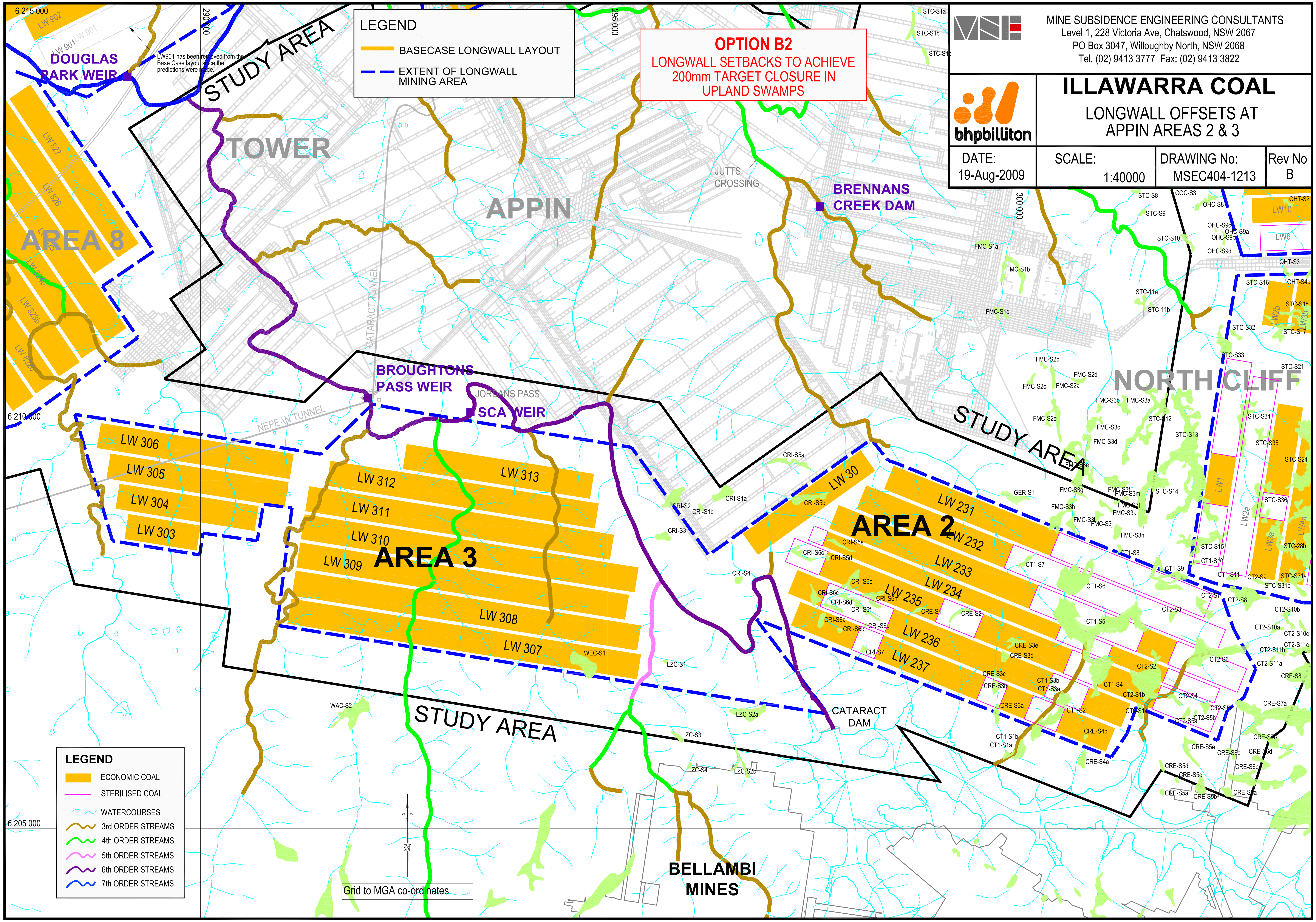

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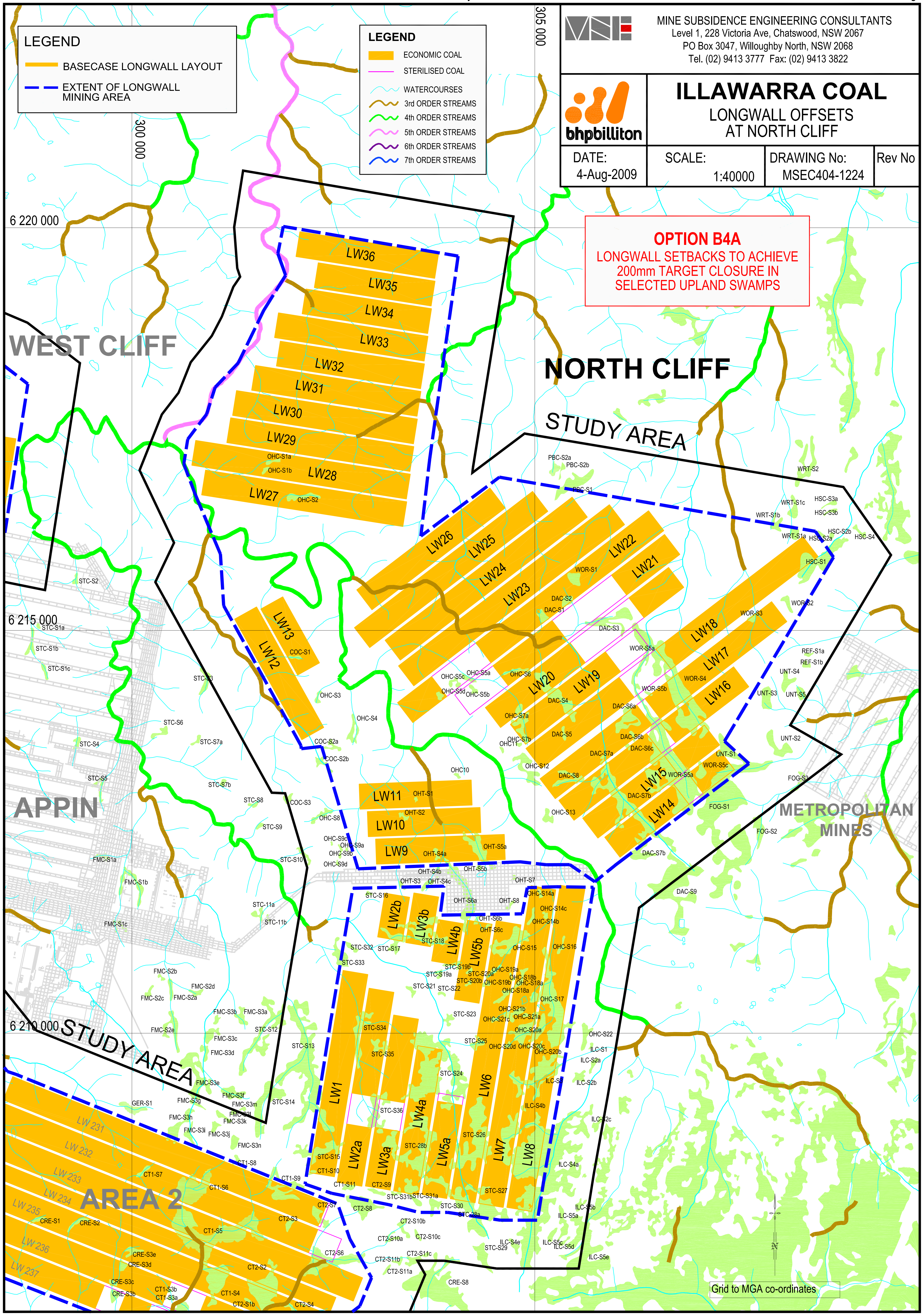

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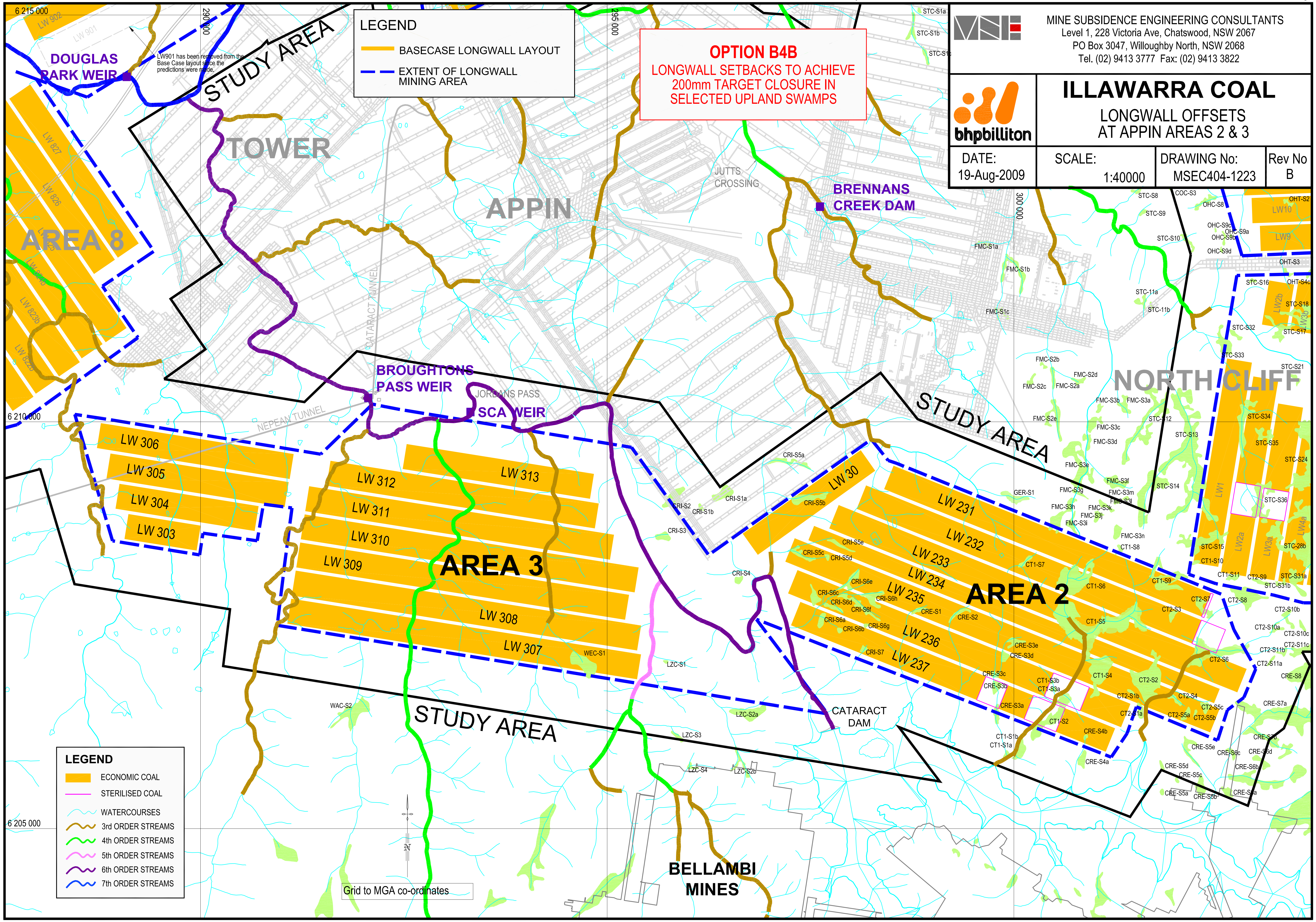

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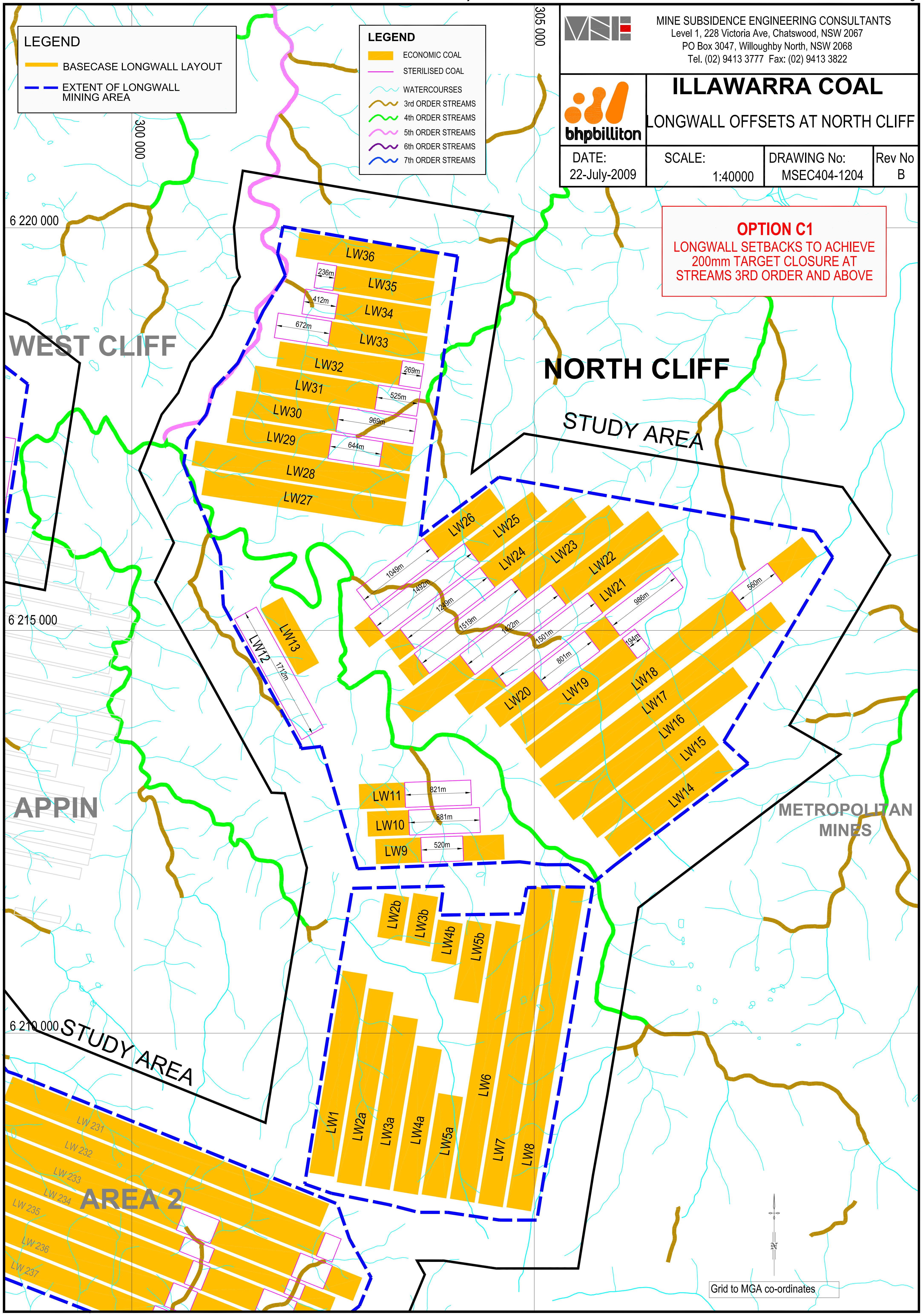

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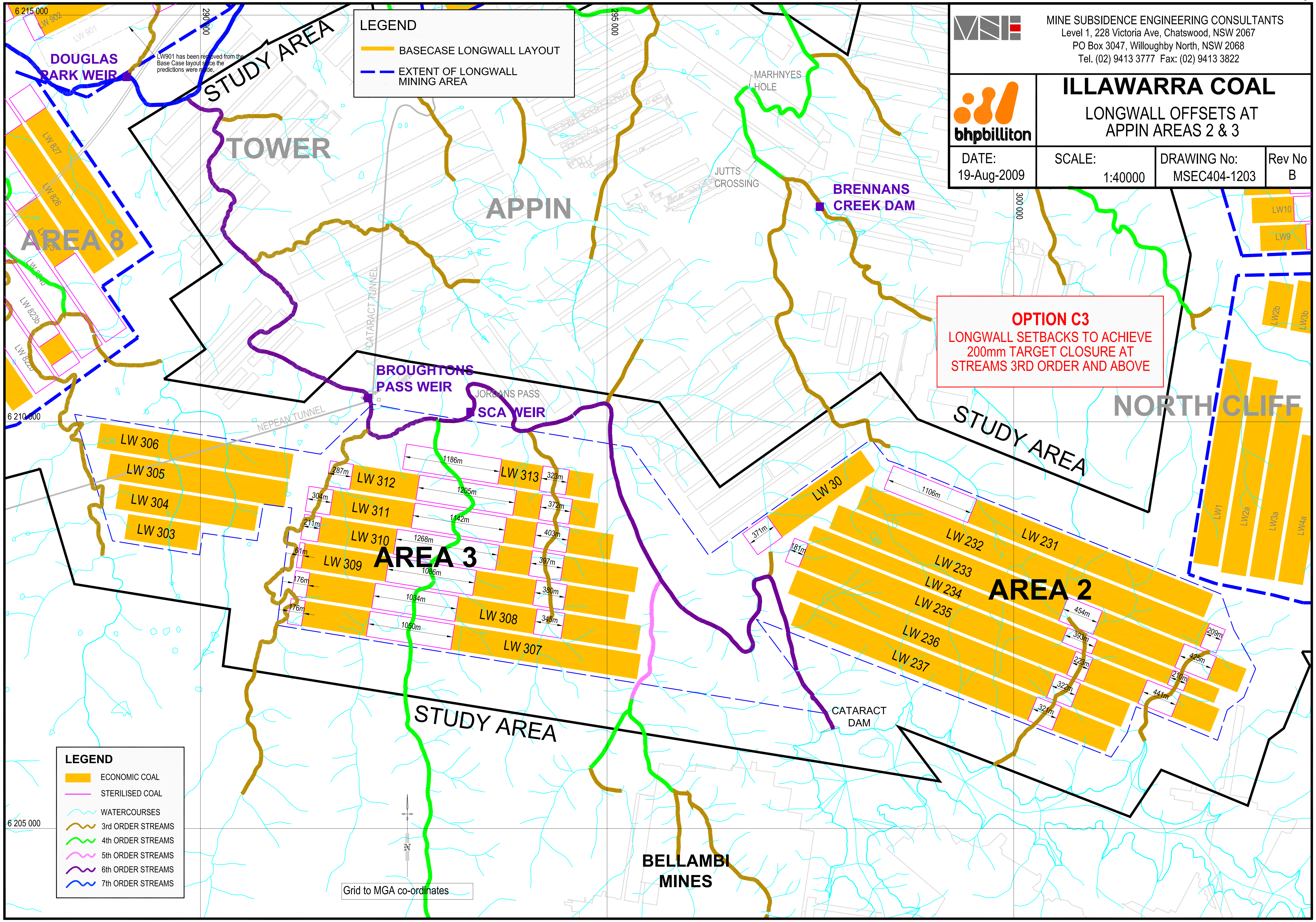

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bhpbilliton

ILLAWARRA COAL

LONGWALL OFFSETS AT APPIN AREAS 2 & 3

DATE:	SCALE:	DRAWING No:	Rev No
19-Aug-2009	1:40000	MSEC404-1203	B

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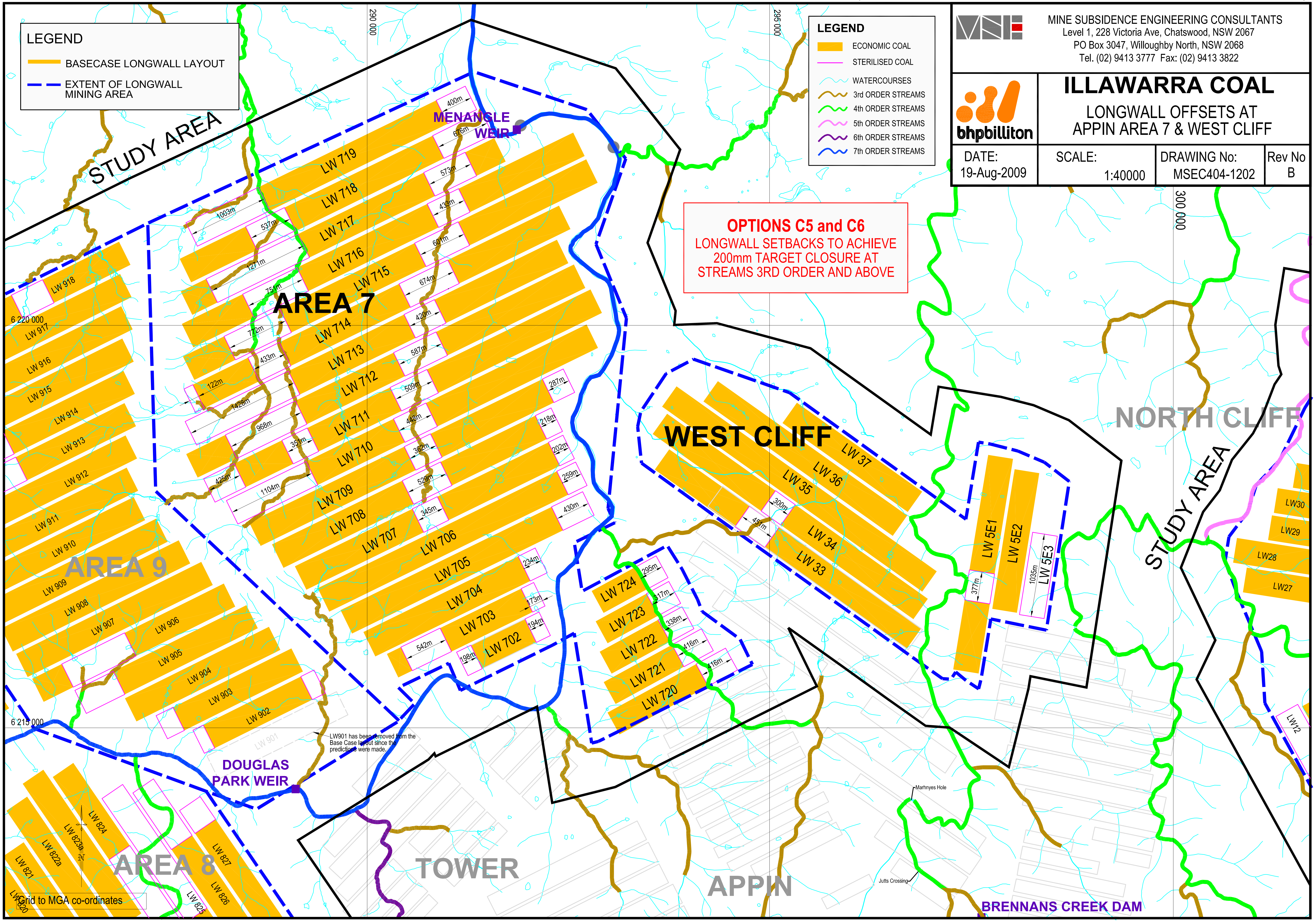

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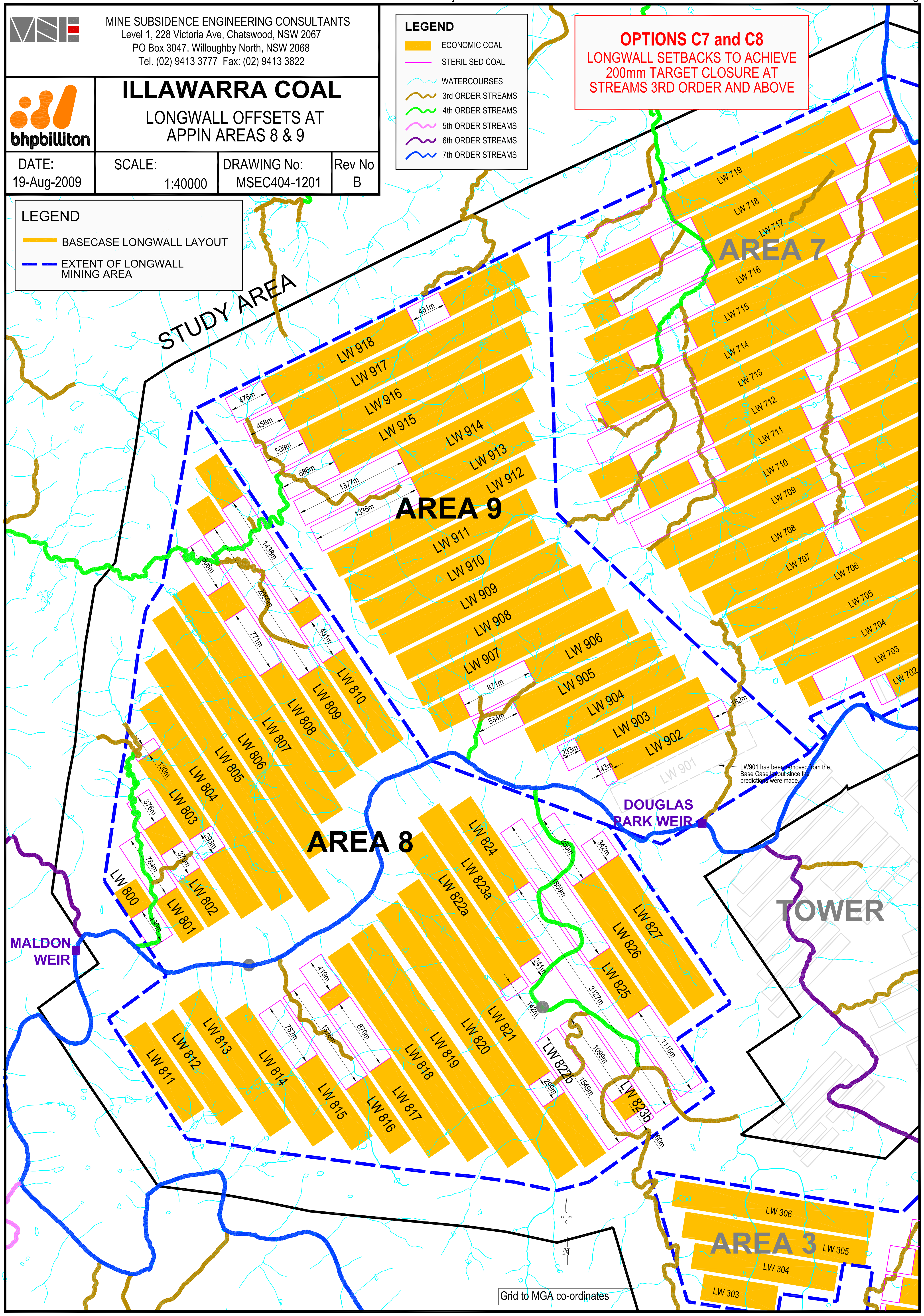

ATTACHMENT E – THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

“The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the non-ferrous metals and building and construction sectors. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study. It also means that the method should be used by an analyst who is familiar with the economy being modelled, or at least someone with that familiarity should be consulted.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). That means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table E-1 (Powell and Chalmers, 1995).

Table E-1
The GRIT Method

Phase	Step	Action
PHASE 1		ADJUSTMENTS TO NATIONAL TABLE
	1	Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
PHASE II		ADJUSTMENTS FOR REGIONAL IMPORTS
		(*Steps 4-14 apply to each region for which input-output tables are required*)
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
PHASE III		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
PHASE IV		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
PHASE V		DERIVATION OF FINAL TRANSACTIONS TABLES
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Bayne and West (1988).

REFERENCES

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