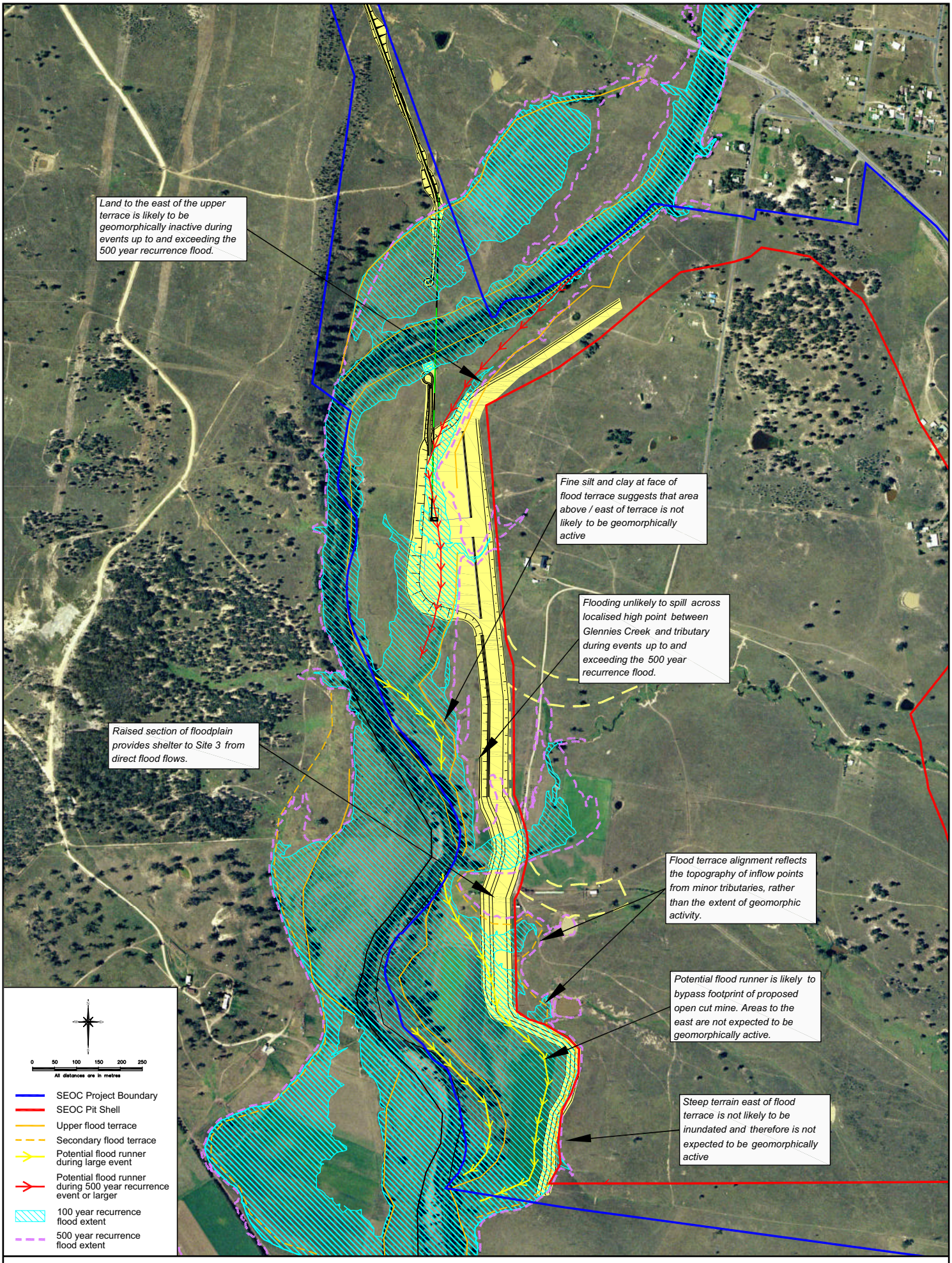

AshtonCoal

South East Open Cut Project

Conceptual model of geomorphic process for Glennies Creek adjacent to the SEOC

Worley Parsons

Figure 5.33

Plan 57

Prepared by Pegasus Technical

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5.13.3 Mitigation Measures

The flood protection levee proposed along the edge of the open cut area will be designed to resist scour due to flood flows based on the peak overbank flow velocities for the 500 year recurrence flood. This should include strict compaction criteria, particularly around the riverward toe of the levee. This will ensure that the levee is constructed using suitable materials and will reduce the potential for levee breaching should an event rarer than the 100 year recurrence flood occur.

Notwithstanding, it is recognised that predicted peak (section averaged) flow velocities are typically less than 1.0 m/s, even in the design 500 year recurrence flood. Therefore, a grass covered embankment will in the majority of circumstances provide sufficient protection. It may be appropriate to provide additional protection in the form of rock armour at localised sections where increased overbank velocities are predicted.

5.14 Soils, Agricultural Suitability and Rural Land Capability

A Soils, Land Capability and Agricultural Suitability Assessment was undertaken by the Department of Lands Soil Conservation Service for the SEOC and is reproduced in **Appendix 8** in Volume 4.

The assessment is based on interpretation of aerial photographs and topographic maps, along with a series of site observations and data collection through excavation of soil test pits and laboratory analysis of soil samples.

5.14.1 Soil Types

Loamy Rudosols, Brown Sodosols, Grey Sodosols, Red Chromosols, Mottled-Sodic Red Chromosols and Sodic Bleached-Mottled Brown Chromosols soil types were identified on the SEOC. These soils were identified on the creek flats, terrace, footslopes, lower slopes, hillslopes and ridge lines. Soil properties identified across the area included moderately acidic to moderately alkaline pH. Slight to moderate salinity and high dispersion was a common characteristic. Soil type boundaries are shown by **Figure 5.34**.

5.14.1.1 Rudosols

Rudosols are young soils with little modification of parent sediments. They are the sandy loam and loamy sands identified adjacent to Glennies Creek. Laboratory testing showed low soil salinity, slight acidity, an inclination to slake with sight dispersion and likely to set hard if cultivated when wet. This soil type was recorded to a depth of 1.2m.

5.14.1.2 Chromosols

Chromosols have a clear or abrupt boundary between A and B horizons, where the subsoils are not strongly acidic and are not sodic. The Chromosol soils observed on the SEOC project site consisted primarily of two distinct groups; the Red Chromosols and Mottled-Sodic Red Chromosols and the Sodic Bleached-Mottled Chromosols.

Red Chromosols were identified on the ridge saddles and upper slopes and consisted of moderately acidic reddish brown, clay loam topsoil to a depth of approximately 0.12m. Typically underlying the topsoil was a strongly structured but moderately acidic yellowish, red medium clay.

The Sodic Bleached-Mottled Brown Chromosols were identifed on the rounded ridge tops and the upper slopes. The topsoil comprised of a moderately acidic, dark greyish brown, sandy clay loam A1 and a pale brown bleached AS horizon. The subsoil was yellowish brown, medium clay with orange and grey mottles, characteristically indicative of impeded drainage throughout the subsoil.

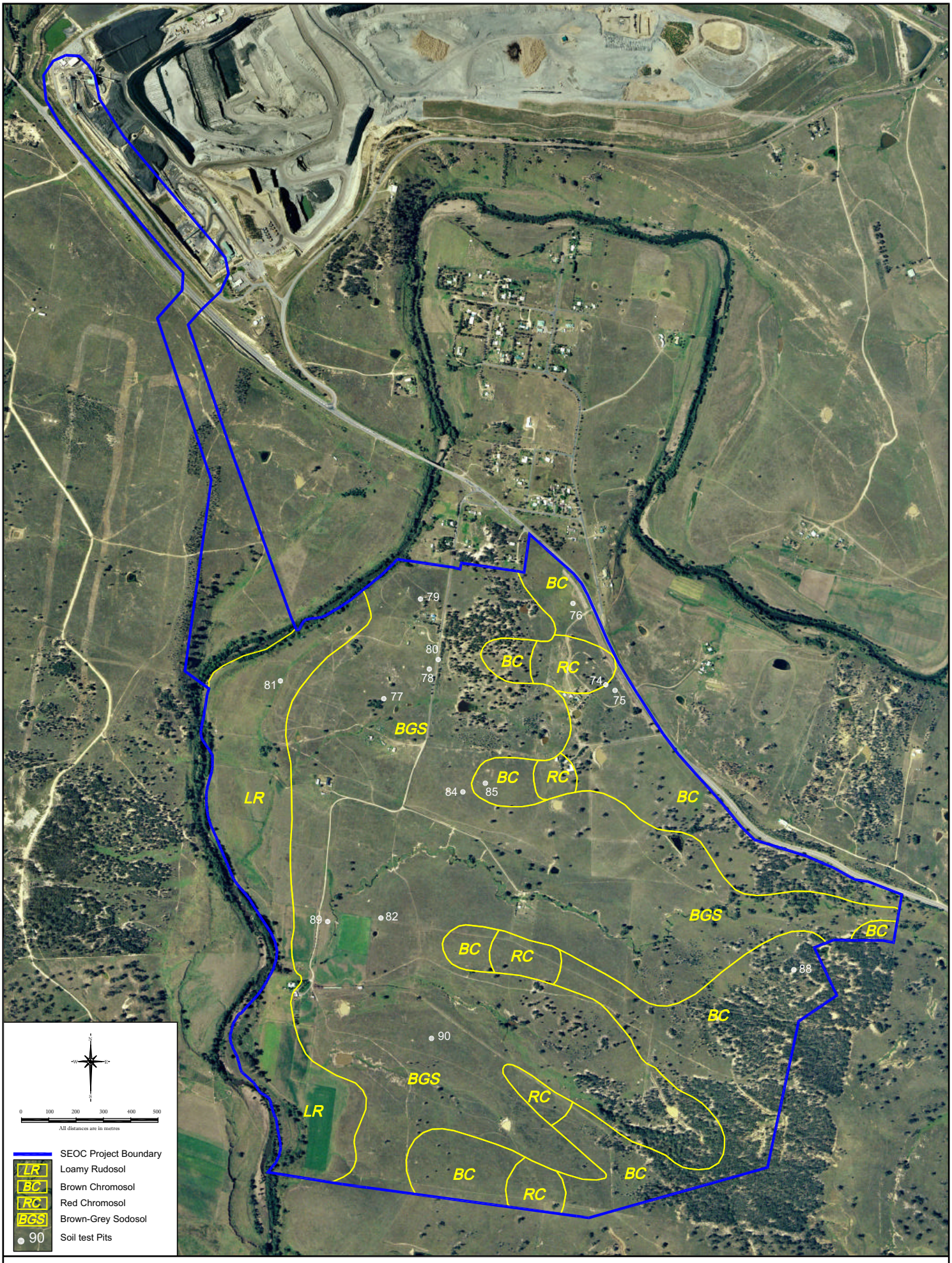
Laboratory analysis found low salinity for all chromosols tested. The topsoil and subsoil samples were prone to slake but with slight dispersion when reworked.

5.14.1.3 Sodosols

Sodosols are soils with a clear or abrupt textural change and in which the B2 horizon is sodic but not strongly acidic. This was the major soil type identified across the SEOC, with Grey Sodosols and Brown Sodosols found on the midslopes, lower slopes, footslopes and terrace.

Brown and Grey Sodosols located on the slopes comprised of moderately acidic to neutral topsoils with low salinity and the subsoil was moderately alkaline or moderately saline. Sodosols in the creek terrace landscape comprised neutral pH and low salinity throughout the profile.

Sodosol topsoils were prone to slake but exhibited only slight dispersions which reflects the surface crusting and hardsetting, with high dispersion found in the B horizon indicative of the tendency for poor drainage and susceptibility to erosion in the subsoils.



AshtonCoal

South East Open Cut Project

Soil Type Boundaries

Soil Conservation Service

Figure 5.34

Plan 58

Prepared by Pegasus Technical

CAD FILE: 05056B.dwg

5.14.2 Rural Land Capability

The Department of Lands Soil Conservation Service conducted a rural land capability assessment in accordance with the NSW eight class system. The system recognises three types of land use and eight land classes, these being:

- Land suitable for cultivation (Classes I to III).
- Land suitable for grazing (Classes IV to VI).
- Land not suitable for rural production (Classes VII and VIII).

Four rural land capability classes were identified as being specific to the SEOC as shown by **Figure 5.35** and are described below in accordance with Cunningham et al; (undated).

- Land Capability Class II – suitable for regular cultivation – soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation.
- Land Capability Class V – suitable for grazing with occasional cultivation – structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with pasture improvement, stock control, application of fertilizer and minimal cultivation for the establishment or re-establishment of permanent pasture..
- Land Capability Class VI – suitable grazing with no cultivation – soil conservation practices including limitation of stock, broadcasting of seed and fertilizer, prevention of fire and destruction of vermin. May include some isolated structural works.
- Land Cabability Class VIII – cliffs, lakes or swamps and other lands unsuitable for agriculture and pastoral production.

The Soil Conservation Service Camberwell Land Capability Map (Sheet 9133, 1:100,000) shows the proposed SEOC site as a rural land Class V on the hillslopes and as rural land class II on the creek flats, terrace and footslopes.

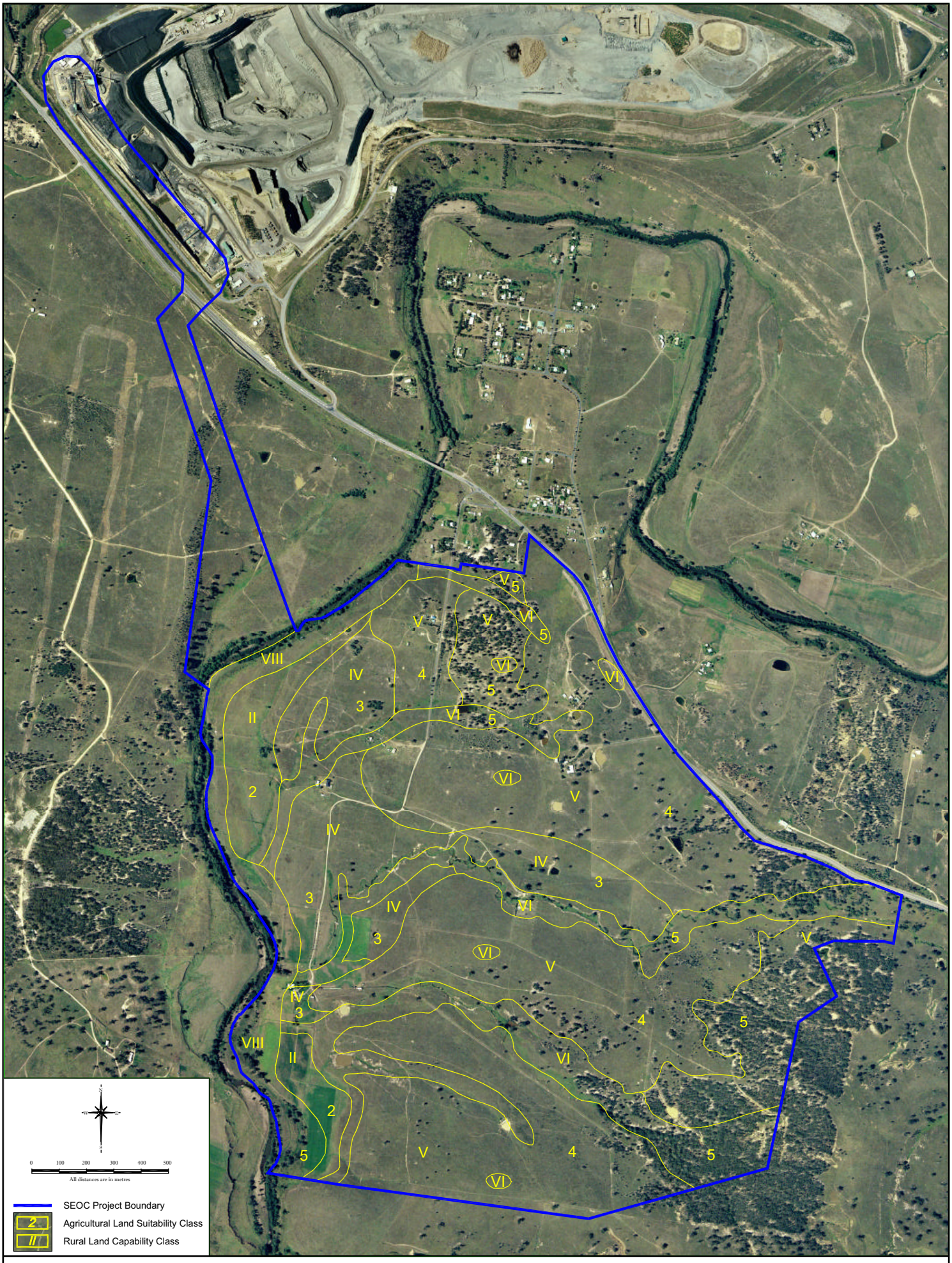
Based on the detailed site and soil assessment undertaken, rural land capability Class II was considered to be appropriate for the light textured creek flats. However, the hardsetting, and in places poached, soil surface, massive structured topsoil and highly dispersive subsoil of the terraces and footslopes suggests that rural land classification VI would be applicable. The appropriate management practices would include grazing management, application of fertiliser as well as conservation tillage, direct drill and crop rotation. The identification of hardest poached soil surface condition of some paddocks within the terrace landforms reinforces the requirement for soil conservation practices to minimise soil degradation.

With the exception of the rocky areas and drainage lines, and consistent with the Camberwell Land Capability Map (Soil Conservation Service), the hillslopes were mapped as rural land Class V. The minor drainage lines and rocky hillcrests were mapped as rural Class VI. Well defined, incised drainage channels of fifth order or greater would be rural land Class VIII.

5.14.3 Agricultural Suitability of the SEOC Area

An agricultural suitability assessment was conducted by the Department of Lands Soil Conservation Service in accordance with the five class system (Riddler, 1996) which classifies land according to its productivity for a wide range of agricultural activities. The classification is based on biophysical factors, social factors and economic factors.

Data provided by the NSW Department of Primary Industries shows the creek flats, terraces and footslopes as agricultural land Class 1 (arable land with very good capability for agriculture). The hillslopes were either agricultural land Class 3 (lands not suitable for regular cultivation, but suited to improve pasture) or agricultural land Class 4 (poor grazing lands not suited for cultivation).



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South East Open Cut Project

Land Capability and Agricultural Suitability

Soil Conservation Service

Figure 5.35

Plan 59

Prepared by Pegasus Technical

CAD FILE: 05057B.dwg

More detailed survey and assessment suggests that:

- Agricultural land Class 2 (arable land suitable for regular cultivation) would be appropriate for the light textured creek flats;
- Agricultural land Class 3 (rotation of pasture and cropping) would be appropriate for the hardsetting and dispersive terrace and footslopes;
- Agricultural land Class 4 (grazing but no cultivation) would be appropriate for hillslopes; and
- Agricultural land Class 5 (light grazing) would be appropriate for the timbered slopes and major drainage lines. The requirement for the construction of structural soil conservation works to minimise erosion with cultivation of hillslopes would make cultivation of these areas uneconomic and thus the recommendation of Class 5 agricultural land.

Agricultural land classes found within the SEOC are shown by Figure 5.35.

5.14.4 Topdressing Material

Soil characteristics can influence the soil suitability for rehabilitation and the successful establishment of vegetation. Generally, the soils were considered to be poorly suited for use as topdressing materials. A hard setting soil surface, appeal structure, mottles, moderate salinity and high dispersion limit the suitability of the soil materials. However, the soil characteristics could be improved by treatment with the appropriate soil ameliorant.

Within the SEOC, the massive or apedal structure and the lack of coherence indicate that the A horizon (topsoil) would be primarily classified as restricted use for topdressing suitability. The A horizon was observed to be prone to hard setting and surface sealing that would impact on revegetation , however, treatment with organic matter may improve the soil condition.

Also handling of the soil in the appropriate moisture conditions may minimise the destruction of the soil structure during stripping. Despite these characteristics, the A horizon (to an average depth of about 0.15m) was considered to be the most valuable resource for revegetation of the site. As such, topsoil will be stripped prior to mining for spreading over the mined site and use in revegetation activities.

Table 5.37 details the estimated quantities of topsoil within the key disturbance areas and details the respective stripping depth. However, due to the soil variability, the actual depth of stripping should be varied to meet soil conditions on site. Small areas where topsoil may not be stripped have been identified as ridge lines where sandstone outcrops occur and in the north west of the project site where a high proportion of gravel was recorded in the A horizon.

Table 5.37: Estimated topsoil stripping depths and topsoil volumes from key disturbance areas.

Soil type / horizon	Top dressing material	Stripping		
		Depth (m)	Area (ha)	Volume (m^3)
Red Chromosols				
A	Suitable	0.1	13.02	13,020
B	Suitable	0.3		39,060
Brown Chromosols				
A	Suitable	0.2	43.72	87,440
B	Suitable with amelioration	0.3		131,160
Brown Grey Sodosols				
A	Suitable	0.2	209.54	419,080
B	Poor suitability	0.3		628,620
Loamy Rudosols				

Soil type / horizon	Top dressing material	Stripping		
		Depth (m)	Area (ha)	Volume (m^3)
A	Suitable	1	13.26	132,600
B	Mostly unsuitable	NA		NA

5.14.5 Impacts to Soils and Agricultural Characteristics from the SEOC

The soil assessment identified the following potential impacts:

- Increased erosion of soils.
- Exposure of soils due to vegetation stripping.
- Stripping of soils within mining disturbance areas.
- Soil contamination resulting from spillage of hydrocarbons and other chemicals.
- Alteration of physical and chemical soil properties.
- Erosion of proposed final landforms.
- The SEOC will directly impact 8.5ha of Class 2 agricultural lands and 52ha of Class 3 agricultural lands, refer to **Table 5.38** and **Table 5.39.**

Table 5.38 provides estimates of impacts based on rural land capability, while Table 5.39 provides estimates of the impacts to agricultural lands by agricultural suitability class.

Table 5.38: Estimated impacts to rural lands by Land Capability class for the key project components.

Component	Class II (ha)	Class III (ha)	Class IV (ha)	Class V (ha)	Class VI (ha)	Class VII (ha)	Class VIII (ha)
Pit Shell	0.5	0	39	121	37	0	0
Out of pit emplacement	0	0	7	38	8	0	0
Infrastructure	8	0	6	13	2	0	0.5
Total	**8.5**	**0**	**52**	**172**	**47**	**0**	**0.5**

Table 5.39: Estimated impacts to agricultural lands by Agricultural Suitability for the key project components.

Project Component	Class 2 (ha)	Class 3 (ha)	Class 4 (ha)	Class 5 (ha)
Pit Shell	0.5	39	111	48
Out of pit emplacement	0	7	38	8
Infrastructure	8	6	12	4
Total	**8.5**	**52**	**160**	**60**

5.14.6 Mitigation and Management of Soils

The management and mitigation of impacts to soils within the SEOC will be addressed through the integration of the SEOC with the existing ACP Erosion and Sediment Control Plan (ESCP) and Soil Stripping Management Plan.

5.14.6.1 Soil Handling Requirements

The soil will be stripped and handled to in a manner to minimise the degradation of the soil structure as well as preserve biological activity within the soil material. Ideally, the soil structure will be stripped and handled when in a moist state and not when either wet or dry and used immediately.

Material stripped for use as topsoil/topdressing material or as subsurface material will be stockpiled separately for reuse. A stockpile height of less than 3m with maximum batter grades of 2:1 (horizontal: vertical) is also desirable.

If the soil is to be stockpiled for a period of time, the stockpile will be revegetated. Furthermore, assessment of weed infestations is also suggested prior to stripping and spreading.

5.14.6.2 Soil Limitations and Ameliorants

Soil limitations were identified across the SEOC project site that may limit plant growth and thus revegetation and rehabilitation. Limitations to plant growth identified included a hard setting soil surface, poor soil structure, slaking, dispersion, and moderate salinity. Some of the soils observed also exhibited characteristics of poor drainage (most significantly the Sodosol soils). Treatment of the soil these inherit soil characteristics should improve the soil conditions for plant growth.

The immediate break-up of soil into microscopic fragments when placed in water, referred to as slaking, was a consistent characteristic of the topsoil observed at the site. The hard setting soil surface observed is also a common characteristic of slaking soils. Hard setting soil is problematic for revegetation as seed germination and establishment is usually decreased. Slaking is recognised as being indicative of less than optimal soil organic matter and as such, the recognised treatment is the application of organic matter and mulch. The application of mulch also serves to protect the soil surface from the effects of raindrop impact. Treatment of the soils with organic matter mulch during revegetation is suggested for all soils across the project area.

Spontaneous and high soil dispersion, associated with high levels of exchangeable sodium and low levels of exchangeable calcium, is a widespread inherit characteristic of soils through the central lowlands of the Hunter Valley and also within some soils of the SEOC project site. The term sodic is used to describe soils with high exchangeable sodium, which usually occurs in conjunction with low exchangeable calcium. The poor soil structure and mottled colours is, in part, the physical expression of the inherent chemical imbalance between sodium and calcium. Poor drainage and also water logging are also associated with high sodium levels and poor structure.

Treatment of sodic or highly dispersive soils is a widely adopted agricultural practice, with the addition of calcium to balance the sodium levels suggested. The most common forms of calcium utilised for the treatment of dispersive soils are agricultural lime and natural gypsum products. The soil pH provides a basis for selection of either agricultural lime or gypsum. For slightly acidic to alkaline soil such as recorded for the SEOC project site, gypsum is suggested as the most effective ameliorant. The application of organic matter is recommended for treatment of soil slaking, which would also be expected to provide benefits for the management of sodic or dispersive soils. **Table 5.40** details the recommended ameliorants for soils in the project area.

Table 5.40: Soil amelioration required for soil management.

Soil type / horizon	Limitations	Soil ameliorants
Red Chromosols		
A	Hard setting Low nutrients	Organic matter, mulch Fertiliser
B	Slaking Low fertility	Organic matter, mulch Fertiliser
Brown Chromosols		
A	Hard setting Low nutrients	Organic matter, mulch Fertiliser
B	Poor structure Mottles Dispersion	Organic matter, mulch Fertiliser Gypsum
Sodosols		
A	Hard setting Low nutrients	Organic matter, mulch Nitrogen and phosphorus fertiliser
B	Poor structure, mottles	Organic matter mulch

Soil type / horizon	Limitations	Soil ameliorants
	Low nutrients Dispersion	Fertiliser Gypsum
B (deep subsoil)	Poor structure, mottles Low nutrients Dispersion Salinity	Not suitable – isolate from plant roots
Loamy Rudosol		
A	Sandy texture Low nutrients	Organic matter, mulch Fertiliser
B	Sandy texture	Not suitable – isolate from plant roots

Natural soils are recognised as having low plant nutrients and it follows that the application of fertilisers to improve soil nutrient deficiencies is adopted not only for soil rehabilitation but also for agricultural practice. The application of fertilisers (such as nitrogen and phosphorus) is thought to be of critical importance to allow adequate plant growth that may provide soil ground cover to protect the soil surface from erosion. This also allows the build up of soil organic matter, carbon and biological activity.

5.14.6.3 Soil Salinity

There were no saline soil scalds (or saline topsoil layers) observed on the SEOC project site. However moderately saline subsoil (at depths below about 0.6m) were, recorded in the soils on the lower slopes and foot slopes (Sodosols). Traditional practice for treatment of salines soil includes amelioration with gypsum and application of organic matter such as mulch. Due to the difficulties associated with the treatment of saline soils, the moderately saline subsoil material should be identified during the stripping process and isolated and buried to isolate from plant roots.

5.14.6.4 Guiding Principles for the Prevention of Land Degradation

The prevention of land degradation through the adoption of appropriate soil conservation practices will be an integral component of site management over the entire mining operations area.

The identification of land degradation issues in combination with immediate and correct remedial solutions provides good environmental management. The adoption of these principals along with broader land management activities to maintain the land within the SEOC will be incorporated into a Land Management Plan.

The following guiding principles should be adhered to for the SEOC project to prevent or arrest any land degradation:

- Continual monitoring and reporting on all mining areas for occurrences of soil erosion and landform irregularities.
- Minimise disturbance areas to all essential mining activities and infrastructure developments only.
- An Erosion and Sediment Control Plan be prepared in accordance with the requirements of Managing Urban Stormwater: Soils and Construction (NSW Department of Housing, 1998) for all open cut mining and infrastructure disturbance areas.
- All erosion control and drainage works to be appropriately designed in accordance with Urban and Sediment Control Guidelines (DLWC, 1992).
- Where surface irregularities are identified caused by mining activities, appropriate soil conservation measures are to be immediately implemented.
- Prevent the diversion of overland flow to areas without adequate stable disposal areas.

- Revegetate all disturbed areas with appropriate revegetation species and techniques which may include hydro mulching and seeding immediately after the mining activity has ceased or erosion has been controlled.
- All access roads and haul roads to be constructed with appropriate pavement surfaces and storm water drainage systems.

The soil survey of the disturbance areas identified the dominant soils throughout the project area. From the physical assessment and the chemical analysis of the soils it was determined that the soils are suitable for rehabilitation with the appropriate soil ameliorant and nutrient inputs applied. A small percentage of soils were deemed unsuitable due to having a very high sand and gravel content or having poor characteristics.

5.15 Geochemical Assessment

ACOL commissioned Environmental Geochemistry International Pty Ltd (EGI) to assess the acid rock drainage (ARD) and salinity characteristics associated with the development of the SEOC. A copy of the report is contained in **Appendix 9** in Volume 4.

5.15.1 Assessment Methodology

The main potential sources for ARD from open cut mining operations include:

- Overburden.
- Open pit floors and void.
- Washery rejects and tailings.
- Raw coal and product coal stockpiles.

To determine the geochemical characteristics and the subsequent potential for ARD, EGI undertook the following assessment:

- Review of the proposed SEOC project.
- Review of the geology of the area and existing mining operations.
- Review of drill logs and drill core from exploration holes to gain an understanding of the mineralogy and select drill core for further sampling and analysis.
- Selection of core sampling intervals to represent full stratigraphical sequence.
- Collection of washery waste samples from existing ACP CHPP.
- Sampling and preparation of samples by crushing and pulverising for further analysis.
- Analysis of samples.
- Review and discussion of analysis results and potential for ARD.

Geochemical testing was carried out on representative samples from four (4) drill cores, with samples taken from continuous intervals from the top to the bottom. The holes were selected in conjunction with the site geologists to best represent the full mine stratigraphic sequence from above Pikes Gully Seam to below Hebden 2 Seam.

Analysis of the 295 samples of overburden, coal seam, seam roof, seam floor, and washery waste samples included:

- Total Sulphur (S) by Leco or Leco equivalent methods.
- pH and electrical conductivity (EC) of deionised water extracts at a ratio of 1 part solid to 2 parts water (pH1:2 and EC1:2).
- Acid neutralising capacity (ANC).
- Standard single addition net acid generation (NAG) test.

Specialised testing was carried out on selected samples to help resolve uncertainties in the above test results, as follows:

- Extended boil and calculated NAG testing to account for high organic carbon contents.
- Sulphur speciation testing by Leco total S, chromium reducible sulphur (CRS) and potassium chloride (KCl) digestion.
- Kinetic NAG test.
- Acid buffering characteristic curve (ABCC) test.

Sample preparation and analysis was undertaken by the following companies:

- Leco total sulphur assays for overburden samples were carried out by Sydney Environmental Soil Laboratory (SESL).

- Total S testing of coal seam, roof, floor and washery waste samples was arranged by Ashton personnel and was carried out by SGS Australia Pty Ltd in Carrington using Leco equivalent techniques.
- CRS of sample solids were carried out by ALS Laboratory Group (Brisbane) and KCl digest solutions were carried out by ALS Laboratory Group (Sydney).
- Analyses of NAG solutions were carried out by Levay & Co. Environmental Services (Adelaide).
- All other analyses were carried out by EGi.

5.15.2 Assessment Results

5.15.2.1 Overburden and Coal Characteristics

Total Sulphur concentrations were available for all samples, however many of the coal seam, roof and floor samples were not available for follow up testing, and could not be classified where S was greater than 0.05%S. All samples with S values of less than or equal to 0.05%S were classified non-acid forming (NAF) due to the negligible risk of acid formation.

A total of 94% of classifiable samples (i.e. excluding those samples with total S >0.05%S and not available for testing) were classified NAF or uncertain (UC; NAF), and 6% of samples were classified potentially acid forming (PAF) or uncertain UC(PAF).

A close association of PAF/UC (PAF) samples with coal seam units and immediately adjacent roof and floor horizons was identified. Only two isolated PAF samples within overburden materials were identified.

Results indicate that overburden materials will be NAF, with minor isolated horizons of PAF. The two PAF overburden samples had relatively low acid capacities of 10 kg H2SO4/t or less, and it is unlikely that these materials would result in ARD due to operational mixing with surrounding higher acid neutralising capacity (ANC) NAF overburden.

The coal seams and immediate roof and floor appear to include more pyrite materials than overburden. Roof and floor samples are reasonably well represented in the data set, and of the 53 samples tested, only 5 samples (10%) were classified PAF or UC (PAF). The coal seams were not well represented, and it is not possible to check for continuity of the isolated PAF coal seam intercepts.

5.15.2.2 Coal Reject Characteristics

Washery waste samples from SEOC coal were not available for testing, but the rejects and tailings currently produced from washing NEOC coal and underground operations are expected to be geochemically similar to those produced from the SEOC, since the coal seams in the SEOC are essentially continuous extensions of those currently mined.

66 samples of coarse drain and rinse screen (D&R) rejects from dense medium processing, spiral rejects and tailings were collected between August 2008 and November 2008.

Results of NAPP and single addition net acid generation (NAG) testing indicate that 16 of the 20 samples subjected to full geochemical testing were NAF, with negative NAPP values and NAGpH values greater than or equal to 4.5. The remaining four samples had positive NAPP values and NAGpH values less than 4.5, and three of these were confirmed to be PAF based on calculated NAG testing and re-calculated NAPP values (from S speciation and ABCC test results). The calculated NAG value was negative for one of the 4 NAPP positive samples, indicating the sample is NAF.

Results confirm that washery waste materials are more pyritic than overburden materials, but the overall pyritic content of these materials is likely to be relatively low given that 80% of the 66 samples tested had total S values less than 0.5%. The presence of pyrite in washery waste materials is consistent with the occasional observation of pyrite during field inspection, and the apparent higher ARD potential of roof, floor and coal seams.

ABCC testing indicated that most of the ANC measured was likely to be readily available, and hence an ANC/MPA ratio of 2 or more would be an adequate factor of safety. The ratio of the average ANC to the average MPA (calculated from total S) from the 20 samples tested is 6, highlighting the overall excess of ANC in these materials, and a low likelihood of ARD conditions developing from washery wastes represented by these samples.

5.15.3 Summary of Results

A total of 295 overburden, coal seam, seam roof and seam floor samples, and 66 washery waste samples were geochemically tested. This was supported by examination of core with Ashton geologists during a site visit, focusing on the occurrence of pyrite and carbonate minerals in the mine stratigraphy.

Results of testing indicate that overburden and pit floor materials from the Ashton SEOC are likely to be non acid forming (NAF) overall, and should not require any special handling for ARD control. It is expected that although minor pyritic materials may occur, these are likely to be isolated. Since the remaining spoils have excess alkalinity, mixing of mined materials as part of normal operations is expected to mitigate any isolated ARD generated.

Salinity appears to be low for most overburden materials, with a small portion having moderate salinity, mainly associated with carbonaceous samples.

Washery waste samples from the existing NEOC and underground operations were used as an analogue for the washery wastes expected from processing SEOC coal. Results of geochemical testing of the NEOC samples confirm that significant pyrite may occur in washery waste materials, but this appears to be offset by an excess of buffering capacity, so that washery waste materials represented by the samples tested are expected to be NAF overall with a high factor of safety.

5.15.4 Management and Mitigation Measures

Water quality monitoring of key seepage, pit water and drainage from overburden materials and washery waste materials will be regularly carried out for indicators of ARD and salinity to confirm the expected benign nature of these materials, and provide warning of any anomalously pyritic materials extracted during mining. Monitoring will include analysis of pH, EC, Sulphate (SO_4) and acidity/alkalinity, with follow up multi element testing if any low pH conditions (<5.0) are detected.

If monitoring shows identifies a potential for ARD to occur ACOL will apply appropriate mitigation measures to reduce impacts, including amelioration of low ph with additives such as lime, or the burial of problematic strata within the open cut to limit oxidation.

5.16 Flora and Fauna (Terrestrial Ecology)

The assessment of ecology for the SEOC has been divided in to two disciplines, where ACOL engaged the services of:

- Environmental Resources Management (ERM) to undertake a flora and fauna assessment, refer to this section (*Section 5.15)* and **Appendix 10** in Volume 4.
- Marine Pollution Research Pty Limited (MPR) to undertake an aquatic ecology assessment, refer to *Section 5.16* and **Appendix 11** in Volume 4.

5.16.1 Assessment Methodology

ERM has undertaken autumn and spring field surveys within the SEOC to assess vegetation types and habitat and to determine the presence of threatened species in accordance with Part 3A Guidelines for the Threatened Species Assessments. These field surveys have been supplemented with a combination of literature reviews, database searches and flora and fauna surveys undertaken within the mine lease area since 2005.

5.16.1.1 Literature Review and Database Searches

In preparing the flora and fauna assessment for the SEOC, ERM has reviewed the various studies previously undertaken for the existing ACP. These include:

- Biannual fauna surveys by ERM in 2005, 2006, 2007, 2008 and 2009.
- Flora and fauna baseline monitoring of Bowmans Creek in 2006.
- The original ACP EIS by HLA from 2001.
- Aquatic ecology surveys undertaken by MPR.

The following databases were reviewed for flora, fauna and endangered ecological community (EEC) records / habitat requirements:

- A DECC Wildlife Atlas database (now DECCW) review was conducted in order to identify all recent records of threatened flora and fauna as listed under the *Threatened Species Conservation Act 1995* (TSC Act) that occur within the locality (defined as within 10 kilometres (km) of the SEOC project area).
- The Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) Online Protected Matters Search Tool was used to identify the likely presence of threatened and migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, 1999)* considered likely to occur within the locality.

Flora and fauna species and Endangered Ecological Communities (EECs) identified within the searches were analysed to determine the likelihood of their occurrence in the SEOC area, to assist the field flora and fauna surveys.

5.16.1.2 Flora Survey

Aerial photography was used to identify broad vegetation communities within and adjacent to the site, which was verified in the field, through 20 by 20 metre quadrats and random meander transects during October 2008, October 2009 and within the proposed offset areas in October, 2009. The conservation status of the vegetation communities was assessed based on their condition, occurrence of threatened flora, and distribution in the community.

During fieldwork, targeted habitat searches were undertaken for threatened flora species identified by literature and database searches.

For a full list of flora species recorded within the study area refer to Appendix 10.

5.16.1.3 Fauna Survey

The fauna survey was based on the literature review, database searches, past fauna surveys from the ACP site, vegetation mapping and known habitat requirements for the threatened species records in the locality.

The following surveys were undertaken:

- Habitat surveys and general observations during June 2008, October 2008, July 2009 and October 2009.
- Small terrestrial and arboreal mammal surveys using twenty hair tubes over ten consecutive nights in June and October 2008.
- Diurnal and nocturnal amphibian surveys in October 2008 and October 2009.
- Targeted Grey-Crowned Babbler surveys during June and October 2008 and June and July 2009.
- Targeted Speckled Warbler surveys during June and October 2008.
- Targeted Hooded Robin surveys during June and October 2008.
- Microchiropteran Bat surveys using an Anabat echolation call detector over two non-consecutive nights in June and October 2008 and three consecutive nights in October 2009 in the site and within the proposed offset areas.
- Owl call broadcasts within an hour of dusk in woodland west of Glennies Creek using a directional megaphone with 1000m range for threatened owl species followed by spotlighting by two ecologists in June and October, 2008 and October 2009.
- Spotlighting for nocturnal birds and mammals on three nights in October, 2009.

For a full list of habitat records and fauna species recorded within the study area refer to Annex C and D of the ERM Report.

5.16.2 Existing Flora and Fauna

The SEOC lies within the Hunter Valley part of the larger Sydney Basin Bioregion. The lowlands of the Hunter Valley have been largely cleared of remnant native vegetation with remnant vegetation largely associated with the northern and southern ranges of the Hunter Valley and fragmented corridors often associated with riparian corridors. The southern range of the Hunter Valley is approximately 18 kilometres south west of the SEOC area.

The narrow riparian corridor along Glennies Creek, Hunter River and Wollembi Brook is considered significant as a fragmented wildlife movement corridor linking remnant vegetation and the northern and southern ranges of the Hunter Valley.

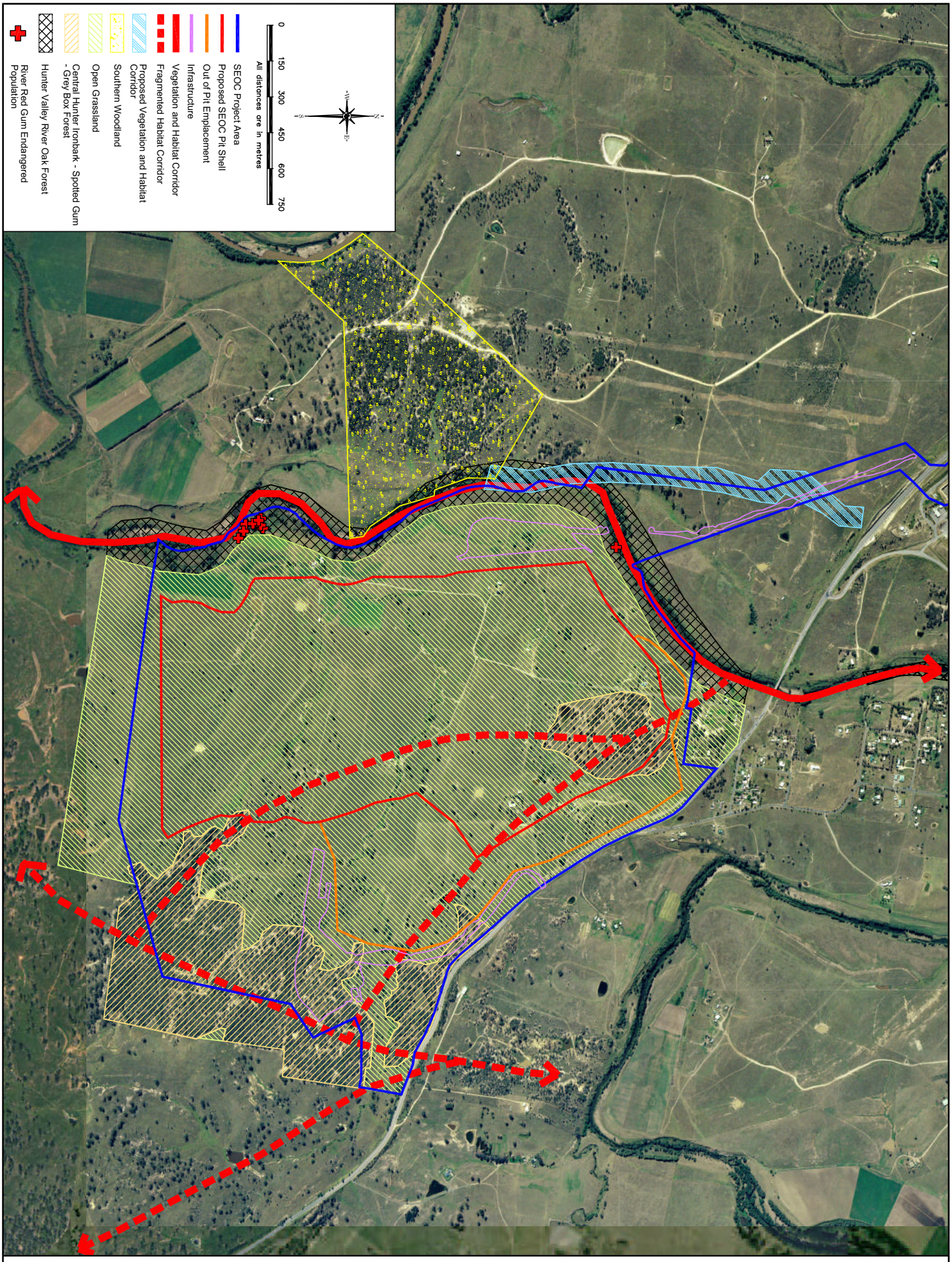
The SEOC project area consists of large areas of grassland with isolated shade trees. Recovering woodland communities are located in the north of project area within the Temporary Common, to the south west within the Ashton Voluntary Conservation Area (VCA), along the riparian corridor of Glennies Creek and to hills east of the project area. The recovery of these communities is seen by comparing the 1958 aerial photograph of the study area (refer Figure 5.3) to the 2007 aerial shown in Figure 5.1.

5.16.2.1 Flora

Three major vegetation communities were identified within the SEOC project area:

- Open grassland.
- Central Hunter Ironbark-Spotted Gum-Grey Box Forest.
- Hunter Valley River Oak Forest.

Vegetation communities of the SEOC project area are shown by **Figure 5.36.**



AshtonCoal

South East Open Cut Project

Vegetation Communities of the SEOC Project Area

ERM

Figure 5.36

Plan 60

Prepared by Pegasus Technical

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Open Grassland

The grassland communities are a result of extensive clearing of the original woodland vegetation. Within the grasslands, isolated trees exist and some regeneration is occurring. Scattered trees noted during flora surveys included Bulloak (*Allocasuarina luehmannii*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Yellow Box (*E. melliodora*), and Grey Box (*E. moluccana*). Exotic species occur below the canopy of the isolated trees. Many exotic herbaceous species are present across the grassland, including species used to improve the pasture for grazing. The percentage cover of the ground layers varies with grazing intensity.

Central Hunter Ironbark-Spotted Gum-Grey Box Forest

Two remnant woodland areas occur within the site that differ slightly in composition. The woodland area to the north of the site known as 'The Common' contained open woodland dominated by Narrow-leaved Ironbark, with the subdominant species Grey Box, Forest Redgum (*E. tereticornis*) and Bulloak. Stands of regenerating *Eucalyptus* sp. characterise the sparse understorey, with native grasses and exotic species dominating the grass layer.

The woodland area to the south east of the proposed SEOC project area is a regenerating community dominated by Narrow-leaved Ironbark and contained a high density of sapling and juvenile Narrow-Leaved Ironbark trees, with few other canopy species. The understorey is dominated by *Paspalidium* sp. and Purple Burr-Daisy with very sparse ground and leaf litter present. Evidence of past clearing, grazing and weed invasion was noted across most of this woodland.

The remnant and regenerating woodland identified within the SEOC project area is considered to be consistent with the Central Hunter Ironbark-Spotted Gum-Grey Box Forest as described by Peake (2006). The Central Hunter Ironbark-Spotted Gum-Grey Box Forest identified on the site was once extensive across the central to upper Hunter Valley lowlands with most remnants on ridges and crests on rolling hills.

In May 2009 the Central Hunter Ironbark-Spotted Gum-Grey Box Forest was given preliminary determination by the NSW Scientific Committee as an EEC under Part 3 of Schedule 1 of the Threatened Species Conservation (TSC) Act.

Hunter Valley River Oak Forest

The Glennies Creek riparian corridor is predominantly Hunter Valley River Oak Forest. This is characterised by a dominate overstorey of River She-Oak (*Casuarina cunninghamiana*) supporting a sparse midstorey dominated by scattered exotic African Boxthorn and Willow (*Salix* sp.). The moderate groundcover was dominated by exotic species. In low lying areas sedges and rushes dominate the groundcover.

The Hunter Valley River Oak Forest is described as a regionally significant community with key threats including weed invasion, livestock grazing and lack of structural intactness.

Threatened Flora Species

No threatened flora species were recorded within the study area during the flora surveys.

Three threatened flora species, Slaty Red Gum (E. glaucina) (listed as vulnerable under the EPBC Act, 1999 and TSC Act, 1995 Ozothamnus tesselatus (listed as vulnerable under the TSC Act) and Lobed Blue-grass (Bothrichloa biloba) (listed as vulnerable under the EPBC Act) have previously been recorded within the locality. Potential habitat has been recorded for an additional two threatened flora species, Pine Donkey Orchid and Austral Toadflax (Thesium austral) (both listed as vulnerable under the TSC Act, 1995 and EPBC Act, 1999).

All of these species are considered to have a low to moderate likelihood of occurrence within the site given the disturbance and grazing pressures.

An Endangered Population - River Red Gums

A small isolated narrow stand of approximately 10 mature River Red Gum (*E. camaldulensis*) was recorded along the eastern side of Glennies Creek to the south west of the proposed SEOC. In addition, one individual River Red Gum was recorded along the northern portion of Glennies Creek, near the proposed conveyor (refer to **Figure 5.37**).

The River Red Gum population in the Hunter Catchment has been identified as an endangered population under Part 2 Schedule 1 of the TSC Act, 1995. The population of River Red Gum in the Hunter Valley is unique in NSW as it is the only population of River Red Gum to occur in a coastal

catchment. The population faces a high risk of becoming extinct in NSW and it is of conservation value because it is disjunct and near the limit of its geographic range.

Abundant fruits and buds were noted and most of the trees were very large, with a maximum diameter at breast height (DBH) of 5 metres, indicating these individuals are very old although no regeneration was evident. Regeneration is generally not occurring in most remnant populations in the region because of changes to hydrology, cropping and grazing of the understorey or weed infestations.

Endangered Ecological Communities

As detailed above, in May 2009 the Central Hunter Ironbark-Spotted Gum-Grey Box Forest was given preliminary determination by the NSW Scientific Committee as an EEC under Part 3 of Schedule 1 of the TSC Act, 1995.

5.16.2.2 Fauna

Habitat Resources

Four major habitat types were observed across the site, being remnant and regenerating woodland, grassland, Glennies Creek riparian corridor and aquatic habitat.

Remnant and Regenerating Woodland

This habitat type is consistent with the areas identified as the Central Hunter Ironbark-Spotted Grey Box Forest. Two areas were identified, the Common to the north of the proposed SEOC and the regenerating woodland to the south east of the proposed SEOC.

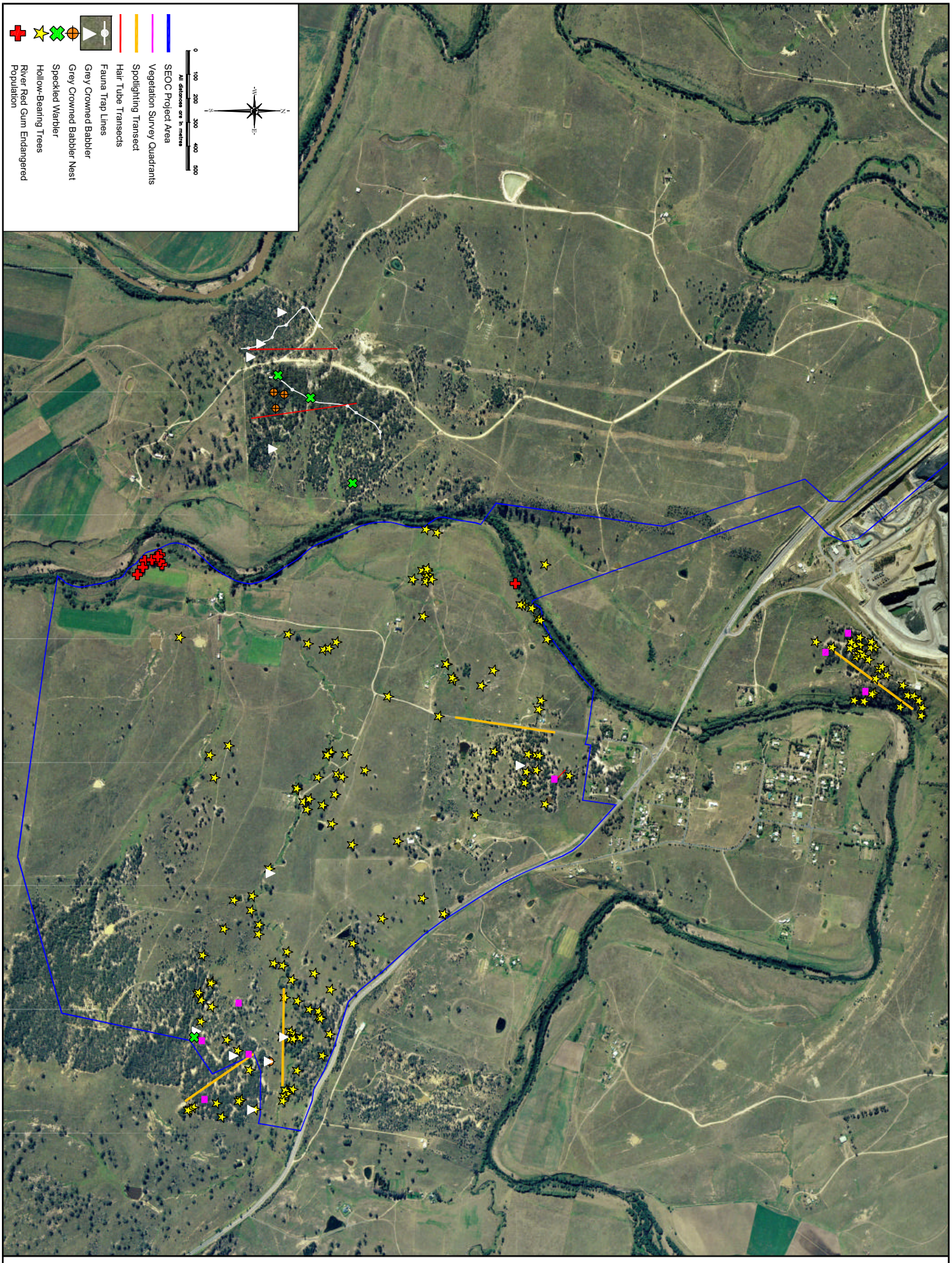
The Common contained numerous mature hollow bearing trees and stags, providing potential shelter and breeding habitat for a number of bird and arboreal mammal species. Several dense stands of regenerating canopy species were scattered across the woodland with small open grassy areas, contributing to the diversity of resources available within the area.

The regenerating woodland appeared to be of a relatively young age and contained only a small number of mature hollow-bearing trees capable of providing shelter and breeding habitat for bird and arboreal mammal species.

Mammal species identified in the SEOC area during targeted direct and indirect surveys and opportunistically include the Common Brushtail Possum, Eastern Grey Kangaroo, House Mouse, European Rabbit, Brown Hare and Fox. The hollow bearing tree survey identified indirect evidence of the presence of gliders in the area of the proposed clean water dam.

Bat species identified included Gould's Wattled Bat, White – striped Mastiff Bat, Large – eared Pied Bat, Yellow – bellied Sheathtail–bat, Lesser Long – eared Bat, Eastern Bentwing - Bat and Freetail – Bat.

Fallen logs and leaf litter were present across both woodland areas, which are likely to provide shelter for small ground dwelling mammals and reptiles. The grassy understorey and fallen timber also provides suitable foraging habitat for the Grey-crowned Babbler, Speckled Warbler and various scrub-wren species.



AshtonCoal

South East Open Cut Project

Threatened species and hollow bearing trees within SEOC area

ERM

Figure 5.37

Plan 61

Prepared by Pegasus Technical

CAD FILE: 05059D.dwg

Grassland

Grassland areas across the SEOC project area have largely been cleared and disturbed through previous and continued grazing and/or cropping. The level of ground cover largely depends upon the current land use and grazing intensity.

Isolated mature trees provide hollows for nesting and tree roosting fauna. These older trees occur mainly along the drainage lines throughout the grassland. During surveys it was noted that some trees are being utilised as nesting sites by Red-rumped Parrots (Psephotus haematonotus) and Galahs (Cacatua roseicapilla).

The native and exotic grasses are expected to provide seed and stem resources for granivorous and herbivorous species including birds, reptiles and terrestrial mammals.

Glennies Creek Riparian Corridor

This habitat type is consistent with the areas identified as Hunter Valley River Oak Forest.

A review of aerial photography confirms that the Glennies Creek riparian vegetation forms part of a fragmented corridor south along the Hunter River and Wollombi Brook. This corridor is considered to be important for fauna movement from the surrounding area into Wollemi National Park.

Aquatic Habitat

Aquatic habitat is provided within the numerous farm dams and within Glennies Creek. Frogs heard calling during the October 2009 survey in farm dams and along the ephemeral drainage line in the north of the SEOC area include Emerald Spotted Treefrog, Dwarf Tree Frog, Common Eastern Froglet and Smotth toadlet.

Koala Habitat

The woodland habitat is dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*) and Grey Box (*E. moluccana*) with scattered Forest Red Gum (*E. tereticornis*) associated with the lower slopes and drainage line in The Common.

Forest Red Gum and the River Red Gum (*E. camaldulensis*) identified along Glennies Creek are listed in Schedule 2 of SEPP 44 as a preferred feed tree for the Koala however they occur in such low numbers that they are not considered potential Koala habitat.

Threatened Fauna Species

Those species identified as likely to occur within the site and be impacted by the proposal have been assessed in the threatened species significance assessment. Marine mammals and shoreline birds were excluded from the threatened species assessment, as it is reasonable to assume they are not present or dependant on habitats within the site. **Table 5.41** lists threatened flora and fauna species likely to occur within the study area that may be impacted by the proposed SEOC, refer to Table 3.2 of Appendix 10 for consideration of all other threatened fauna species.

A summary of the threatened fauna species recorded within the site or adjacent southern woodland VCA is provided below and illustrated in Figure 5.37:

- **Birds** – two threatened birds listed as vulnerable under the TSC Act, 1995 were recorded onsite:
  - The Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), commonly encountered in the Southern Woodland VCA. Recent surveys identified seven groups, of two to seven individuals. Two nests were also observed on the edge of the regenerating woodlands.
  - Speckled Warbler (*Pyrrholaemus saggitatus*) observed in the regenerating woodland to the east of the site.
  - In May 2009 the NSW Scientific Committee gave a preliminary determination to list the Scarlet Robin (*Petroica boodang*) and Flame Robin (Petroica phoenicea) as a vulnerable species under Part 1 of Schedule 2 of the TSC Act. It has been observed in the Southern

Table 5.41: Threatened flora and fauna species of the study area likely to occur within the SEOC project area that may be impacted.

Species	TSC Act EPBC Act	Preferred Habitat	Likelihood of Occurrence
BIRDS			
Gang-gang Cockatoo *Callocephalon fimbriatum*	V -	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet schlerophyll forests. In winter, this species moves to lower altitudes, preferring more open eucalypt forests and woodlands, particularly in box-Ironbark assemblages, or in dry forest coastal areas. This species favours old growth attributes for nesting and roosting.	This species has the potential to occur within the site during winter, as there is preferred box-Ironbark woodland located within the site. This species has been recorded in the locality and has the potential to use the resources present within the site on a seasonal basis.
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	Prefers drier eucalypt forests and woodlands with an open grassy understorey, through central NSW and coastal areas, and dry open woodlands in the Hunter Valley, Cumberland Plains, Snowy River Valley and parts of Richmond and Clarence River. Also River Red Gum forest.	This species has been recorded in the locality and potential habitat occurs within the riparian corridor and woodland. As it is a sedentary species that is present throughout the year, the lack of records during site inspection and monitoring reduces likelihood of a group of this species occupying a territory in the woodland in the SEOC project area.
Hooded Robin *Melanodryas cacullata cucucllata*	V -	Prefers eucalypt woodland supporting a diverse range of structures including mature eucalypt, saplings, shrubs and tall, native, grassy understorey and can have home ranges that vary from 10 hectares in the breeding season up to 30 hectares.	This species has been recorded within the Ashton Coal Mine lease area on the western side of Glennies Creek. This species has the potential to use the resources present within the site and is likely to occur within the riparian corridor along Glennies Creek and the remnant woodland areas.
Black – chinned Honeyeater Melithreptus gularis gularis	V -	Dry forests and woodlands from the tablelands and western slopes of the Great Dividing Range rarely east of the divide except from the Richmond River district, Hunter River, Central Coast and Illawarra regions.	This species has been recorded within Ravensworth State Forest to the north of Camberwell and has the potential to occur within the riparian corridor as a transient species.
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	V -	Open woodlands dominated by mature eucalyptus, with regenerating trees, tall shrubs and intact cover of grass and forbs. Also along streams in cleared areas.	This species has been recorded within open woodland in the proposed SEOC project area and is likely to use the resources present across the site.
Speckled Warbler *Pyrrholaemus sagittatus*	V -	Lives in a wide range of eucalypt dominated communities that have a grassy understorey. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	This species has been recorded within regenerating Ironbark woodland in the south east of the proposed SEOC project area. This species is also likely to occur within the riparian corridor along Glennies Creek and the remnant woodland within The Common.
Diamond Firetail *Stagonopleura guttata*	V -	Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Potential habitat is available along Glennies Creek. This species has been recorded in the locality and has the potential to occur within the riparian corridor as a transient species.

Species	TSC Act EPBC Act	Preferred Habitat	Likelihood of Occurrence
Little Lorikeet *Glossopsitta pusilla*	V -	Dry open eucalypt forests and woodlands from coast to western slopes of Great Dividing Range. Forage in small flocks in tree canopy on nectar and pollen of eucalypts, paperbarks and mistletoe. Nest in 'traditional' sites in tree hollows with small entrances (approximately three centimetres diameter). Breeds May to September.	Moderate to high likelihood of occurrence given presence of habitat and tree hollow resource for nesting. Has been recorded in the Mount Owen Coal Mine Complex.
Turquoise Parrot *Neophema pulchella*	V -	Lives on the edges of eucalypt woodlands and open forests adjoining clearings, timbered riges and creek in farmland. Nests in tree hollows, logs or post From August to December.	Moderate to high likelihood of occurrence based on presence of preferred habitat adjoining clearings. Opportunistic sighting of bird in locality by an ERM ecologist in June 2009.
MAMMALS			
Spotted-tail Quoll *Dasyurus maculatus*	V E	Wide range of forested habitats including rainforest, open forest, coastal heath, riparian forest. Nests in caves, hollow logs or tree hollows.	Moderate to high likelihood of foraging in area in particular along the Glennies Creek riparian corridor. The high levels of surrounding disturbance and the open nature of the shrub layer may deter this species.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V -	Roosts in caves, old mines, stormwater channels; forages above the forest canopy.	Potential hunting habitat only is available across the site, Suitable roosting sites are not present. This species has been recorded in the locality and is likely to occur in the site. It has the potential to be impacted by the proposed mining activities.
Eastern Freetail-bat *Mormopterus norfolkensis*	V -	Wide range of forested habitats including rainforest to dry open forest. Roosts in tree hollows and under loose bark.	High likelihood. Potential hunting and roosting habitat is available across the site. This species has been recorded in the locality and is likely to occur in the site. It has the potential to be impacted by the proposed mining activities.
Large-footed Myotis *Myotis adversus*	V -	Roosts in caves, tunnels, under bridges and in dense vegetation. Forages over nearby lakes, rivers, large streams.	Potential hunting habitat only is available across the site. Preferred roosting sites are not present although this species has been recorded roosting in trees in the upper catchment of Bettys Creek in the locality. This species is likely to occur on site and has the potential to be impacted by proposed mining operations.
Squirrel Glider *Petaurus norfolcensis*	V -	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range. Nests socially in tree hollows.	Suitable foraging and nesting habitat is available within the riparian corridor and remnant woodland. This species has been recorded in the locality and is likely to occur in the site.
Brush-tailed Phascogale *Phascogale tapoatafa*	V -	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Nest and shelter in tree hollows with entrances 2.5 to 4 cm wide and use many different hollows over a short time span.	This species has been recorded to the east of the Integra open cut mine in woodland near Glennies Creek (Countrywide Ecological Surveys 2007). May forage and nest in woodland habitat across the SEOC project area.
Grey-headed Flying-fox *Pteropus poliocephalus*	V V	Forages on fruits, blossoms and nectar of eucalyptus. In early summer roosts in large groups in forests or mangroves.	Limited seasonal foraging habitat is available within the site. No suitable roost sites were noted. This species has been recorded within the locality and is likely to occur in the site.

Species	TSC Act EPBC Act	Preferred Habitat	Likelihood of Occurrence
Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*	V -	Roosts in tree hollows, abandoned nests of sugar gliders (*Petaurus breviceps*) and animal burrows. Forages in almost all habitats including forest and woodland.	Potential hunting and roosting habitat is available across the SEOC project area.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V -	Rivers and creeks within the ranges, roosting in tree hollows.	Potential hunting and roosting habitat is available across the site, particularly within Glennies Creek riparian corridor. This species has been recorded in the locality and is likely to occur in the site. It has the potential to be impacted by the proposed mining activities.
Large-eared Pied Bat Chalinolobus dweryi	V -	Roosts in caves. Variety of habitat types including dry and wet sclerophyll forest and tall open eucalypt forest with a rainforest sub-canopy.	Recorded in woodland habitat in The Common, in the north east of the Project Area and in the proposed offset area to the north of the highway. Project Area provides hunting habitat but no potential cave roosting sites.

- Woodland VCA and is expected to occur within the site. The Flame Robin was recorded for the first time in the Southern Woodland in surveys conducted in June 2009. The Turquoise Parrot has been recorded opportunistically near the ACOL site offices in June 2009.

- **Mammals** – Three threatened bats including the Eastern Bentwing – Bat, Large – eared Pied Bat and Yellow – bellied Sheathtail – Bat have been recorded in the SEOC area. In addition ten (10) threatened mammal species have previously been recorded in the locality and four threatened mammal bat species including the Eastern Freetail-Bat (*Mormopterus norfolkensis*), Eastern Bentwing-Bat (*Miniopterus schreibersii oceansis*), Large-footed Myotis (*Myotis adversus*) (all listed as vulnerable under the TSC Act) and Grey-headed Flying-fox (*Pteropus poliocephalus*) (listed as vulnerable under the EPBC and TSC Acts) have been recorded within the Southern Woodland VCA and are likely to utilise habitats in the project area.
- **Frogs** – No threatened frogs have been recorded within the project area. Two threatened frog species have previously been recorded within the locality, though none are expected to occur in habitats within the project area.
- **Reptiles** – No threatened reptiles have been recorded within the project area. One is predicted to occur in the locality, but is not expected to occur in the habitats present on the site.

5.16.3 SEOC Ecological Impacts

The main impacts to flora and fauna are as a result of direct clearing impacts associated with the open cut, out of pit emplacement and facilities, including the re-alignment of powerlines.

The proposed modification to the existing ACP will not have significant impacts to flora and fauna.

Other impacts include those to hydrology and surface drainage, terrestrial and aquatic habitats and indirect impacts to surrounding areas such as dust deposition, noise, sedimentation and contamination.

5.16.3.1 Flora

Clearing

The SEOC project will result in clearing approximately 262 ha, plus impacts associated with the realignment of powerlines. The breakup of this clearing is shown within **Table 5.42**.

Table 5.42: Estimated vegetation clearance required by the SEOC.

Community	Approximate Extent of Clearance (hectares)				
	SEOC	Out of Pit Emplacement	Surface Facilities	Dams	Total
Central Hunter Ironbark – Spotted Gum – Grey Box Forest	13.15	2.38	6.14	3.07	24.74
Grassland	184.30	50.97	23.22	3.73	262.22
Surface facilities include the office, workshops, access road, ROM, surface infrastructure, conveyor belt and access road.					

As the grasslands are largely a product of past land use, impacts to this community are not considered significant.

A large portion of the impact to the Central Hunter – Spotted Gum- Grey Box Forest will occur within the first year, with establishment of surface facilities and the commencement of open cut mining within the Common, by year 3 the majority of the estimated clearing will have occurred.

This clearing is unlikely to significantly impact any threatened species or population such that a local extinction would occur, however it will contribute to cumulative impacts of vegetation and habitat loss at a regional scale.

It is estimated that within the Upper Hunter there is an estimated 18,306ha of Central Hunter – Spotted Gum- Grey Box Forest remaining, from a predicted pre-European area of 46,753ha. Therefore the clearance of 24.74ha of this community represents a further reduction of 0.14% of this community.

The majority of the Glennies Creek riparian corridor is outside of the SEOC project area. Only a small section of the Hunter Valley River Oak Forest will be impacted during the construction of the conveyor across Glennies Creek.

Powerline Realignment

The realignment of the power lines (refer to Figure 4.19) will result in some vegetation clearing. Two options for the realignment have been identified; Option 1 and Option 2 (refer to Section 4.6.4). The realignment of powerlines is not required until approximately 2012.

It should be noted that while the establishment of the either of the easements will require clearing of some vegetation during construction, there are numerous native species that can be planted within the easement that will not interfere with the lines and maintain good vegetation and habitat connectivity. Once constructed and under-planting is established the impacts associated with the powerline easements are minimal.

Option 1 will result in the clearing of an easement through the Southern Conservation Area in a north south direction. The clearing will result in the removal of canopy vegetation over an area of approximately 4.3ha, and disturbance within this area for staunchion erection and an access road. The line also crosses Glennies Creek and may require some removal or trimming of vegetation in the riparian corridor.

The Southern Conservation Area is a 67ha flora and fauna and archaeological offset developed for the existing ACP. The conservation area contains an easement for the existing Southern 132kV power alignment. The Southern Woodland is mapped in the Hunter Valley Remnant Vegetation Project (Peake 2006) a stand of Central Hunter Grey Box - Ironbark woodland. The Central Hunter Box - Ironbark woodland has also been given preliminary determination the by the NSW Scientific Committee for listing as an Endangered Ecological Community under Part 3 of Schedule 1 of the TSC Act.

Option 2 is located primarily within cleared lands or those disturbed by the proposed SEOC, the alignment will traverse Glennies Creek which will necessitate the clearance of an easement through the Hunter Valley River Oak Forest (less than 0.5ha).

Changes to Hydrology and Surface Drainage and Groundwater Dependant Ecosystems

The SEOC will alter the topography of the area and has the potential to impact on surface catchment flow patterns and alter minor drainage lines.

Alteration of natural flow regimes has been identified as one of the major causes preventing regeneration of most remnant River Red Gum populations. However, given regeneration was not observed within this stand, the potential changes to hydrology as a result of the proposed SEOC are unlikely to be the sole cause of the already very low recruitment potential of the endangered River Red Gum.

The River Red Gum populations are expected to have some dependence on Glennies Creek baseflows and associated alluvial groundwater. Impacts to these flows may therefore impact the population. However it is considered that the regulated baseflow that is maintained within Glennies Creek and the minor impact predicted to alluvial groundwaters will not result in any significant impacts to this population. Refer to *Section 5.17.2.8* for further consideration of GDEs.

Indirect Impacts

Vegetation that is not cleared as part of the SEOC mining operation has the potential to be affected by indirect environmental impacts. Open cut mining is expected to increase the potential for dust and other particulate emissions, erosion and sediment mobilisation, contamination and other secondary physical disturbances along the Glennies Creek riparian corridor.

Another indirect impact of clearing of vegetation is the increase in edge effects in retained vegetation particularly associated with increased light penetration and changes in microclimate. The proposed

office and workshop facilities are located largely in grassland and in an area of regenerating woodland with the hollow-bearing trees defining the edge of the remnant woodland trees. Clearing around the surface facilities will increase edge effects in the Central Hunter Ironbark-Spotted Gum-Grey Box Forest to the east and south east of the office and workshop facilities area.

5.16.3.2 Fauna

Loss of Terrestrial Habitat

Vegetation clearing will have impacts to local fauna due to cumulative habitat loss. The woodland areas provide foraging, shelter and breeding habitat for a range of native species including the Speckled Warbler and Grey-crowned Babbler.

The SEOC project will clear approximately 70 hollow-bearing trees that are expected to provide nesting, shelter and/or roosting habitat for birds, microchiropteran bats and other mammals. The majority of those to be removed are scattered through the grasslands. The removal of these will be progressive over the first 3 - 5 years of mining.

Fifteen (15) hollow bearing trees are located within the footprint of the proposed water storage dam CW1. These trees will not be removed and may continue to be used by birds and microchiropteran bats.

No hollow bearing trees will be removed from the Glennies Creek riparian corridor.

Powerline Realignment

Option 1 of the powerline realignment traverses the Southern Woodland, and if selected will require the removal of at least the canopy vegetation.

Hollow-bearing trees are a limited resource in the Southern Woodland and as part of management of the area, 39 artificial nest and roost boxes have been installed targeting arboreal mammals and microchiropteran bats in 2004 and 2005. To date these have been largely occupied by Common Brushtail Possums with Ringtail Possums recorded in 2006 and an Australian Owlet Nightjar found in a nest box in Autumn 2007.

Associated with clearance of vegetation within the Southern Woodland is the potential loss of hollow-bearing tree resource within the easement, fragmentation of canopy cover, potential impacts on the Grey-crowned Babbler population including loss of nest sites, potential impacts on Speckled Warblers and other threatened fauna species identified in the Southern Woodland including the Eastern Freetail-bat, Eastern Bentwing-bat, Large-footed Myotis and Grey-headed Flying-fox.

It should be noted that the impact of the easement on habitat values may be minimised by the retention of any fallen logs/timber to provide shelter and foraging habitat for fauna, and through the retention and managed rehabilitation of groundcover and shrubs to provide cover for small terrestrial fauna minimising fragmentation impacts.

The final design of the powerline easement and the placement of stanchions will be cognisant of the fauna habitat features within the Southern Woodland and where feasible avoid their disturbance.

Degradation of Aquatic Habitat

Consideration of impacts to aquatic habitat and fauna is included within *Section 5.17*.

5.16.3.3 Impacts on Threatened Species, Populations and Communities

Threatened Species Conservation Act 1995

Assessment of the potential effects of the SEOC project on threatened species, populations or ecological communities listed under the TSC Act, 1995 follows the draft Guidelines for Threatened Species Assessment under Part 3A prepared by the Department of Environment and Conservation (now known as DECCW) and Department of Primary Industries (now known as DII).

The assessment requires the consideration of the following questions for threatened biodiversity considered likely to occur onsite:

a) How is the proposal likely to affect the lifecycle of a threatened species and/or population?

b) How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

c) Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

d) How is the proposal likely to affect current disturbance regimes?

e) How is the proposal likely to affect habitat connectivity?

f) How is the proposal likely to affect critical habitat?

The assessment concluded that for each of the questions above that the proposal was unlikely to significantly affect the threatened biodiversity provided appropriate mitigation measures are implemented to adequately mitigate and offset impacts.

Environmental Protection and Biodiversity Conservation Act 1999

The Large – eared Pied Bat and the Grey Headed Flying-Fox are listed as vulnerable under the EPBC Act 1999. The assessment has considered that the SEOC project is unlikely to impact on the availability of foraging resource or life cycle of individuals within the populations such that it would:

- Decrease the size of a population.
- Reduce the area of occupancy of the species.
- Fragment an existing population.
- Adversely affect critical habitat.
- Disrupt the breeding cycle of a population.
- Affect the availability or quality of habitat to the extent that the species is likely to decline.
- Result in harmful invasive species becoming established on the Project Area.
- Introduce disease that may cause species to decline.
- Interfere with the recovery of the species.

The proposal is unlikely to impact on a threatened species as listed under Commonwealth legislation.

Twelve (12) migratory birds have potential to occur within the region. Of these seven (7) are identified as having the potential to occur within 10km of the SEOC project area. Migratory species have the potential to inhabit a wide variety of habitat types. As such the SEOC project is not expected to:

- Substantially modify, destroy or isolate an area of important habitat of the migratory species.
- Result in harmful invasive species becoming established in the SEOC project area.
- Seriously disrupt the life cycle of an ecologically significant proportion of a population of the species.

The proposal is not expected to have a significant effect upon the health and viability of any threatened or migratory species listed under the provisions of the EPBC Act, 1999.

Given the proposal will not impact on matters of national environmental significance, approval from the Commonwealth Minister for the Environment, Heritage and the Arts is not required.

5.16.4 Mitigation Measures

The mitigation of impact is a stepped process including:

- **Avoiding** the impact; this may mean making some changes to the proposed development.
- If avoidance is not possible, then some form of **mitigation** may be required.
- Finally, if neither avoidance nor mitigation is possible, then some form of **offset or compensation** will be required. This could entail the construction or rehabilitation of similar habitat nearby.

The mitigation and offset measures proposed below will be implemented at the site through the development of a management plan. The management plan will be an extension of the existing Flora and Fauna Management Plan for the ACP as vegetation is similar across the ACP and will allow integrated management over the site.

5.16.4.1 Avoidance

The main avoidance measures undertaken for the SEOC project with respect to impacts to flora and fauna are:

- Moving the western pit and infrastructure boundary back from Glennies Creek to avoid significant impacts on Glennies Creek riparian corridor.
- Design of conveyor over Glennies Creek and floodplain will result in less direct disturbance of vegetation and habitat and has avoided an isolated River Red Gum.
- Clipping of the open cut in the north west to avoid direct mining impacts to the lower reaches of Tributary 2 and portions of the Central Hunter Ironbark-Spotted Gum-Grey Box Forest located north of the Temporary Common.
- Clipping of the open cut in the south west to avoid direct mining impacts to the lower portions of Tributary 5 that increases the separation between the open cut and the River Red Gum population.
- Clearing of Central Hunter Ironbark-Spotted Gum-Grey Box Forest has been avoided by locating the office and workshop facility largely within cleared areas.
- The proposed transmission line Options 1 or 2 will require establishment of easements either 75 metre wide (Option 1) across Glennies Creek. However, the need to clear vegetation in the corridor may be avoided by placement of infrastructure at points where clearing of vegetation is avoided. The need to clear vegetation in the riparian corridor to provide appropriate clearance of the lines could be avoided however, pruning or lopping of some trees may be required to achieve this.

5.16.4.2 Mitigation

To minimise the impact (injury and death of fauna) on threatened species known to occur within the woodlands of the SEOC project area the following measures will be implemented:

- Targeted surveys for nest sites to be undertaken within the woodland prior to vegetation clearance, with any nests belonging to threatened species identified to be protected or relocated if possible;
- Pre-clearance inspections to locate and mark potential habitat trees and verify number and type of hollows to be removed.
- Vegetation clearance will be avoided where possible in spring when the threatened birds and arboreal mammals assessed are likely to have young in the nests.
- To allow for or encourage dispersal of individuals, vegetation should be selectively cleared around habitat trees or nest trees. Habitat trees should be felled a minimum of 24 hours later.
- Employ a suitably qualified animal handler or ecologist during identified habitat tree vegetation clearing, in order to safely capture and relocate disturbed resident fauna. This will also assist in reducing the injury and death of fauna during the removal of habitat.
- Where possible relocate any fallen timber and dead wood to the riparian corridor and/or offset area.
- Clearing where the transmission line traverses the Southern Woodland should be modified to provide for minimal disturbance of groundcover and shrub coverage to optimise regrowth of endemic species under the lines. In addition timber and logs on the ground should be retained in the easement and fallen trees relocated to this area where this habitat resource is limited to provide coverage for terrestrial fauna.

To minimise the impacts upon the Glennies Creek riparian corridor and River Red Gum population during construction the following measures will be implemented:

- Locate disturbance footprint for the conveyor including required sedimentation dams external to riparian vegetation.
- Fence the riparian corridor to define the extent of clearance.
- Locate and fence the River Red Gum to the drip line to ensure no direct or indirect impacts during construction and ongoing maintenance.
- Employ a suitably qualified animal handler or ecologist prior to and during any vegetation pruning for the conveyor, in order to safely capture and relocate disturbed resident fauna.
- Rehabilitate disturbed areas to minimise erosion and further weed invasion.
- Where the transmission line traverses Glennies Creek clearing should be modified to avoid disturbance of groundcover and shrub coverage to minimise erosion and provide for continuity of cover. Where possible trees should be lopped and/or pruned to provide clearance to the line.

Revegetation along Glennies Creek riparian corridor will be undertaken in order to provide a buffer against potential indirect impacts of the adjacent SEOC and to encourage natural regeneration of the riparian vegetation and the endangered River Red Gum population. These measures will also serve to enhance the habitat value of the Glennies Creek riparian corridor, encourage a more diverse range of native species and provide a safe movement/habitat corridor in conjunction with habitat corridors to the west of Glennies Creek. To achieve the proposed riparian enhancement, the following measures will be implemented:

- Enhance and manage a corridor of vegetation approximately 100 metres wide (i.e. approximately 20m both sides of creek) along the length of Glennies Creek adjacent to the SEOC project area, equating to an area of approximately 35 ha.
- Enhance the corridor through supplementary plantings of locally occurring native species along the length of Glennies Creek to enhance the connection with the riparian vegetation along the Hunter River to the south. The minimum width of the riparian corridor should be 10 m, preferably closer to 20 m where possible, either side of the watercourse. Species to be used in the revegetation should include locally occurring species such as River Oak (*Casuarina cunninghamiana subsp. cunninghamiana*), River Red Gum (*Eucalyptus camaldulensis*), Rough-barked Apple (*Angophora floribunda*) and Forest Red Gum (*Eucalyptus tereticornis*).
- Fence the riparian corridor to define the extent of clearance, in particular when constructing the conveyor and where surface facilities are in close proximity to the creek.
- Fence the riparian corridor to exclude cattle.
- Divert clean surface drainage around the open cut mine and toward Glennies Creek wherever possible.
- Revegetate using species from an acceptable level of local provenance except where this is not practicable.
- Weed and pest management.
- Annual surveys within the revegetated areas to record any significant loss of trees as well as monitoring the use of the newly established corridors by native fauna.

5.16.4.3 Flora and Fauna Offset

The SEOC project has been designed to avoid impacts and with the above measures reduce the severity of impact to flora and fauna in the project area, however some impact is unavoidable. The SEOC project will result in the unavoidable loss of approximately 24.74ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest community and 70 tree hollows located predominantly within grasslands. Approximately 4.3ha of Central Hunter Iron Bark Woodland would be impacted from the construction of the transmission line Option 1, if selected.

The Strategy

The proposed offset strategy for flora and fauna is summarised as follows:

- Revegetate the open cut and emplacement area with native vegetation, utilising felled vegetation to improve habitat.

- Undertake Glennies Creek Riparian Corridor Enhancement.
- Enhance offset areas of 'like for like' vegetation.
- Provide 3 nest boxes for each tree hollow removed.
- Provide like offset for vegetation impacted by the SEOC project.
- Provide for the management of offset areas and riparian corridor.
- Provide for the long term management and protection of the riparian corridor and offset areas.

Potential Offset Areas

These unavoidable impacts will be offset through the management and protection of an area of the same community and habitat attributes in the immediate area to provide a net improvement in ecological values.

Identification of suitable offset areas was guided by consideration of the following principles, where an offset must:

- Consider the structure, function and compositional elements of biodiversity including threatened species.
- Enhance biodiversity.
- Consider the conservation status of ecological communities.
- Ensure the long-term viability and functionality of biodiversity.
- The offset areas should preferably be located on site or in the locality, contain the same or equivalent vegetation communities and be in equivalent or better condition to provide for an offset of 'like for like'.
- To ensure long term security and implementation of management measures, the offset area should be located on land owned by, or which can be purchased by the proponent. The proponent must also commit to the protection and management of the offset area through legal enforcement of the offset strategy.

The offsets will also be undertaken as follows:

- Contain community of similar floristic and structural characteristics which has equivalent of greater conservation value to that identified in the SEOC area.
- Contain suitable habitat features and resources for the suite of threatened fauna potentially affected by the proposal including the Grey-crowned Babbler, Speckled Warbler, Eastern Bentwing-Bat, Yellow-bellied Sheathtail-Bat and Large-eared Pied Bat.
- The offset ratio is approximately 2.5:1 which is approximately 62 ha.
- The offset must be identified, purchased and secured within three years from the date of approval. In the interim ACOL would provide a bond or security to DECCW which could be used in the event of a default in satisfying the offset.
- The offset area must be permanent and secured by a conservation agreement or reservation as agreed with DECCW.

At this stage ACOL have identified two offset areas within their land holding. To meet the offset ratio ACOL commit to the acquisition of additional area of 34.5 ha within three years of approval.

The two potential areas total approximately 27.5ha and satisfy the above principles to provide suitable offset for the loss of the 24.74ha. These offsets are as follows:

- 10.7ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest (Woodland Offset Site 1) located off Glennies Creek Road, between Glennies Creek and the existing NEOC. The vegetation has been known to support a Grey-crowned Babbler population since 2006 and contains a number of older trees with hollows. The landform is steeper than the Temporary Common lands, but is continuous with the Hunter River Oak Forest along Glennies Creek and would provide good connectivity through to revegetated areas of the NEOC.

  A summary of the habitat features in the two offset areas and areas within the SEOC area is provided in Appendix 10. The survey data identified a higher diversity of flora and fauna species,

and habitat features in Woodland Offset Site 1 relative to the woodland area in the north east of the SEOC area. While floristically more diverse than the woodland in The Common, habitat features in Woodland Offset Site 1 are comparable to those in The Common. Disturbance impacts are greatest in Woodland Offset Site 1 with rubbish dumping, unauthorized tracks and a higher number of weed species while grazing is the major disturbance at the other sites. There is limited connectivity of woodland habitats from Woodland Offset Site 1 however the woodland is continuous with the riparian corridor along Glennies Creek and this provides connectivity for fauna movement. Further this area is identified in the Synoptic Plan for integrating coal mine rehabilitation landscapes (DMR 1999) as an area that can be managed to enhance local wildlife corridors and increase connectivity with mine rehabilitation works in the area north of the highway.

- 16.8ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest (Woodland Offset Site 2) located immediately east and north of the office and workshop facilities, around the proposed water storage dam. The vegetation is of a similar age, floristics and structure to the vegetation lost within the Temporary Common. This area would also provide habitat for threatened birds, bats, microchiropteran bats, and mammals.

  Diversity, habitat features and grazing pressure impacts in Woodland Offset Site 2 are comparable to the contiguous woodland within the impact area of the SEOC area while The Common supports a greater number of mature trees than this area largely due to different land management. Woodland Offset Site 2 has greater connectivity being continuous with a large remnant of woodland to the south of the SEOC area and provides for connectivity, be it fragmented, to the north of the highway. Implementation of offset the strategy would provide for flow on benefits in habitat corridor function to the south of the New England Highway.

  The eastern offset (offset site 2) adjacent to the facilities will remain intact during the operations; the introduction of the clean water dam into the area will provide greater water availability for fauna. While trees within the dam footprint will in time become water logged it is expected that habitat values will be retained in the form of eventual stags and hollows for bats and birds.

  The office and workshop facilities will generate some noise that may disturb noise sensitive fauna species on the fringes of the offset area. However, given the facilities are set into the hillside that will provide acoustic attenuation and connectivity with adjoining lands is maintained, it is likely that noise sensitive species on the fringes will move to the east, and other species will replace them on the fringes. The disturbance on the fringes can also provide good foraging grounds. In consideration of the above it is considered that the impacts to the offset area as a whole will be minimal and the area will be a valuable offset area into the future for now and beyond mining.

The above offset areas are within ACOL ownership and can be secured through legal enforcement of the offset strategy via a voluntary conservation agreement under the National Parks and Wildlife Act 1974 or Section 88B-E covenant of the Conveyancing Act 1919 as agreed by ACOL and the Department of Planning.

It is expected that with the implementation of the revegetation activities and enhancement of the Glennies Creek riparian corridor, the site would continue to be capable of supporting a diverse range of species which is likely to result in a greater need for roost sites. Therefore, to offset the loss of hollows, for each hollow removed from the SEOC site, three nest boxes will be placed in the riparian corridor and habitat offset areas. Monitoring of these nest boxes will form part of the annual monitoring surveys.

Management of Offset Areas and Riparian Corridor

To enhance the habitat value of the offset areas for threatened species and to encourage a more diverse range of native species the following recommendations have been made:

- The offset areas will be fenced to exclude cattle and so remove or reduce grazing pressure.

- Control of feral animals where practical.
- Weed management program to reduce competition and encourage growth of native species in the understorey.
- Fallen timber and branches within the disturbance area will be relocated to the offset areas to provide additional nesting and foraging habitat.
- Install and monitor a combination of bat, Squirrel Glider and Brushtail Possum nest boxes within the retained habitats at a rate of 3:1 to compensate for the loss of this critical habitat feature.
- Species to be used in any revegetation should include locally occurring species such as Narrow-leaved Ironbark *(Eucalyptus crebra*), Grey Box (*E. moluccana*), Forest Red Gum (*E. tereticornis*), Grey Gum (*E. punctata*), Gorse Bitter Pea (*Daviesia ulicifolia*), Western Golden Wattle (*Acacia decora*), Fan Wattle (*A. amblygona*) and Silver-stemmed Wattle (*Acacia parvipinnula*).
- Monitoring and reporting on biodiversity and management actions undertaken including annual surveys conducted within the offset areas in conjunction with the riparian habitat monitoring to record any significant loss of trees as well as monitoring the use by the threatened Grey-crowned Babbler and Speckled Warbler populations.

An increase in habitat size should contribute to the long term viability of the local breeding populations of these vulnerable species. For the Grey-crowned Babbler population, the following recommendations should be considered in order to provide supplementary habitat and closely monitor the population:

- Fallen hollow logs and branches will be retained and if possible increased through relocation from the areas to be cleared, to provide additional foraging habitat within the revegetation and habitat offset areas.
- Surveys should continue to be conducted during the breeding months between July and February targeting the Grey-crowned Babbler.

The habitat value for the Speckled Warbler population will be encouraged by carrying out the following:

- Fallen hollow logs and branches will be retained and if possible increased through relocation from the areas to be cleared, to provide additional nesting and foraging habitat within the revegetation and habitat offset areas.
- Searches for nests to determine habitat range of this population and to establish an appropriate monitoring strategy to ensure its long term viability in the area.

Implementation of the above species specific measures will also enhance habitat value for a number of other threatened species, in particular birds and bats, that are known from the locality and that may use woodland habitat in the SEOC project area on a transient basis or as part of a larger home range.

A management plan will be prepared for the offset area and riparian corridor of Glennies Creek. The management plan shall incorporate the above aspects and include consideration of the following:

- Baseline assessment of the community and habitat values of the offset area.
- Identification of environmental weeds to be targeted in the weed management plan.
- Any fencing reconfiguration requirements.
- Safety issues for revegetation and weed management works on the steeper slopes above Glennies Creek.
- An ongoing monitoring program.

This management plan would be amended to incorporate additional 60 ha of habitat offset areas

5.17 Aquatic Ecology

The assessment of ecology for the SEOC has been divided into two disciplines, where ACOL engaged the services of:

- Environmental Resources Management (ERM) to undertake a flora and fauna assessment, refer to *Section 5.15* and **Appendix 10** in Volume 4.
- Marine Pollution Research Pty Limited to undertake an aquatic ecology assessment, refer to this section (*Section 5.16)* and **Appendix 11** in Volume 4.

5.17.1 Assessment Methodology

The aquatic ecology assessment consisted of the following elements:

- Field studies to assess the aquatic ecology of Glennies Creek and of the SEOC project area.
- Additional field walkover inspections of Glennies Creek and tributaries within the study area, to ascertain whether there are any aquatic GDEs on the site and to ascertain present aquatic habitat conditions and fish passage attributes.
- A review of the literature regarding potential for open-cut mining related impacts on creek and drainage structure, function and water quality.
- A review of regional aquatic ecology information plus agency databases to assess the potential for threatened and protected aquatic species to utilise the creeks and drainages of the study area.

5.17.1.1 Survey

Four seasonal aquatic ecology surveys were undertaken at a number of locations in Glennies Creek in autumn and spring 2007 and autumn and spring 2008. The survey included the following sites along Glennies Creek:

- GCUp: An upstream-of-mine reference site located approximately 300m upstream of the New England Highway.
- GCOCUp: A reference site located adjacent the upstream limits of SEOC on Glennies Creek, approximately 600m downstream of the New England Highway.
- GCMid: an intermediate next-to-mining site located approximately 1.2km downstream of New England Highway.
- GCOCDown: A site located towards the downstream limits of the SEOC mine footprint, approximately 2.2km downstream of the New England Highway.
- GCDown: a downstream reference site located approximately 0.9km downstream from GCOCDown, and 2.0km upstream from Hunter River confluence.

In addition to the Glennies Creek site walkover inspections plus aquatic ecology sampling, surveys were undertaken in tributaries/ sub-catchment drainages and dams in the SEOC area over seven days in 2008, 3 July, 14 to 16 and 28 October plus 9 and 10 December 2008. The surveys included:

- Inspections over the full length (headwaters to Glennies Creek) of tributaries T1 to T5 (refer to Figure 5.23).
- Aquatic ecology (fish and macroinvertebrate sampling) and water quality (water depth, temperature, dissolved oxygen concentration and saturation, pH, conductivity, salinity and turbidity) sampling at several in-line pond and dam sites on the major tributaries T3 to T5 (refer to **Table 5.43**).
- Water quality (water depth, temperature, dissolved oxygen concentration and saturation, pH, conductivity, salinity and turbidity) sampling sites at numerous locations through T3 to T5 (refer to Table 5.43).

Table 5.43: Sampling sites used in the aquatic ecology assessment.

Tributary	Sampling Site	Sampling Undertaken	Features
T3	D1	Aquatic ecology & water quality.	Offline dam.
	D8	Aquatic ecology & water quality.	Offline dam.
	T3 dam	Aquatic ecology & water quality.	Inline dam.
	3.1	Water quality.	Inline pool.
T4	D6	Aquatic ecology & water quality.	Offline dam.
	D7	Aquatic ecology & water quality.	Offline dam.
	D12	Aquatic ecology & water quality.	Offline dam.
	P4	Aquatic ecology & water quality.	In stream pool.
	4.1 to 4.10	Water quality.	Inline pools.
T5	D9	Water quality.	Inline dam on feeder line.
	D11	Water quality.	Offline dam.
	P5	Aquatic ecology & water quality.	In stream pool.
	5.1 to 5.4	Water quality.	Inline pools.

A vehicle based survey was also made of Glennies Creek above the New England Highway up to Glennies Creek Dam to assess the likelihood of native fish colonisation and fish passage attributes of the upper creek.

5.17.1.2 Sampling Methods

The adopted aquatic ecology sampling methods are based on existing methods being utilised for monitoring long-term aquatic ecological change in Illawarra and Hunter coal mining catchments. Taking into account site specific limitations to sampling methods the adopted sampling design included the following features:

- Sampling of the aquatic macroinvertebrate fauna at five creek pool sites in Glennies Creek twice a year (in spring and autumn) using the AusRivAS sampling, sorting and identification protocols.
- AusRivAS sampling of a representative number of tributary and dam sites in the study area when there has been sufficient rainfall to provide suitable sampling sites.
- Estimation of fish occurrence by a combination of bait-trapping, dip netting and observation, with all captured fish identified in-situ and immediately released.
- Depth profiles of basic water quality parameters: Temperature, Electrical Conductivity (salinity), water acidity (pH), Dissolved Oxygen and Turbidity, at each site during each sampling run.
- Recording of changes in creek riparian condition and of aquatic plant distribution within the study areas at each sampling time.
- Recording of other aquatic fauna utilising the study area aquatic habitats including specific searches for platypus and native water rat, with observations where made of fishing bat, reptiles, birds, turtles and snakes. Platypus and native water rat usage is also assessed by searching for suitable bank conditions for burrow sites or feeding stations and inspection of scats.

5.17.1.3 Evaluation of Sampling Data

The AusRivAS derived macroinvertebrate data are used to compile:

- Site species diversity indices (i.e., number of macroinvertebrate taxa at each site)
- Site pollution sensitivity indices (using the Stream Invertebrate Grade Number Average Level (SIGNAL) biotic index).

- Site condition measurements are used to compile a stream site condition index, based on the River-Creek-Environment (RCE) method developed by Petersen (1992), as reported by Chessman et al 1997) for the greater Hunter River catchment.

Assessments between seasons and sites were then made by comparing these site indices and comparing changes in the indices for each site over time (i.e. between surveys).

SIGNAL is a pollution tolerance index for stream macroinvertebrates (Chessman, 1995; Chessman *et al.*, 1997, Chessman, 2003b). SIGNAL is used to assign average pollution sensitivity grades to each of the sites for site comparisons across each survey and for comparison over time.

When mean SIGNAL indices are calculated for sites, the sites can be grouped into site condition categories (Chessman *2003b*) as follows:

- SIGNAL Index > 6 = Healthy Unimpaired.
- SIGNAL Index 5-6 = Mildly Impaired.
- SIGNAL Index 4-5 = Moderately Impaired.
- SIGNAL Index < 4 = Severely Impaired.

The River-Creek-Environment (RCE) method assesses the site condition through the scoring of 13 different attributes on a scale of 1 to 4, where 1 is essentially ideal conditions, and 4 is highly disturbed. The scores are then tallied, where the minimum possible is 13 and the maximum 52.

Considering the results of the combined aquatic ecology literature review, field studies and surface water plus groundwater study results were used to classify the SEOC sub-catchment drainages and the receiving waters (Glennies Creek) against the NSW DPI (now known as DII) Fisheries' stream classification scheme (NSW Fisheries 1999b):

- **Class 1 -Major fish habitat –** Large named permanently flowing stream, creek or river. Threatened species habitat or area of declared "critical habitat' under the threatened species provisions of the Act. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.
- **Class 2 -Moderate fish habitat –** Smaller named permanent or intermittent stream, creek or watercourse. Clearly defined drainage channels with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.
- **Class 3 -Minimal fish habitat –** Named or unnamed watercourse with intermittent flow, but has potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). None to minimal defined drainage channel. Semi-permanent pools, ponds, farm dams or wetlands nearby, or form in the watercourse after a rain event. Watercourse interconnects wetlands or stream habitat.
- **Class 4 - Unlikely fish habitat –** Named or unnamed watercourse with intermittent flow during rain events only, little or no defined drainage channel, little or no free standing water or pools after rain event finishes (e.g. dry gully, shallow floodplain depression with no permanent wetland aquatic flora present). No aquatic or wetland vegetation present.

5.17.2 Existing Aquatic Ecology

5.17.2.1 Habitat

Glennies Creek

Glennies Creek is a perennial creek that caters for mixed seasonal and downstream demand to provide environmental and compensatory base-flow to the Hunter River from the Glennies Creek Dam storage at Lake St Claire.

Glennies Creek is deeply incised into its channel throughout the study area and consequently the banks are generally steep and in some cases unstable. Other than at the New England Highway road bridge there are minimal rocky outcrops instream, with the channel comprising several long

pools more or less permanently connected with their downstream ends defined by shallow but mostly submerged drift sediment and cobble banks that partially obstruct the channel and comprise areas of cobbles with some drift sediment banks. Large woody debris occurs in the creek and is generally swept against the banks. There were no rock-bar limited pools found in the creek over the 1.5 year study period.

Tributaries

There are five sub-catchment drainages to Glennies Creek from the SEOC project area. The two upper sub-catchments T1 and T2 are very small and drain from the New England Highway through the Town Common and through the rural sub-division portion of the study site generally via grassy swales. The connections to Glennies Creek are deeply incised and eroded into the Glennies Creek bank and are partially filled with waste metal and rock rubble. These sub-catchment drainages do not provide any significant aquatic habitat.

Sub-catchment T3 is longer with a slightly larger catchment. It also drains via the Town Common then through cleared agricultural lands, before meandering across the Glennies Creek flood plain. Its confluence is also deeply incised and eroded into the Glennies Creek bank. There are a number of in-line plus feeder dams on this tributary, including the dam in the Town Common. Between dams, the creek is generally confined to grassy swales and the swales in the flood plain are often boggy after rainfall. There are no significant aquatic habitats within the creek line other than the inline and feeder dams.

Sub-catchment T4 is the largest sub-catchment and has the longest creek line. The creek has its origins well to the east of the Ashton SEOC project area and flows through patchy lightly wooded areas plus cleared farmlands. The creek generally has a well defined structure with narrow V shaped channels in the upper wooded section plus a broad and highly meandering chain of ponds for much of its length. There are both in-line and feeder drainage dams all along the length of the creek. The creek itself has many sections of shallow clay-incised ponds alternating with grassy/boggy riffle sections plus narrow and deep rock or tree root confined pools. The creek flows through agricultural lands under cultivation in the Glennies Creek floodplain before plunging to Glennies Creek via a deeply incised and eroded channel in the Glennies Creek riparian bank.

Sub-catchment T5 is the second largest sub-catchment within the Ashton SEOC project area. It has similar characteristics to T4 sub-catchment drainage but with overall less frequent pool/pond structure and more grassy swale connection between ponds. There are two large dams where the tributary drains to the Glennies Creek floodplain, one in-line and the other on a major feeder line to the tributary. The feeder dam was brimful at the time of sampling but the in-line dam held considerably less water due to an old breach in the dam wall.

5.17.2.2 Sample Site Water Quality

Glennies Creek

For water quality within Glennies Creek refer to *Section 5.11.2.3.*

Tributaries

Water quality in the tributaries including in line dams can be summarised as follows:

- Temperature of surface waters ranged between 11.0°C and 14.8°C in July 2008 and 16.9°C and 29.2°C in October 2008.
- Conductivity ranged between 70µS/cm and 250µS/cm for the majority of sites. Site P5 showed conductivities up to 589 µS/cm, while some sites in T4 reached 334µS/cm.
- Dissolved oxygen (DO) values varied from 5.6% to 91.5% saturation.
- Water pH values within all sub-catchment tributary pools were slightly acidic ranging between 6.54 pH units to 6.98 pH units. Values within the sub-catchment tributary in-line dams were slightly higher, ranging from 7.30 pH units to 7.71 pH units.

- Water turbidity was slight to moderate at most sites in all three tributaries, ranging from 17.8 NTU to 98.9 NTU, and high at five sites in T4 and T5, ranging from 187.5 NTU to 600.0 NTU.

Results for the surface water quality comparisons from the sub-catchment off-line dams may be summarised as follows:

- Temperatures were lower for the mid October survey ranging between 18.6°C and 22.9°C when compared to the late October and December surveys (29.7°C to 32.4°C).
- Conductivity was generally low ranging between 92µS/cm and 175µS/cm, except for Dam1, which was slightly higher at 300µS/cm.
- Dissolved oxygen values varied between 35.4% sat and 132.8% sat, with an overall mean of 71.0 ± 14.9% sat.
- With the exception of Dam9 and Dam12, pH values at all off-line dam sites were around neutral, ranging between 6.86 pH units and 7.44 pH units. Dam9 and Dam12 waters were alkaline (9.09 pH units and 9.19 pH units respectively).
- Water turbidity at off-line dam sites varied from clear water (3.7 NTU at Dam12) to turbid (386.6 NTU at Dam11)

5.17.2.3 Macroinvertebrates

For the study period from autumn 2007 to summer 2008, a total of 70 macroinvertebrate taxa were identified, 60 from Glennies Creek and 45 from sub-catchment tributary aquatic ecology sample sites. Whilst the macroinvertebrate diversity was higher for Glennies Creek sites (mean 21.9 ± 0.7 taxa per site), the sub-catchment sites (sampled once in October 2008) compared favourably, with a mean of 20.4 ± 0.6 taxa per site.

There were 22 taxa found in Glennies Creek sites that were not recorded in the subcatchment sites, 18 of which were insect taxa. There were 10 taxa specific to sub-catchment sites. That is, 36 taxa were found in both creek and sub-catchment sites. A number of the more sensitive macroinvertebrate groups such as caddis-flies were better represented in Glennies Creek sites (8 taxa) with only 3 taxa found in the sub-catchment sites. However, some taxa that are key indicators of longer-lasting (i.e., drought resistant) sites were found in sub-catchment sites (e.g., freshwater shrimp at P5 and Dam7, freshwater limpets at P4, P5 and Dam7).

Comparison of site SIGNAL indices indicated that Glennies Creek macroinvertebrate assemblages included slightly more pollution-sensitive animals, with more tolerant taxa occurring in the sub-catchment sites. Despite this difference, both creek and sub-catchment sites supported a range of pollution tolerant taxa, ranging from most-sensitive rating 10 (mayfly family Leptophlebiidae at sites P4, P5) to least-sensitive rating (snail family Physidae, T3 Dam).

5.17.2.4 Fish and Threatened Species

Glennies Creek

Based on the combined sampling from Glennies Creek plus the more intensive sampling on the adjacent Bowmans Creek, particularly during the drought prior to the June 2007 floods, there have been 16 fish species recorded from the combined Glennies and Bowmans Creek lower catchments, three of which are introduced species.

Hunter Catchment Management Trust (HCMT, 2003) listed three other expected fish species for Glennies Creek below the dam, none of which have been recorded from either Glennies or Bowmans Creek to date; freshwater herring, common jollytail and freshwater mullet.

No species of fish or aquatic invertebrates, as currently listed under the NSW Fisheries Management Act 1994 (FMA), or under the EPBC Act 1999, were recorded or are expected in any of the monitoring conducted to date, and no protected fish, as listed under the FMA 1994, have been found or observed in either Bowmans or Glennies Creeks.

Two species of concern include the Darling hardyhead (*Craterocephalus amniculus*) and Freshwater catfish (*Tandanus tandanus*). These species were not identified during surveys.

The surveys identified the following fish species in Glennies Creek:

- *Anguilla reinhardtii* - Long-Finned Eel (native).
- *Cyprinus carpio* - Carp (introduced).
- *Eleotridae* – Gudgeon (native).
- *Mugil cephalus* – Mullet (native).
- *Gambusia holbrooki* - Eastern Gambusia (introduced).
- *Retropinna semoni* - Australian Smelt (native).

The introduced pest species, plague minnow (Gambusia holbrooki), has been the most commonly encountered fish during all aquatic ecology monitoring surveys.

Tributaries

Fish were caught from one site only during the sub-catchment tributary field investigations. The introduced pest species plague minnow was present at T3 Dam.

Whilst the landowner of Dam 12 stated that the dam contained golden perch (*Macquaria ambigua*) from stocking with around 200 fish five years ago, no golden perch were observed during sampling.

5.17.2.5 Other Fauna

Glennies Creek

Field investigations observed both the native water rat *Hydromys chrysogaster*, and platypus *Ornithorhynchus anatinus*, in the long pool section adjoining the Glennies Creek GCOCUp site. There were also multiple observations of long necked turtles Chelodina longicollis and eastern water dragon (Physignathus lesueurii). Water birds observed included water hens, black duck, wood duck and white-faced herons.

Tributaries

Long necked turtles were present at four locations within the study area and one location upstream of the project area on T4. The eastern water dragon was also observed at an in-line dam located 50m upstream of P5 sample site. Numerous green reed frogs *Litoria fallax* were observed on cumbungi leaves in P5. White faced herons, spur-whinged plovers, wood ducks and black ducks, and swamp hens were also observed on or around dams.

5.17.2.6 Stream and Site Classification

Glennies Creek

Glennies Creek within the study area provides valuable fish habitat and supports permanent flow throughout its length. A number of native fish species are known to inhabit the area, and platypus reside within the study area. Aquatic vegetation is present throughout the creek length. There are no site significant impediments to fish or platypus migration through the study area.

RCE scores, mean site diversity numbers and mean SIGNAL indices averaged over the August 2007, September 2007 and September 2008 for the Glennies Creek sampling sites are detailed within **Table 5.44** below.

Table 5.44: Mean site diversity numbers, mean SIGNAL and RCE indices for sampling sites within Glennies Creek.

Glennies Creek Sampling Site	RCE Score	Mean Taxa Diversity (Aug07, Sept 07, Sept08)	Mean SIGNAL index (Aug07, Sept 07, Sept08)
GCUp	35	23.8	5.11

Glennies Creek Sampling Site	RCE Score	Mean Taxa Diversity (Aug07, Sept 07, Sept08)	Mean SIGNAL index (Aug07, Sept 07, Sept08)
GCOCUp	34	23.3	4.99
GCMid	35	21.0	4.88
GCOCDown	33	23.0	4.78
GCDown	33	19.3	4.58

SIGNAL values indicate the majority of sites in Glennies Creek to be 'moderately impaired' with a few 'mildly impaired' sites. To place these results in perspective, Chessman (1997) recorded SIGNAL values just below Glennies Creek Dam and just above the dam on Carrow Brook as 'mildly impaired' with SIGNAL values of 5.2 and 5.5 respectively.

SIGNAL values decrease from the umpstream site GCUp to the downstream site GCDown potentially an indication of land use intensity.

Under the NSW Fisheries' classification scheme, Glennies Creek within the study area is considered a Class 2 stream.

Tributaries

Site diversity numbers, SIGNAL and RCE indices for the tributary sampling sites are detailed within **Table 5.45** below.

Table 5.45: Site diversity numbers, SIGNAL and RCE indices for sampling sites within the site tributaries.

Tributary Sampling Site	RCE Score	Taxa Diversity	SIGNAL Score
P4	32	23	4.63
P5	24	20	4.71
T3dam	25	18	4.13
Dam1	24	19	4.06
Dam7	22	19	4.19
Dam8	23	22	4.47
Dam6	23	21	4.11
Dam12	21	21	3.81
Mean	**-**	20.4	**4.26**

The SEOC sub-catchment tributaries T1 and T2 are classified as Class 4 drainages. They are generally dry gullies, grassy pasture depressions or shallow floodplain depressions with no permanent wetland aquatic flora present. They have intermittent flow during rain events only and most have little or no defined drainage channels. There is little or no free-standing water or pools after rain events (other than in the in-line farm dams).

Sub-catchment tributary T3 is considered a Class 3 drainage as it contains permanent aquatic habitats, aquatic vegetation, supports fish populations (albeit exotic species) and turtles. Whilst T3 has minimal defined channel areas, there is a series of ponds and dam habitats downstream of Glennies Road that would become connected following rainfall.

Both the sub-catchment tributaries T4 and T5 are considered to be Class 2/3 habitats as they do provide more or less permanent aquatic habitats and moderate drought refuge, are known to support frog and turtle populations and have the potential to support native fish. Both drainages contain alternating sections of clearly defined channels followed by sections with no defined channel areas at all. Aquatic vegetation is present in both of the tributaries.

5.17.2.7 Fish Passage

Glennies Creek in the study area provides a continuous passage for fish to move upstream from the Hunter River into the upper catchments of Glennies Creek.

T3, T4 and T5 sub-catchments include suitable longterm drought refuge ponds and dams and may allow fish passage into the sub-catchment creeks during high flow events, when the Glennies Creek flood plain is drowned out.

The only opportunities for fish to access the upper T4 sub-catchment is during high flow events, where there is potential for the habitats to support fish. Thus, it is considered that sub-catchment T4 does provide suitable fish passage and long-term fish habitat function (except under prolonged drought conditions).

The only available permanent aquatic habitat in sub-catchment tributary T5 above the mining area is in the form of a dam (Dam11). Fish passage between Dam11 and the next available permanent water downstream (T5.1 dam) is very poor, and it is therefore considered that sub-catchment T5 does not provide suitable fish passage or any long-term fish habitat function.

It is most likely that the native freshwater eel (*Anguilla reinhardtii*) occurs throughout most of the sub-catchment tributaries.

5.17.2.8 Groundwater Dependant Ecosystems

Both the Groundwater Report (Aquaterra 2009) and this aquatic report considered the occurrence of GDEs in the study area. Potential GDEs were identified using the eight-step rapid assessment (DLWC 2002), and it was concluded that there are no known or likely wetland, terrestrial or aquifer/cave ecosystem GDEs in the study area. Whilst there were several flushes of green observed in drainage channels leading to dams, inspection of these indicated that the flush of new grass growth could be attributed to shallow sub-surface water flow associated with recent rainfall. Assessment of Glennies Creek plus tributary creek riparian vegetation did not indicate any specific riparian plant communities which could be considered groundwater dependent.

With regard to the degree of dependency of possible aquatic or hyporheic GDEs to baseflow in the Glennies Creek study area the following factors are relevant:

- Glennies Creek is perennial with sub-surface creek sediment saturation controlled for the majority of the time by surface water rather than upwelling groundwater.
- Due to there being surface flow most of the time, riparian and edge emergent vegetation plus riffle zone fauna are more dependent on fluctuating surface water levels than on groundwater upwelling, and there is insufficient groundwater upwelling to make any significant impact on surface water levels except under prolonged drought periods.
- Owing to the controlled release nature of the water passing through Glennies Creek at the study site, there is generally sufficient surface water during prolonged drought conditions such that the baseflow cannot become significant.

It is concluded that possible aquatic and hyporheic GDEs in Glennies Creek within the study area would not be considered significantly dependent on baseflow groundwater.

It should be noted that River Red Gum (refer to Flora and Fauna in *Section 5.16.3.1)* are generally considered to be dependent on groundwater, however considering the aspects raised above impacts to these are expected to be negligible.

5.17.3 Impacts to Aquatic Ecology

The proposed SEOC includes the construction, operation and rehabilitation of an open cut mine. Potential impacts arising from the construction and operation of the SEOC that relate to aquatic ecology include:

- Loss of sub-catchment aquatic habitats.
- Changes to water quality and quantity relationships during and post mining within and between the sub-catchment aquatic habitats and to Glennies Creek.
- Lowering of the water table within Glennies Creek and its associated alluvium.
- Leakage of Glennies Creek water to the mine pit.

Impacts to the tributaries are discussed within *Section 5.10.5*.

With respect to aquatic habitat in the defined project area, the main direct impact is the loss of drainage lines and farm dams to the various mining elements. Whilst much of the combined sub-catchment tributaries to be lost comprise creek sections with poor water retention capabilities and no or little aquatic habitats, sections of the larger tributaries T3 to T5 provide permanent refuges and habitat for aquatic macroinvertebrates, frogs and reptiles, birds, plant communities and possibly for native fish. These sections also support riparian and fringing terrestrial habitats that border the aquatic refuges, along with the associated animals such as insectivorous birds and bats.

On the downstream (western) side of the proposed pit/ infrastructure boundary overlying the flood plain alluvial terraces, none of the tributary drainage channels supported aquatic habitats, nor was there any indication that semi-permanent surface water would prevail for any extended periods after rainfall. Thus the impacts of losing the upstream feeder channels or the potential surface water aquatic habitat resources of this area are considered minor.

The maximum predicted drawdown of the groundwater within Glennies Creek alluvium during mining, is less than 2m, localised at the western margin of the SEOC. The majority of the alluvium is expected to experience draw-downs of 0.5m or less (refer Section 5.9.5). From the aquatic ecological perspective, it is concluded that there are no significant surface water aquatic habitats or any aquatic GDEs supported by the alluvial groundwater, thus this is not expected to be a significant impact.

The lowering of groundwater levels will result in a consequent reduction in baseflow contributing to Glennies Creek, however the proportionate amount of contributions is minor (0.03% of average flow, and 0.33% of the 5 percentile flow in this section of creek) which will cause the reach of Glennies Creek within the assessment area to change from a slightly gaining stream to a slightly loosing stream during mining operations (Aquaterra 2009).

Inflows of Glennies Creek alluvial flow to the mine pit is expected to commence in year 3 and reach a maximum of 24m^3/d by year 7 of the mine operation. Post mining, water levels within the alluvium are expected to return to pre-mining levels within 100 years. Some minor residual impacts from the SEOC (<1m drawdown) may remain within the Permian coal seams, but this is expected to have a negligible impact on surface water tables or river baseflows.

Glennies Creek within the study area is already subjected to variable flow rates due to a combination of natural factors such as catchment rainfall and evaporation, plus dam releases, irrigation and water consumption from agricultural and mining operations in upstream areas. Accordingly the predicted losses from the alluvial aquifer and the effect of this on Glennies Creek stream flows are considered to have minimal potential for impact on the aquatic ecology of Glennies Creek or downstream.

5.17.4 Indirect impacts to aquatic ecology

The main indirect impact on aquatic ecology arising from the proposal relates to the issue of surface water and groundwater quality and quantity for study area and downstream aquatic habitats during and post mining.

The Surface Water Management Report (WorleyParsons 2009) contains specific details about the collection, diversion, treatment and reuse of stormwater runoff from the project site and the sub-catchments above the project site in T4 and T5, plus the disposal of runoff to Glennies Creek. The initial phase of mine construction and operation includes the establishment of a clean water dam in above the mining boundary on T4, followed by the establishment of a second clean water dam located in the upper catchment of T5 between years 3 to 5. These dams provide two functions;

intersecting the upper catchment runoff to prevent inflows to the SEOC mine, and providing a clean water contribution to Glennies Creek to compensate for loss of mining related sub-catchment input of surface water runoff and seepage.

With regard to potentially contaminated surface runoff or infiltrated water:

- Dirty water captured within the open cut will be contained and used within the mine for dust suppression within the SEOC or piped to other areas within the ACP for use elsewhere.
- Sediment water basins will be created over the life of the mine to capture surface runoff from the rehabilitated overburden. These storages will also serve as alternative sources of water for use within the ACP if the primary water source becomes depleted.

With regard to groundwater quantity and quality impacts during mining, Aquaterra (2009) notes that as groundwater flows will be towards the pit, no groundwater quality impacts are expected on aquifers outside of the pit shell during mining operations. Post-mining there is potential for some flow of water from the pit void to Glennies Creek as the pit and overburden become saturated. (Aquaterra 2009) predicts that the water quality impacts arising from water from the open cut to Glennies Creek alluvial aquifer and Glennies Creek post-mining would be negligible and that long-term recovery should take place within 100 years.

5.17.5 Mitigation Measures

The mitigation of impact is a stepped process including:

- **Avoiding** the impact; this may mean making some changes to the proposed development.
- If avoidance is not possible, then some form of **mitigation** may be required.
- Finally, if neither avoidance nor mitigation is possible, then some form of **offset or compensation** will be required. This could entail the construction or rehabilitation of similar habitat nearby.

5.17.5.1 Avoidance

The main avoidance measures undertaken for the SEOC project with respect to impacts to aquatic ecology are:

- Moving the western pit and infrastructure boundary back from Glennies Creek to avoid significant impacts on Glennies Creek alluvials and avoid potential impacts to the groundwater exchange (including potential loss of water from Glennies Creek to the mine).
- Clipping of the open cut in the north west to avoid direct mining impacts to the lower reaches of Tributary 2.
- Clipping of the open cut in the south west to avoid direct mining impacts to the lower portions of Tributary 5.

5.17.5.2 Mitigation

Proposed mitigation for the loss of valuable sub-catchment aquatic habitat includes the construction of new sub-catchment drainages with aquatic habitat function within the overburden profile and the reconnection of the upstream T4 sub-catchment through to Glennies Creek via a constructed channel connection. The creation of drainage lines and of new dams will be integrated with site overburden rehabilitation plans and incorporate appropriate design of bed control structures and of aquatic habitat attributes using rehabilitation guidelines as per (for example) Rutherford et al (2000).

Impact of cattle on the present tributary channels and aquatic habitats is evident in T3, T4 and T5, in the form of channel erosion from stock access routes, nutrient inputs from manure, water quality issues and trampling of edge macrophyte communities. Therefore, excluding cattle access to rehabilitated aquatic ecosystems is imperative for achieving desired aquatic and riparian ecological function.

Accordingly, newly built in-line ponds and selected dams would be progressively 'value added' with aquatic habitat (fringing emergent and submerged macrophytes) established in the water-bodies plus riparian shade trees and shrubs planted around the perimeters to lower evaporation losses and provide valuable roosting plus foraging habitat for woodland and wading birds, and bats. Dams plus riparian wooded habitats would be fenced off from direct stock access, further enhancing aquatic and riparian habitat values for a diversity of species. Stock watering could be achieved by gravity fed 'on demand' watering stations.

With respect to dewatering areas of aquatic habitat it is recommended that, prior to dewatering of dams and in-stream ponds to be lost to mining, native fish species and turtles should be collected and translocated to Glennies Creek, or in the case of any golden perch that have been stocked in dams, to another suitable farm dam following authorisation by DPI (now known as DII) Fisheries pursuant to Part 7(7) of the Fisheries Management Act 1994.

5.17.5.3 Offset

Impacts to drainage corridors will be offset through the following measures:

- Enhance Glennies Creek riparian corridor and rehabilitate portions of tributaries not directly impacted by mining.
- Tributary and dam rehabilitation will be integrated with site overburden rehabilitation plans and the Glennies Creek riparian corridor enhancement, to extend connective corridors between Glennies Creek and sub-catchment tributary riparian works.
- Rehabilitation and enhancement will include:
  - Bank erosion stabilisation (where caused by land use, predominantly in the tributaries).
  - Planting of native riparian vegetation.
  - Enhancement of the isolated River Red Gum community.
  - Introduction of in stream habitat (where absent) within tributaries.
  - Exclusion of livestock from direct river or tributary access in the area adjacent to the SEOC and Glennies Creek.
  - Commencement of a weed and feral pest management program in the riparian corridor adjoining the site.

5.18 Visual Impact Assessment

ACOL commissioned O'Hanlon Design Pty Ltd to undertake an analysis of the area's visual character and to assess the SEOC impacts and provide recommendations for the mitigation of those impacts. A copy of the report is contained in **Appendix 12** in Volume 5.

5.18.1 Assessment Methodology

O'Hanlon Design Pty Ltd undertook a visual assessment study method to suit the topography, likely viewer characteristics and suitable distance zones. The method is based on the model developed by the Forest Commission of Victoria and the landscape assessment techniques of the U.S. Department of Agriculture (USDA). This method utilises a systematic approach to visual assessment using quantitative measures to assess the influence of landform, vegetation, water and other landscape factors on scenic quality with refinement applied for the sensitivity levels of the viewers from various selected viewpoints.

Several site inspections were undertaken to gain an understanding of landforms, vegetation, water, and other scenic factors of not only the SEOC locality but the wider area. From these inspections eight (8) viewpoints were selected to assess the sensitivity from various publicly accessible locations of the landscape to the proposed SEOC.

5.18.2 Existing Visual Character of the Area

5.18.2.1 Regional Landscape Character

The regional landscape character of the upper Hunter Valley has several consistent elements. The uplift of the Great Dividing Range and the Hunter River are the unifying elements that develop consistency in the landscape.

Toward the east, the terrain transforms into foothills, the predominantly rural countryside and the undulating areas of the Hunter Valley. At the western edges the foothills are often steep and highly undulating.

The dominant rural activity in the region is dry land grazing, however on the floodplain and more fertile areas, cropping and its variety of textures and colours is a significant visual element. For the casual observer this creates diversity and visual interest with a seasonal quality. Smaller areas within the west of the region are also under cultivation as vineyards for grape production. Where they occur, vineyards have a more structured appearance. Similar to cropping, the vines themselves can create visual interest due to the changes in colour and density of vegetation visible in different seasons.

Another consistently strong visual element within the regional character is open cut coal mining. Often screened from main travel routes or hidden from view in remote locations, the region is home to a large number of open cut coal mines and their associated infrastructure. Commencing near Maitland to the north west of Lake Macquarie and extending north to beyond Muswellbrook, the central plains and western edges of the Hunter Valley are dotted with numerous open cut coal mining projects. Mining operations are visible along New England and Golden Highways as well as many secondary and rural roads. Many of the associated infrastructural elements, including coal handling facilities and coal preparation plants are also visible within the region.

Major cultural modifications to the existing landscape in the region include:

- Towns and villages: Singleton, Muswellbrook and a variety of smaller towns and villages.
- The widespread transformation of open eucalypt forest into grazing and farming pasture lands and crop production.
- The New England Highway and a range of local road infrastructure.
- The Main Northern Railway line.

- A series of power generating facilities (Liddell, Bayswater and Redbank).
- A number of man made lakes and water storage facilities.
- A range of open cut and underground coal mining facilities in various stages of development and rehabilitation.
- The horizontal lines of coal conveyors and the vertical lines of a series of hoppers, loaders and coal preparation plants associated with each mine.
- A variety of power transmission lines criss-crossing the landscape.
- A sprinkling of smaller communities and rural residential properties.

5.18.2.2 Local Landscape Character

Similar to the regional character, the local landscape character is heavily influenced by the topography, drainage lines and the underlying geology of the study area. For the local landscape around the ACP one of the key elements is the influence of the waterways: the Hunter River to the south, Glennies Creek and Bowman's Creek winding through the study area and a wide range of intermittent creeks and tributaries.

The dominant form is the undulating slopes and foothills. The foothills vary in elevation gradually reducing in elevation to the east. Cultural modification has occurred where the foothills are suitable to allow clearing for agricultural purposes. Remnant pockets of vegetation occur, particularly on steeper slopes, creating some diversity of colour, line and form. In keeping with the rural landscape the foothills are traversed by a myriad of fence lines and a variety of coloured patterns formed by the changes in the fenced vegetation.

The alignment of the New England Highway generally follows the ridges and significantly influences the scenic quality for the majority of viewers. From the elevated ridges the landscape opens and closes revealing a mixture of distant vistas and enclosed valleys. Many of these are rural, some are dissected by operational open cut mines and others have the harder edges of recently re-vegetated and rehabilitated landforms.

Major cultural modifications in the local visual landscape include:

- The New England Highway;
- Camberwell village;
- A range of local road infrastructure;
- A variety of power transmission lines;
- The Main Northern Railway line: north of the Ashton north east open cut; and
- The existing Ashton north east open cut and associated infrastructure;
- The Narama open cut and associated infrastructure;
- Glennies Creek open cut and associated infrastructure;
- Camberwell open cut and associated infrastructure;
- Rixs Creek open cut and associated infrastructure;
- Maison Dieu and rural residential properties.

5.18.2.3 The SEOC Project Area

The SEOC project area can be broken into broad homogenous landscape units of slope, vegetation and landscape cover. These units and their relationship to the SEOC is described below:

- **Ridgeline and Upper Wooded Slopes** - The bulk of this landscape unit forms a distant backdrop to the west beyond the boundary of the study area. Slopes range from 20 to 40%. Within the study area some small and isolated pockets of steep slopes occur adjacent to the edges of Glennies Creek. These isolated areas are relatively insignificant in the overall character of the study area. Within the study area this landscape unit has been assessed to have a moderate to low scenic quality.

- **Undulating Foothills (Vegetated and Cleared)** - Undulating foothills are the predominant unit visible within and outside the study area. Consequently this unit contributes significantly to the overall character of the study area. This unit is comprised of slopes in the range of 10 to 20%. Within the study area this landscape unit has been assessed to have a moderate scenic quality.
- **Valleys and Floodplain Areas (slopes less than 10%)** - The valleys and creek floodplain areas are the other significant unit visible within the study area. The main body of this unit is located throughout the centre of the study area. They include the catchments of Glennies Creek and Bowman's Creek and several other un-named creeks. Within the study area this landscape unit has been assessed to have a moderate scenic quality.
- **Water Bodies -** The main water body within the study area is Glennies Creek meandering through the centre of the study area. The small creeks and tributaries to Glennies Creek are less significant items. Many only flow intermittently and are not easily visible from public locations. Within the study area this landscape unit has been assessed to have a moderate to high scenic quality.

5.18.2.4 Existing Nightscape

The nightscape character of the local landscape is perceived as being rural/industrial in character, with industrial quality lighting around the significant coal infrastructure, concentrations of light at Camberwell village and scattered groups of residences and very small concentrations of light at individual homesteads. The lighting of the existing Ashton mine infrastructure and working areas stand out as discordant elements in the existing nightscape.

5.18.3 Visual Impact Assessment

The construction of the SEOC project will change the visual character of the immediate area through the construction of the various elements of the project such as:

- The out of pit emplacement/environmental bund along the New England Highway.
- The conveyor connecting the SEOC with the existing ACP, crossing the New England Highway.
- Night lighting effects (direct lighting and sky glow) from infrastructure.

Impacts are likely to be greatest during the construction of the out of pit emplacement. The emplacement is scheduled to be constructed and rehabilitated progressively to ensure that visual impacts and disturbance is kept to a minimum.

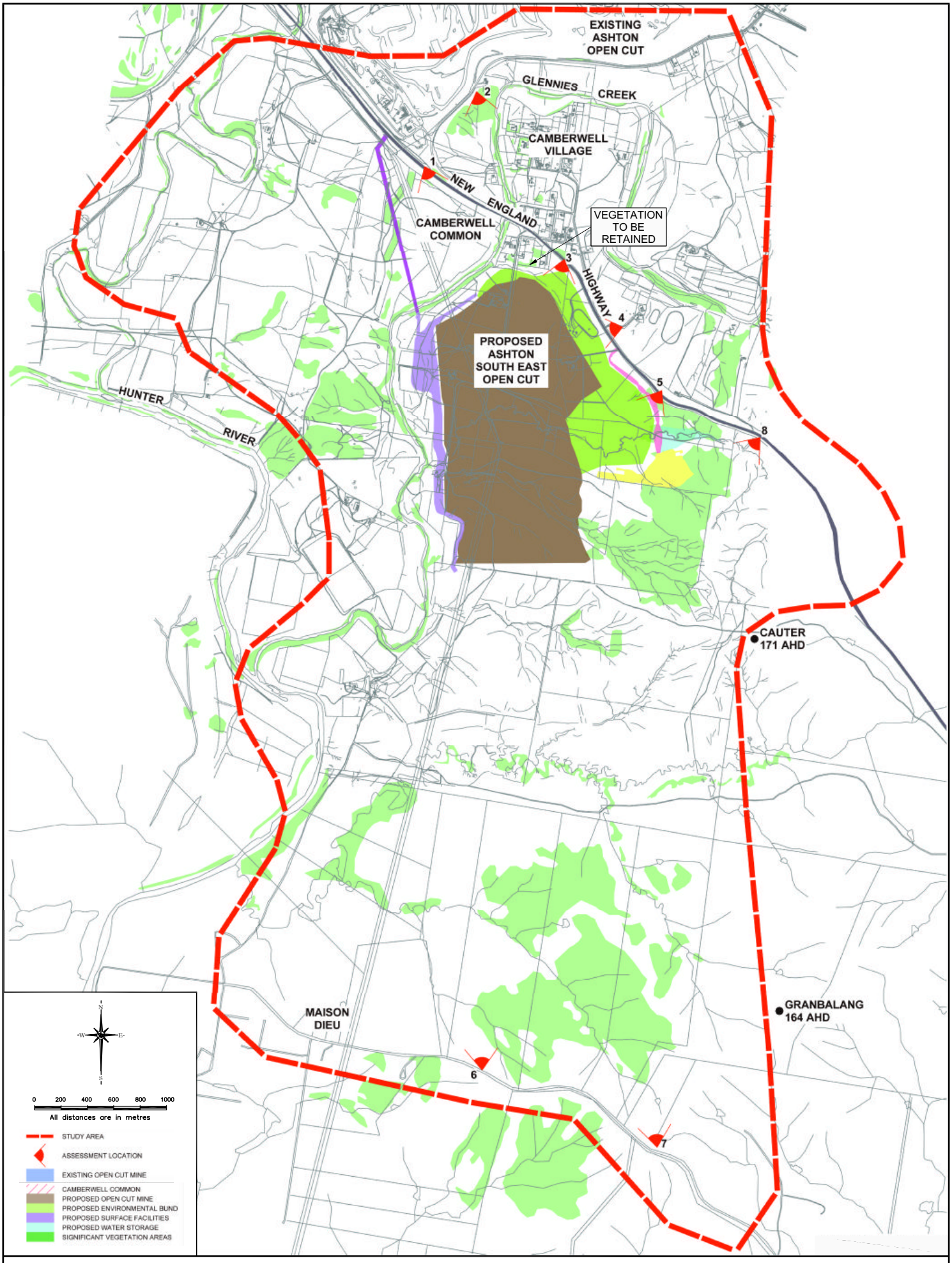
To assess the visual impact of the SEOC eight (8) view points (VP1 to VP8) were selected surrounding the SEOC area. The location of the view points is shown in **Figure 5.38**. The view points were selected based on elevation of the view and the distance to the SEOC. The viewpoints were located on the New England Highway, Maison Dieu Road and Glennies Creek Road looking toward the project.

5.18.3.1 From View Points

VP 1 New England Highway, east end of road cutting: 100AHD

Photograph 5.1 illustrates the current views from VP1.

Viewers travelling east after passing through the road cutting on the New England Highway will have views of the western side of the SEOC, and the ROM transfer area from an elevated location at close middle ground distances of between 600 and 1000m. The duration of the views will be relatively short lasting no more than 60 seconds until the viewer passes over the Glennies Creek Bridge.



AshtonCoal

South East Open Cut Project

Location of selected viewpoints for the visual impact assessment

Ohanlon

Figure 5.38

Plan 62

Prepared by Pegasus Technical

CAD FILE: 05119B.dwg

Photograph 5.1: View south-east from VP1

The southern side of the open cut emplacement will be relatively un-rehabilitated for the first 3-4 years of the project.

Viewers will also have a clear view of the conveyor system as a strong lineal element leading into the ROM facility area. This diminishing lineal element will strongly direct views toward the ROM facility and working faces, highlighting the working surfaces. Similar views of these visual components as foreground elements will be possible from the western Camberwell Common at slightly reduced viewer elevations.

As viewers are elevated, careful selection of colour for the conveyor to match the landscape could slightly reduce impacts. The infrastructure area will be visible as an industrial styled element at a distance of approximately 2500m southeast of the viewer for at least 2 to 3 years until the in pit emplacement rises beyond 100 AHD and closes the view beyond the open cut to the south east.

The open cut working areas, the emplacement and rehabilitation works will be visible throughout the mine lift initially moving west then south. Impacts will reduce toward the end of Year 3 with a lesser impact until Year 7. The levee system will be visible when travelling to the east and from the western Camberwell Common as a foreground element. The base of the levee system will be a significant discordant element due to its lineal form and consistency of the battered slope.

Viewers travelling west on the New England Highway will view the conveyor system as an enlarging element running parallel to the viewer for a duration of approximately 50 seconds. This linearity will focus views toward Transfer Station No.2 at the crest of the road cutting and subsequently on the overhead conveyor system crossing the road at the cutting. Both elements will be silhouetted for a short viewing period, especially evident in the late afternoon as the sun drops toward the horizon behind the elements.

VP 2 Glennies Creek Road 110 AHD

Photograph 5.2 illustrates the current views from VP2.

The Glennies Creek Road access has a significantly lower traffic volume than the New England Highway. Viewers travelling north-east will not view any elements of the SEOC. Viewers travelling south-west will have elevated views of the open cut, conveyor system and ROM facility at variable distances between 2200 m and 3200 m. Views of the open cut and the environmental emplacement will be prominent for approximately 2-3 years. Following rehabilitation at that time the impacts will reduce significantly.

Photograph 5.2: View south-east from VP2 on Glennies Creek Road.

The conveyor system will be visible as a middle ground element highlighted by the lineal shape at variable distances around 1500m. Views down onto the platform of the ROM facility will be possible from some locations at the western end of Glennies Creek Road for the duration of the project.

VP 3 Camberwell Village: McInerney Road 95 AHD

Photograph 5.3 illustrates the current views from VP3.

Photograph 5.3: Views south from VP3 (note the trees in the lower right side of shot will be retained).

Some viewers in Camberwell village will have views of the out of pit emplacement construction and the ROM facility during the initial years of the open cut works at distances between 400 and 1500 m. The highest impacts will be in the early years of the project. Once the out of pit emplacement reaches 100 AHD the views will become restricted. The initial works will be viewed as foreground elements from residences and streets on the south side of the high point on McInerney Road.

The working faces and rehabilitation of the out of pit emplacement and the open cut area will be elevated to the south forming a new horizon line particularly from slightly lower viewer elevations on the south side of the high point on McInerney Road and along the west end of Alpha Street. Views of the conveyor system and the transfer stations will be visible at variable distances up to 1000m.

Elements of the infrastructure area are unlikely to be visible once rehabilitation commences. For more detailed assessment of impacts on residences refer to *Section 5.18.3.2*.

VP 4 New England Highway: Adjacent to the Ernst property 90 AHD

Photograph 5.4 illustrates the current views from VP4.

Photograph 5.4: View south-west at VP4.

Viewers in the vicinity of VP4 are likely to be travelling east/west on the New England Highway. Work on the out of pit emplacement and the access road works will be the earliest works of the project. Over a construction period of 18 months the overburden material will be relocated to form a new landform 1500m long at variable distances approximately 80-100m from the south edge of the New England Highway. The emplacement will rise approximately 25m in height creating a new horizon line and a significant change to the outlook from the road.

The existing landscape is a very lightly wooded downhill slope to the south offering on open vista. The new landform will enclose the south side of the New England Highway with very little remnant vegetation for visual screening between the New England Highway and the out of pit environmental emplacement.

The proposed modelling of the face of the out of pit environmental emplacement is critical to the long term impact of the work. Softened and appropriately manipulated with naturally shaped watercourses and randomly rounded topographic features, the face of the environmental emplacement could be revegetated to successfully blend into the existing landscape. Travellers will view the element as a close foreground element with opportunity to consider the detail. If the detail is highly engineered, straight and not natural in appearance the work will not easily blend into the landscape and will be left as an indicator of the mining works beyond for posterity. The development of a natural appearing landform has the greatest potential to reduce long term visual impacts of the SEOC. ACOL are participating in research utilizing software programs to produce natural looking landforms, refer to *Section 4.4.5*.

VP 5 New England Highway: West of the Burgess property 100 AHD

Photograph 5.5 illustrates the current views from VP5.

Photograph 5.5: View south-west from VP5.

VP5 is relatively close to VP4 and the impacts of the creation of the open cut and the out of pit emplacement will be similar, particularly as viewers approach from the east. From the west however viewers will approach and pass the east edge of the out of pit emplacement and a different vista will emerge.

For viewers at VP5 looking south the access road and the dam wall will be visible as lineal elements viewed along their length. The water would be an attractive feature and create diversity in the landscape. Careful treatment of the edges and dam wall to soften the engineering will reduce visual impact and improve visual quality. The office and workshop area will be visible beyond the dam at a distance of approximately 400m.

Viewers approaching VP5 from the east will travel along the ridge with open woodland to the south. The transition of topography from open woodland to screened water feature and then into access road and out of pit emplacement will be in the direct line of vision of drivers travelling east. The change of topography and variation to the landscape will be highlighted. Opportunities exist to reduce potential impacts by transition of surfaces that avoid a hard engineered appearance, placement density and location of revegetation materials. Retention of existing vegetation between the south edge of the dam proposed water level and the office and workshop area will reduce the visibility of the facilities from the New England Highway.

The Burgess (Pty 121) residence is located approximately 15m above the highway and is likely to have higher impacts depending on the vegetation immediately adjacent to the residence and the individual aspect of rooms and windows.

VP 6 Maison Dieu Road north east of the substation at 100 AHD

Photograph 5.6 illustrates the current views from VP6.

Photograph 5.6: The view north from VP6.

Viewers in this location and houses adjacent to the west may have views to the north toward the SEOC and emplacement areas. At a distance of 4000 to 6000 m the open cut area is a possible background element heavily screened by intervening ridges and vegetation, whilst un-rehabilitated the colour and form may highlight the works. Once rehabilitated and vegetated the work is unlikely to be discernable. The south face of the final landform may be discernable particularly in the morning in summer when it is not in shadow depending on the line and quality of the rehabilitation treatment of the north edge of the final void.

VP 7 Maison Dieu Road on the crest south of the Granbalang 140 AHD

Photograph 5.7 illustrates the current views from VP7.

Photograph 5.7: The view north from VP7.

Slight views of the south face of the out of pit emplacement and the open cut area will be possible for static viewers at the ridge facing north on Maison Dieu Road at viewer elevations around 140 AHD. At a distance of 4000 to 6000 m the works will be background element in the total landscape and of very low impact. Once rehabilitated and vegetated the work is unlikely to be discernable.

VP 8 New England Highway: Adjacent to Burgess Property access entry 110 AHD

Photograph 5.8 illustrates the current views from VP8.

Photograph 5.8: The view south-west from VP8.

Viewers at VP8 will be approaching the Ashton SEOC on the New England Highway travelling to the west. The drop in topography to the south of the highway will allow views of the emplacement area as a foreground element in the direction of travel. The dam wall and the dam will also be highly visible foreground elements of interesting diversity for a short duration. The dense existing vegetation, approximately 200m south west of the New England Highway will significantly screen the office and workshop facilities and the lower southern sections of the out of pit emplacement, thereby reducing the impacts in the first 2-3 years of the mine life.

The main visual intrusion will be the out of pit emplacement. Short duration views of a 250m wide section of the emplacement will be possible down the length of the dam and over the dam wall from the initial stages of construction at a distance of approximately 500m. The bulk of the emplacement will be screened by intervening vegetation until it reaches a height around 95 AHD.

Once the height exceeds 95 AHD, the emplacement is likely to become partially visible over and through the top of the intervening vegetation. The extent of visibility will be determined by the amount of vegetation removal for the access road, dam and office and workshop facilities. Retention of significant existing vegetation around the dam and within the pondage area could reduce visual impacts significantly by leaving a partial vegetative screen.

5.18.3.2 Ranking of Visual Impact

The sequential nature of mining, emplacement, rehabilitation and the location of infrastructure was assessed over the life of the SEOC. Visual impact ratings were ranked in decreasing severity on a scale of between 8 and 0 as follows: very high, high, moderate, low and nil, for each of the eight (8) viewpoints for the life of the SEOC. **Figure 5.39** provides a summary of the daytime visual impact and **Figure 5.40** provides a summary of the night time visual impact of the SEOC.

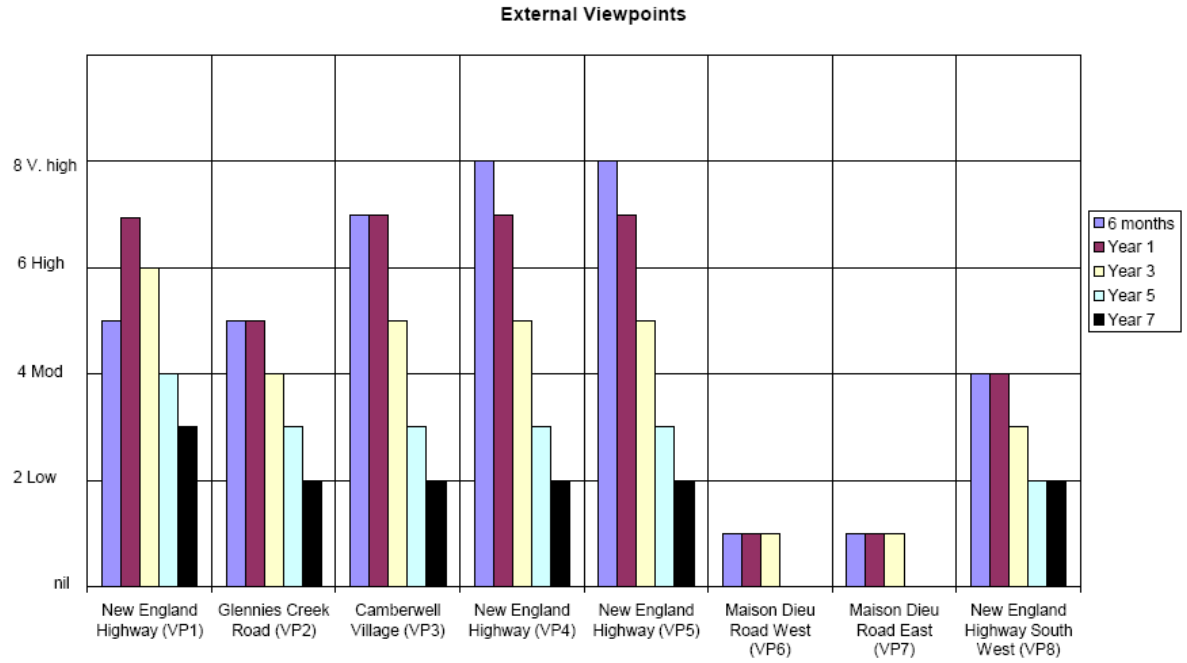


Figure 5.39: Degree of visual impact during the daytime from the SEOC project.

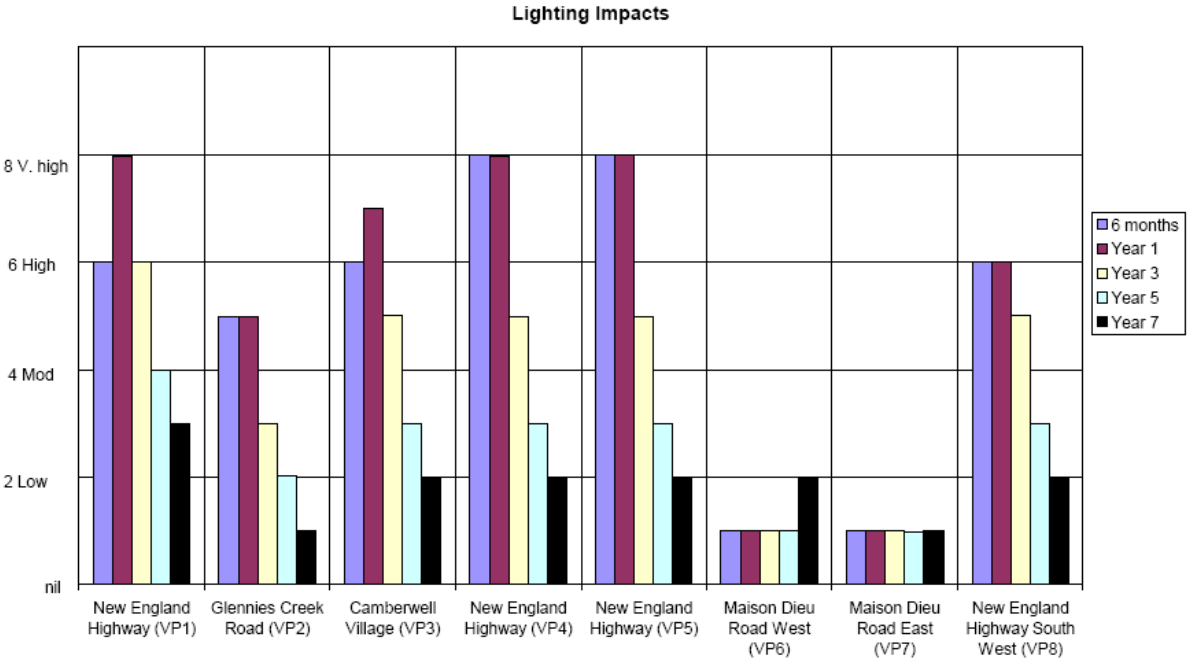


Figure 5.40: Degree of visual impact during the night from the SEOC project.

5.18.3.3 From Camberwell Village

This section should be read in conjunction with Figures 1.2, 1.3 and 4.20 or Plans 2, 3, and 23 in Volume 2 respectively to determine the location of streets, properties and their respective ownership.

The potential visual impacts of the works on the most elevated sections of the Camberwell village are identified at VP3. The village however is composed of a range of residences and allotments that encircle the crest of the ridge at McInerney Road. Generally residences along Alpha Street, Lethbridge Street, Perry Street, Glennie Street and Dunn Close have potential views south matching the impacts noted at VP3.

Residences in Dyrring Street east have potential views of the open cut area and out of pit emplacement from the rear and/or south facing elements of the properties. A significant number of these affected properties are owned by ACOL. Once the topography flattens and commences falling to the north the visual impacts quickly reduce and allotments in Dulwich Place, Dawson Street, Powditch Street and the northern sections of Glennie Street and Lethbridge Street will not be visually affected.

Many of the residences in these streets have been aquired. Residences on properties 2 (Ninness), 8 (Chrisholm), 50 (Standing) and 51 (Bailey), as well as Property 46 (Nowland, Moore and Dunn) which is the site of the Camberwell Hall will have views of the emplacement and initial open cut works.

Properties 46, 50 and 51 are all south of the New England Highway and within 200m of the proposed open cut and out of pit emplacement. Some vegetation will remain between the properties and the emplacement however the mass and relative height of the emplacement within 200m of the viewers will create very high impacts. In addition, if Option 2 is selected for the transmission line easement additional impacts and some vegetation clearing will occur.

Properties 2 and 8 are located north of Alpha Street with outlooks south over the proposed open cut area and out of pit emplacement. The closest works are approximately 250m from the properties. Both properties are elevated above the works. Property 2 would obtain partial screening from the existing vegetation on Property 56-1. Property 8 would be potentially screened by vegetation on Property 47 and 188 north and west of the Camberwell Hall. The existing vegetation would partially screen the early works and initial open cut works, however once the emplacement works reach RL 80 the emplacement and rehabilitation works will be visible above the vegetation. Views of the conveyor system to the west will also be possible at distances of 1000m.

If selected, Transmission Line Option 2 would be visible as a horizontal line element approximately 250m from the properties at its closest point diminishing east and west.

South facing residences in Dyrring Street-east have potential views of the open cut area and out of pit emplacement from the rear and/or south facing elements of the properties. A significant number of these affected properties are owned by Ashton Coal, (refer to Figure 1.2 and 1.3). Once the topography flattens and commences falling to the north the visual impacts quickly reduce and allotments in Dulwich Place, Dawson Street, Powditch Street and the northern sections of Glennie Street and Lethbridge Street will not be visually affected.

Property 11 (Richards) will have views of the open cut and emplacement with the closest elements approximately 350 – 400m from the residence. Property 11 is slightly more elevated than those in Alpha Street and the potential views south are more extensive. Views of the open cut will be of longer duration and work on the out of pit emplacement will also be more visible due to the elevation of the viewer. The transmission easement proposed for Option 2 would be visible at a distance of 300 – 400m. Option 1 would be visible at a distance of approximately 800m.

Once the out of pit emplacement is completed and rehabilitated the impacts will be significantly reduced. The long term change in the topography will have minimal visual impact if the faces of the emplacement are softened and revegetated. The decision by ACOL to maintain part of the significant stand of existing vegetation around and just south of Perry Street reduces the visual impacts on Camberwell village in both the short and long terms.

Views of the infrastructure area and the ROM transfer areas will not be visible once the out of pit environmental emplacement is completed.

Views of the conveyor and transfer station system will be possible from streets and allotments on the south side of the crest of the ridge as a close middle ground element at a distance of around 1000m. The contrast of the lineal form in the landscape and the associated night lighting will make this a significant element that detracts from the rural setting.

5.18.4 Visual Impact Mitigation Measures

The following measures will be implemented to reduce the overall impacts of the open cut mining area, the out of pit emplacement works and the infrastructural elements from various viewpoints as described:

- Soften the engineered faces of the out of pit emplacement with naturally meandering creek lines and modulation of the ridges and faces.
- Remove redundant infrastructure elements and conveyors on completion.
- Implement a revegetation strategy for each rehabilitation area to mirror the existing vegetation removed from the areas to be rehabilitated.
- Retain existing vegetation around the new infrastructure areas and on the road fringes to the highway wherever possible.
- Select colours for the conveyor and transfer station to reduce bulk and scale.
- Maintain, protect and supplement the existing vegetation between Perry Street and the New England Highway to provide a screen to Camberwell and the New England Highway

From a visual perspective Option 1 for the relocation of transmission lines and easements is preferable to Option 2 in reducing visual impacts from areas of public and private land.

ACOL are committed to minimising stray light but is cognisant of the need to meet occupational health and safety requirements. The following measures will be considered by ACOL to mitigate adverse night lighting impacts and will be applied where appropriate:

- Within the infrastructure areas use approximately 15 metre high light columns and low brightness floodlights with the floodlight body horizontal and the floodlight reflector designed to provide sharp cut-off and restrict stray light.
- After initial stripping and bund formation, program works on the north faces of the out of pit emplacement to be carried out during daylight hours and work behind the emplacement during the evenings and night.
- Use wall mounted lights with horizontal bodies and low brightness design to light areas around the offices, ROM facilities, workshop to 50 lux and adjacent portions of the hard stand area to 10 lux or the minimum allowable to meet current Occupational Health and Safety (OH&S) requirements.
- Shield all floodlights in the open cut area to the maximum extent practicable.
- Shield lights on the conveyor system and reduce brightness to 10 lux or the minimum allowable to meet current occupational health and safety requirements.
- Where safe to do so, trucks on access roads should make use of portable visual edge markers to increase drivers' visibility of road edges when driving with dipped headlamps.
- Task and general lighting should be screened from viewers were possible but lighting levels must always be selected to meet safe working practices.

5.19 Aboriginal Heritage

ACOL commissioned Insite Heritage Pty Ltd (Insite Heritage) to conduct an Aboriginal archaeological heritage assessment of the area associated with the SEOC project. A copy of the report is contained in **Appendix 13** in Volume 5.

5.19.1 Assessment Methodology

Community consultation with Aboriginal stakeholder groups and individuals was undertaken in accordance with the DECC (now DECCW) guidelines: *Interim Community Consultative Requirements for Applicants*. Letters of notification of the project were sent to the DECCW, NSW Native Titles Services, Office of the Registrar ALRA, and Singleton Council.

Letters of invitation (to register an interest in the project) were sent to those stakeholders known to ACOL in accordance with their own register. Additional stakeholders identified by the above government agencies were also invited by letter to register an interest in the project.

Public notices advising of the project and inviting registrations from community groups and individual Aboriginal stakeholders were published in the public notices sections of the Singleton Argus newspaper on 7 and 17 October 2008 and Sydney Morning Herald newspapers on 9 and 17 October 2008.

A total of 21 groups/individuals initially registered an interest in the SEOC project. All registered groups and individuals were contacted by mail and invited to attend field work. The field work for the SEOC project was conducted in conjunction with fieldwork for ACOL's Longwall/Miniwall Panel No. 9 project.

5.19.1.1 Registered Aboriginal Heritage Sites

Insite Heritage conducted a search of the Aboriginal Heritage Information Management System (AHIMS) register for an area 30 square kilometres surrounding the area of SEOC project. The search identified 50 sites recorded in that area (refer to Appendix 13).

The review of the register and associated archaeological reports with respect to known sites in the area revealed a distinct pattern. Insite Heritage observed that previous archaeological investigations have shown that sites are more prevalent in areas in close proximity to water sources, with the number and density of archaeological sites increasing with the permanence of the water resource.

An archaeological field survey of the SEOC footprint and surrounding lands was conducted between 15-19 December 2008 by Insite Heritage archaeologists and Aboriginal community representatives as listed in **Table 5.46**.

Table 5.46: List of community groups who participated in the fieldwork assessment.

Aboriginal Native Title Consultants	Biami Pt Ltd	Cacatua Culture Consultants
Culturally Aware.	Gidawaa Walang	Giwiirr Consultants
Hunter Valley Aboriginal Corporation	Hunter Valley Cultural Consultants	Hunter Valley Cultural Surveying
Hunter Valley Natural and Cultural Resource Management	Lower Hunter Wonnarua Council Inc	Ungooroo Aboriginal Corporation
Ungooroo Cultural and Community Services Inc	Upper Hunter Heritage Consultants	Wanaruah Local Aboriginal Land Council
Warren Taggart	Wattaka Cultural Consultants Services	Wonn 1 Contracting
Wonnarua Culture Heritage	Wonnarua Nations Aboriginal Corporation	Yarrawalk Enterprises

Late registrations of interest were received from Yinnar Cultural Services (25 May 2009), Mr S Franks (2 September, 2009 – Mr Franks was also registered as Biami and has advised that all registrations for him are to be listed under Tocomwall Pty Ltd), Mrs B Foot (via email correspondence from the DECCW on 3 September, 2009) and Valley Culture on 19 October, 2009.

Registered stakeholders were invited to attend a field inspection of the geomorphology work undertaken on 27 October, 2010. The geomorphologist – Dr Hughes - explained his results to the community and was available to respond to questions from individuals and groups.

5.19.1.2 Local Indigenous Archaeological Context

Aboriginal occupation within the Central Lowlands of the Lower Hunter Valley occurred over 20,000 years ago, however the majority of dated sites within the Hunter Valley are less than 4,000 years old (Brayshaw 1994). In the course of development related studies, evidence of Aboriginal occupation has generally been dated to the Holocene period (the last 10,000 years). In the upper reaches of Glennies Creek, Koettig (1986) found evidence of a hearth and dated the associated charcoal to 10,000 to 13,000 years ago.

Insite Heritage engaged Dr P. Hughes to undertake a geomorphology assessment of Glennies Creek having regard to the Koettig (1986) report. Field work was conducted on 26 and 27 October, 2009 with registered Aboriginal stakeholders invited to discuss the findings of the geomorphology assessment with Dr Hughes on 27 October 2009. The geomorphology assessment did not find any evidence of Pleistocence landscapes within the SEOC project area.

Other studies that Insite Heritage reviewed to assist their understanding of the local indigenous archaeological context of the study area included Rich (1992), Stuart (1999), HLA Envirosciences (2005), Umwelt (2002 and 2004), Witter (2002) and Insite Heritage (2008).

The closest sites to the study area were located on the western side of Glennies Creek, to the west of the study area. These sites were recorded by Hardy (2001) and Witter (2002). The majority of other sites cluster on the terrace of Bowman's Creek, although a number of sites (including the largest) are located on slopes and the ridge west of Glennies Creek.

A significant Aboriginal population remains in the area today and they take an active interest in their cultural heritage.

5.19.1.3 Survey

The study area was divided into areas to be surveyed based on landform units. Survey transects were carried out within the separate landform units – spur/ridge crest, slopes, creek terrace and gully, that form the survey units or areas. Surface visibility was limited by vegetation and leaf litter. The transects were inspected on foot by groups of four and six persons, walking parallel in relatively straight lines spaced 8 to 10 metres apart. Each individual in the transect group could deviate temporarily to inspect exposed or disturbed areas more closely.

Sites were recorded by the following features:

- Location (Recorded using Garmin GPS 72 hand held GPS, WGS 84 datum).
- Visible Extent - as determined by the extent of the artefact scatter or the extent of the visible area of the scatter and the extent of potential archaeological deposit (PAD) surrounding the scatter and the basis for the PAD definition (for example break of slope, surrounding sterile exposure or thinning of the soil profile), landform i.e. top of creek bank, face of creek margin, base of creek bank, small crest, flat, base of minor slope.
- Aspect.
- Stone Artefacts - were recorded at a basic level including type, colour, raw material, basic dimensions and obvious diagnostic features (eg. cortex, edge wear, backing etc.). Artefacts were not removed from the area.

5.19.2 Assessment Findings

5.19.2.1 Survey Results

A total of over 1,125 aboriginal objects from 85 sites were recorded as a result of the survey assessment.

The basic processes of assessing significance for items of heritage are outlined by *The Australian ICOMOS Charter for the Conservation of Places of Cultural Significance: the Burra Charter (amended 1999)* and associated Guidelines. Sites may be significant according to several criteria, including scientific or archaeological significance, significance to Aboriginal people, aesthetic value, the degree to which a site is representative of archaeological and/or cultural type, and value as an educational resource. In New South Wales the nature of significance relates to historic, aesthetic, social, scientific, cultural or educational criteria and sites are also assessed on the degree to which they exhibit rare or representative characteristics of their type, or whether they exhibit historic or cultural connections.

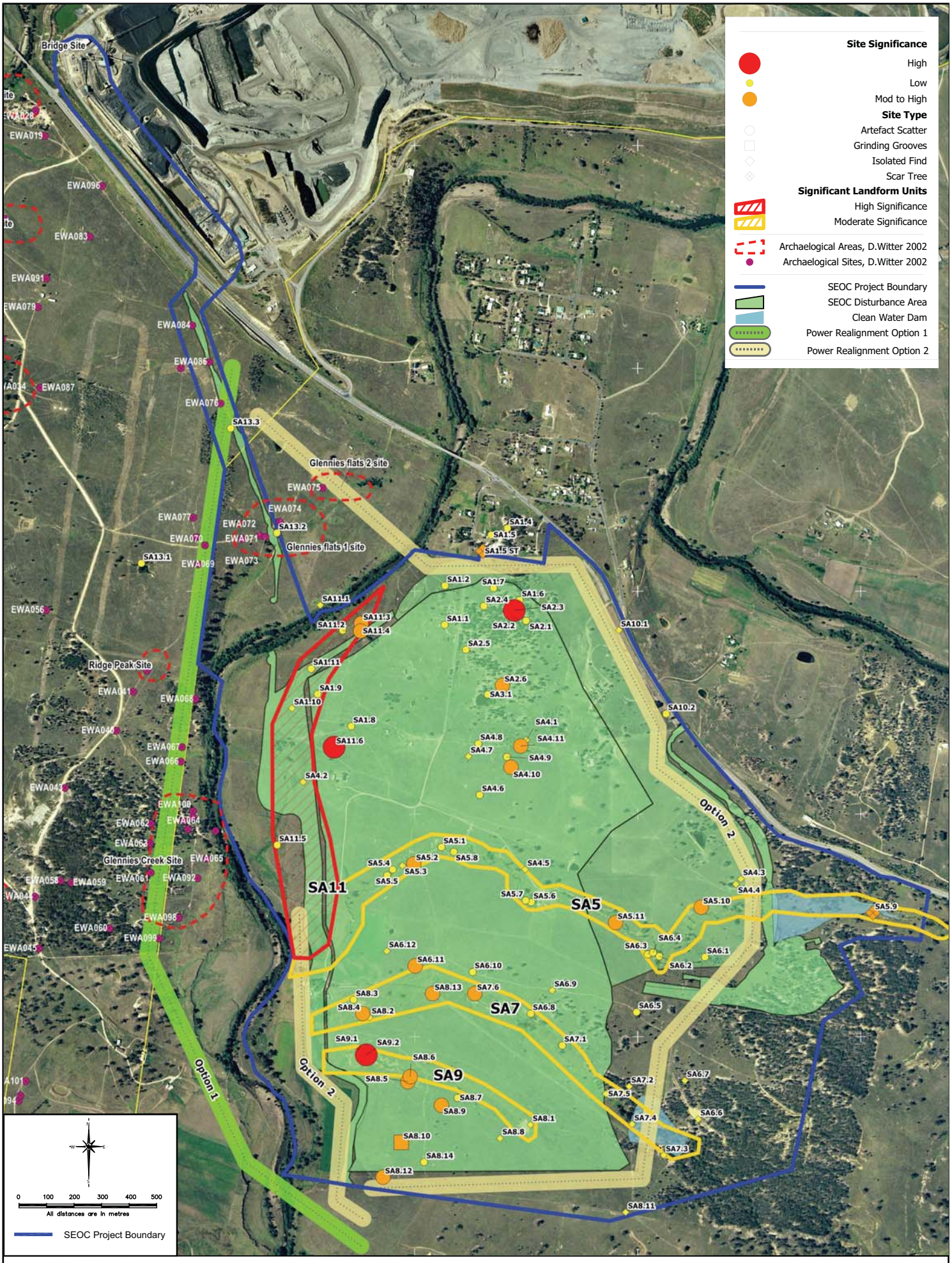
The significance assessment is based on the following:

- **Scientific Significance** – is rated low, medium and high. In order to determine scientific significance it is necessary to first place sites within a local and regional context. This process enables the assessment of any individual site in terms of merit against other sites of similar nature within similar contexts.
- **Public Significance** – of sites are assessed in terms of their educational value, to enhance community knowledge and appreciation of cultural heritage.
- **Representative Significance** – of individual sites is determined by factors such as representativeness, rarity, and the site's potential to add scientific data to what is known about past human occupation of the Australian continent. Conservation outcomes are determined by comparison of a site's qualities with known sites in the region that have been protected.

Table 5.47 outlines the relative significance of the sites surveyed based on the above criteria. A plan of sites and their overall significance is shown by **Figure 5.41**.

Table 5.47: Assessment of site significance.

Unit/Site	SiteType[2]	Scientific Significance	Public Significance	Representative Significance
SA1/1,SA1/2,SA1/4,SA1/5 SA1/6,SA1/7,SA1/8,SA1/9, SA1/10, SA1/11	AS/IF	Low	Low	Low
SA1/5ST	ST	Moderate	Moderate	Moderate-High
SA2/1,SA2/2,SA2/4,SA2/5	AS/IF	Low	Low	Low
SA2/3	AS	High	Moderate	Moderate
SA2/6	AS	Moderate	Moderate	Moderate
SA3/1	AS	Low	Low	Low
SA4/1,SA4/2,SA4/3,SA4/4,SA4/5 SA4/6,SA4/7,SA4/8,SA4/9	AS/IF	Low	Low	Low
SA4/10,SA4/11	AS	Moderate	Low	Low
SA5/1,SA5/3,SA5/4,SA5/5,SA5/6 SA5/7,SA5/8	AS/IF	Low	Low	Low
SA5/2	AS	Moderate	Low	Low
SA5/9	ST	Moderate	Moderate	High -rare



South East Open Cut Project

Results of the Aboriginal survey and overall site significance

Insite Heritage Pty Ltd

Figure 5.41

Plan 63

AshtonCoal

Prepared by Pegasus Technical

CAD FILE: 05060C.dwg

Table 5.47: Assessment of site significance (continued).

Unit/Site	SiteType[2]	Scientific Significance	Public Significance	Representative Significance
SA5/10,SA5/11	AS	Moderate-high	Moderate	Moderate
SA6/1,SA6/2,SA6/3,SA6/4,SA6/5 SA6/6,SA6/7,SA6/8,SA6/9 SA6/10,SA6/12	AS/IF	Low	Low	Low
SA6/11	IF	Moderate	Low-moderate	Low-moderate
SA7/1,SA7/2,SA7/3.SA7/4,SA7/5,		Low	Low	Low
SA7/6	AS	Moderate	Low-Moderate	Low-Moderate
SA8/1,SA8/2,SA8/3,SA8/7,SA8/8, SA8/8,SA8/11,SA8/14	AS/IF	Low	Low	Low
SA8/4,SA8/5,SA8/6,SA8/9,SA8/10, SA8/12,SA8/13	AS/GG	Moderate	Moderate	Moderate
SA9/1	IF	Low	Low	Low
SA9/2	AS	High	Moderate-high	Moderate
SA10/1,SA10/2	AS/IF	Low	Low	Low
SA11/1,SA11/2,SA11/5	AS/IF	Low	Low	Low
SA11/3,SA11/4	AS	Moderate	Moderate	Moderate
SA11/6	AS	High	High	High
SA13/1,SA13/2,SA13/3	AS/IF	Low	Low	Low

[2] AS = artefact scatter, IF = isolated find, GG = grinding grooves, ST = scarred tree

The results of this survey have indicated that the entire study area has been well utilised by Aboriginal people. The site is of very high cultural significance. The following points support such an assessment:

- The integrity of many of the sites located is very high and conducive to further detailed archaeological investigation.
- A site located about 10 kilometres upstream on Glennies Creek has evidence of Pleistocene occupation (Koettig, 1990), an uncommon occurrence in the Hunter Valley. Two small areas of potential for late Pleistocene landscapes were identified by Witter on the western side of Glennies and Bowmans Creeks. The potential for a similar landform to occur in this study area has been addressed by Dr Philip Hughes and no potential Pleistocence areas have been identified.
- Spatial analysis of sites and artefacts would provide a better understanding of how Aboriginal inhabitants interacted with and utilised the landscape.
- Several sites (eg SA2/3, SA9/2, SA11/6) have high concentrations of artefacts. These sites have been rated as significant on the basis of artefact densities and whilst further artefacts will be found within surrounding topsoil, these sites do not have potential for stratified deposit.
- The range of raw materials and artefact characteristics will provide an ideal base for further, detailed investigation.
- The local Aboriginal community representatives have indicated that they believe this area to be of high cultural significance and desire further investigation to be undertaken.
- Further investigation would enhance works previously undertaken in adjoining areas (Hardy, 2001; Witter, 2002).

Following the identification of two potential scarred trees during the survey, ACOL engaged Urban Tree Management Australia Pty Limited (consulting aboriculturists and horticulturists) to assess the

age of tree, age of wounding event/s, likely causation, condition of each tree, possible remaining lifespan or risk to live/dead tree/s and requirements to conserve each artefact where determined to be significant. **Table 5.48** details the findings of the assessment on the potential scarred trees.

Table 5.48: Assessment of identified potential scar trees.

Site.	Age of Tree Approx. age range of tree in yrs.	Age of Scar Approx age range of wound in yrs.	Likely cause of Scar
SA1/5	>200 - <225 (when died 1930-1960c.)	124	Incision from surveyor's blaze dated 1885 and not expected to be a reworking of a wound of Aboriginal origin.
SA5/9	200 - <275	>150 - <200	Incision or laceration likely to be of Aboriginal origin.

5.19.3 Impacts to Aboriginal Heritage

Aboriginal objects located within the SEOC footprint will be impacted to varying degrees. Objects within the footprints of the open cuts and infrastructure area will be directly impacted, whereas objects within the other surrounding areas will have lesser impacts. Where feasible (based on detailed engineering design and potential for effective management) artefacts will be avoided and managed appropriately.

Of the 85 sites identified, the majority of sites will be impacted directly by the open cut, second to the open cut in impact is the ROM facility area on the alluvial terrace. Numerous sites are located on the fringe of disturbance, with expected impacts to be determined during detailed design and construction to be documented in the Aboriginal Cultural Heritage Management Plan.

The ACP Modification will not impact items of Aboriginal Heritage.

Powerline Realignment

The realignment of the power lines (refer to Figure 4.20) is required as part of the SEOC. Two options for the realignment have been identified; Option 1 and Option 2 (refer to Section 4.6.4). The realignment of powerlines is not required until approximately 2012.

Option 1 will pass through the Southern Conservation Area in a north south direction intersecting with an easement for the existing Southern 132kV power alignment. The easement will result in the removal of canopy vegetation over an area of approximately 4.3ha, and disturbance within this area for staunchion erection and an access road. Archaeological sites were identified within this area as part of the original Environmental Impact Statement (EIS). The detailed design of the alignment through this area will be cognisant of the identified sites and avoid where feasible. Where impacts cannot be avoided these will be managed in accordance with the Aboriginal Heritage Management Plan (AHMP).

The following is a desktop assessment based on existing data from Witters 2002 assessment and site patterning found within the study area extrapolated over the additional area.

Option 1 will travel along Ashton Ridge characterised by thin soils. On the ridge crest artefacts were found in 75% of exposures showing artefacts as lag deposit on the B soil horizon. Half the exposures on the spur crests and ridge slopes also produced artefacts. The area was interpreted as containing small concentrations and a frequent isolated finds which form part of a relatively dense background scatter.

The route then crosses the floodplain of Glennies Creek and the creek channel before connecting into the existing line. The floodplain has no identified sites at this time however pit 15 excavated by Mitchell which identified the paleosol is located on the terrace east of the lower dog leg in the line as it follows the ridge.

Option 2 will result in some clearing of vegetation along the western perimeter of the workshop and office facilities and the eastern side of the SEOC pit, no impact to archaeological sites above those impacted by the SEOC have been identified, although the detailed alignment design will be cognisant of any identified sites in the area.

Option 2 is likely to cross similar archaeological contexts as Option 1. The crossing of Glennies Creek terraces which are likely to contain artefact scatters that are likely to be covered with a post European alluvial mantle. No geomorphic test pits were excavated on the northern end of the western flood plan so the potential for buried paleosols and the presence /absence of artefacts, would need to be determined as pole locations are chosen.

Once the route passes over Glennies Creek, the potential for impact on artefacts sites is similar to that of Option 1, as the route traverses the ridge landscape characterised by relatively dense background scatter with some lenses.

5.19.4 Aboriginal Heritage Mitigation and Management

5.19.4.1 Site Management

Given the high significance of a number of specific sites and the overall significance of the combined sites and assemblage and that these sites will be impacted by the proposed works, it is recommended that artefact salvage and further detailed archaeological investigations be undertaken prior to and/or concurrently to the project commencing.

ACOL will undertake the following management measures for Aboriginal Heritage:

- Collection of all artefacts located during this survey, including more detailed recording where necessary to allow spatial analysis of assemblage.
- Undertake test excavations of specific sites (as identified in Table 5.47 and subject to Aboriginal community review). The methodology for the work will include test excavations in areas of high significance to determine the spatial extent of sites, where this cannot be ascertained by surface exposure. Once spatial extent is determined open area excavations will be undertaken to retrieve the maximum number of artefacts possible and to provide further detailed information regarding inter and intra site patterning.
- The determination of open area salvage excavations will be determined in consultation with the Aboriginal community, geomorphology results, test excavations and more detailed recordings. This process may be conditioned as a stage two to the above process to allow continuity in the field work.
- The salvage of sites within the corridor of the coal conveyor will be refined to address detailed impacts. These are anticipated to include, but not confined to, the footprint of the conveyor supports and access roads. Where these impacts intercept sites, the sites will be salvaged by collection (where sub surface deposits are negligible) and excavation where sub surface deposits are evident.
- Complete a detailed analysis of all materials retrieved and appropriately report all works undertaken. Provide copies of reports to relevant authorities and stakeholders.
- Liaise with the Aboriginal community to ascertain whether full monitoring and collection of artefacts will be required as works commence.

ACOL accepts the site specific recommendations as contained in **Table 5.49**, (refer also to Figure 5.42 for site locations). More detail may be added or amended to the site specific recommendations following further consultation between ACOL, Aboriginal community members and the DECCW during the preparation of the SEOC Aboriginal Cultural Heritage Management Plan.

Table 5.49: Site specific management recommendations.

Sites	Significance	Management Recommendations
SA11/6, SA2/3, SA9/2,	High	Record location and collect all artefacts from the surface. Undertake manual salvage excavation to determine the extent of the site in both area and depth. Full extent and methodology of excavation to be determined.
SA1/5 (ST), SA2/6, SA4/10, SA4/11, SA5/2, SA5/9, SA5/10, SA5/11, SA6/11, SA7/6, SA8/4, SA8/5, SA8/6, SA8/9, SA8/10, SA8/12, SA8/13, SA11/3, SA11/4	Moderate to High	Record location and collect all artefacts from the surface. Undertake manual salvage excavation to determine the extent of the sites in both area and depth. Full extent and methodology of excavation to be determined. Further investigation into possible scarred trees, develop mitigation measures accordingly.
SA1/1, SA1/2, SA1/4, SA1/5, SA1/6, SA1/7, SA1/8, SA1/9, SA1/10, SA1/11, SA2/1, SA2/2, SA2/4, SA2/5, SA3/1, SA4/1, SA4/2, SA4/3, SA4/4, SA4/5 SA4/6, SA4/7,SA4/8, SA4/9, SA5/1, SA5/3, SA5/4, SA5/5, SA5/6, SA5/7, SA5/8, SA6/1, SA6/2, SA6/3, SA6/4, SA6/5, SA6/6, SA6/7, SA6/8, SA6/9,SA6/10, SA6/12, SA7/1, SA7/2, SA7/3. SA7/4, SA7/5, SA8/1, SA8/2, SA8/3, SA8/7, SA8/8, SA8/11, SA8/14, SA9/1, SA10/1, SA10/2, SA11/1, SA11/2, SA11/5, SA13/1, SA13/2, SA13/3	Low	Record location and collect all artefacts from the surface.
SA11 (entire survey unit)	High	Undertake grader scrapes at predetermined sections of the terrace to ascertain artefact and feature distribution across this specific landform. Manual excavation of any features or high concentrations of artefacts. Full extent and methodology to be determined.
SA5, SA7, SA9 (entire survey units)	Moderate	Excavate test pits at predetermined sections of the terrace to ascertain artefact and feature distribution across this specific landform. Manual excavation of any features or high concentrations of artefacts. Full extent and methodology to be determined.

5.19.4.2 Aboriginal Cultural Heritage Management Plan

An outcome of the assessment process is that ACOL engage a qualified archaeologist to prepare an Aboriginal Cultural Heritage Management Plan (ACHMP) in order to assist managing cultural resources found within the SEOC area. The ACHMP will be prepared in consultation with the local aboriginal community and government agencies.

5.20 European Heritage

Heritas Architecture was engaged to conduct a European heritage assessment for the area to be impacted by the SEOC project. A copy of the report is contained in **Appendix 14** in Volume 5.

5.20.1 Assessment Methodology

The European heritage assessment involved the following key steps:

- Determine the potential impact area of the SEOC and the associated parcels that would be directly or indirectly impacted by the project.
- Undertake research on the general area and properties that may be impacted.
- Undertake a heritage survey to locate remaining heritage items, record, evaluate significance and condition.
- Determine the likely heritage impact from the loss of identified heritage sites.
- Determine appropriate mitigation and management measures to avoid, reduce or ameliorate heritage impact and loss.

The proposed SEOC project area will impact directly on numerous parcels of land currently being used for farming, residential, and community purposes. In order to assess the heritage significance of the properties proposed to be impacted, a history of the area and the individual properties was undertaken.

Based on the researched history and site inspections, an assessment of significance for each property was then made based on NSW Department of Planning (Heritage Branch) guidelines.

5.20.1.1 Research

A review of the land ownership and cadastre in the area of the SEOC and adjacent lands resulted in a total of 21 properties being identified for further research and investigation. These properties were then surveyed to assess potential for heritage significance.

Historical title searches were undertaken in respect to the 11 properties which will be directly physically impacted by the SEOC project. The information is contained within the property site cards and Appendix B of the specialist report in Appendix 14.

The methodology for assessment of heritage significance is in accordance with the NSW Department of Planning (Heritage Branch) guidelines, and is based on four generic cultural heritage values, being historical, aesthetic, social and scientific values.

5.20.1.2 Survey

The 21 properties identified within or adjacent to the boundary of the SEOC were inspected. Following site inspections the properties were prioritised having regard to the history of the village. The level of inspections for the properties was relative to the prioritisation and accessibility, varying from inspections from the street boundary, to external and internal surveys.

5.20.2 Assessment Findings

Appendix 14 should be reviewed for a detailed description of the key aspects for the history of the local area, a summary of which is provided below.

The Camberwell area, originally known as Falbrook, was surveyed by Henry Dangar in 1824. Significant early landholders included Dr. James Bowman, Henry Glennie and William Nowland, the latter playing a significant role in the development of the village of Camberwell. Located on the main road between Singleton and Muswellbrook, Camberwell enjoyed an initial period of prosperity but fell into decline following the construction in the early 1860s of a new bridge over Falbrook which

diverted the main road away from the village centre. Rural pursuits including dairying in the first half of the 20th century underpinned the area's economy.

As early as 1860 coal was being mined on the Dulwich Estate and also at Glendon, Glennies Creek, but the operations were not commercially viable due to the undeveloped transport infrastructure at the time. Extension of the Great Northern Railway through the area provided a stimulus for the development of coalmining, and by 1869 the Rix's Creek mine was producing coal. Establishment of the Singleton gas works in 1881 increased the local demand for coal, but the Camberwell resources remained untapped to the dismay of those aware of the local resources, as is typified in the quote below:

> *I am sure by the appearance and formation of the land in and around Camberwell that it abounds in coal. It is a great pity that some enterprising gentleman, who has land in the locality, would not open a real coal pit. The place affords every facility for the purpose.*
>
> *Maitland Mercury*, 21 August 1880

Rosedale mine, which operated between 1885 and 1931 in the Rix's Creek area, is believed to have been a source of employment for some Camberwell residents. Other early mines which operated for varying periods between 1886 and 1939 included Ellesmere, New Park, Rix's Main, Rix's Creek and Singleton Coal. The Rix's Creek mines were closed in 1921.

From the 1970s coal mining has increased in importance. In 1969 the Liddell power station was constructed which led to the development of the Ravensworth open cut west of Camberwell. In 1990 mining started on the eastern side of Camberwell with the commencement of production from Rix's Creek open cut, followed by the Camberwell Coal open cut in 1991, and by Ashton which gained development consent in 2002 for both underground and open cut operations immediately to the west and north of Camberwell.

The majority of the properties which are the focus of this study can be traced to early holdings owned by Glennie and Nowland, but a number are linked to smaller holdings which were later purchased from the Crown. A detailed study of the breaking up of the Glennie and Nowland properties is beyond the scope of this report, but it is likely that a variety of factors influenced their descendants to subdivide the holdings, eventually leading to the creation of the small farms which are included in the study site.

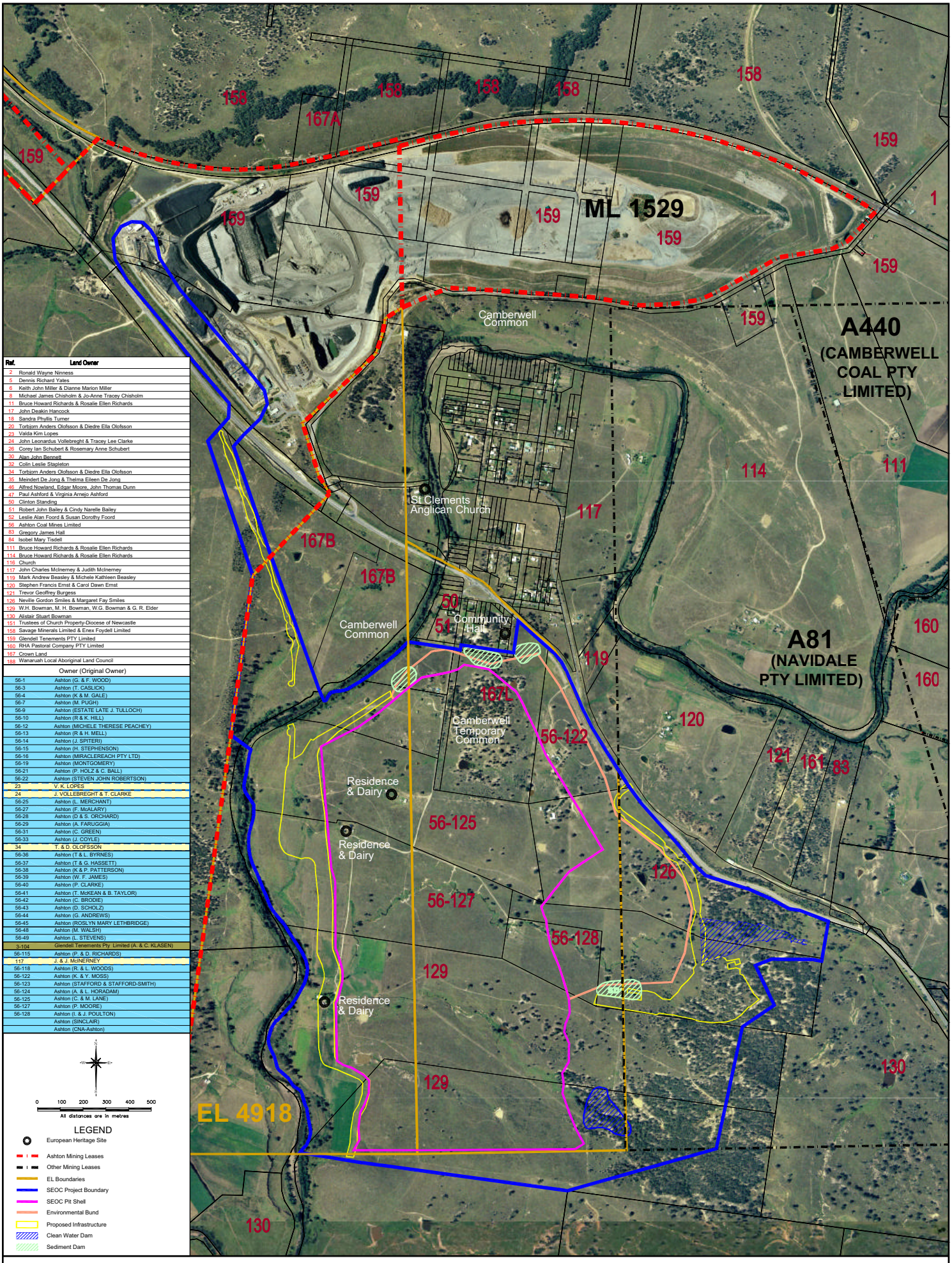
5.20.3 European Heritage Sites and Impacts

Table 5.50 provides details of sites identified by the survey that were considered to have a low, moderate or high local significance It should be noted that some properties were assessed to have no heritage significance and have not been included in Table 5.50. These sites are illustrated in **Figure 5.42**. For a full description of all sites surveyed refer to Appendix 14.

The proposed ACP Modification will not impact items of European heritage.

Table 5.50: Summary of property assessments for European heritage.

Property No.	Property Description	Condition	Significance	Impacted By	Heritage Impact	Recommendation
46	Community Hall Lot 2/13 DP 758214	Poor to very poor	High local significance.	Indirect –blast vibration. (Probable exceedance of blast vibration criteria for structures, *see Section 5.9.4*)	Moderate.	Archival photographic record prior to SEOC commencing.



Ref.	Land Owner
2	Ronald Wayne Ninness
5	Dennis Richard Yates
6	Keith John Miller & Dianne Marion Miller
8	Michael James Chisholm & Jo-Anne Tracey Chisholm
11	Bruce Howard Richards & Rosalie Ellen Richards
17	John Deakin Hancock
18	Sandra Phyllis Turner
20	Torbjorn Anders Olofsson & Diedre Ella Olofsson
23	Valda Kim Lopes
24	John Leonardus Vollebreght & Tracey Lee Clarke
26	Corey Ian Schubert & Rosemary Anne Schubert
30	Alan John Bennett
32	Colin Leslie Stapleton
34	Torbjorn Anders Olofsson & Diedre Ella Olofsson
35	Meindert De Jong & Thelma Eileen De Jong
46	Alfred Nowland, Edgar Moore, John Thomas Dunn
47	Paul Ashford & Virginia Arnejo Ashford
50	Clinton Standing
51	Robert John Bailey & Cindy Narelle Bailey
52	Leslie Alan Foord & Susan Dorothy Foord
56	Ashton Coal Mines Limited
83	Gregory James Hall
84	Isobel Mary Tisdell
111	Bruce Howard Richards & Rosalie Ellen Richards
114	Bruce Howard Richards & Rosalie Ellen Richards
116	Church
117	John Charles McInerney & Judith McInerney
119	Mark Andrew Beasley & Michele Kathleen Beasley
120	Stephen Francis Ernst & Carol Dawn Ernst
121	Trevor Geoffrey Burgess
126	Neville Gordon Smiles & Margaret Fay Smiles
129	W.H. Bowman, M. H. Bowman, W.G. Bowman & G. R. Elder
130	Alistair Stuart Bowman
151	Trustees of Church Property-Diocese of Newcastle
158	Savage Minerals Limited & Enex Foydell Limited
159	Glendell Tenements PTY Limited
160	RHA Pastoral Company PTY Limited
167	Crown Land
188	Wanaruah Local Aboriginal Land Council

	Owner (Original Owner)
56-1	Ashton (G. & F. WOOD)
56-3	Ashton (T. CASLICK)
56-4	Ashton (K & M. GALE)
56-7	Ashton (M. PUGH)
56-9	Ashton (ESTATE LATE J. TULLOCH)
56-10	Ashton (R & K. HILL)
56-12	Ashton (MICHELE THERESE PEACHEY)
56-13	Ashton (R & H. MELL)
56-14	Ashton (J. SPITERI)
56-15	Ashton (H. STEPHENSON)
56-16	Ashton (MIRACLEREACH PTY LTD)
56-19	Ashton (MONTGOMERY)
56-21	Ashton (P. HOLZ & C. BALL)
56-22	Ashton (STEVEN JOHN ROBERTSON)
23	V. K. LOPES
24	J. VOLLEBREGHT & T. CLARKE
56-25	Ashton (L. MERCHANT)
56-27	Ashton (F. McALARY)
56-28	Ashton (D & S. ORCHARD)
56-29	Ashton (A. FARUGGIA)
56-31	Ashton (C. GREEN)
56-33	Ashton (J. COYLE)
34	T. & D. OLOFSSON
56-36	Ashton (T & L. BYRNES)
56-37	Ashton (T & G. HASSETT)
56-38	Ashton (K & P. PATTERSON)
56-39	Ashton (W. F. JAMES)
56-40	Ashton (P. CLARKE)
56-41	Ashton (T. McKEAN & B. TAYLOR)
56-42	Ashton (C. BRODIE)
56-43	Ashton (D. SCHOLZ)
56-44	Ashton (G. ANDREWS)
56-45	Ashton (ROSLYN MARY LETHBRIDGE)
56-48	Ashton (M. WALSH)
56-49	Ashton (L. STEVENS)
3-104	Glendell Tenements Pty Limited (A. & C. KLASEN)
56-115	Ashton (P. & D. RICHARDS)
117	J. & J. McINERNEY
56-118	Ashton (R. & L. WOODS)
56-122	Ashton (K. & Y. MOSS)
56-123	Ashton (STAFFORD & STAFFORD-SMITH)
56-124	Ashton (A. & L. HORADAM)
56-125	Ashton (C. & M. LANE)
56-127	Ashton (P. MOORE)
56-128	Ashton (I. & J. POULTON)
	Ashton (SINCLAIR)
	Ashton (CNA-Ashton)

0 100 200 300 400 500

All distances are in metres

LEGEND

- European Heritage Site
- Ashton Mining Leases
- Other Mining Leases
- EL Boundaries
- SEOC Project Boundary
- SEOC Pit Shell
- Environmental Bund
- Proposed Infrastructure
- Clean Water Dam
- Sediment Dam

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South East Open Cut Project

Identified European heritage sites of low, moderate or high local significance

Figure 5.42

Plan 64

Prepared by Pegasus Technical

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Table 5.50: Summary of property assessments for European heritage (continued).

Property No.	Property Description	Condition	Significance	Impacted By	Heritage Impact	Recommendation
56-125	Residence and dairy Lot 3 DP 264089.	Fair to poor.	Low local significance.	Direct – open cut and infrastructure.	High.	Archival Record – site survey; photographic; measured drawing of house, dairy and associated outbuildings.
56-127	Residence and dairy Lot 10 DP 877004.	House appears good, dairy is fair.	Moderate local significance.	Direct – open cut and infrastructure.	High.	Archival Record – site survey; photographic; measured drawing of dairy and associated outbuildings.
129	Residence and dairy Lot 2 DP 1111313.	Appears to be in good condition.	Moderate local significance.	Direct – open cut & levee and out of pit emplacement	High.	Archival Record – site survey; photographic; measured drawing of house, dairy and associated outbuildings.
151	St Clement's Anglican Church Lot 103 DP 738182.	Generally good, some cracking in stone work. 2008 fire damage still not repaired.	High local significance.	Indirect –potential blast vibration and visual outlook. (No exceedance of AS2187 heritage vibration criteria, *see Section 5.9.4*)	High – views from the church to the southern portion of the village and valley, although impact reduces with rehabilitation progress.	Archival Record – photographic record of views to and from church. In situ Conservation – strategy to protect fabric from blast damage.
167L	Camberwell Common (south) Lot 7004 DP 93630	Vacant land - appears good.	High local significance.	Direct – open cut and out of pit emplacement.	High.	Archival Record – site survey; photographic. Consider ex situ conservation through relocation, if warranted.

5.20.4 European Heritage Mitigation and Management

With the destruction of some sites as a result of the project an opportunity exists to increase historical knowledge of the area by undertaking historical research, surveying and photography to compile an archival record of sites to be impacted. Some of the sites would be considered relics, and Section 139 of the NSW Heritage Act 1977 would apply. Some sites are so disturbed, altered or damaged that there is little historic value remaining in the sites.

The management of the sites will be undertaken as specified by Table 5.50, by an appropriately qualified heritage consultant prior to the direct impact of the identified sites. The management undertaken will include details of mitigation and management measures specified in **Table 5.51**.

Table 5.51: Measures for European heritage management.

Measure	Description of Measure
Historical Research	In some cases further detailed historical research will be required in order to confirm the history of the property. This research should be carried out by a professional historian (registered with the Professional Historians Association of NSW, or equivalent organisation).
Physical Inspection	In some cases further detailed physical inspection of the place will be required prior to impact, in order to confirm the existence of any significant items.
Archival Record	Archival records of heritage items contribute to our understanding and appreciation of our culture. They record for the future the environment, aesthetics, technical skills and customs associated with the creation and use of heritage items before they are lost, either by progressive changes or the ravages of time. The archival record will vary according to the type of heritage item and the reasons for its preparation. Recording during work on the heritage item may also be required, for instance

Measure	Description of Measure
	during demolition.
Archaeological Assessment	Some sites warrant further archaeological investigation or to provide more definite information on known past uses of the place prior to impact. The extent of archaeological investigations should be confirmed on a site-by-site basis, by an archaeologist experienced in the relevant area of work.
In situ Conservation	Where items are not proposed to be directly impacted in situ conservation may be warranted, depending on the assessed heritage significance of the item. Work to the item or relic may extend to all components of the definition of conservation, and should be developed within a secondary management framework for each particular site.
Ex situ Conservation	Where items are proposed to be completely impacted (destroyed) relocation may be warranted, depending on the assessed heritage significance of the item. Work to the item or relic may extend to all components of the definition of conservation, and should be developed within a secondary management framework for each particular site.

5.21 Transport

ACOL commissioned Sinclair Knight Merz Pty Ltd (SKM) to undertake an assessment of road transport impacts associated with the SEOC project. A copy of the report is contained in **Appendix 15** in Volume 5.

5.21.1 Transport Assessment Methodology

The methodology of the transport assessment undertaken by SKM included:

- Review of existing road network conditions including a review of current traffic safety data on the New England Highway from the RTA.
- A 7 day classified traffic count on the New England Highway east of Camberwell.
- Peak period traffic count at the intersection of New England Highway and Glennies Creek Road.
- Estimation of SEOC traffic generation and access requirements.
- Design of intersection based on RTA Road Design Guide including Channelised Right Turn and Auxiliary Left Turn treatments and new and existing chevron overlap considerations.
- New intersection design assessed using *SIDRA Intersection* modelling software.
- Consideration of construction traffic management.

5.21.2 Existing Conditions

5.21.2.1 Road Network

The ACP is located near the village of Camberwell, on the New England Highway. The ACP's current operations are accessed via Glennies Creek Road, which intersects the New England Highway north-west of Camberwell (refer to Figure 4.20 and Plan 23 in Volume 2).

The New England Highway is part of the National Highway network, and forms the main inland route between Sydney and Brisbane. In the vicinity of the ACP, the highway varies in width from two to four lanes. South-east of Glennies Creek Road is generally one lane per direction, however a southbound overtaking lane commences approximately one kilometre south east of the village of Camberwell. A four lane section begins at Glennies Creek and extends to the north-west.

Glennies Creek Road is a local road providing access to the existing ACP and to rural landholdings north of the New England Highway.

The primary access to the village of Camberwell is via McInerney Road, although access is also available through Alpha Street.

5.21.2.2 Traffic Volumes

A 7 day classified count on traffic on the New England Highway east of Camberwell was undertaken from the 23 to 29 October 2008. The average daily traffic volume during that week was 11,109 vehicles including 17% heavy vehicles. The average weekday volume was slightly higher at 12,391 vehicles, including 18% heavy vehicles.

The AM peak hour on a weekday is between 6.00 am and 7.00 am with an average weekday volume of 1,306 vehicles per hour, the majority heading westbound. The PM peak hour is between 4.00 pm and 5.00 pm, with an average of 947 vehicles per hour, mostly eastbound.

RTA data on the New England Highway near Camberwell shows a steady growth in traffic since 1980, with a peak in the late 1990's and an overall linear growth rate of 1.7% per annum (base year 2004). This is considered a reasonable assumption for future growth.

5.21.2.3 Traffic Generating Activity

The existing ACP employees are the main users of Glennies Creek Road, although the road does provide access to rural lands to the north and an alternate route to Singleton Heights.

The hourly traffic volume entering Glennies Creek Road in the AM peak was 40 vehicles, with 13 leaving in the same hour. In the PM peak, there were 60 vehicles exiting Glennies Creek Road, with 32 vehicles entering. Some of this activity will transfer to the proposed SEOC.

The New England Highway / Glennies Creek Road intersection was analysed using the SIDRA Intersection software, which refers to various performance measures for intersection performance. One performance measure that is commonly quoted is the Level of Service (LoS), determined by the average delays experienced by vehicles using the intersection. For unsignalised intersections, LoS is based on the worst-performing movement. It is generally accepted that in the long term (15 years +), when future conditions have been taken into account, Level of Service should be D or better, while in the short term, intersections should be operating at Level of Service C or better. The LoS for the New England Highway / Glennies Creek Road intersection is C in the AM peak and B in the PM peak. Therefore the intersection is currently operating satisfactorily.

5.21.2.4 Public Transport and School Buses

The proposed SEOC project is located away from regular public transport services. Singleton and Muswellbrook are the main public transport hubs near Camberwell. Several bus and coach services travel the highway past Camberwell (with no scheduled stopping in Camberwell). These services include:

- A daily service with return between Newcastle and Dubbo on Sid Fogg's Coachlines.
- A daily service with return between Sydney and Toowoomba on Greyhound Australia.

Two school bus services operate through Camberwell, with several bus stops within Camberwell, and isolated stops at some properties along the New England Highway. They include:

- Singleton to Camberwell operated by the Blue Ribbon Bus Company Pty. Ltd.
- Hebden – Ravensworth - Singleton operated by the Blue Ribbon Bus Company Pty. Ltd.

The nearest railway stations to Camberwell are at Singleton and Muswellbrook.

5.21.2.5 Road Safety

Data obtained from the RTA about road safety history on the New England Highway between Singleton and Muswellbrook indicates that between September 2003 and August 2008 there were 88 crashes recorded, including four fatal crashes and 32 injury crashes. A crash rate, where the number of crashes is compared to the volume of passing traffic, has been calculated at approximately 10 crashes per 100 Million Vehicle Kilometres Travelled (MVKT). This is significantly below the NSW state average crash rate of approximately 75 crashes per 100MVKT.

In the immediate vicinity of the proposed SEOC, there were three crashes recorded in the past five years, including one injury crash. There were two off-path type crashes and one where a temporary object on the roadway was hit.

5.21.3 SEOC Traffic Impact Assessment

5.21.3.1 South East Open Cut Traffic Generation

The SEOC will employ approximately 160 people working in two shifts. The SEOC employees would essentially be transferred from the existing NEOC when open cut mining ceases.

Given the SEOC is located remote to significant residential areas where employees reside, and away from regular public transport services, it has been assumed that each worker at the SEOC would drive their own vehicle to and from each shift. As such, at each change of shift it is expected that

there will be 80 vehicles arriving to start work and 80 vehicles leaving soon after. There would be little overlap between arriving and departing vehicles.

In addition to worker travel which would be focussed on shift changeover times, there would also be deliveries to the facilities that take place at other times. Based on the current activities, these are expected to include:

- 15-20 light trucks per week delivering general stores.
- 1-3 trucks per week delivering explosives.
- 10-15 trucks per week delivering diesel.
- 30 courier vans per week.

It should be noted that these will not be new trips added to the network, as there will be a corresponding reduction in traffic accessing the ACP facilities off Glennies Creek Road. Some traffic generating activity will remain at Glennies Creek Road, associated with the existing underground facility, coal handling and processing plant and administration offices.

5.21.3.2 Access to the South East Open Cut

Main Operational Access

It is proposed to construct a new intersection on the New England Highway, approximately 450 m to the east of McInerney Road, to facilitate access to the SEOC. All existing roads and driveways that currently service the land to be occupied by the SEOC will be removed.

The location of the intersection coincides with an existing access on the eastern edge of Lot 3, DP747327, and has been chosen taking into consideration the available sight distances.

The proposed intersection for access to the SEOC will consist of Channelised Right Turn (CHR) and Auxiliary Left Turn (AUL) treatments, as these will minimise the impact on New England Highway traffic, and will provide a safer environment for turning vehicles. The design of the proposed intersection is based on the RTA Road Design Guide. **Figure 5.43** illustrates the conceptual design of the proposed intersection with the New England Highway.

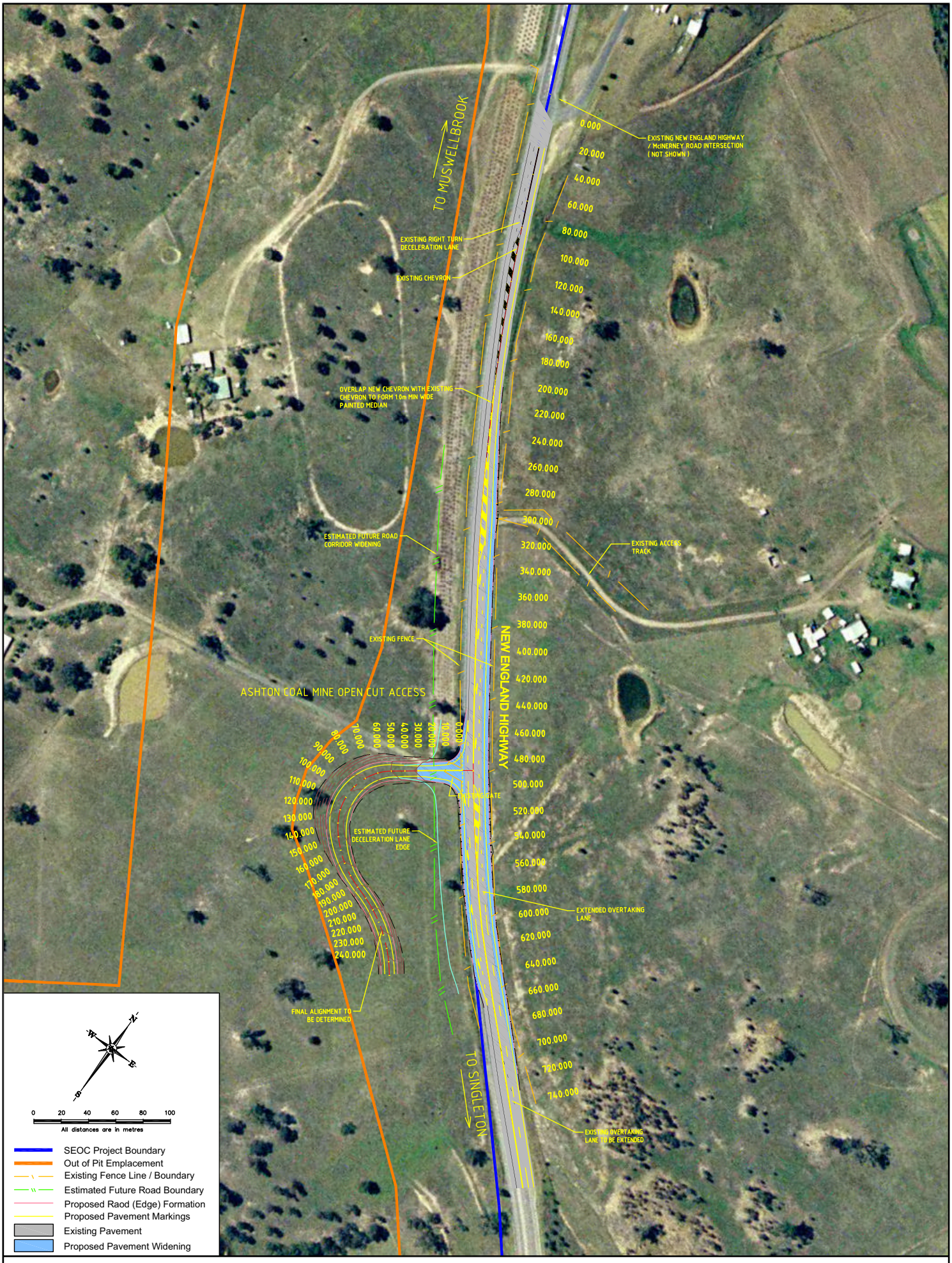
The operation of the proposed intersection has been assessed using *SIDRA Intersection* modelling software to determine the expected Level of Service (LoS), determined by the average delays experienced by vehicles using the intersection.

The unique situation with this intersection, with almost all inbound and outbound movements occurring separately, has been addressed by assuming that all staff will arrive within the 30 minutes prior to the start of a shift, and leave in the 30 minutes after the completion of the previous shift, and by analysing each 30 minute period separately. Each scenario contains a small volume of counter-direction traffic entering or leaving the access road and uses worst-case scenarios. The results of the intersection analysis are shown in **Table 5.52**.

Table 5.52: Operation of the proposed SEOC access intersection.

Scenario	Average Delay	Level of Service
AM - Staff arriving	53 seconds	D
AM - Staff leaving	40 seconds	C
PM - Staff arriving	27 seconds	B
PM - Staff leaving	14 seconds	A

The highest average delays are experienced in the AM peak, when staff are arriving to start the day shift. However, the delay reported in Table 5.52 is for traffic leaving the access road, which would be minimal. Traffic turning into the access road operates at LoS C. There is expected to be minimal queuing in the right turn lane on the New England Highway, and on the access road waiting to turn onto the highway. Based on these predictions, SKM have concluded that the intersection is forecast



AshtonCoal

South East Open Cut Project

Conceptual design for the proposed primary SEOC access intersection with the New England Highway

SKM

Figure 5.43

Plan 65

Prepared by Pegasus Technical

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to operate at an acceptable LoS for the life of the SEOC, and provide a safe environment for all road users.

Construction Access

Construction of the SEOC will take approximately six months, and will be timed so that there is a transition of staff from the NEOC to the SEOC, as the mining operations wind down.

The new access intersection will be one of the first items of infrastructure completed, allowing construction staff and associated traffic to safely enter and exit the site. The intersection will have sufficient capacity to cater for expected construction traffic levels.

A Traffic Management Plan, including specific Traffic Control Plans and Road Occupancy Licences, will be prepared and submitted to the RTA prior to commencement of construction of the new intersection. No significant delays to through traffic on the highway are expected.

Glennie Street

Some construction activities will require access to the western boundary of the SEOC. For these activities, it is proposed to make use of the existing intersection on the New England Highway and Glennie Street. It is expected that use of this intersection will be minimal, and limited primarily to the construction period. Sight distance to the west is very good, but to the east there are some restrictions due to a crest in the road. Whilst not substandard, it would be appropriate to install, for the duration of construction works, some warning signage as detailed within the traffic mitigation measures.

Conveyor Construction and Maintenance

The construction and occasional maintenance of a section of the conveyor that is bounded by Glennies Creek to the east and the New England Highway to the north will be via an existing access road to the former Ashton property that is currently used for access to the underground area.

It is anticipated that the volume of traffic using this access will be extremely low and concentrated during the construction period. Access for maintenance will be on an infrequent basis and generate negligible numbers of vehicular trips.

Sight distance from the intersection of the access road along the New England Highway is extremely good in both directions and far in excess of the minimum required.

5.21.3.3 Road Safety

As there will be no net increase in traffic associated with the ACP, no change is expected in the rate of accidents on the New England Highway between Singleton and Muswellbrook.

The proposed new access intersection will be designed to provide a safe road environment for all users. There are sufficient sight distance and acceleration/deceleration provisions to ensure compliance with relevant design standards.

5.21.4 Public Transport and School Bus Impacts

The majority of school bus stops are within the village of Camberwell and a few isolated sites on the New England Highway. Given the SEOC project will not increase traffic within Camberwell or on the highway these stops will not be impacted by the operation of the SEOC.

The school bus currently stops at the existing underground area. During the construction of the conveyor, traffic at this location will increase for a short duration. To minimise impacts construction access will be limited to 10 minutes outside the normal pickup and drop off time.

5.21.4.1 Future Traffic Volumes

There is expected to be no change in the volume of traffic associated with the SEOC, although traffic on the New England Highway is likely to continue to grow at a rate of approximately 1.7% per annum.

The SEOC will operate from 2010/11, for approximately 7 years. Through traffic has therefore been forecast for 2018. The forecast peak hour volumes on the New England Highway are shown in **Table 5.53**.

Table 5.53: Existing and forecast New England highway peak hour volumes.

Period	2008		2018	
	East Bound	West Bound	East Bound	West Bound
AM	370	1,090	430	1,270
PM	350	340	760	400

The existing and forecast peak hour volumes on the New England Highway were assessed against its theoretical capacity which, based on uninterrupted single lane sections, is approximately 1,500 vehicles per hour in each direction. This capacity is likely to be an underestimate given the overtaking lanes to the east and west of the SEOC.

The Volume to Capacity ratio for this section of highway was calculated to be between 0.23 and 0.85, where a ratio of greater than 1 would indicate that a section of road is operating in excess of its theoretical capacity and some reduction in the level of service afforded to motorists would be expected. Therefore this section of Highway is and will continue to operate in 2018 well within its capacity.

5.21.4.2 Cumulative Traffic Assessment

The expansion of neighbouring mines in the locality would not be expected to propose new intersections in the vicinity of the proposed SEOC intersection. Even assuming mine expansion that may lead to traffic generation from two additional developments of a similar size to the SEOC there would be available capacity on the New England Highway. With the existing and predicted volume to capacity ratios for the New England highway, cumulative impact of other mine expansions and the SEOC on the New England Highway will be negligible.

5.21.4.3 Mitigation Measures

The following measures are proposed to minimise traffic related impacts as a result of the SEOC project:

- The intersection for access to SEOC will consist of Channelised Right Turn (CHR) and Auxiliary Left Turn (AUL) treatments based on the RTA Road Design Guide.
- The new access intersection will be one of the first items of infrastructure completed, allowing construction staff and associated traffic to safely enter and exit the site.
- Warning signage will be placed on the New England Highway for the duration of the construction works at each construction intersection.
- All staff during inductions, and regularly during construction, will be reminded of the times that the school bus is operating and that it is an offence under the NSW road laws to pass a school bus at more than 40km/h when the flashing warning lights are illuminated.
- A Traffic Management Plan, including specific Traffic Control Plans and Road Occupancy Licences, will be prepared and submitted to the RTA prior to commencement of construction of the new intersection.

5.21.5 Rail Transport

On average the existing ACP requires approximately 1.5 trains per day to transport product coal to the Port of Newcastle. The proposed SEOC project combined with the proposed increase in peak production ,will increase train numbers to approximately 2.5 trains per day on average or an additional one (1) train per day.

Consultation has been undertaken with the Hunter Valley Coal Chain Logistics Team (HVCCLT) regarding forecast growth in system capacity over forthcoming years. HVCCLT has confirmed that the current system capacity is approximately 95 Mtpa. Modelling undertaken by HVCCLT indicates that with the on time delivery of committed track works it will be possible to achieve 105 Mtpa system capacity by the end of 2009 and 110 Mtpa within the same period with the accelerated completion of the third track Road at Minimbah Bank, and by 2011 with further works it will be possible to achieve 140 Mtpa. These increases in system capacities are also contingent upon commercial arrangements to secure additional trains.

Considering the relatively small increase in required trains and the planned track upgrades, the proposed SEOC project and increase in peak production will not have a significant impact on rail capacities.

Rail transport to Newcastle is the only feasible transportation method; if rail capacity is constricted ACOL will adjust production as required.

5.22 Utility Services

The development of the SEOC will not require any new public utilities or infrastructure to service the project. However, power and telecommunications that exist in the area will be extended to the SEOC facilities.

Utility services such as power and telecommunications that prevail in the locality will be impacted by the SEOC project in some locations. A description of the impacts and proposed mitigation measures is detailed within *Section 4 – Project Description*.

5.23 Hazard and Risks

AECOM Environmental undertook a detailed hazard analysis of the SEOC project to determine what incidents may have potential to result in off-site impact. A copy of the hazard analysis for the project is contained in **Appendix 16** in Volume 5.

5.23.1 Assessment Methodology

The methodology selected for the study was that recommended by the NSW Department of Planning (DoP) in the Multi Level Risk Assessment – level 2. The approach to the hazard analysis study is generally as follows:

- Identify the hazards.
- Assess the hazard consequences.
- Determine whether the hazards would impact beyond the site boundary.
- Where no offsite impact is identified, conduct no further assessment.
- Incidents identified to have the potential for an offsite impact are subject to a further risk assessment and risk reduction measures recommended.

5.23.2 Results of Assessment

Table 5.54 shows the operational activities considered in the hazard identification analysis.

Table 5.54: Key operations and facilities considered in the hazard identification analysis.

Operation Activity	Infrastructure
• Surveying • Top soil stripping • Drill Pad Preparation • Drilling • Blasting • Excavator and truck operations • Coal Ripping • Coal mining (excavators and trucks) • Coal Preparation Plant • Backfill of spoil • Grading • Re-topsoiling • Revegetation	• Administration office and bath house. • Crib and muster facilities. • Workshop and store. • Fuel farm and compound. • Sewage treatment plant and raw water storage.

The hazard identification analysis determined the following hazards to have a potential to impact offsite. These hazards were carried forward for consequence analysis.

- Front end loaders(FEL), dozer, truck, mix truck fuel leak and fire.
- Mix truck fire.
- Explosion on the shotfirers vehicle.
- Premature explosion of the Amonium Nitrate Fuel 0:1 (ANFO) mix on the mix truck.
- Diesel fuel storage fire.
- Lubricating oil storage fire.
- Magazine explosion.

Acceptable levels of heat radiation from fires and overpressure from explosions were selected from the DoP consequence impact criteria document "*Hazardous Industry Planning Advisory Paper No.4, Risk Criteria for Land Use Safety Planning*". This document published the following acceptable impact criteria at the site boundary:

- Heat Radiation – 4.7kW/m^2.
- Explosion Overpressure – 7kPa.

Where incident impacts do not exceed these criteria, the operation would be classified as acceptable under the provisions of *State Environmental Planning Policy No. 33, Hazardous and Offensive Developments*.

A quantitative consequence analysis was conducted for each of the incidents identified. The results of the analysis, shown in **Table 5.55**, determined heat radiation impact and explosion overpressures distance to permissible impact levels as published by the DoP.

Table 5.55: Consequence analysis of identified incidents and distances for permissible impact levels.

Fire Incident	Heat Radiation Distance to 4.7kW/m2
FEL, dozer, truck fire	14.2m
Mix truck fire	24.4m
Diesel storage bund fire	31.1m
Lube oil storage bund fire	19.9m
Explosion Incident	**Explosion Overpressure Distance to 7kPa**
Shot firers vehicle – detonators and cords explosion	44m
Mix truck ANFO explosion	34m
Magazine explosion	119m

5.23.3 Risk Reduction Management and Mitigation Measures

As a result of the analysis conducted in this study, the following conclusions are made:

- The impact of the consequences of all identified hazards in the surface mine and pit top facilities, with the exception of the magazine explosion, do not have the potential to impact offsite due to the application of a 100m buffer zone around the open cut workings and a 50m set back of the fuel/oil storages in the pit-top services facilities from the site boundary.
- In the event the portable explosives magazine was placed on the edge of the 100m buffer zone, and an explosion occurred in the magazine, there would be an offsite overpressure in excess of 7kPa for 20m beyond the site boundary.

Notwithstanding the majority of analysis results indicate no off-site impacts, a number of risk reduction recommendations have been made to enhance the hazard mitigation and site emergency response. Whilst it was identified that the majority of hazardous incidents have no offsite impact, the following recommendations are made in relation to risk reduction to ensure the ALARP (as low as reasonably practicable) principle is applied. The measures are as follows:

- An Emergency Response Plan will be developed utilising the results of the hazard analysis along with other incidents identified to have onsite impact to mine equipment and personnel.
- Regular emergency response drills will be conducted as part of the Mine Rescue Team (MRT) exercises. The hazards identified in this study will be included in the drill exercises to ensure MRT readiness.
- As the study indicated that fire in vehicles was a potential major hazard on site, and that fire growth has the potential to result in serious damage to vehicles, all vehicles on site be fitted with at least one dry powder type extinguisher. Larger vehicles will carry at least one 9kg dry powder extinguisher and smaller vehicles at least one 4.5kg dry powder extinguisher.

- Portable magazines stores will be located no closer than 150m to the site boundary.
- Prepare a dangerous goods notification form, in accordance with the NSW *Occupational Health and Safety (Dangerous Goods Amendment) Regulation 2005* and submit the forms to WorkCover NSW, for the proposed diesel storage, and other dangerous goods storages on site, in accordance with the *Section 6a* and *Schedule 5* of the regulation.

5.24 Bushfire

5.24.1 Existing Bush Fire Setting

According to Bushfire Prone mapping undertaken for Singleton Council by the Rural Fire Brigade, the SEOC area does not contain any mapped bushfire prone vegetation.

The native vegetation of the locality is largely restricted to lands to the east of the SEOC and south of and adjacent to the proposed office and workshop facilities. Vegetation is mostly of open woodland structure with a woody herbaceous/ shrubby understorey.

Local fire suppression resources include the Jerrys Plains, Glennies Creek and Darlington Rural Fire Brigades, which form part of a wider resource base contained within the Singleton Council local government area.

5.24.2 Potential Bushfire Impacts

The presence of bush fire prone lands within the locality represents potential risk to the operation of the SEOC in following areas:

- The safety of personnel and residents of the area (i.e. contact with smoke and flame).
- Damage to plant and buildings (i.e. vehicles, machinery, workshop and office facility).
- Ignition of coal stockpiles and flammable materials such as fuel and lube storages.
- Interruption of mining and agricultural operations.
- Loss of rehabilitation/ revegetation works.

Also of importance is the potential increase of ignition sources during the undertaking of routine construction and operational activities such as the use of machinery in vegetated lands or the undertaking of hot works under inappropriate conditions. The incidence of accidental/deliberate human related ignition sources may also rise due to increased human activity in close proximity to native vegetation in remote areas.

5.24.3 Bushfire Mitigation

The SEOC will implement a bushfire management strategy to minimise bush fire risk to activities, processes, infrastructure and other assets located in close proximity to bush fire prone lands.

The management strategy will include the use of:

- Perimeter roads, management tracks and management zones.
- Incorporation of fire suppression assets such as water carts, dozers, static water storages into the mine and facility design.
- Design and maintain appropriate access for emergency vehicles.

5.25 Waste Management

The SEOC project and existing ACP will generate the following waste streams:

- Demolition related waste.
- Construction related waste.
- Putrescibles waste from employees.
- Workshop related wastes.
- Effluent.
- Coal reject and tailings.

Effective waste management follows the hierarchy listed below:

- Avoidance.
- Reduction.
- Reuse.
- Recycling or reclamation.
- Waste treatment.
- Disposal.

This means that decisions will be made to avoid waste generation in the first instance rather than options to reuse or recycle. However, as the generation of some waste materials will not be avoidable, then actions will be implemented to maximise the diversion of these materials from disposal to landfill.

5.25.1 Existing ACP Waste Management

The existing ACP operates under an approved Waste Management Plan, developed and approved in 2003.

In February 2007 ACOL entered into an alliance with Transpacific Industries to create a total site waste management program with the aim to increase and maximise re-use and recycling of waste material on-site. **Table 5.56** details the relative proportions of waste generated at the existing ACP. The key objective of the waste management program is to reduce waste to landfill by 20% in the next 5 years.

Table 5.56: Breakdown of the proportions of waste generated at the existing ACP.

Month	Disposal	Energy Recovery	Recycling	Reuse	Treatment
Average percentage	59.7 %	0.3%	37.5 %	0.4 %	2.1 %

To date the following changes have been implemented as part of the program:

- Increase in paper and cardboard recycling bins including under desk baskets, wheely bins and skip bins across site.
- Timber skip bins have been placed at each of the surface areas (underground surface, CHPP and open cut workshop).
- Batteries are now recycled where possible.
- Used printer cartridges are now fully recycled through the ‘Cartridges 4 Planet Ark’ program.

A Transpacific Waste Management Officer (WMO) inspects ACOL’s waste streams on a weekly basis. During these inspections the WMO identifies contamination of waste streams, and where efficiencies and improvements can be made to the system. All of this information is provided in a monthly report which is presented in Occupational Health, Safety and Environment meetings.

Where heavy contamination is identified, the WMO will provide a toolbox talk to the relevant employees to increase the awareness of the problem.

Waste tracking is also completed by Transpacific with data provided in the monthly reports.

ACOL are committed to improving waste management and will apply waste management program to the SEOC.

5.25.2 Estimates of Waste Generation

5.25.2.1 Demolition

Seven (7) dwellings and associated rural structures will be removed in advance of mining along with fencing that is no longer required.

Fencing materials will be reused where feasible and suitable.

All materials from demolition will be carefully screened to identify any materials that require disposal through licenced facilities. The waste contractor will provide suitable containment equipment for these materials as required. All other demolition wastes will be segregated and where feasible recycled or disposed of to landfill.

5.25.2.2 Construction

Construction wastes are likely to include timbers, metal, oils and fuels, batteries and general domestic rubbish.

It is important to acknowledge that during construction materials such as conveyor systems and buildings are generally all fabricated offsite and are assembled at the site. This minimises the wastage of fitout materials such as construction timber, electrical fittings, plumbing and telecommunications wire. Culverts are fabricated offsite for the smaller variety, but if larger ones are required then these will be made onsite. Other resources will be ordered based on accurate calculation as to requirements so that there will be no wastage.

Strict purchasing and monitoring of specifications for prefabricated infrastructure will reduce the generation of wastes onsite. As part of their contractual obligations, the waste contractor provides monthly reports on the volumes of materials collected and management pathways. The contractor also advises on identified opportunities to increase landfill diversion.

Estimates of additional construction waste (where in excess of normal operational quantities) is included within **Table 5.57**.

All waste will be segregated to allow responsible waste management with recycling or disposal to a local licensed waste facility via the licensed site waste contractor.

5.25.2.3 Operations

Table 5.57 provides an estimate on the quantity of waste (based on the existing ACP operations) that will be generated when the SEOC becomes operational. Estimates of additional construction waste is noted where relevant.

Refer to *Section 4.4.6.4* for further information with respect to tailing and reject management, and *Section 5.15* for characterisation of reject and tailings.

Table 5.57: Estimated operational waste streams from the SEOC project.

Waste Stream	Source	Yearly Total (t)
Absorbents	Workshop	2.86
Air Filters	Workshop	0.30

Waste Stream	Source	Yearly Total (t)
Air Filters (refurbished)	Workshop	1.91
Batteries - Lead Acid	Workshop	4.24
Commingled recyclables	Generated by personnel – this includes beverage containers.	10
Contaminated Rags – Hydrocarbons	Workshop	12.00
Effluent	Bathhouse and office areas	72.00 (see section below)
Empty Drums (Contaminated, that are not returned to suppliers)	Workshop	0.44
General Waste (Putrescibles waste, Plastic Packaging)	Workshop and office areas	301.75
Grease	Workshop	1.78
Oil Emulsions	Workshop	90.67
Oil Filters	Workshop	37.44
Paper & Cardboard		11.91
Resin	Workshop	0.41
Scrap Metal	Workshop and general excess materials during construction (e.g. electrical wire). Parts from machinery that are not able to be reused. Fencing wire and metal gates.	150
	Demolition of existing onsite dwellings and structures within mining footprint.	20
Timber	Normal operations (un-returned wooden pallets, fences, isolated construction)	90
	Construction related (General offcuts concrete formwork, timber fencing)	120
	Demolition of existing onsite dwellings and structures within mining footprint.	50
Paint wash	From the construction of buildings.	2
Tyres	Expended tyres from vehicle fleet.	65
Chemicals	These are excess or out of specification chemicals.	0.2
Rubber from conveyor belts	This is rubber material generated during the installation of coal conveying equipment.	Cannot be estimated
Reject and Tailings	Processing of ROM coal.	~1.2Mt from SEOC ROM coal ~1.6Mt from UG ROM coal at peak

5.25.3 Waste Management Plan

The ACP has an approved Waste Management Plan (WMP) that governs waste management across the existing ACP site. The WMP will be updated and adapted for the construction and operation of the SEOC project to ensure integrated waste management across the ACP.

Targeted key areas within the WMP include:

- Liaison with contractors to identify areas where they can reduce waste and reuse materials in their respective scope of works.
- Meet local, state and federal waste minimisation legislative and associated standards.
- Prevent pollution and damage to the environment.
- Protect the safety and health of employees and the general public.

It should be noted that the capacity to recycle many materials is dependent on the quantities generated and the availability of systems to process such material.

The waste contractor (currently Transpacific Industries) has demonstrated at the existing ACP a capacity to manage all waste and recyclables that are generated with a willingness to assist in identifying opportunities to maximise diversion of materials from landfill by assisting in segregation, training and locating suitable recycling facilities.

The objectives, actions and performance of the waste management plan are detailed within **Table 5.58**.

Table 5.58: Objectives, actions and performance measures for the Waste Management Plan.

Objective	Actions	Performance Measures
The production of waste on site is minimised.	Most equipment (eg, conveyor belt systems and office facilities) are prefabricated offsite, or specifications for materials are such that there is no waste of these materials. A program to encourage waste minimisation is in place. This involves: • Continuing monitoring through waste assessments. • Contractor feedback and reporting on diversion activities and levels of leakage/contamination. • Personnel induction and training programs.	• Weekly waste assessments of waste/recycling containers: • Monitoring of the onsite waste/recycling system on a weekly basis to identify any materials that are fabricated offsite that have been deposited into this system. If such materials are identified, contractors are then required to submit a plan to address the issue(s). • Actions to be implemented for waste avoidance and recycling included in the onsite induction program. • Waste management issues included in weekly toolbox meetings. • Records maintained of all personnel trained in site waste management principles.
Potential reuse or recycling avenues are identified and appropriate handling and collection procedures are in place.	• Discussions with contractors though purchasing and contract negotiations. • Weekly personnel/contractor toolbox sessions. • Weekly waste assessment conducted of waste and recycling containers. • Waste contractor provided sufficient and appropriate coloured/signed containers to ensure all recyclable/reusable materials are collected separately.	• No wastes transported offsite for disposal to landfill that has potential for reduction and/or recycling. • No observed incidence of contamination of recycling/reuse streams or leakage of any of these materials into the landfill disposal container.
Opportunities for on-site reuse/reclamation are utilised where feasible.	• Opportunities identified through weekly waste assessments and discussion with personnel/contractors.	• No wastes transported offsite for disposal to landfill that has a reasonable and feasible potential for reduction and/or recycling onsite.

Objective	Actions	Performance Measures
Disposal of waste material conforms with any applicable licence conditions.	• Appropriate disposal methods for waste material are identified and utilised. • Sewage treatment facilities are in place to treat waste from office and bath house facilities in accordance EPL criteria. • All solid waste and putrescibles matter is disposed of to the satisfaction of MWRC and DECCW, as relevant.	• All wastes are disposed of in accordance with all applicable legislation. • No penalty notices or other actions in relation to incorrect waste disposal issued by any regulatory authority.
Storage areas are designed and maintained to contain any spillage.	• All containers for wastes are clearly signed and colour coded to allow recognition of where to deposit wastes/recyclables. • Litter fences and container covers used to prevent any materials being blown out of the waste storage area. • A waste water treatment facility with oil separator is installed to treat waste from the vehicle servicing and general workshop areas. • Areas in which fuels, oils or chemical are stored are appropriately bunded to contain any spillage.	• No environmental impacts outside the waste storage areas.

5.25.3.1 Effluent

WorleyParsons was engaged to undertake an assessment of the site suitability of the SEOC project office and facilities area for effluent disposal, this section summarises the details of effluent at the SEOC and the assessment. A complete copy of the assessment is included within Appendix E of the Surface Water Assessment Report (Appendix 6)

Wastewater will be generated from the proposed on-site amenities, which include showers, bathroom facilities and washrooms. Wastewater contains human waste and associated pathogens.

All wastewater generated will be treated using an Envirocycle or equivalent waste water treatment system (*WWTS*). Treatment would be by an aerated wastewater treatment system (*AWTS*) as well as UV disinfection or equivalent (*removes pathogens and other potentially harmful organisms*). The WWTS is commonly used for commercial wastewater applications and is approved by relevant health authorities throughout Australia. Treated effluent will be disposed through irrigation of landscaped areas surrounding the office and workshop facilities area. The treatment plant would provide holding tanks sized to retain up to 5 days of effluent production to allay the need to irrigate during rainfall periods.

The estimated peak and average daily wastewater loads will be 7.7 l/s and 23.6 KL/day respectively. A 20KL balancing tank will be required upstream of the WWTS to attenuate the peak flows, allowing for the WWTS to operate at the average waste water loading rate.

Soil testing has been undertaken to determine the appropriate irrigation loading rates based on methodologies detailed in *On-site Sewage Management for Single Households* (*Environment and Health Protection Guidelines,1998*). A recommended irrigation area of approximately 1.8 ha will be required to dispose of all wastewater generated by the SEOC operation. Phosphorus was determined to be the limiting nutrient for the waste water disposal.

5.25.3.2 Hazardous Materials Management

The SEOC project will require the use of hazardous materials throughout the mining operation. Hazardous materials management will follow leading practice incorporating the following key principles (from *Leading Practice Sustainable Development Program For The Mining Industry, 2005)*:

- Knowledge of which hazardous materials are on site;
- Allocating clear responsibility for managing hazardous materials;
- Understanding the actual or potential hazards and environmental impacts in transporting, storing, using and disposing of these materials;
- Minimising the use and/or generation of hazardous materials;
- Constructing storage facilities that contain the materials in all foreseen circumstances;
- Disposing of waste materials in a way that eliminates or minimises environmental impacts;
- Seeking alternatives to disposal such as reducing, reusing and recycling products;
- Implementing physical controls and procedural measures to ensure that no materials escape during normal or abnormal operations;
- Having emergency response plans in place to ensure immediate action to minimise environmental effects should accidental or unplanned releases occur;
- Monitoring any discharges and also the environment to detect any escapes of the materials and measure any subsequent impacts; and
- Keeping adequate records including Material Safety Data Sheets (MSDS's) of chemicals onsite and reviewing them regularly so future environmental and health and safety problems are anticipated and avoided.

5.26 Economic and Social Environment

This section of the EA report contains economic and social assessments of the SEOC project.

From an economic perspective there are two important aspects of the SEOC project, these being:

- The regional economic impacts of the Project (i.e., the economic stimulus that the project would provide to the economy) which can be evaluated using an economic impact assessment.
- The economic efficiency of the project (i.e., the consideration of the economic costs and benefits) which can be evaluated using benefit cost analysis.

The Hunter Valley Research Foundation (HVRF) was commissioned to prepare an economic impact assessment of the SEOC project. The economic impact assessment contains a socio-economic profile of the four dominant local government areas of Singleton, Cessnock, Maitland and Muswellbrook, which provide the vast majority of miners currently employed at the ACOL NEOC. These miners will be employed by ACOL to operate the SEOC project and therefore the above local government areas stand to receive the most benefits if the project is approved. A copy of the HVRF report is contained in **Appendix 17** in Volume 5.

Gillespie Economics was commissioned to prepare a benefit cost analysis of the SEOC project. A copy of this report is contained in **Appendix 18** in Volume 5.

This section also contains a review of Singleton Council's planning policies that have and will shape most planning decisions for the future of Camberwell. The section details consultation by ACOL representatives since 2002 with land owners and residents of Camberwell that has contributed to ACOL's concept plans for Camberwell with a vision to maintain and enhance the village during and post mining. These concept plans for the enhancement of the village are presented in this section.

5.26.1 Economic Impact Assessment

5.26.1.1 Assessment Methodology

The socio economic profile presented by the HVRF contains a collection of data describing the characteristics of the population where the majority of the workforce for the SEOC reside and will be drawn from to construct and operate the SEOC. In this regard the existing ACP workforce reside across sixteen (16) local government areas of which the dominant four (4) areas are Singleton, Cessnock, Maitland and Muswellbrook. The four local government areas of Singleton, Cessnock, Maitland and Muswellbrook will receive the most immediate benefits from the project.

The economic impacts generated from both the construction and operational phases of the SEOC were assessed by the HVRF using input-output analysis. Impacts are identified as direct or induced effects (sometimes referred to as flow on effects), measured in terms of the value of output generated and number of jobs created in the regional economy. Estimates are also provided for taxation revenues generated for the Federal and State Governments for the SEOC project.

5.26.1.2 Workforce Area Profile

The following is a summary of the socio-economic profile of the four (4) local government areas (Singleton, Cessnock, Maitland and Muswellbrook) that will receive the most immediate benefits of the proposed SEOC project. These local government areas (LGA) are defined as the "workforce area".

5.26.1.2.1 Population growth and distribution

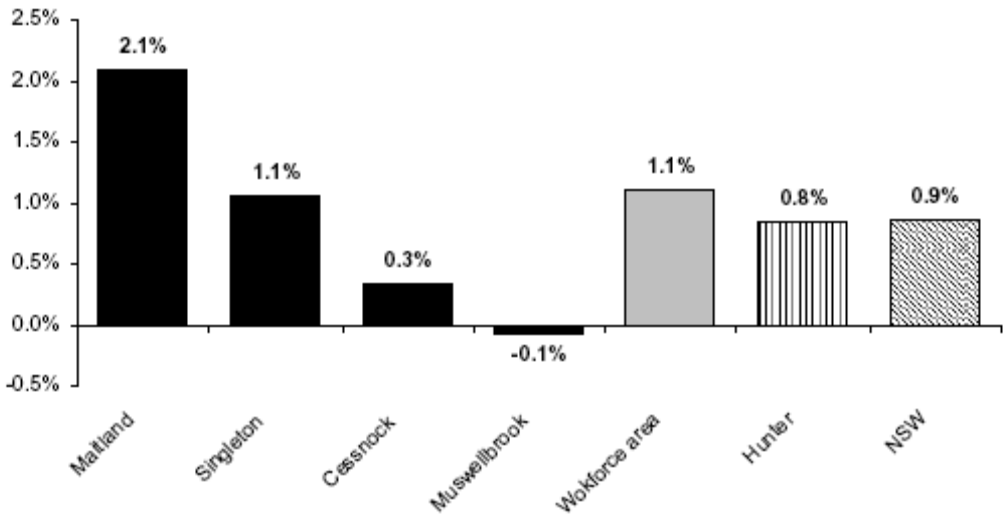
Table 5.59 provides details of the age and growth of the population in each LGA, the whole of the workforce area, the Hunter Region and New South Wales.

Figure 5.44 graphically displays the change in population for the period 1996 to 2006.

Table 5.59: Population and growth rate in each LGA, the workforce area and New South Wales.

Region		Age Bracket						
		0-14 years	15-25 years	25-39 years	40-54 years	55-64 years	64+ years	Total
Muswellbrook	2006	3,695	2,059	3,171	3,209	1,560	1,542	**15,236**
	Change^	*-0.90%*	*-0.70%*	*-1.60%*	*0.60%*	*3.50%*	*2.00%*	*-0.10%*
Cessnock	2006	10,043	5,875	8,707	9,725	5,575	6,281	**46,206**
	Change^	*-0.50%*	*-0.50%*	*-1.10%*	*0.80%*	*4.60%*	*0.90%*	*0.30%*
Singleton	2006	5,366	2,911	4,575	4,826	2,187	2,075	**21,940**
	Change^	0.10%	0.80%	-0.50%	1.80%	5.10%	2.60%	**1.10%**
Maitland	2006	14,208	8,430	12,553	12,960	6,495	7,235	**61,881**
	Change^	1.30%	1.40%	1.00%	2.50%	6.00%	3.10%	**2.10%**
Workforce area	2006	33,312	19,275	29,006	30,720	15,817	17,133	**145,263**
	Change^	0.30%	0.50%	-0.20%	1.60%	5.10%	2.00%	**1.10%**
NSW	2006	1,298,916	871,716	1,365,729	1,387,494	719,547	904,777	**6,549,179**
	Change^	0.10%	0.30%	-0.20%	1.50%	3.40%	1.70%	**0.90%**

^ *Annual average change in population between 1996 and 2006*
Source: Australian Bureau of Statistics, Census of Population and Housing, 1996 and 2006, Cat. No. 2068.0



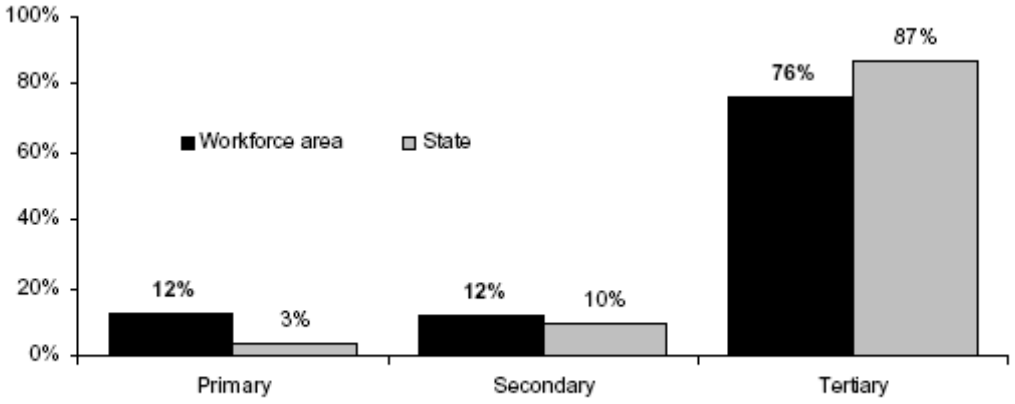
Source: Australian Bureau of Statistics, *Census of Population and Housing* , 1996 and 2006, Cat. No. 2068.0

Figure 5.44: Average annual rate of population change, 1996-2006.

The HVRF identified the following key points with respect to their review of the workforce area population, these being:

- In 2006 the population of the workforce area totalled 145,263 persons;
- Population growth in the workforce area averaged 1.1% between 1996 and 2006, a slightly higher percentage than for NSW (0.9%) and the Hunter Region (0.8%). Growth was highest in Maitland (2.1%), Singleton (1.1%) Cessnock (0.3%) and Muswellbrook declined (-0.1%).

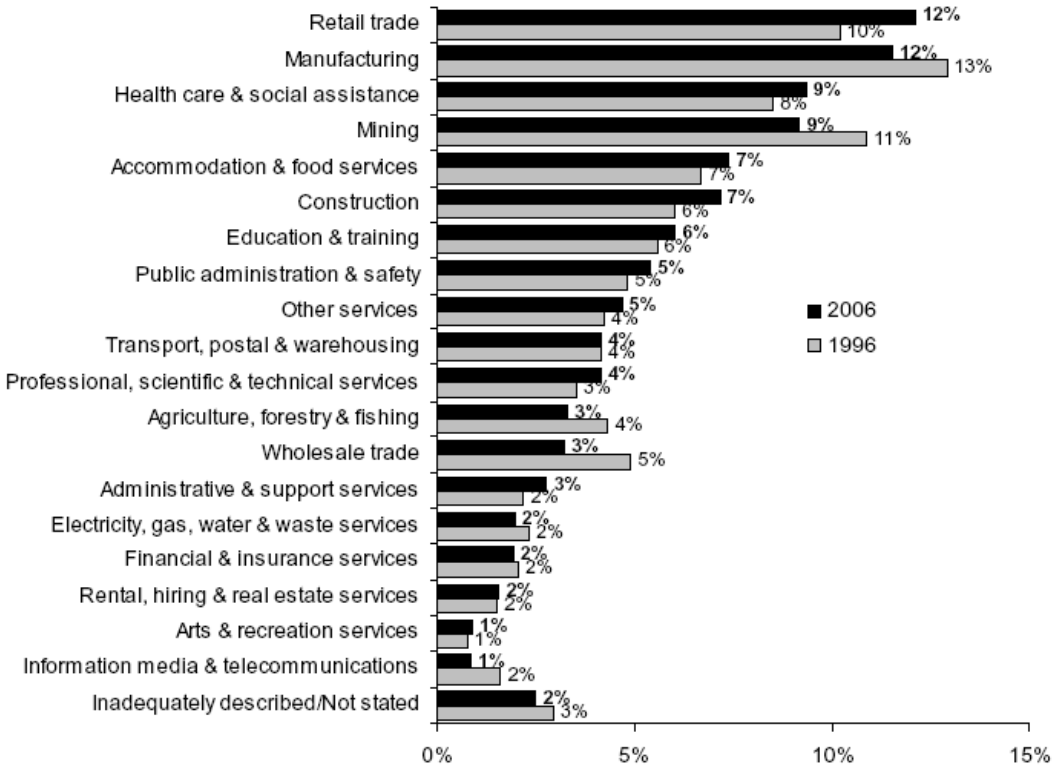
- In the workforce area (as in NSW and Australia) growth in the number of "older" persons exceeded growth in number of "younger" persons. The proportion of the total population age under 40 years of age declined from 62% in 1996 to 56% in 2006.
- The workforce area is substantially more dependent on the primary sector and less dependent on the tertiary sector than NSW as a whole. **Figure 5.45** shows that in 2006 primary industry (agriculture, forestry, fishing and mining) was a significant employer in the workforce area, accounting for 12% of total employment. This relatively high proportion reflects the prominence of mining in the area.



Source: Australian Bureau of Statistics, *Census of Population and Housing* , 2006, Cat. No. 2068.0

Figure 5.45: Broad industry structure of the workforce area and State, 2006, proportion of total employment

Figure 5.46 provides a detailed breakdown of employment sectors within the workforce area for 1996 and 2006. The four major employment generating industries in the workforce area are retail trade, manufacturing, health care/social assistance and mining.

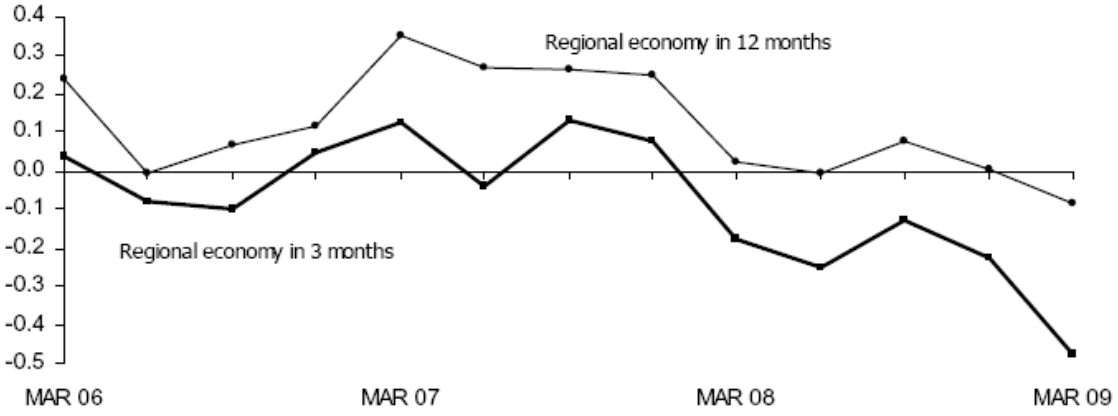


Note: percentages are rounded to the nearest whole number
Source: Australian Bureau of Statistics, *Census of Population and Housing* , 1996 and 2006, Cat. No. 2068.0

Figure 5.46: Detailed industry breakdown of the workforce area, 1996 and 2006, proportion of total employment.

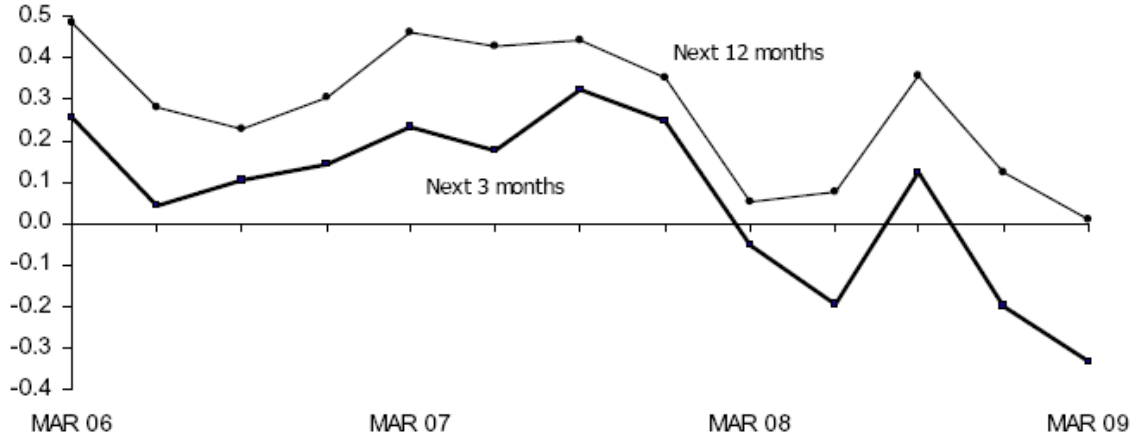
5.26.1.2.2 Consumer and Business Confidence

The HVRF advise that consumer and business confidence in the Hunter Region economy plummeted in 2008/2009 as the enormity of the global financial crisis and consequent world economic downturn became evident as shown by **Figures 5.47** and **Figure 5.48**.



Source: HVRF household surveys

Figure 5.47: Consumer confidence in the Hunter Region economy, 2006-2009 +1+most optimistic; -1+most pessimistic.



Source: HVRF business surveys

Figure 5.48: Business confidence in the Hunter Region economy, 2006-2009 +1+most optimistic; -1+most pessimistic.

The downturn has seen previous certainties dispelled as governments nationalize banks and imperious institutions such as General Motors and Lehman Brothers prove fallible. Uncertainty regarding employment, personal investments and the whole economic context remains prevalent in the region's households, instilling cautious behaviour and entrenching weak retail and housing demand coupled with declining business investment in equipment and employment growth.

5.26.1.3 Economic Impacts of the South East Open Cut

The HVRF, utilizing input-output analysis has estimated the economic impacts generated in the Hunter Region from the construction and ongoing operation of the SEOC project. Input-output analysis identifies and evaluates linkages between sectors in the economy. The analysis uses the expenditure by a firm on its final product as a starting point and then tracks backward through the various sectors of the economy to identify the contribution each sector makes to that final product.

The analysis is made in terms of the direct (or initial) impacts of the final expenditure and the induced (or flow on) impacts as all sectors provide input to enable the final production. The impacts are qualified using multiplier coefficients derived from the model, in terms of value of the goods and services and the number of jobs which result from production of the specified good or service and the expenditure of salaries and other income earned due to that production. The HVRF has provided estimates for taxation and royalties generated for the government sectors of our economy.

5.26.1.3.1 Economic and Employment Benefit – Construction Phase

Expenditure on construction of the SEOC facilities has been estimated to total $49.9 million over two years apportioned over four (4) (mining, machinery and equipment, construction, property and business services) sectors. Total expenditure of $49.9 million over 2 years is expected to stimulate additional production in the region valued at $31 million and additional consumption worth $20 million – providing a total benefit to the Hunter Region of $101 million.

Total construction expenditure of $49.9 million is expected to create an average of 127 full time equivalent jobs in each year of the two (2) year construction period. Additional production in the region will create a further 52 jobs and additional consumption will create a further 57 jobs – an induced benefit of 109 jobs providing a total employment benefit to the Hunter region of 236 full – time equivalent positions in each year of construction in the sectors of mining, machinery/equipment, construction, property and business services.

The HVRF estimate that in total, 430 full-time equivalent positions will be created for the construction phase of the SEOC project.

Over the 2 year construction period the HVRF estimate that taxation revenue to the Federal Government will total approximately $9 million, $5.8 million from income tax, $1.8 million from indirect taxes and $1.3 million from company tax. Payroll taxation revenue to the State Government has been estimated at $1.6 million yielding a total public sector benefit of $10.6 million.

5.26.1.3.2 Economic and Employment Benefits in Operational Phase

Output and employment impacts resulting from the ongoing operation of the SEOC will be directly generated in the mining sector of the input-output model analysis. The HVRF have assessed that production will be over 7 years with saleable output valued at $100 AUD per tonne.

On the basis of these assumptions the total value of the SEOC is estimated at $1.2 billion whilst operational employment should remain constant at 160 full time equivalent positions in each year of production.

With total production at $1.2 billion this will stimulate further production in the Hunter Region to the value of $808 million and additional consumption estimated at $322 million an induced benefit of approximately $1.13 billion, providing a total benefit to the Region of approximately $2.3 billion.

Employment at the SEOC will be equivalent to 160 full time positions for each of the seven years of production. Induced production and consumption in the Hunter Region attributable from the operations will generate a further 309 and 213 jobs respectively – an induced benefit of 522 jobs. In total approximately 682 full time equivalent positions will be created from the SEOC project.

Of particular note is that the SEOC is being established to allow the continuation of employment for the existing North East Open Cut. Hence the employment of these people is current within the local area and towns and without the approval of the SEOC there would be the effective loss of employment equivalent to that detailed above.

Over the seven year operational period, Federal Government taxation receipts are estimated to total $152 million - $92 million from income tax, $29 million from indirect taxes and $31 million from company tax. Revenue to the State Government is estimated at $125 million - $26 million from payroll tax and $99 million from production royalties.

The total public sector is expected to benefit by $277 million.

5.26.1.4 Economic Impact Assessment Conclusions

Over the decade to 2006 the population in the area has aged at a greater rate than in the State as a whole, and in Cessnock and Muswellbrook there has been a substantial decline in the population aged under 40. Unemployment in the area generally exceeds the State average, and educational attainment and income levels are lower than in the State. The current economic downturn has seen residential building approvals decline at a faster rate in the workforce area than in the State, and consumer and business confidence in the broader Hunter Region have deteriorated to levels not seen since 1991. Lower consumer confidence and weaker demand are being reflected in a deterioration of regional businesses' trading performance, lower profit margins, falling orders and less overtime being worked.

The SEOC will provide a substantial boost to the Hunter Region in general and the workforce area in particular, primarily by increasing employment, income and demand. Construction of the facilities is expected to generate output in the Hunter Region worth more than $100 million, and their subsequent operation will generate an estimated $2.3 billion worth of output. Around 127 jobs will be created, on average, in each of the two years of construction and 160 will be created in each of the seven years of operation. This creation of employment will directly off set the planned closure of the existing ACOL NEOC. The SEOC project approval will allow for the direct transfer of this workforce to the new SEOC. Without this approval there will effectively be a loss of 160 direct jobs and 682 full time equivalent positions.

Over the medium-term, economic development, job creation and job retention promoted by the project will contribute to population growth and assist in keeping younger people in, and attracting them to, the workforce area. Growth in tertiary sector industries will be encouraged as the population increases which, in turn, will assist in further increasing incomes and promoting higher educational attainment in the area.

5.26.2 Benefit Cost Analysis

Benefit cost analysis is the methodology used to consider the economic efficiency of proposals. A project is economically efficient and desirable on economic grounds if the benefits to society exceed the costs.

Benefit cost analysis is essentially the "weighing-up" of potential economic benefits and costs of a project to a community and upon the environment.

5.26.2.1 Base Case or Do Nothing Scenario

The benefits and costs of the SEOC project can be identified and estimated through a comparison of the project to the "base case" or "do nothing" scenario. In the assessment by Gillespie Economics (refer to Appendix 18) the base case or do nothing scenario involves:

- The NEOC will cease at the end of 2010.
- 160 full time employees will lose their jobs.
- Land acquired in Camberwell village as a buffer will be able to be sold.
- The residual value of the capital equipment from the NEOC would be sold and realised.
- The Ashton Underground Mine, coal handling and preparation plant will continue operating.

In contrast, the SEOC project involves:

- Development of the SEOC with extraction of up to 3.6 Mtpa of ROM production for up to 7 years.
- Continued employment of 160 full time employees.
- Utilisation of existing buffer land and capital from the NEOC.
- Development of ancillary infrastructure.

- Provision of an ecological offset for the vegetated land that will be cleared.
- Rehabilitation of the SEOC at cessation of mining and sale of land including buffer land
- Sale of residual capital at the cessation of the SEOC.

The benefit cost analysis identified a range of benefits and costs for the project. Indicative values were identified and discussed within the Gillespie Economics report an assigned.

The analysis found that the net production benefit of the SEOC project (after consideration of greenhouse gas effects, air quality impacts, noise and vibration impacts, Aboriginal and European heritage impacts, ecological impacts, groundwater and surface water impacts, visual and traffic impacts) would result in a net community benefit of $368 million.

The net community benefit is distributed or shared amongst a range of stakeholders including:

- ACOL.
- NSW Government via royalties.
- Commonwealth Government in the form of company tax.

The estimated net community benefit of the SEOC project represents the “lost” opportunity cost to the community if the project does not proceed.

5.26.3 Local Government Planning Policy (Singleton Council)

5.26.3.1 Situation Analysis

Singleton Council in March 2006 engaged Planning Workshop Australia Pty Ltd to undertake a Situation Analysis to provide background information to support the preparation of a Land Use Strategy for the Singleton local government area. The purpose of the Situation Analysis document was to provide Singleton Council with a profile of Singleton, identify and establish key land use planning issues, strategic policies and actions to be considered in the preparation of the Singleton Land Use Strategy and subsequent local environmental and strategic plans for the local government area. The Situation Analysis document was publicity exhibited and work shopped in November 2006.

Planning Workshop Australia (2006) placed Camberwell in the “rural west” planning area and identified the key planning issues as “coal mining impacts” and “limited development pressure”. The Planning Workshop Australia analysis was consistent with the 1983 and 1995/96 reviews undertaken by Singleton Council regarding development constraints and opportunities associated with the village of Camberwell. Planning Workshop Australia argued that the information contained in the previous studies was still relevant today.

The key rural issues identified by Planning Workshop Australia in the Situation Analysis document are:

- Catering for rural residential subdivision and development.
- Promoting agricultural development, protection of employment opportunities and the natural resources base.
- Planning for rural servicing requirements (costs and maintenance).
- Planning for rural highway frontage development.
- Identifying environmental values, constraints and protection requirements.

Key land use issues identified by Planning Workshop Australia for coal mining are:

- Protection of coal mining resources and preventing sterilization of resources as a result of conflicting land uses.
- Transportation of coal.
- Water use and management.
- Environmental impacts associated with mining activities.
- Employment and economic activity generated by mining, and other social impacts.

- Associated land use activities.
- Land rehabilitation and future use of mining sites.

5.26.3.2 Singleton Land Use Strategy

Planning Workshop Australia was engaged by Singleton Council in 2007 to produce the Singleton Land Use Strategy on behalf of Singleton Council. Planning Workshop Australia utilised the key planning issues identified with the 2006 Situation Analysis document and results from community consultation workshops which culminated in the preparation and public exhibition of the Singleton Land Use Strategy. The draft Singleton Land Use Strategy document was publicly exhibited and work shopped in November/December 2007. The exhibition of the draft Singleton Land Use Strategy received fifty one (51) submissions from both private and government organisations – none of which objected to the findings in relation to the rural west planning area which contains Camberwell.

The rural west planning sector includes Camberwell and was identified as having a "*stable population with considerable open cut mining activity and associated land use change and environmental impact*", (Planning Workshop Australia, 2008).

No urban expansion is planned for the rural west planning sector as a consequence of open cut coal mining and associated impacts. Camberwell has not been identified for the provision of town water and/or sewer services.

With respect to Camberwell the Singleton Land Use Strategy document recommended that the special provisions contained in Clause 19 of the Singleton Local Environmental Plan 1996 be continued. Clause 19 restricts the development of dwellings within the village to "existing parcels" or land having an area of 8,000 square metres. This clause was introduced to restrict development within the village of Camberwell and limit conflict with the mining of coal resources.

A number of specific objectives, policies and strategic actions are contained and recommended within the Singleton Land Use Strategy document in relation to the areas currently zoned 1(d), Rural Small Holdings by Singleton Local Environmental Plan 1996. In summary the objectives, policies and strategic actions place restrictions upon the development of Camberwell whilst coal mining is occurring on nearby lands.

In contrast the coal mining industry has been identified as the most significant land use and economic activity in the rural west planning sector of the Singleton local government area.

Singleton Council at its meeting held 21 April, 2008 adopted the Singleton Land Strategy. Singleton Council also resolved that a new comprehensive draft Local Environmental Plan (LEP) in accordance with the Standard Instrument, based on the provisions of the Singleton Land Use Strategy, pursuant to Section 54 of the Environmental Planning and Assessment Act, 1979 be prepared.

The Singleton Land Use Strategy was endorsed by the Director-General, Department of Planning on 8 June, 2008. The Singleton Land Use Strategy has a timeframe of 25 years but its principle focus is on the next 10 years.

ACOL has a vision to sustain Camberwell both during and at the cessation of coal mining consistent with the adopted Singleton Land Use Strategy.

5.26.4 Attributes of Camberwell Village

Camberwell village is located approximately 12 kilometres north west of Singleton. The village was originally established on a traditional rectangular grid layout in close proximity to fresh water (Glennies Creek). The New England Highway bisects the southern portion of the village.

For the purpose of describing Camberwell village, the village has been assumed to include those lands zoned 1(d) Small Rural Holdings and extending some 500 metres from the zone boundary. Within this area there are:

- Thirty three (33) dwellings owned by ACOL.
- Seventeen (17) dwellings privately owned.
- St Clements Church.
- Camberwell Community Hall (now derelict).

There are currently no commercial premises located within the village providing goods or services to local residents. All commercial services are provided within Singleton. Plan 3 shows the location of the above dwellings, St Clements Church and Camberwell Community Hall.

The dwellings within the village are generally owner – occupied or leased by ACOL to occupants. ACOL have a "waiting list" of persons wanting to rent or lease dwellings within the village as rents are less than within the Singleton township. For those residing in Camberwell village and employed within the mining industry there is generally less travel involved when compared to living in Singleton.

Those who reside within the village have basic services such as overhead electricity, telephone (land lines and mobile coverage), bitumen roads, garbage collection, postal and school bus services. There are no schooling, retail, commercial, social or recreational facilities within the village – all these services and facilities are located in Singleton. Due to the structure of the village there is not seen to be an impact from the SEOC on the services currently provided, taking into consideration the current Singleton Council policies and proposal by ACOL to ensure that the village is sustained into the future beyond mining.

5.26.5 Potential Risks and Impacts to Camberwell Village

By far the greatest risk to the village of Camberwell is the deterioration of the area's amenity and housing stock as a consequence of the encroachment of open cut mining towards the village. The proximity of mining has the potential to impact the area with respect to any or all of the following:

- Blasting (ground vibration and over pressure).
- Increase in noise levels.
- Decrease in air quality due to dust fallout.
- Night time illumination.
- Changes to the landscape and visual amenity.

If the mining impacts are severe then the risk is that the area's permanent population would decline and that the housing stock and associated utility services may deteriorate as a consequence of reduced usage, maintenance and investment.

There is also a cumulative impact from mining as identified within the current Council strategic plans. Camberwell has mining on all sides with many of the nearby mining companies planning expansions which will move toward Camberwell increasing impacts over the next 5 to 7 years.

ACOL will be required to acquire (upon request by the land owner) those properties that are impacted above the relevant criteria for air, noise and blasting. The acquisition of the property will be undertaken at not less than market value with ACOL bearing reasonable costs for disturbance, relocation, valuation and legal expenses associated with the acquisition. A number of these properties are already located within the management and acquisition zones of neighbouring operations and planned expansions.

It should also be noted that some private properties immediately north of the SEOC will be impacted by blasting (ground vibration and over pressure). Where the properties are within the blast exclusion zone (500 metres or as otherwise assessed by a risk assessment) residents will be required to evacuate the blast exclusion zone.

Since the commencement of the ACP, ACOL have acquired 33 dwellings. The village has continued to function throughout this time with acquired houses being let to the rental market. The area of Camberwell generally provides cheaper housing (rental/leases) then those within Singleton reflecting

the fact that it is being impacted by mining. Impacts from the purchase of properties which will continue as a consequence of the SEOC and also by other mining operations moving closer to Camberwell will give rise to a change in "community". This issue has been raised by residents throughout consultation undertaken for a number of years. There has been significant change to the Camberwell community with mining encroaching on the area in recent times, the purchase of properties has caused the dynamic of the village to move from being predominantly privately owned residents to rental tenancies. While it can be demonstrated that the tenancies have remained fairly consistent there is a sense of division within the community with a feeling of loss as previous residents move on and friendships formed are not as robust. Due to the past small village environment there also exists an intergenerational family grouping within the village where each family can own property, but remain living in close proximity to other family members. There is a potential with future impacts and acquisition that this structure will be impacted.

ACOL also seek to close or relocate the Temporary Common located south of the New England Highway. The use of the common has diminished considerable over the years (as is evident by sapling regrowth) and the "playground" section of the common which was to be potentially provided by Singleton Council has not been constructed.

The physical division of the village by the New England Highway and associated traffic movements is not conducive to the movement of stock from a commoners residence across the highway into the common or vice versa.

Similarly the development of a playground in the northern section of the common has not taken place presumably due to the small population and possible dangers of children crossing the highway.

5.26.6 Community Survey's

ACOL have conducted community surveys in 2005, 2006 and 2009. In addition to these there has also been consultation with the residents of Camberwell in relation to improvement programs for both the existing ACP and plans for the SEOC. ACOL have had an active Community Consultative Committee (CCC) since 2003 who have been engaged and consulted with since 2005 in relation to exploration works in the SEOC area and more actively since 2008 for the current plans for the SEOC.

The recent 2009 survey indicates that the majority of those residing in Camberwell knew the members of the CCC and found the CCC to be effective in conveying information. Earlier surveys were split in their response to this question with some feeling that the information from CCC was not reaching the community and that there needed to be more representation from the south side of the village. In response to this issue, minutes from each CCC meeting have been distributed to the community and an additional member was added to the CCC.

Those living in Camberwell have identified the people, the rural lifestyle, proximity to work, a permanent river and its location as the positive aspects of Camberwell, while negative aspects include noise, dust, blasting, mining, lack of town services, highway noise and the transition of long term landowners to people renting in the local area, and the resulting loss of neighbourly friendship.

Those who attended the Community Information Session on 7 and 8 April, 2009 were also provided with an overview of ACOL's concepts to assist in the preservation and improvement of Camberwell village.

The basic concept is to provide an injection of capital into physical improvements such as cycleways, walking paths, park facilities, tennis court – meeting place and landscaping improvements. The concept seeks to promote and enhance the village as a place for families to live, work and enjoy.

As part of the survey, participants were asked what improvements to the village would be valued, such as more street tree planting, walking and cycle paths, a community meeting place or park facilities. The response was mixed with some valuing tree planting and park facilities as the most

important and a community meeting place receiving some support, while many would like to see all aspects implemented, in contrast some were content with its existing form.

5.26.6.1 Community Issues

Figure 5.49 shows the results from the 2009 survey in order of relative importance of potential issues pertaining to the proposed SEOC from the entire survey group. The results of the survey reflect in part the make-up of the survey participants that comprised a high percentage of employees of the existing ACP and mining industry where ongoing employment is their number one concern.

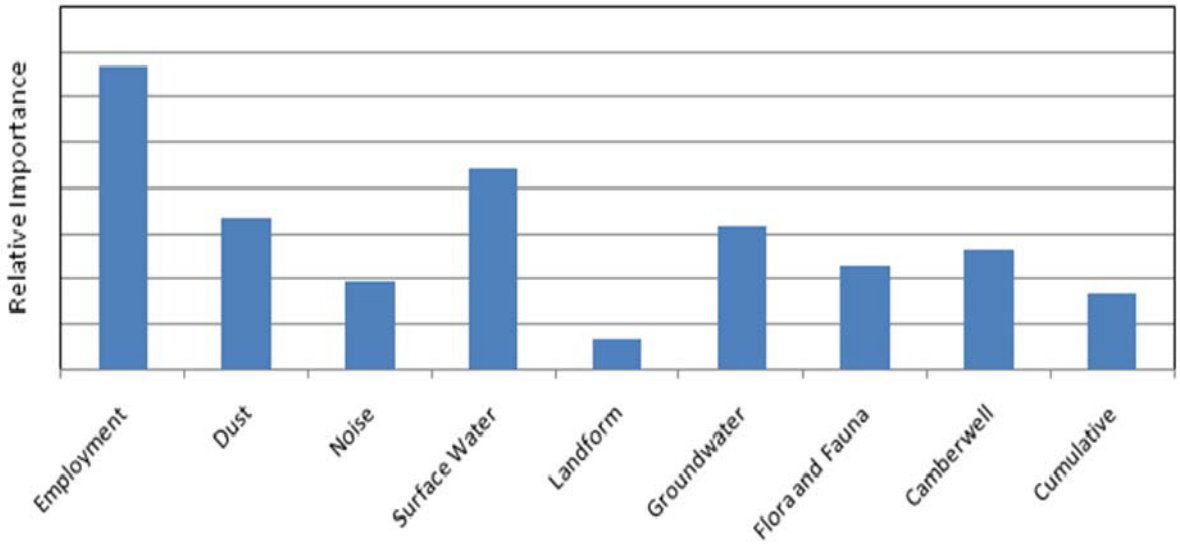


Figure 5.49: Results of survey on the SEOC project from all 31 participants.

Figure 5.50 illustrates the response from Camberwell residents including those employed in the mining industry. The results of this survey clearly show that cumulative impacts from noise and dust are prominent issues, along with the future of Camberwell. Employment is still a significant issue, but not foremost.

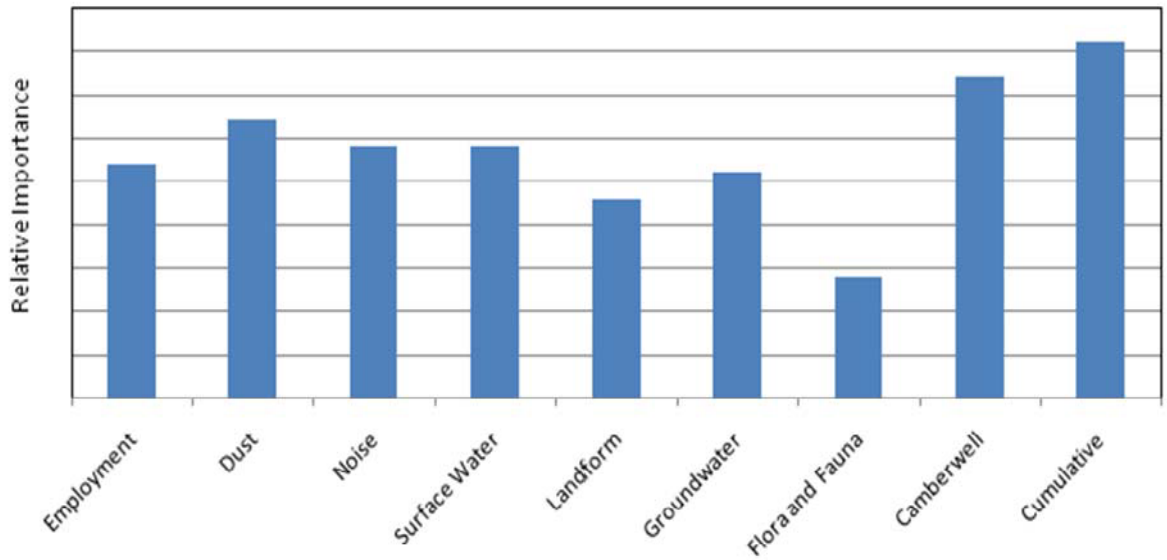


Figure 5.50: Results of survey on the SEOC project from the nine (9) participants that reside within Camberwell.

Figure 5.51 illustrates the response from Camberwell residents with no direct employment from the mining industry, in particular the ACP. The results shown here are similar to Figure 3.2, however employment is not a significant concern for those that are not directly employed in the sector or by ACOL.

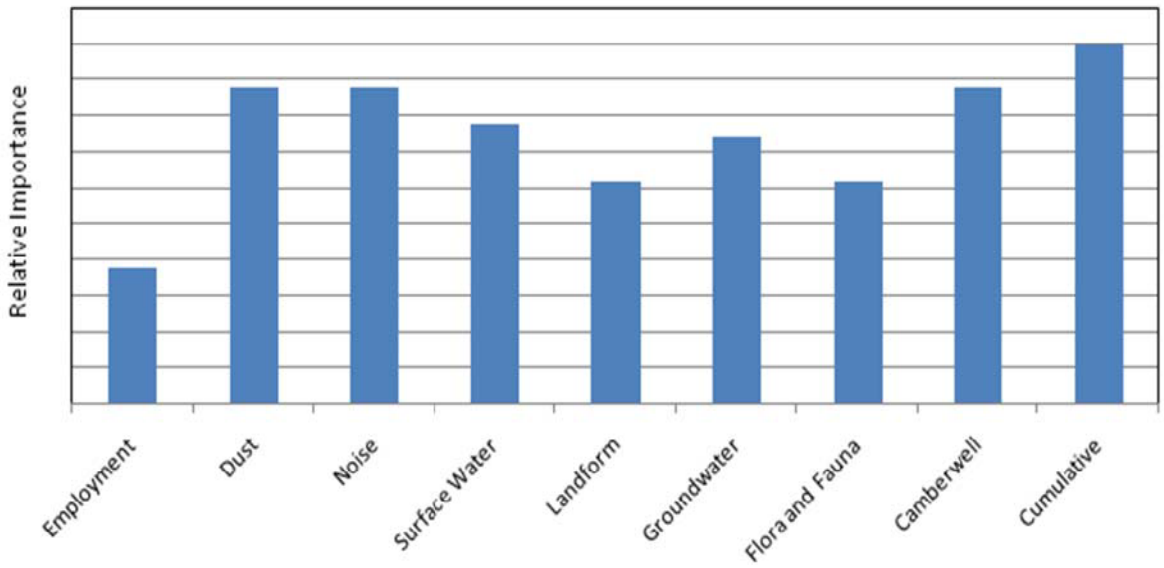


Figure 5.51: Results of survey on the SEOC project from the five (5) participants that reside within Camberwell and are not employees of ACOL.

While it is acknowledged that the sample size from the survey is relatively small, the population size being sampled is small and the results still provide a good account of the relative importance of key issues relating to the SEOC Project. The results of the 2009 survey also reflect the opinions shared by participants of the earlier 2005 and 2006 surveys which had sample sizes up to 27. The key theme being that impacts from mining are valued greater by those that are in live close to the impacts, while those that are disconnected from the impacts value their employment and other issues such as surface water impacts (that may impact their recreational activities, such as fishing) greater than impacts from noise or dust.

The following summarises the issues and themes expressed in consultation since 2005 and presented in the above figures.

Employment

Employment was the key issue raised by the wider survey group. This has a relationship to the broader survey group having employment within the mining industry. Examples of comments included:

> *"continued employment for my family and other people associated with the project, new opportunities for other local people"*
>
> *"There are no issues it will continue employing a couple of hundred people which in this day and age is a good thing"*
>
> *"it would be a shame if the pit was not approved I would loose my job"*

Cumulative Impacts

Cumulative impacts from mining were one of the key impacts raised by survey participants who reside in the Camberwell area and are not employed directly within the mining industry. This encapsulates impacts of noise, dust, blasting and other environmental impacts from a number of

mines that surround Camberwell. There were no comments relating directly to cumulative impacts but it was ranked the highest in the recent survey.

"Don't know who owns the dust, dust is from all mines 25/30 years"

"Dust is biggest problem. Accumulated dust from all sites (Camberwell)."

Dust

Dust was one of the key issues raised by Camberwell residents who are not directly employed within the mining industry. This is consistent with earlier survey results. Examples of comments include:

"Dust in pool water tank, washing, house, medical conditions from dust particulates in lungs"

"The dust is incredible no one can do anything about it"

"Dust – water tank – mud out of tank. Need to clean water tank out."

Following the 2006 survey that identified dust in water tanks as a significant issue, ACOL offered an annual tank cleaning program to all private residents within the Camberwell area and in later years extended to ACOL rental properties. Water filters and first flush devices have been offered to private residence since the commencement of the ACP and has been reoffered during the annual tank cleaning program for those residents who had not already taken up the offer.

There are however some comments from residents in the Camberwell area that suggest they do not see dust as a huge issue;

"No real complaints – as much or more dust coming from unsealed road."

"Not a big problem with dust and noise."

There has been recent media attention in relation to dust and in particular the effect it may have on health and current respiratory problems.

Noise

There were also concerns raised in relation to noise. This was ranked equal to dust, there were however few direct comments in relation to noise. Night time noise seemed to be the biggest concern. There were also comments that highway was also an issue for the village and that it was often noisier than current mining operations.

Loss of Camberwell as a village

Concern in relation to this issue was ranked in the 2009 survey by Camberwell residents as being equal to dust and noise. Some comments;

"Ashton buying the entire village and letting it go to ruin like Ravensworth and then mining what's left?"

"We don't want it to become like Ravensworth and Warkworth"

Sense of Community

A changing sense of community has been raised throughout consultation undertaken for a number of years. Rather than this issue being raised in the recent surveys in relation to impacts from the proposed SEOC it has been something identified that has already occurred;

"Loss of community",

"Most of our friend have moved on"

"Use to have lots of weekend get-to-gethers at each others places"

There is also another level to this where remaining residents do not want to move on.

> *"The people (friends) who have lived here forever like me and refuse to move cause why should we?"*

Other issues

Other issues that were raised during the survey included the following:

- Proposed 24 hour operating time for the SEOC project.
- Night lighting along conveyor and on out of pit emplacement.
- Visual impacts.
- Apparent lack of acceptance by government agencies and long term Camberwell residents of the opinions and issues of people renting within the village.

5.26.7 Maintaining Camberwell Village

The potential loss of another village from the Singleton local government area is one of the most significant issues identified in consultation with residents within the Camberwell area and also the broader local community. Similar concerns have been raised by Singleton Councillors and Council officers with the issue also being publicised in the local newspaper and media. This concern has been recognised by ACOL within the current project proposal and ACOL strongly believe that Camberwell will be able to be maintained beyond mining in the area. A review of neighbouring mining operations indicates that mining will be at its closest to Camberwell in the next three to five years then progressively move away. ACOL believe that during this time the village can be sustained albeit predominantly company owned with rental tenancy.

Supporting this belief is that ACOL has already acquired dwellings and vacant land in and around the village of Camberwell consistent with its undertakings associated with the ACP. The properties under the ownership of ACOL are rented. There is currently a "waiting list" for dwellings within the village of Camberwell as the weekly rental (on average) is less than that for a similar dwelling within the Singleton rental market. The dwellings provide low cost housing in a very competitive housing market sector.

As the coal resources in and around Camberwell are extracted and the mining impacts retreat the rural-residential lifestyle will be enhanced. ACOL following cessation of mining will divest its interests in dwellings and land. The continuing occupancy and maintenance of dwellings will assist ACOL in recouping their investment at the cessation of mining.

The investment in the dwellings' ongoing maintenance and occupancy of the dwellings will assist in sustaining the village of Camberwell. It should be noted that from an economic viewpoint ACOL have a financial interest as a significant landholder in ensuring that Camberwell is maintained beyond mining, as the value of acquired dwellings and land in Camberwell will be greater on the relinquishment post-mining in a rural residential context if it is well maintained and an attractive location to live.

5.26.7.1 Vision for Camberwell Village

Land use within and around the village of Camberwell is controlled generally by the provisions of Singleton Local Environmental Plan 1996.

On 21 April 2008 Singleton Council resolved to prepare a city wide local environmental plan to replace the existing planning instrument. This new local environmental plan will utilise the Singleton Land Use Strategy document that was adopted at the same meeting.

The Singleton Land Use Strategy identifies where growth and change is expected to occur within the local government area, land use planning objectives and strategies to guide growth and change. The

importance of coal mining to Singleton's social and economic framework is clearly identified within the document.

The village of Camberwell and the SEOC project are located in the "rural west" sector of the LGA. According to the Singleton Land Use Strategy this area is characterised by a "stable population, with considerable open cut mining activity and associated land use change and environmental impact". The strategy recommends that the current controls contained in Singleton Local Environmental Plan 1996 be maintained and that there is no significant development potential due to coal mining impacts.

The EA within *Section 3* and *Section 5.26* document consultation undertaken with local residents, landholders and the Singleton Council, this consultation has assisted in the formation of ACOL's vision for Camberwell and provides a good starting point to develop a strategy to maintain and enhance the village post mining.

Some respondents during consultation indicated a preference to leave the village in its current state and form, while others identified improvements to Camberwell Village such as:

- Kerb and gutter.
- Reticulated sewer.
- Reticulated water.

Further consultation with Singleton Council officers in relation to some of these suggestions was undertaken and subsequently these improvements were not considered to be justified based on the required capital expenditure and ongoing maintenance costs relative to the population. The area has not been identified by Singleton Council as an area for increased population or expansion of existing water and sewer services.

ACOL's vision for Camberwell is based on the continuing occupancy and maintenance of dwellings for that part of the village located north of the New England Highway. Community surveys undertaken in April 2009 identified the positive aspects of living in Camberwell (the people, rural lifestyle, proximity to work and Glennies Creek). The survey also sought feedback with respect to initiating a village enhancement program that potentially provides for a cycleway, walking paths, small recreation area and possibly a hall or the like and street plantings and landscaping.

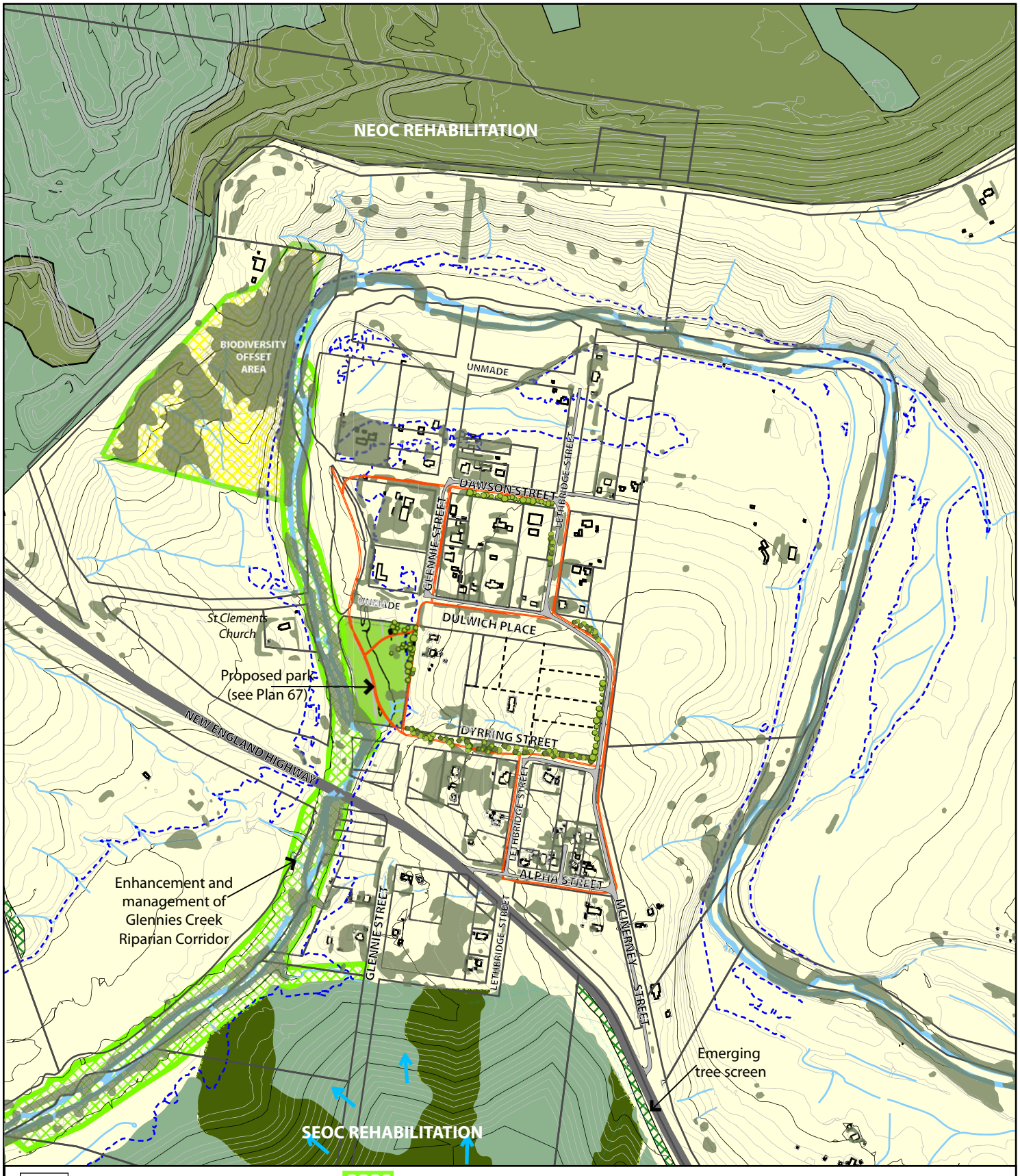
The current ACOL concept presented in this document for Camberwell is consistent with Council's adopted policy for the development of villages and existing 1(d) zoned land – viz:

> *" Maintain and enhance the distinctive character and landscape setting of existing villages;*
>
> *" Minimum lot sizes for each village are to take into account existing lots, character requirements, on - site waste water servicing requirements and separation distances from existing dwellings."*

Through consultation with Council officers the existing level of services currently supplied to Camberwell is consistent with Singleton Councils financial sustainability planning for water and sewer services, adopted policies, current population levels and impacts from coal mining. Considering this ACOL has prepared conceptual plans as illustrated in **Figure 5.52** and **Figure 5.53** for the enhancement of the village.

ACOL do not suggest that the conceptual plans presented in this EA document address all potential options for Camberwell Village – rather it is a starting point for the maintenance and enhancement for the village during and post mining, other improvements raised during consultation have included:

- Installation of acoustic barriers along the highway.
- Support for improving mobile phone coverage in the village.
- Bus shelters.



AshtonCoal

South East Open Cut Project

Concepts for an enhancement program for the village of Camberwell

Figure 5.52

Plan 66

Prepared by Wells Environmental Services

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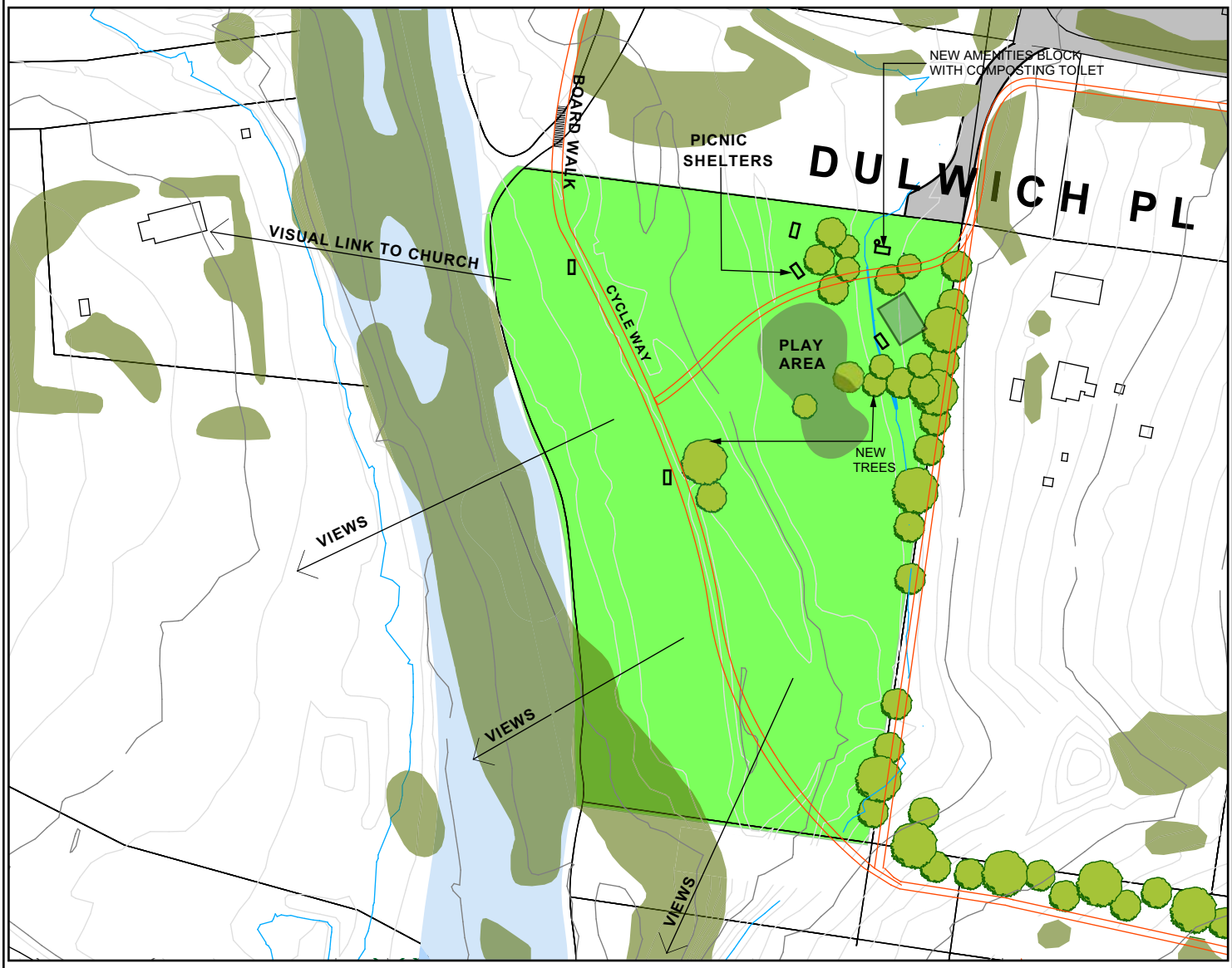

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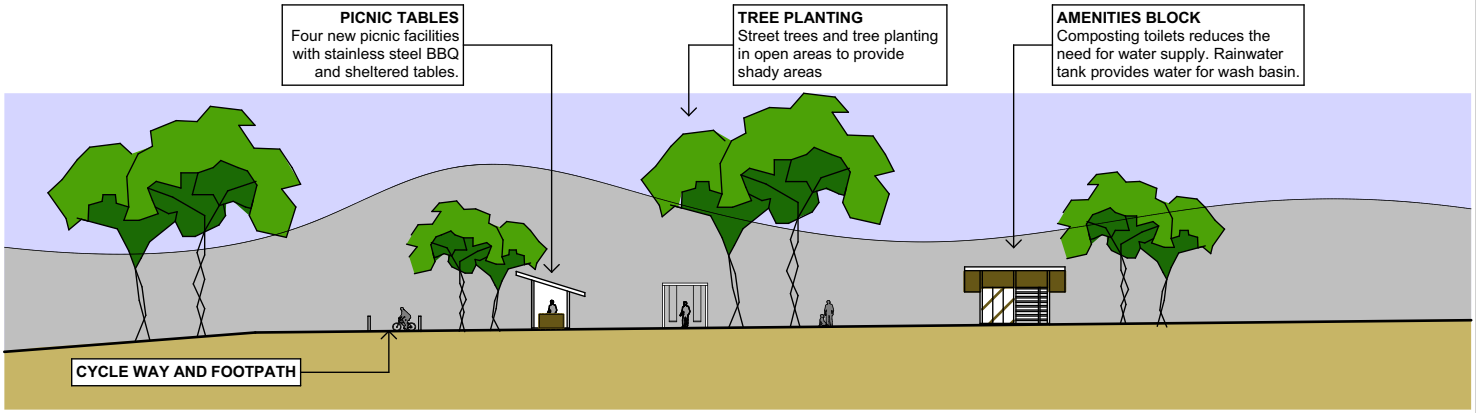

SECTION

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Prepared by Wells Environmental Services

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South East Open Cut Project

Concept plan for development of a park area in the Camberwell village

O'HANLON DESIGN PTY LTD

Plan 5.53

Plan 67

The above and other improvements where reasonable and feasible based on the receiving population and prevailing planning policies could be undertaken pursuant to the provisions of a Voluntary Planning Agreement.

ACOL's vision is for the continuation of the village as a vibrant rural residential community. ACOL is prepared to commit to and fund the enhancement of the village or other identified social – community infrastructure for the local government area and as such will enter into a Voluntary Planning Agreement with the Minister for Planning and Singleton Council.

The residents of the Singleton local government area have access to a range of services and facilities that are funded by government(s) and private organisations. The range of services include health and medical (Singleton hospital, general practitioners, dentists, pathologists, pharmacists, physiotherapist, social worker, drug and alcohol counsellor, family support, lifeline, marriage guidance),education, commercial, religion, community support services, services for the frail, aged, elderly and disable, arts – crafts groups, associations/societies, sporting organisations, recreational facilities, licensed and services clubs. These services and facilities assist in the development and well being of individuals and the Singleton community. Most of these services and facilities are located in the Singleton township which is 12 minutes by car from Camberwell.

If the project proceeds there will be no additional impact upon the existing social and or community infrastructure as the project involves the continuation of employment of personnel from the NEOC mine. The existing Ashton NEOC workforce that reside in Singleton currently use these facilities and services.

If the project does not proceed there may be additional demand upon services (government and private), such as those assisting the unemployed until such time as jobs are found for the NEOC workforce.

5.27 Summary of Air Quality and Noise Property Acquisitions

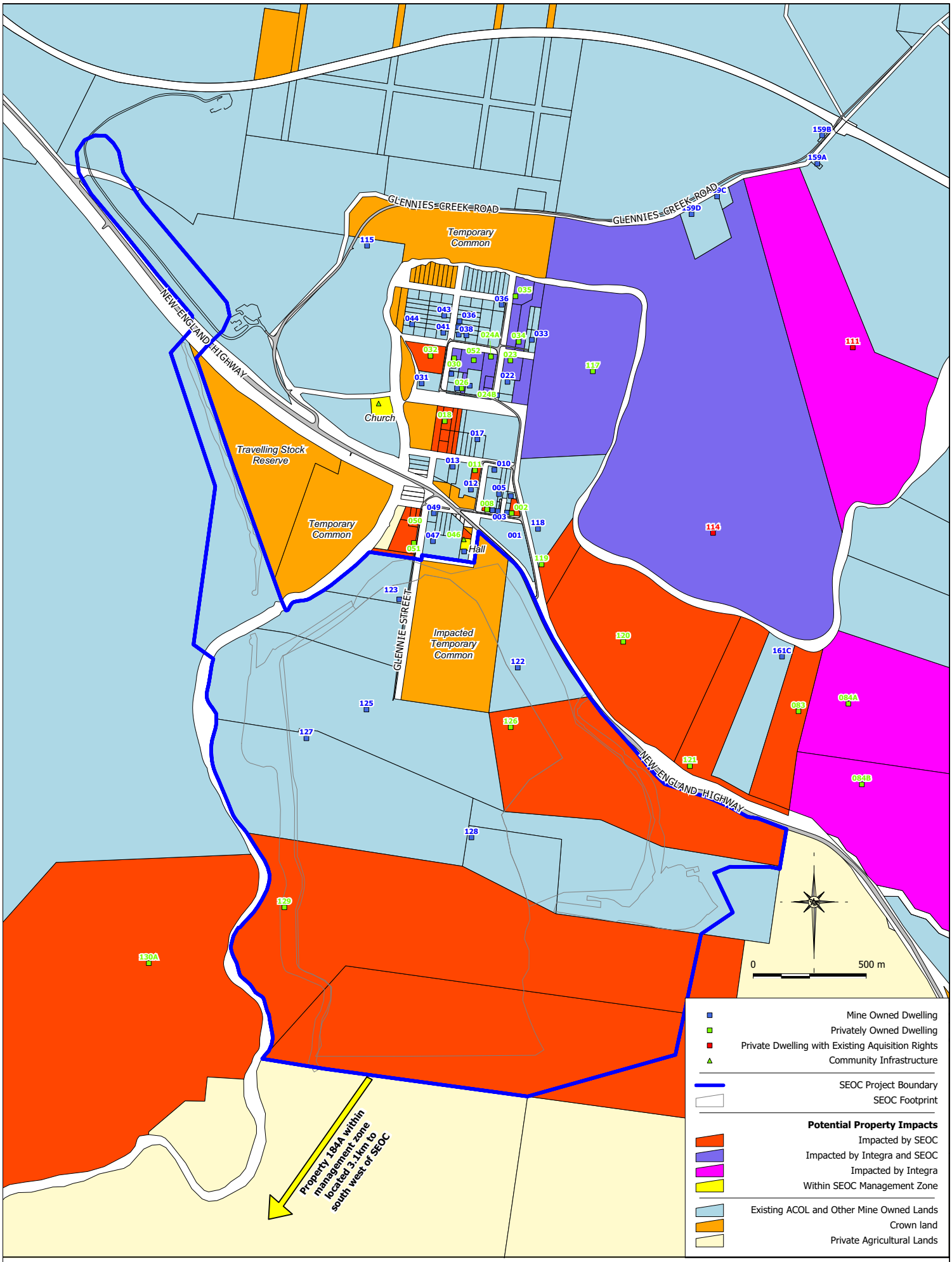
Table 5.60 provides a summary of the predicted impacts to privately owned receptors as a result of the SEOC Project and ACP Modification and the proposed Integra Open Cut Extension (08_0102).

Privately owned dwellings that are predicted to be within the SEOC Project Affectation Zone are shown in bold, this includes all privately owned dwellings within Camberwell village and immediate surrounds with the exception of properties 111 and 184A. These properties (111, 184) and St Clements Church are within a management zone. The Camberwell Community Hall is currently unused, impacts to this building will be significant and above the criteria.

Potentially impacted properties as detailed in the table below are illustrated in **Figure 5.54**.

Table 5.60: Receptors predicted to be impacted by SEOC project and Integra Open Cut Extension.

Property Number	Landowner	Impacts from the Ashton SEOC Year 1 = 2010, Year 3 = 2013, Year 5 = 2015, Year 7 = 2017					Proposed Integra Open Cut Extension (MP Number 08_0102)
		Air Quality (PM_{10})		Noise			
		24 hour ($50\mu g/m^3$)	Annual ($30\mu g/m^3$)	Management Zone		Acquisition Zone	First Year of Predicted impact above acquisition criteria Year 1 = 2009 Year 4 = 2013
		Project alone[a)]	Cumulative	1-2dB (Minor)	3-4dB (Moderate)	5dB or more (Major)	
2	Ninness	Year 1 Year 3 Year 5 -	-	-	-	Year 1 Year 3 Year 5 Year 7	-
8	Chisholm	Year 1 Year 3 Year 5 -	-	-	-	Year 1 Year 3 Year 5 Year 7	-
11	Richards	Year 1 - Year 5 -	-	-	-	Year 1 Year 3 Year 5 Year 7	-
18	Turner	-	-	-	-	Year 1 Year 3 Year 5 Year 7	-
23	Lopes	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Year 1 – A.A. PM10
024A	Vollebreght & Clarke	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Year 1 – A.A. PM10
024B	Vollebreght & Clarke	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Reference unknown
26	Schubert	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Reference unknown, assume Pty 29 values. Year 1 – A.A. PM10
30	Bennett	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Reference unknown, assume Pty 29 values. Year 1 – A.A. PM10



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South East Open Cut Project

Properties Predicted to be Impacted by Mining

Figure 5.54

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Table 5.60: Receptors predicted to be impacted by SEOC project and Integra Open Cut Extension (continued).

Property Number	Landowner	Impacts from the Ashton SEOC Year 1 = 2010, Year 3 = 2013, Year 5 = 2015, Year 7 = 2017					Proposed Integra Open Cut Extension (MP Number 08_0102)
		Air Quality (PM_{10})		Noise			
		24 hour ($50\mu g/m^3$)	Annual ($30\mu g/m^3$)	Management Zone		Acquisition Zone	First Year of Predicted impact above acquisition criteria Year 1 = 2009 Year 4 = 2013
		Project alone[a)]	Cumulative	1-2dB (Minor)	3-4dB (Moderate)	5dB or more (Major)	
32	Stapleton	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	-
34	Olofsson	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Year 1 – A.A. PM10
35	De Jong	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Year 1 – A.A. PM10
46	Camberwell Community Hall	Year 1 Year 3 Year 5 -	Year 1 - - -	-	-	Year 1	-
50	Standing	Year 1 Year 3 Year 5 -	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	-
51	Bailey	Year 1 Year 3 Year 5 -	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	-
52	Foord	-	Year 1 - - -	-	-	Year 1 Year 3 Year 5 Year 7	Year 1 – A.A. PM10
83	Hall	- Year 3 Year 5 -	-	-	-	Year 1 - - -	Year 8 – 24hr PM10 Noise
084A	Tisdell	- Year 3 - -	-	-	Year 1 - - -		Year 1 – Noise
084B[c]	Tisdell	- Year 3 Year 5 -	-	-	-		Year 1 - Noise
111	Richards	-	-	Year 1	-		Glendell / Year 1 Noise
114	Richards	-	-	- Year 3 - -	- - Year 5 -	Year 1 - - -	Glendell / Year 1 Noise
117	McInerney	-	Year 1 - - -	-	Year 3 - -	Year 1 - Year 5 Year 7	Year 1 – A.A. PM10

Property Number	Landowner	Impacts from the Ashton SEOC Year 1 = 2010, Year 3 = 2013, Year 5 = 2015, Year 7 = 2017					Proposed Integra Open Cut Extension (MP Number 08_0102)
		Air Quality (PM_{10})		Noise			
		24 hour ($50\mu g/m^3$)	Annual ($30\mu g/m^3$)	Management Zone		Acquisition Zone	First Year of Predicted impact above acquisition criteria Year 1 = 2009 Year 4 = 2013
		Project alone[a)]	Cumulative	1-2dB (Minor)	3-4dB (Moderate)	5dB or more (Major)	
119	Beasley	Year 1 Year 3 Year 5 -	Year 1 - - -	-	-	Year 1 - - -	-
120	Ernst	Year 1 Year 3 - -	Year 1 - - -	-	-	Year 1 - - -	Year 4 – A.A. PM10
121	Burgess	Year 1 Year 3 Year 5 -	Year 1 Year 3 - -	- Year 3 Year 5 -	-	Year 1 - - -	-
126	Smiles	Year 1	Year 1			Year 1	Year 4 – A.A. PM10
129	Bowman, W., M., G.	-	- Year 3 - -	-	-	Year 1 Year 3 Year 5 Year 7	-
130A	Bowman, A	- - Year 5 Year 7	- - Year 5 Year 7	-	-	Year 1 Year 3 Year 5 Year 7	-
130B	Bowman, A.	-	-	-	-	Year 1 Year 3 Year 5 Year 7	-
151 Church	Trustees of Church				Year 1	-	-
184A	Moxey	-	-	- Year 3 Year 5 -	-	-	-

Note:
a. Only includes residences where the predicted concentrations exceed the 24-hour average PM_{10} impact assessment criteria on more than five days.
b. These residences have Acquisition Right under Glendell Mine.

5.27.1 Findings of the Independent Review of Cumulative Impacts on Camberwell Village

The DGR's sought an assessment of the findings of the Independent Review of Cumulative Impact on the village of Camberwell with regard to noise and dust. At the time of preparing the EA report the findings of the Independent Review of Cumulative Impacts on Camberwell village have not been publicly released.

5.28 Rehabilitation and Future Land Use

This section describes the rehabilitation and revegetation proposed for the SEOC in order to offset the impacts of the project while improving the long term biodiversity values of the area.

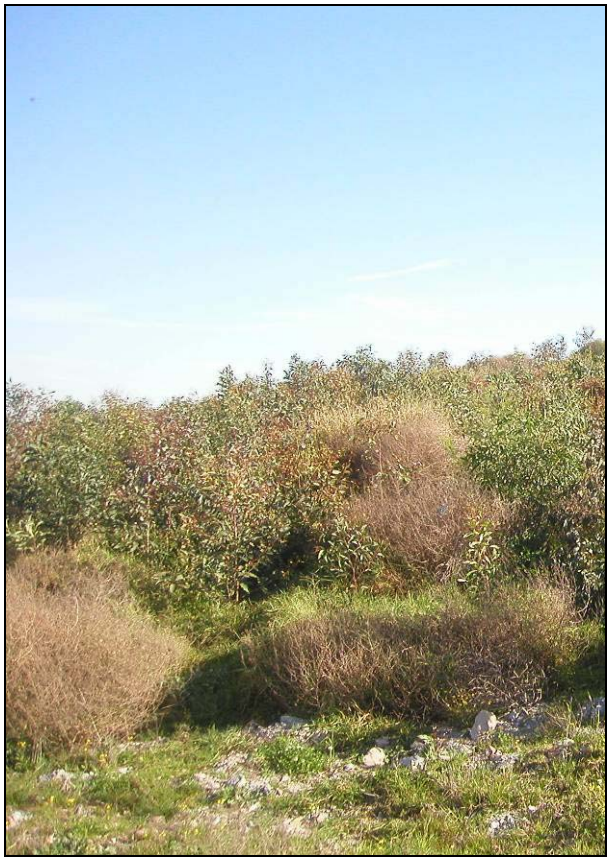
5.28.1 Rehabilitation Experience at the NEOC

ACOL has gained valuable experience from rehabilitation activities at the NEOC, through trials of different cover-crops, and seed mixes and soil ameliorants aimed at improving native vegetation growth and reducing weeds.

The use of organic soil ameliorants has proved to be productive as a substitute for traditional fertilisers and additives. In particular ACOL has been trialling the use of Organic Growth Medium (OGM) at the NEOC, a renewable resource composed of municipal solid waste and commercial waste generated by Global Renewables Ltd (GRL). The OGM product is certified under AS4454 for Composts and Soil Conditioners and has New South Wales Department of Primary Industries CA05 certification for phylloxera.

Due to the success of soil ameliorants within the NEOC rehabilitation areas it is proposed to continue the use of various organic soil ameliorants within the rehabilitation of the SEOC.

Photographs 5.9 and **5.10** illustrates the some of the rehabilitation undertaken within the NEOC.



Photographs 5.9 and 5.10: Example of woodland (left) and pasture grassland (right) revegetation occurring within the NEOC.

5.28.2 Rehabilitation of the South East Open Cut

Rehabilitation of the SEOC will utilise experience gained from the rehabilitation of the NEOC. Knowledge of local conditions will be invaluable in future rehabilitation activities.

The rehabilitation objectives are to:

- Achieve a stable landform that is capable of supporting self-sustaining ecosystems consisting of pastures and woodland consisting of locally endemic native trees and shrubs;
- Minimise wind and water erosion potential;
- Establish habitat corridors
- Minimise visual impact on the community.

Rehabilitation of mined areas will occur progressively over the life of the project.

The conceptual design of the rehabilitation for the SEOC has been based on the following:

- The rapid establishment of rehabilitation areas on the northern face of the environmental bund and out of pit emplacement.
- Creation of a varied landscape through the incorporation of grasses and trees along drainage lines. With the incorporation of undulations consistent with natural landscapes within the dump design.
- Initial establishment of grass on slopes to provide rapid binding of soil.
- Trees to be established along the ridge tops and drainage lines to promote diversity in the landscape.
- Trees around the final void slopes to reduce visual prominence.

Both understorey and canopy tree species will be planted to encourage the natural characteristics and storeys of a native ecosystem. The timbered areas of the SEOC rehabilitation have been shaped to promote connectivity across the site, and to improve visual appearance of the northern overburden face.

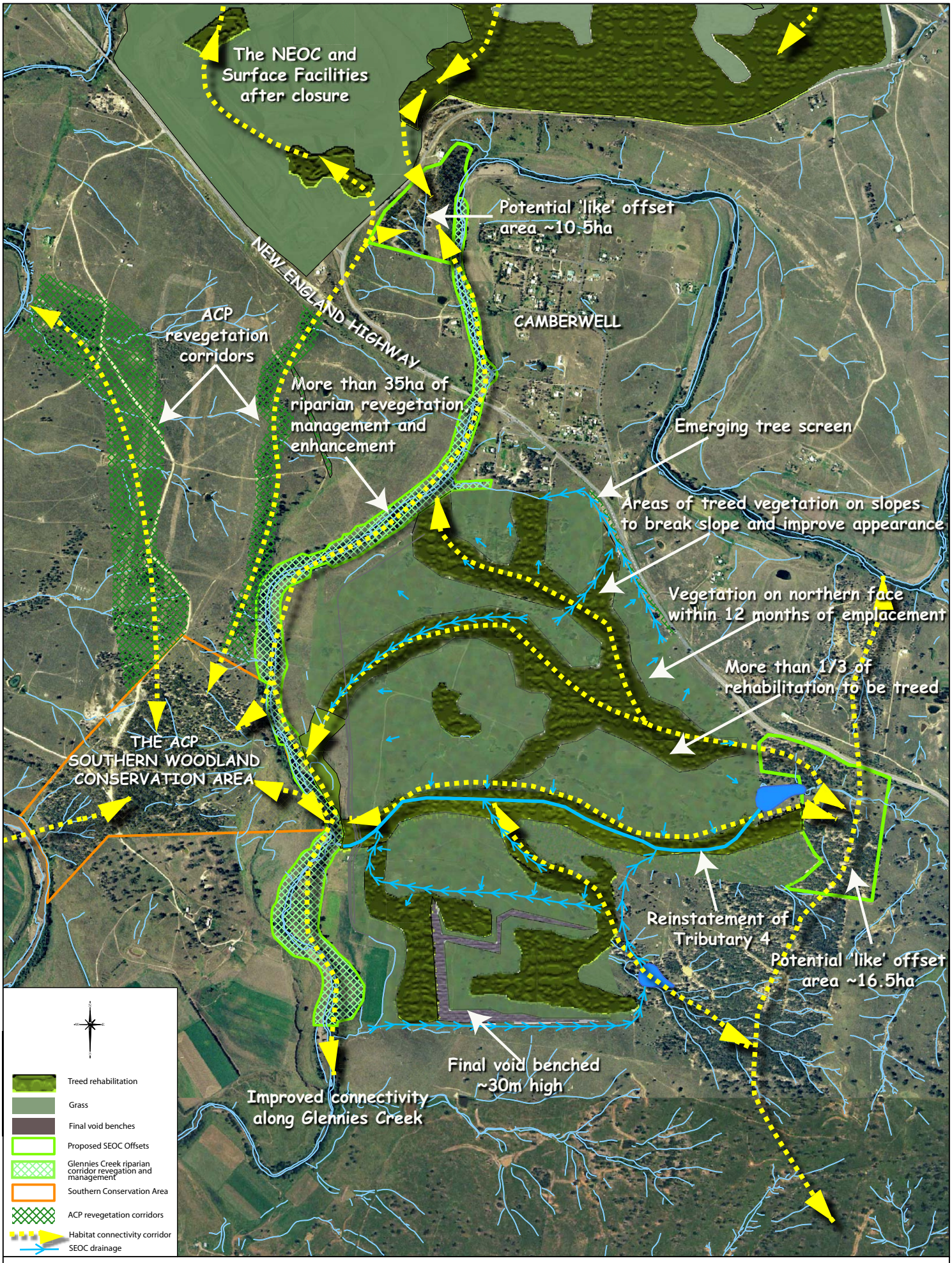
Based on the conceptual revegetation strategy it is estimated that approximately 125ha or more than one third of the rehabilitated land will consist of treed vegetation, 25ha of which will be riparian rehabilitation along Tributary 4 and the other tributaries. The remaining areas will consist of pasture grasses.

Linkage between remnant vegetation and areas of rehabilitation will also be undertaken as discussed below to help reduce fragmentation of natural bushland. Management of the rehabilitation in the SEOC will be addressed through the integration of the SEOC with the existing ACP Landscape and Revegetation Plan.

As detailed in Section 4, ACOL are currently participating in an Australian Coal Association Research Project (ACARP) that utilises a software package to establish final landforms that mimic the surrounding topography while taking into consideration the material types and natural erosion processes. The focus of the research will be developing an appropriate model for implementation on the SEOC landform.

The use of these software packages on the SEOC will provide ideal opportunities for research that aims to improve industry practices through the creation of final landforms that are more natural and nonlinear, avoiding “typical” rehabilitation techniques that can include benching and almost flat surfaces with linear drains and drop structures.

Figure 5.55 illustrates the proposed rehabilitation structure for the SEOC.



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Conceptual final landuse and offset strategy proposed for the SEOC Project area and the ACP at completion of longwall mining

Figure 5.55

Plan 69

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CAD FILE: WES

5.28.3 Rehabilitation Stages

5.28.3.1 Landform Shaping

Bulk landform shaping will be undertaken progressively as the mine develops. The rehabilitation staging will initially be focused on establishing vegetation on the northern face of the environmental bund and out of pit emplacement within 12 months of its emplacement.

Rehabilitation will continue to the south as shaping of the final landform. Each rehabilitation zone has a final dump shape which will be specifically defined and set out in the MOP. These fundamental specifications must be met before further rehabilitation works can continue.

5.28.3.2 Drainage Design

As detailed above ACOL are currently evolved with an ACARP project aim to enhance standard rehabilitation landform design eliminating the need for contour drains and drop structures which concentrate flows. Contingent on the success of the trial this approach would be adopted within the drainage design of the SEOC area. In the event that the ACARP project does not provide confident in this new approach, contour drains and rock drop structures will be constructed in accordance detailed designs undertaken by a suitable qualified engineer. These designs will be detailed within the site MOP.

5.28.3.3 Soil Amelioration

Soil investigations undertaken for the SEOC area have identified the prevailing soil types and their characteristics for the disturbance area. *Section 5.14.6.2* provides an overview of the limitations for each soil type identified, with *Table 5.40* identifying potential soil ameliorants relevant to the soils to be encountered.

Gypsum Application

Gypsum improves the physical structure of the soil reducing the likelihood of slaking and dispersion. Trials are currently being undertaken in the NEOC area with the use of organic soil ameliorants as a substitute to standard gypsum application. This approach will continue within the SEOC. Should soil testing however within the SEOC area show that additional gypsum is required, gypsum will be applied to topsoil at rates determined by soil testing.

5.28.3.4 Deep Ripping

All rehabilitation areas will be deep ripped to a depth of 600 mm for the purposes of relieving compaction. The ripping should be undertaken with a bulldozer (or other suitable equipment) and rip lines should closely follow the contour.

5.28.3.5 Rock Raking / Removal

Rock raking will be undertaken on all rehabilitated areas will have large rocks greater than 500 mm in diameter removed from the land surface. Rocks will be either buried within the spoil structure or may be left in groups on the surface as habitat.

5.28.3.6 Topsoil Re-spreading

Topsoil will only be re-spread on final landforms designated as supporting future pasture. Topsoil will be re-spread at a minimum depth of 100 mm. Topsoil re-spreading operations will not be undertaken when the material is excessively dry or wet.

5.28.3.7 Habitat establishment

The addition of natural items (such as rocks, stags and hollow logs) in the rehabilitated area will be used to provide shelter and nesting places for native fauna and encourage the fauna back into the rehabilitated areas.

5.28.3.8 Pasture Seed Mix

The pasture mix may vary depending on the planting season and required species composition, for the existing NEOC, **Table 5.61** details the most successful pasture mix used to date, this will be utilised for the SEOC.

As stated above trials are currently being undertaken in the NEOC area with the use of organic soil ameliorants as a substitute to standard fertiliser application. This approach will continue within the SEOC. Should soil testing however within the SEOC area show that additional fertiliser is required, Granulock 15 fertiliser (or equivalent) will be applied at a rate of determined by the results of soil testing. All legume species should be inoculated and lime pelleted by the seed supplier.

Table 5.61: Proposed pasture species mix.

Common Name	Taxonomic Name
Rye Corn	
Wimmera rye grass	*Lolium rigidum*
Perennial rye grass	*Lolium perenne*
(Aurora) Lucerne	*Medicago sativa*
Namoi (Woolly Pod) Vetch	*Vicia villosa spp. dasycarpa*
Kikuyu	*Pennisetum clandestinum*
Green Couch	*Cynodon dactylon*
Haifa White Clover	
Rhodes Grass	

5.28.3.9 Native Tree Seed Mix

To minimise the competition effects of weeds from topsoil, experience at the NEOC has indicated that the tree seed mix is most successfully applied to overburden or subsoil areas. A cover crop is also applied to provide rapid stabilisation of the soils while the tree species become established. **Table 5.62** details the current native tree seed mix used at the NEOC, this seed mix is considered to be consistent with vegetation communities in the SEOC area.

Table 5.62: Native tree seed species mix.

Common Name	Taxonomic Name
Rough-barked Apple	*Angophora floribunda*
Bull Oak	*Allocasuarina leuhmanii*
River Oak	*Casuarina cunninghamiana*
Swamp Oak	*Casuarina glauca*
Gorse Bitter Pea	*Daviesia ulicifolia*
False Sarsaparilla	*Hardenbergia violaceae*
Fan Wattle	*Acacia amblygona*
Western Golden Wattle	*Acacia decora*
Black Wattle	*Acacia decurrens*
Silver-stemmed Wattle	*Acacia parvipinnula*
Spotted Gum	*Corymbia maculata*
Blakely's Red Gum	*Eucalyptus blakelyi*
River Red Gum	*Eucayptus camaldulensis*
Narrow-leaved Iron Bark	*Eucalyptus crebra*
Red Ironbark	*Eucalyptus fibrosa*
Yellow Box	*Eucalyptus melliodora*
Grey Box	*Eucalyptus moluccana*
Grey Gum	*Eucalyptus punctata*

Common Name	Taxonomic Name
Forest Red Gum	*Eucalyptus tereticornis*
Hickory Wattle	*Acacia Implexa*
Cover Crop	
Rye Corn	
Namoi (Woolly Pod) Vetch	*Vicia villosa spp. dasycarpa*
Haifa White Clover	

Note: *Acacia* spp. seed will require pre-treatment prior to use. This commonly involves seed coat scarification and heating to break the thick seed coats. Further details about tree seed treatment should be sought from the supplier prior to purchase.

5.28.3.10 Rehabilitation Maintenance

Rehabilitation areas will be monitored on an annual basis as outlined in *Section 5.29.3.11* (below). Should issues be identified monitoring may be increased. Should monitoring indicate an issue maintenance works will be undertaken to address the concern identified. This may include the re-application of topsoil, re-seeding, re-planting, weed control, additional fertiliser or ameliorant application, repair to drainage works and regrading of eroded areas.

5.28.3.11 Monitoring and Reporting

Completion Criteria Assessment

While ACOL does not currently have a formalised list of completion criteria, this will need to be developed to allow relinquishment of rehabilitated areas in the future. We propose to adopt the generic set of completion criteria established by Owen Nichols in the ACARP completion criteria study. To facilitate the monitoring of the rehabilitation we propose to establish a set of domains where monitoring will be conducted.

The completion criteria assessed will include:

- Establishment of a monitoring transects (similar to those described by Nichols, in *Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on Coal Mines in the Hunter Valley,* 2005), the plots will be marked and GPS coordinates taken.
- The monitoring plot includes:
  - A 50m erosion monitoring transect on the contour running through the centre line of the plot.
  - Five 2m x 2m quadrats.
  - One 20m x 10m plot overlying the 2m quadrats and located 5m either side of the centreline.

Landscape Function Analysis

It is proposed that the rehabilitation will be monitored by Landscape Function Analysis (LFA). This involves monitoring the resources of an area. It also uses transect but are oriented in the down slope direction as resources are generally water driven.

LFA assesses 11 indicators, one directly defines the soil type and ten (10) are assessed parameters. These are:

1. Soil Cover (area of soil that is protected from rain splash erosion).
2. Perennial grass butt cover and canopy cover of trees and shrubs (contribution from plant roots to soil nutrients).
3. Litter cover (availability of litter for decomposition and nutrient cycling).
4. Soil surface crust broken-ness (crust materials available for erosion).
5. Lichen and moss cover (contribution to soil stability and nutrients).
6. Forms of erosion (nature and severity of loss of soil material).
7. Loose and mobile material (amount of material moving about).
8. Surface nature (information for erosion assessment).

9. Surface roughness (relates to capture of seed and water).
10. Slake test (soil stability during rain).

From the recorded indicators, the LFA spreadsheets will be utilised to determine sustainability indexes including:

- Stability Index.
- Infiltration Index.
- Nutrient Cycling Index.

These will be plotted, and over time all measured completion criteria and LFA indices will help establish the success of rehabilitation or provide information on what corrective action is required to achieve progression towards sustainable rehabilitation.

The efforts and progress of rehabilitation will be documented in the Annual Environmental Management Report (AEMR).

5.28.4 Offsets and Revegetation

To offset impacts associated with the SEOC it is proposed establish an offset package in consultation with the DECC and the DoP for the clearing of approximately 24.7ha of native vegetation and impacts to 4.3ha of vegetation if Option 1 is used.

The management and offset package will include:

- Revegetation of open cut operations with suitable species for a mix of grasslands and woodlands (refer to Section 5.28.2).
- Offset and manage 62 hectares of 'like' vegetation (for a ratio of 2.5:1 for cleared vegetation) in the local area within 3 years of Project Approval.
- As detailed with *5.16.4.3,* to offset the clearing of the 24.7ha of native vegetation (Central Hunter Ironbark-Spotted Gum-Grey Box Forest) within the footprint of the mining operations it is proposed to offset to areas of like vegetation that provide strategic corridors for habitat connectivity in the broader landscape.
- Two areas have been identified for potential conservation and offset comprising approximately 27.5ha of Central Hunter Ironbark-Spotted Gum-Grey Box Forest similar or better to that to be cleared as part of the SEOC, therefore an additional 34.5ha would be required to satisfy the 2.5:1 ratio. The location of these is illustrated in Figure 5.55.
- Implement vegetation management for the offset areas (refer to Section 5.16.4.3).
- Offset the loss of hollows with replacement of 3 nest boxes/hollows for each hollow removed.
- Enhance and manage the Glennies Creek riparian corridor consisting of approximately 35ha to improve linkages between the SEOC, Southern Woodland and other proposed offset areas, refer to *Section 5.16.4.2*, including.
- Revegetation as required that includes locally occurring species such as River Oak (*Casuarina cunninghamiana subsp. cunninghamiana*), River Red Gum (*Eucalyptus camaldulensis*), Rough-barked Apple (*Angophora floribunda*) and Forest Red Gum (*Eucalyptus tereticornis*).
- Weed and pest management.
- Erosion control.

5.28.5 Future Land Use

The SEOC and other mining projects recently announced will act as a catalyst in establishing long term future land uses in and around Camberwell village. The proponent has a vision for that part of the village located north of the New England Highway, and has made commitments with respect to retaining housing stock and embellishing the amenity of the area to ensure it can continue as a village whilst mining occurs and long after coal resources have been extracted. The proponent is the

majority land owner within Camberwell village and has a vested interest to ensure that its investment in housing and land within the village is maintained and enhanced.

The part of the SEOC project that will be directly impacted contains a mix of arable cropping land along Glennies Creek and low intensity livestock grazing for agricultural purposes. In addition the riparian corridors either side of Glennies Creek and unnamed tributaries will be enhanced with river red gum assemblages and plantings together with the more elevated sections of the final landform.

The land use associated with the final landform will be a mix of agriculture (not indifferent to existing) and improvements to the area's long term ecological and biodiversity values as shown by Figure 5.55 The long term land use will be consistent with prevailing government policy and relevant environmental planning instruments and policies.

5.28.6 Connectivity

The proposed rehabilitation, revegetation and offset areas have been developed with consideration of strategies, policies, and neighbouring developments to improve connectivity across the wider landscape. **Figure 5.56** illustrates offset areas and rehabilitation proposed at the existing ACP, Mt Owen, Ravensworth East, Glendell coal mine, and HVO coal mines (sourced from the respective recent Environmental Assessment Reports). The Integra Complex and Narama mines have not been included as they are outside the dominant north – south trending connectivity provided by those that have been mapped. Notwithstanding their exclusion from Figure 5.56, the aerial photography illustrates the potential connectivity to these mines through existing vegetation and riparian corridors.

5.28.6.1 Great Eastern Ranges Initiative

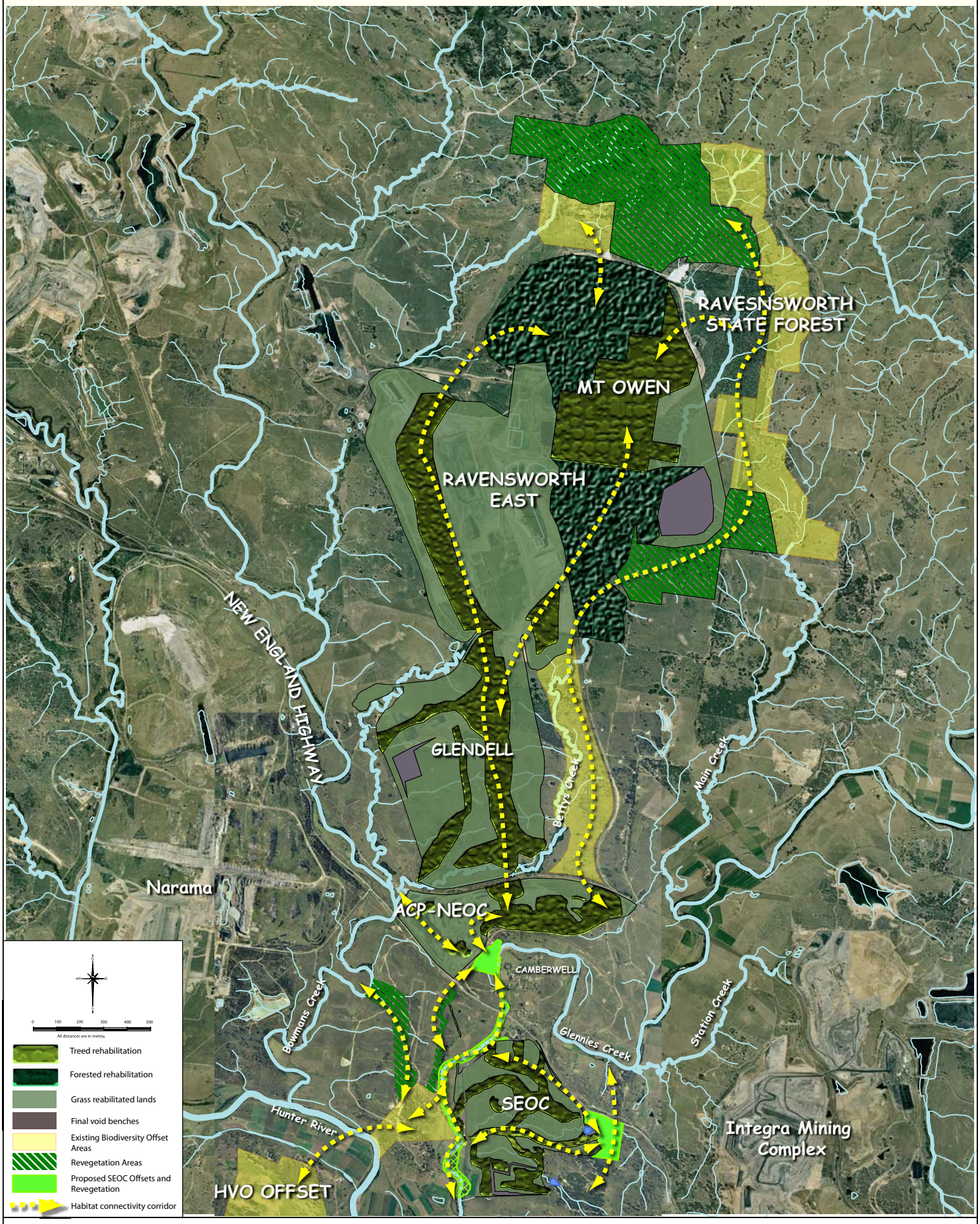
The Great Eastern Ranges (GER) Initiative (formerly the Alps to Atherton Initiative) is a conservation program that aims to connect and conserve ecosystems along the great eastern ranges of Australia from the Alps north of Melbourne in Victoria to the Atherton Tablelands west of Cairns in Queensland. It is a strategic response to climate change and other threats and seeks to maintain and improve the environment to help maintain the health of native flora and fauna, and people. The NSW Environmental Trust manages the 1,200-kilometre section of the GER Initiative in NSW,

The Hunter Valley is identified within the initiative as a priority area due to the limited connectivity across the valley floor. The SEOC project will improve connectivity in a north-south direction within this priority area.

5.28.6.2 Synoptic Plan

In 1999 the *Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW*, was developed by the Department of Mineral Resources (now DII) in conjunction with the NSW Minerals Council, Singleton and Muswellbrook Councils, Department of Land and Water Conservation (now DECCW) and NSW State Forests.

The purpose of the study is to provide a basis for development of a long term integrated strategy for the rehabilitation of mines, the study developed two snapshots of mine development and rehabilitation, one for 1998 and another for 2020 based on current approvals. The 2020 plan is conceptual and proposes opportunities for revegetation across the Hunter coalfield in an integrated approach that considers biodiversity. **Figure 5.57** has been adapted from the 2020 plan to illustrate how the ACP and SEOC integrate with the conceptual plan undertaken in 1999. As can be seen by the Figure 5.53 the revegetation and rehabilitation of the SEOC and ACP will improve connectivity in the local mining landscape in a south westerly direction toward the southern ranges of the Hunter Valley. The proposed rehabilitation is consistent with the concepts promoted within the Synoptic Plan by linking riparian corridors, both along the creek an up the slopes to existing vegetation, linking existing offsets and proposed rehabilitation of the ACP, Glendell and HVO South.



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South East Open Cut Project

Connectivity corridors in the wider post mining landscape incorporating the SEOC Project

Figure 5.56

Plan 70

Prepared by Wells Environmental Services

CAD FILE: WES

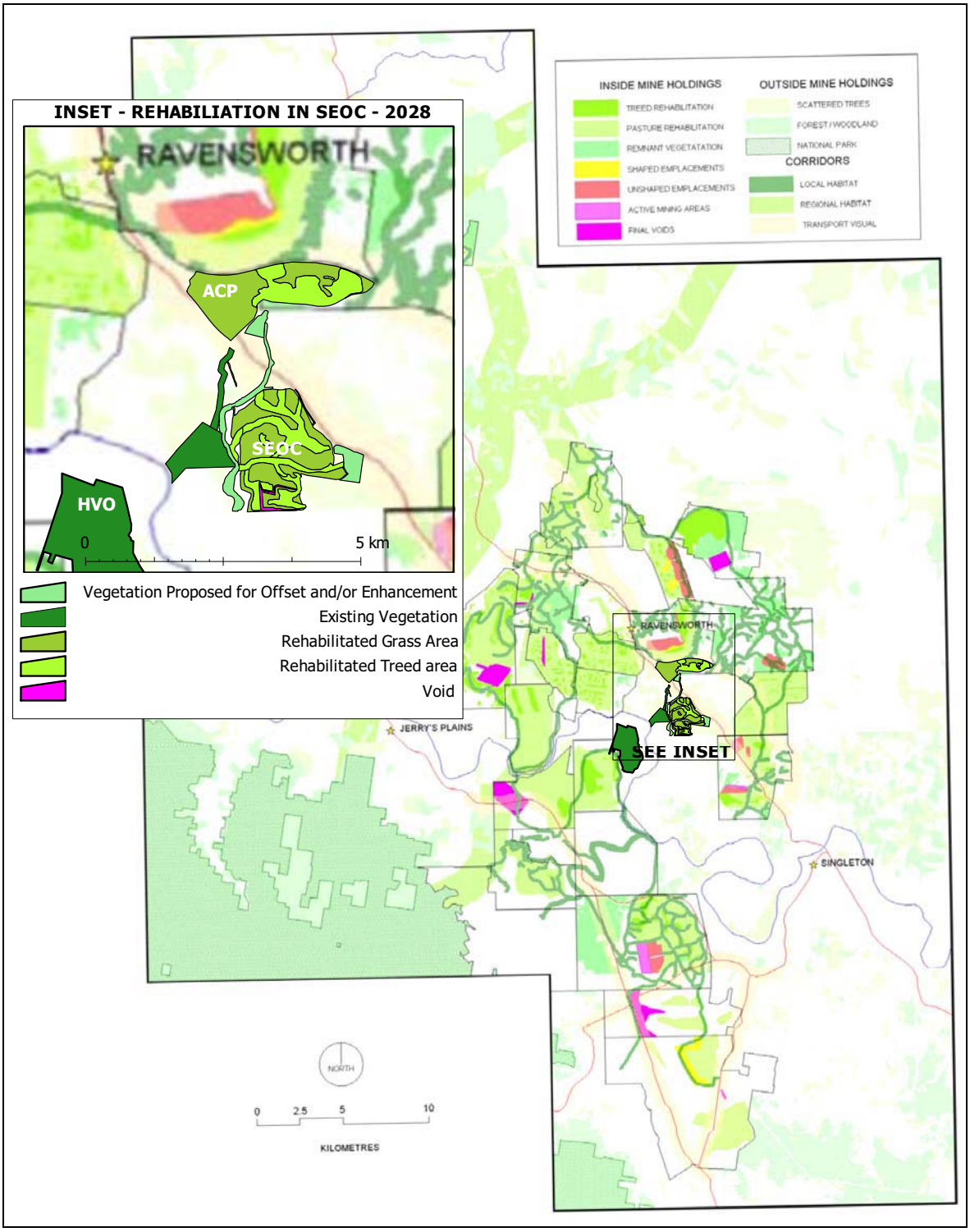

Figure 5.57: The SEOC Project final landform (~2028) in the context of the 2020 connectivity snapshot from the 1999 Synoptic Plan.

5.29 Mine Closure

The SEOC project is expected to have a mining life of approximately 7 years (i.e. 2017), following mining it is proposed to utilize the final void for the storage of tailings from the ACP Underground. On completion of the underground mine in 2023, the tailings storage area will require several years of drying before the void storage area can be capped and vegetated, meaning complete closure of the site in by 2028. A mining schedule for the SEOC and ACP Underground is provided within Figure 4.22 or Plan 24 in Volume 2. This time frame is obviously dependant on the rate of mining in the underground, where a lower mining rate will result in a later final mine closure.

Mine closure is required to take into consideration the principles and objectives for mine closure specified within the ANZEC MCA document *Strategic Framework for Mine Closure*, 2000.

A Mine Closure Plan will be developed at 2 years prior to the completion of mining in the SEOC for approval by the DII and DoP to ensure adequate planning is undertaken for the final void. Developing complete mine closure plans prior to commencement of mining in the SEOC does not allow for the adequate consideration of the site specific limitations and changing requirements that may be identified during mining. The key objectives (from *Strategic Framework for Mine Closure*, 2000) of the Mine Closure Plan will be:

- Protection of the environment and public health and safety by using safe and responsible closure practices.
- To reduce or eliminate environmental effects once the mine ceases operations.
- To establish conditions which are consistent with the pre-determined end land use objectives.
- To reduce the need for long-term monitoring and maintenance by establishing effective physical and chemical stability of disturbed areas.

Table 5.63 details the principles and objectives of the *Strategic Framework for Mine Closure*, 2000 with the preliminary consideration of these relative to the closure of the SEOC.

Table 5.63: Consideration of the objectives and principles for mine closure.

Principle	Objectives	Consideration
STAKEHOLDER INVOLVEMENT *To enable all stakeholders to have their interests considered during the mine closure process.*	1. **Identification** of stakeholders and interested parties is an important part of the closure process. 2. **Effective consultation** is an inclusive process which encompasses all parties and should occur throughout the life of the mine. 3. A **targeted communication strategy** should reflect the needs of the stakeholder groups and interested parties. 4. **Adequate resources** should be allocated to ensure the effectiveness of the consultation process. 5. Wherever practical, **work with communities** to manage the potential impacts of mine closure.	Key stakeholders in the SEOC mine closure are likely to include: • ACOL and its employees, contractors and shareholders. • Government Agencies including; DoP, DII, DECCW. • Singleton Council. • The Camberwell Community and landowners neighbouring the SEOC. ACOL has been active in discussing the future plans for the ACP and SEOC with the above stakeholders and wider community by distributing and discussing issues through the CCC, newsletters, information days and one-on-one consultation, refer to *Section 3* for further detail including the results of a survey on the expected final landform for the SEOC. The EA process provides for consultation with the above stakeholders and the wider community and organisations during the exhibition period, these stakeholders are provided an opportunity to make comment on a range of issues including mine closure. One of the core needs and objectives of the development of the SEOC is to delay impacts associated with the loss of employment and associated economic impacts to those families and the wider community from the completion of the existing NEOC.
PLANNING *To ensure the process of closure occurs in an*	1. Mine closure should be **integral** to the whole of mine life plan. 2. A **risk-based approach** to	*Section 4* provides a description of the SEOC project including conceptual mine plans for both the life of mining and the use of the final void, outlining the conceptual closure plans for the

Principle	Objectives	Consideration
orderly, cost-effective and timely manner.	planning should reduce both cost and uncertainty. 3. **Closure plans** should be developed to reflect the status of the project or operation. 4. **Closure planning** is required to ensure that closure is technically, economically and socially feasible. 5. The dynamic nature of closure planning requires **regular and critical review** to reflect changing circumstances.	SEOC. *Figure 4.22 / Plan 24* provides a conceptual timeframe for the life of the project taking into consideration factors such as the time required for settlement of overburden in order to establish an effective tributary through the mine spoil and for the tailings to dry prior to capping. An essential component of this closure is the utilisation of the final void for 6 to 7 years after mining that ensures the effective closure of the SEOC through the economic importance of the securities held by the DII. As discussed above ACOL propose to develop a Mine Closure Plan for the SEOC at least 2 years prior to the anticipated completion of mining (i.e. ~ 2015), this allows for technical experience gained during mining at the SEOC to be applied in mine closure reflecting the local conditions and requirements at that time. Once prepared the Mine Closure Plan will be regularly reviewed against milestones to assess the progress toward mine closure and adapt unexpected circumstances. Integral to the mine closure will be the effective rehabilitation of the landform to a final land use of low intensity agriculture and open woodland to improve habitat corridors (refer to *Section 5.28*). The rehabilitation of the SEOC will be managed through the integration of the SEOC with the existing ACP Landscape and Revegetation Plan.
FINANCIAL PROVISION *To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability.*	1. A **cost estimate** for closure should be developed from the closure plan. 2. Closure costs should be **reviewed regularly** to reflect changing circumstances. 3. The **financial provision** for closure should reflect the real cost. 4. **Accepted accounting standards** should be the basis for the financial provision. 5. **Adequate securities** should protect the community from closure liabilities.	In the development of the Mine Operations Plan (MOP) and prior to the granting of the mining lease, ACOL will be required to estimate the anticipated costs of rehabilitation based on DII guidelines and submit this to the DII for approval. The estimation must consider the Government's full costs in undertaking rehabilitation in the event of default by the titleholder. The DII will consider the estimation in determining a security deposit to be held by the government ensuring the State (and community) is not left with a financial liability.
IMPLEMENTATION *To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan.*	1. The **accountability** for resourcing and implementing the closure plan should be clearly identified. 2. **Adequate resources** must be provided to assure conformance with the closure plan. 3. The **on-going management** and monitoring requirements after closure should be assessed and adequately provided for. 4. A closure **business plan** *provides the basis for implementing the Closure Plan.* 5. The **implementation** of the Closure Plan should reflect the status of the operation.	The holding of a security deposit by the government provides a ACOL and its shareholders with a financial incentive for the progressive rehabilitation of the site, with the DII the partial release the deposit based on the progress achieved in rehabilitation. The Mine Closure Plan will be required to ensure that accountability for aspects of mine closure are assigned, resources provided, on-going management and monitoring provided, and a business plan that incorporates these to ensure the effective implantation of mine closure. As discussed above the use of the final void following the mining of the SEOC, and the security bond provide security for the Government to ensure that the rehabilitation is successful.
STANDARDS	1. **Legislation** should provide a broad regulatory framework for the	The Mine Closure Plan will be developed with due consideration of the prevailing and relevant legalisation, policies, guidelines

Principle	Objectives	Consideration
To establish a set of indicators which will demonstrate the successful completion of the closure process.	closure process. 2. It is in the interest of all stakeholders to develop **standards** that are both acceptable and achievable. 3. **Completion criteria** are specific to the mine being closed, and should reflect its unique set of environmental, social and economic circumstances. 4. An agreed set of **indicators** should be developed to demonstrate successful rehabilitation of a site. 5. **Targeted research** will assist both government and industry in making better and more informed decisions.	and plans to the mine closure at the time of the plan development. *Section 5* and the specialist reports describe various measures to assess and monitor the performance of the SEOC mining operations during mining, these measures will be considered in the development of a comprehensive set of sign-off criteria established in the Landscape and Revegetation Management Plan and Mine Closure Plan. The conceptual key environmental indicators to demonstrate successful rehabilitation will include: • A stable landform, free draining landform. • A final landform that incorporates undulations and variation in the topography. • Established vegetation across the site consisting of both pastures and open woodland that indicates a status that is trending toward a self-sustaining nature. • Tributary 4 and the other minor reconstructed drains are stable and provide habitat similar or better to existing habitat. • Water quality from the rehabilitated lands and Tributary 4 is generally commensurate with existing water qualities found in these drainages. • A final void with stable battered/ benched highwalls incorporating surface diversion drains and adequately capped reject storage. As detailed in *Section 4*, ACOL are currently participating in an Australian Coal Association Research Project (ACARP) that utilises software packages to establish final landforms that mimic the surrounding topography while taking into consideration the material types and natural erosion processes. The focus of the research will be developing an appropriate model for implementation on the SEOC landform. The use of these software packages on the SEOC will provide ideal opportunities for research that aims to improve industry practices through the creation of final landforms that are more natural and nonlinear, avoiding "typical" rehabilitation techniques that can include benching and almost flat surfaces with linear drains and drop structures.
RELINQUISHMENT *To reach a point where the company has met agreed completion criteria to the satisfaction of the Responsible Authority.*	1. A **Responsible Authority** should be identified and held accountable to make the final decision on accepting closure 2. Once the completion criteria have been met, the company may **relinquish** their interest. 3. **Records** of the history of a closed site should be preserved to facilitate future land use planning.	ACOL aim to, through the development of management and monitoring plans, mine closure plans and consultation with key stakeholders relinquish the SEOC site in a condition that is accepted by the DoP and DII that requires not endanger public health and safety and allows the use of land as described for low intensity grazing and enhancement of local biodiversity. The SEOC site will be relinquished in a condition that does not require ongoing maintenance above that would be otherwise expected as part of responsible land management. Records of the rehabilitation and mine closure undertaken will be maintained by ACOL, the Singleton Council and the relevant Government Agencies, in particular the DII. The use of the land in the future will be required to be undertaken in accordance with the relevant environmental planning instruments prevailing at that time, taking into account the limitations that may apply to the site.

5.30 Impacts and Management

The SEOC will result in positive and negative impacts. The project will impact Camberwell village, air quality, noise, water resources, flora and fauna, Aboriginal heritage and the visual amenity in the vicinity of the SEOC. However the project balances these impacts with positive benefits gained from the economic benefits at local, state and federal levels, retention of employment for 160 people and other indirect employment, the proposed enhancement program for the village of Camberwell together with the proposed mitigation and offset strategy to improve ecological connectivity across the landscape.

The ACP Modification will result in minor changes to air quality and noise associated with the increased coal processing. The modification will result in increased demand for water when mining and processing at peak production rates, this demand will be met through existing water supplies, new licences or a reduction in the production or processing rates.

ACOL has designed the project to where feasible avoid impacts. Where impacts are unavoidable ACOL are committed to minimising, managing and offsetting impacts to reduce the short, medium and long term effects of the South East Open Cut.

These measures detailed within Sections 3, 4 and 5 have been amalgamated to form the basis of ACOL's Statement of Commitments detailed within Section 6.

The management of the SEOC will be undertaken through the integration of the SEOC with existing management plans, or where relevant the creation of a new SEOC management plan.