# Glennies Creek Colliery
# Longwalls 10 to 17
# Environmental Assessment

## Glennies Creek Colliery
## Longwalls 10 to 17
## Part 3A

Environmental Assessment

for Integra Coal Operations Pty Ltd

September 2007

0047481

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INTEGRA COAL

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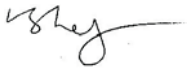
ERM

| | |
|---|---|
| **Project Manager:** | *Joanne Woodhouse* |
| **Signed:** |  |
| **Date:** | *19 September 2007* |
| **Partner:** | *Mike Shelly* |
| **Signed:** |  |
| **Date:** | *19 September 2007* |

*Environmental Resources Management Australia Pty Ltd Quality System*

# Glennies Creek Colliery
# Longwalls 10 to 17
# Part 3A

Environmental Assessment

for the
Integra Coal Operations Pty Ltd

September 2007

Project No. 0047481

**SUBMISSION OF ENVIRONMENTAL ASSESSMENT REPORT**

PREPARED UNDER THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 - SECTION 75


| | | |
|---|---|---|
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**PROPOSED DEVELOPMENT** Continuation of longwall mining at Glennies Creek Colliery

**PROJECT APPLICATION**

Applicant Name: Integra Coal Operations Pty Ltd

Applicant Address: Lot 6 Enterprise Crescent, Singleton

Land to be developed:

**ENVIRONMENTAL ASSESSMENT** An environmental assessment report is attached.

**CERTIFICATE**

I certify that I have prepared the contents of this EA and to the best of my knowledge

- *it is in accordance with Section 75 of the EP&A Act and the Director General's Requirements;*
- *it contains all available information that is relevant to the environmental assessment of the development to which this statement relates; and*
- *it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.*

| | | | |
|---|---|---|---|
| Name: | Mike Shelly | Name: | Joanne Woodhouse |
| Signature: |  | Signature: |  |
| Date: | 19 September 2007 | Date: | 19 September 2007 |

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# *EXECUTIVE SUMMARY*

## *INTRODUCTION*

*This Environmental Assessment (EA) has been prepared by Environmental Resources Management Australia Pty Ltd (ERM), on behalf of Integra Coal Operations Pty Ltd, under Part 3A of the Environmental Planning and Assessment Act 1979 to accompany an application to the Minister for Planning for project approval for continuation of mining at the underground mine at Glennies Creek Colliery, New South Wales.*

*The EA report describes the project, outlines relevant statutory provisions, identifies the key issues and comprehensively assesses the potential environmental impacts of the proposal. It also describes a range of monitoring and control measures proposed to ensure that the short term impacts of the project are minimised.*

## *PROJECT DESCRIPTION*

*Glennies Creek Coal Management Pty Ltd (GCCM) is proposing to mine Longwalls 10 to 17 within the Middle Liddell seam at its Glennies Creek Colliery (GCC). This application applies to approximately 600ha wholly within CL382, and specifically the proposed Longwalls 10 to 17 and associated first workings in the Middle Liddell seam, including mains and gateroad development. The existing mains or access ways, conveyors and handling facilities established to enable the mining of Longwalls 1 to 9, will continue to be used to provide underground access for employees and materials to the Project Area, and for the transportation of coal extracted within the Project Area to the mine portal area in ML1437*

*The proposal includes first workings and secondary extraction of up to 15.58 Mt of run of mine coal (ROM) over approximately five years at an annualised rate of up to 4.5Mt. Mining within the Project Area requires only minimal surface infrastructure (gas drainage boreholes) and will not involve an increase in production rate or variation to mining methods.*

## *PROJECT LOCATION*

*GCC is located in the Hunter Valley Coalfield of the Sydney Basin, approximately 12km north-west of Singleton, within the Singleton Local Government Area. The majority of surface land within the Project Area is owned by subsidiaries of the mining company Xstrata, including Glendell Tenements Pty Ltd, Savage Minerals Ltd & Enex Foydel Ltd, Enex Ravensworth Pty Ltd and Xstrata Mount Owen (XMO). WE and AM Gardner own 2.2ha of land within the Project Area overlying Longwall 9. The operating Mount Owen Mine, Ravensworth East Mine and the approved but yet to be commenced Glendell Mine (all currently owned by Xstrata) are in the vicinity of the Project Area.*

*Xstrata has approval to develop an open cut (the Eastern Rail Pit) over an area of approximately 200 hectares within the Project Area by open cut methods. It is anticipated that open cut mining of Eastern Rail Pit will have significantly changed the existing environment in the area of that pit before GCC commences second workings, ie longwall extraction of the coal seam. Consequently, it has been assumed that the existing environment in the area of the Eastern Rail Pit, including Bettys Creek, vegetation and some archaeological features, will be significantly altered by the time mining commences in Longwall 10.*

### *PROJECT ACTIVITIES*

*First workings will be developed using continuous miners to extend the North-West Mains and to progressively develop the Northern Mains and the gateroads that delineate the individual longwall panels. Shuttle cars will transport the coal from the continuous miners to the conveyor system. As is the case in the existing underground workings, the mains and gateroads will provide for personnel and material movement, and mine ventilation.*

*Secondary extraction of the coal seam will use retreating longwall methods. Longwalls 10 to 17 will be proposed to be approximately 246m wide (rib to rib) and range in length from 472m (Longwall 17) to 2555m (Longwall 10) long. The full Middle Liddell seam will be extracted. Longwall extraction is the preferred method of secondary extraction as it has a proven history of safety and provides greater production and economic efficiencies than other methods.*

*In accordance with existing practices and approvals, up to 4.5 Mtpa of ROM coal will be trucked along a private haul road from GCC to the nearby Camberwell Coal Mine coal handling and preparation plant (CHPP or washery) facilities. From the CHPP, the washed product coal will be transported to the Port of Newcastle by rail.*

*Gas levels in the GCC underground workings necessitate the use of gas drainage boreholes. Disturbance associated with each gas borehole will be minimal (approximately 8m by 8m) and at any one time there will only be three or four boreholes operational. Once each borehole is no longer required, the infrastructure will be removed, and the area rehabilitated. Once the approved Envirogen (Oaky) Pty Ltd gas powered electricity generation plant (currently under construction) is operational (projected for August 2007), and, subject to access agreements between Envirogen and the individual landowners, it is envisaged that the gas produced from the boreholes will be reticulated to that plant rather than venting to the atmosphere.*

### *STAKEHOLDER CONSULTATION*

*Extensive consultation was undertaken between October 2005 and January 2007 during the development of the Subsidence Management Plan (SMP) for Longwalls 10 to 17, and addressed all aspects relevant to this 3A application, other than gas drainage boreholes. Additional follow-up consultation with the relevant Departments and key stakeholders as outlined within the Director-General's requirements was undertaken in October 2006.*

*The Guidelines for Best Practice Community Consultation in the New South Wales Mining and Extractive Industries (MCMPR, 2005) were applied during the consultation process. As well as this initial consultation, GCCM proposes that there will be regular subsidence management and consultation meetings with stakeholders during the mining of Longwalls 10 to 17. The stakeholders involved, and the frequency of these meetings, will be determined by the progress of subsidence and actual and predicted impacts on surface and sub-surface features.*

## *IMPACTS*

### *Subsidence*

*Assessments indicate that a maximum 1.6m of subsidence may occur over the Project Area. Maximum systematic tilt of 12mm/m, maximum strains of 6mm/m in tension and 9mm/m in compression have been predicted.*

*The existing program of subsidence monitoring will be extended to include the Project Area in order to develop a better understanding of the dynamic subsidence behaviour at GCC. The monitoring of subsidence impacts on surface features will comprise three phases, starting with pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment. This will be followed by monitoring during mining within predicted subsidence impact zones to ensure the implementation of subsidence impact management processes. Finally, post-mining monitoring will establish that no further subsidence impacts are likely and to allow the completion of subsidence impact management processes.*

### *Mining Infrastructure*

*The Ravensworth East Open Cut extends into the very north-western corner of the Project Area, but does not extend over the Longwall 17 goaf. The subsidence impacts on the Ravensworth East Open Cut are likely to be insignificant and imperceptible for all practical purposes because it is largely outside the Project Area.*

*Development of the Ravensworth East Mine has included the excavation of two shallow box cuts (tailings pits) up to 35m below the surface. Mining in the southern pit was completed in May 2005 and it has been partially backfilled. This pit is located within the north-western portion of the Project Area, over Longwalls 15 to 17, although its final use has not been confirmed. If this pit is filled with tailings, the critical impacts from subsidence are likely to be differential vertical subsidence with the potential for tailings to overtop perimeter embankments. These impacts, if they occur, would appear capable of being managed through control of the tailings level and building up perimeter bunds to reflect the projected vertical subsidence. XMO will be responsible to manage any subsidence-related impacts on the tailings pit. In this regard, GCCM will cooperate with XMO/Xstrata by providing them with relevant monitoring data to enable them to develop their plans and appropriate management strategies.*

*The approved but as yet undeveloped Glendell Open Cut is located outside of the Project Area on the western side of Bettys Creek. The latest Glendell "Application to carry out Open Cut Mining Operation", dated February 1998, which expired in 2004, shows an overburden dump overlying Longwalls 14, 15 and 16. This has been confirmed through consultation with Xstrata representatives. It is understood that XMO is currently seeking a modification of the development consent and are proposing to commence works in late 2007.*

*Glendell has accepted liability for subsidence-induced damage which might be caused to its overburden dump under the terms of a Mining Purposes Lease Application (MPLA) Agreement with Maitland Main Collieries (MMC) dated 13 February 1996. Managing and repairing any subsidence damage to the overburden dump is therefore the responsibility of Glendell.*

*The Mt Owen Eastern Rail Pit is located above Longwalls 13 to 16. Overburden from the initial mining area of the Eastern Rail Pit will be placed within the West Dump. The current understanding based on the Mt Owen EIS (2003), the latest Mt Owen Mine Operations Plan (MOP) dated January 2006 and ongoing consultation between XMO and GCCM, is that work on the Eastern Rail Pit commenced in August 2006 and is expected to be completed in March 2007. By comparison, extraction of Longwall 13 is projected to commence mid 2010. GCCM has prepared a subsidence management plan for the Eastern Rail Pit, on the basis of consultation with Xstrata, which was submitted as part of the GCC SMP. GCCM will receive and consider any technical comments from Xstrata on that management plan and, if considered appropriate, may seek amendment of the management plan to give effect to those comments.*

*The Eastern Rail Pit requires Bettys Creek to be diverted prior to mining. Excavation of the pit, construction of the dump and the three stage stream diversion has commenced and will significantly affect Bettys Creek through removal and filling of the natural channel. The XMO/Xstrata developments over Bettys Creek will overwhelm any adverse changes that may occur from subsidence over Longwalls 13 to 16. Whilst the creek bed over Longwalls 10 to 13 will not be directly mined by XMO/Xstrata, open cut mining and the associated stream diversion will cause downstream changes in creek flow, sediment transport and stream water quality.*

*Approximately five kilometres of the Mt Owen Rail Spur traverses the Project Area. The Rail Spur, which is owned by XMO/Xstrata and operated by Thiess, is used to transport coal from the Mt Owen Mine to Newcastle. GCCM is in the process of preparing a specific management plan for the Mt Owen Rail Spur for Longwalls 10 to 17, in cooperation with Xstrata, which will be submitted to the Department of Primary Industries (DPI). GCCM will assist this process wherever possible. As was the case for the approved Rail Line Management Plan submitted to DPI in relation to Longwalls 7 to 9, the specific Rail Line Management Plan for Longwalls 10 to 17 will contain a series of Action Plans. These Action Plans will include detailed monitoring and mitigation measures in accordance with the Rail Safety Act 2002 (RS Act).*

***Surface Water***

*The proposed Mt. Owen operations and the diversion of the upper catchment of Bettys Creek into Main Creek will substantially reduce Bettys Creek flows across the Project Area prior to being undermined. Stage 1 and Stage 2 diversion of flows will be in constructed channels around the West Dump and Eastern Rail Pit, discharging back into Bettys Creek downstream of the Eastern Rail Pit. Stage 3 diversion will divert flows around Pit C from Bettys Creek to Main Creek by the end of 2007.*

*On the presumption that the proposed Bettys Creek diversion schedule is achieved, the diversion will be unaffected by subsidence for approximately 3.5 years after its construction. Throughout this period, the stability and operation of the channel can be monitored and appropriate management and mitigation measures developed.*

*If adverse effects on Bettys Creek due to subsidence are observed, the creek and/or diversion will be rehabilitated to an appropriate standard to return the creek, diversion channel and floodplain to a similar state as existed prior to subsidence. This may include, but is not limited to, draining ponded areas, re-establishing drainage paths or diverting surface water flows from areas of potential ponding. Based on the predicted impacts as a consequence of subsidence, no specific mitigation measures are proposed for either the Bettys Creek main channel or floodplain.*

*Should water begin to pond in an area outside of the creek, GCCM will carry out temporary or permanent earthworks to allow the water to drain away. If earthworks are not possible within a short time frame, eg due to legislative requirements or access restrictions, a strategy of pumping water from the ponded area will be assessed by GCCM in consultation with the landowner(s).*

*Following undermining, GCCM will, in consultation with the relevant landowner, remediate any dam that is damaged by subsidence (or has its storage capacity reduced by more than 10 percent) to a condition similar to that prior to subsidence. Should water be lost from a dam to the extent that livestock are impacted, an alternative water supply will be provided by GCCM, in consultation with the landowner.*

*Both clean and dirty surface runoff within the combined Camberwell operations/ Glennies Creek surface facilities and portal areas, and any dirty water pumped from the underground workings is managed through the existing integrated Glennies Creek / Camberwell water management system, a system which has evolved to reflect to physical, operational and management links between both operations. The system design has been based on maintaining a balance between the total containment of all dirty water inflows and direct rainfall and evaporation losses and water exports in coal, as well as export to neighbouring mines, other than Camberwell, whenever possible. The existing on-site mine water management system, including mine water storage, clean and dirty water separation, clean water release and runoff control will continue and will service any operations associated with the underground mining of Longwalls 10 to 17.*

***Groundwater***

*There are no registered groundwater bores in either the alluvial or basement coal measure (bedrock) aquifers within the Project Area.*

*Groundwater quality in the coal measures is poor due to terrestrial salts. Based on monitoring data, there are no beneficial aquifers in the Project Area, with highly brackish to saline water contained in the low permeability sandstone or coal seams. It is important locally only for use in coal washeries.*

*The existing open cut mines within the locality have already had a significant impact on the local and regional groundwater. Subsidence effects on groundwater caused by the continuation of underground mining within Longwalls 10 to 17 will be significantly overshadowed as a consequence of the excavation of the 270m deep Mt Owen Open Cut, and to a lesser degree by the Ravensworth East and Mt Owen Eastern Rail Pits. Groundwater level and water quality monitoring in the GCC piezometers will enable an assessment of subsidence effects within the vicinity of Longwalls 10 to 13 prior to mining and following completion of the proposed open cuts.*

*The FEFLOW model indicates the main groundwater depressurisation will occur in the confined Middle Liddell Seam, as well as the overlying goaf and highly fractured overburden. The reduction in groundwater head depressurisation with increasing height in the stratigraphy results from the change from brittle to ductile sagging of the overburden and the resultant variation in fracture development and connection. No registered bores and wells will be observably affected by groundwater depressurization following extraction of Longwalls 10 to 17 and no observable adverse effects are anticipated on Glennies Creek, Main Creek or Bettys Creek and/or their associated alluvial groundwater systems.*

*As confirmed with the Department of Natural Resources, conventional groundwater modelling such as the FEFLOW methodologies do not integrate the ground deformations that are recognised to occur as a result of longwall mining and which are known to impact on groundwater behaviour. Consequently, these standard modelling techniques alone are not considered appropriate for use at GCC to determine the impacts of subsidence.*

*GCCM propose that numerical modelling (Dr Winton Gale approach) be undertaken for Longwalls 10 to 17 to provide a basis for integrating the various field measurements into a cohesive model which would allow the impacts of various mining geometries on subsidence and groundwater behaviour to be assessed and evaluated (SCT, 2007b). This technique, which has been found to be very successful within NSW, will be initiated prior to mining Longwall 10 and submitted to the DOP for approval.*

### *Air Quality and Greenhouse Gas*

*The proposed mining activities will not generate surface dust as this is an underground operation. Borehole drilling activities and stockpiles of extracted material will employ the existing and proven methods to minimise the generation of dust.*

*The main sources of energy used and consequent greenhouse gas emissions from the proposed continuation of mining into Longwalls 10 to 17 will include electricity consumption, methane released from coal and rock strata; and carbon dioxide, nitrous oxide and methane generated by diesel powered equipment. Australia's greenhouse gas emissions in 2004 were estimated to be 564 Mt of CO2 equivalent ($CO^2$-e) (AGO 2004), with New South Wales contributing 158 Mt ($CO^2$-e) to this total. Extending mining into Longwalls 10 to 17 could potentially contribute approximately 140 164 t ($CO^2$-e) annually from the mine resource fugitive emissions, and 39 429 t annually from associated plant and processes. Annual emissions from GCCM would therefore equate to less than 0.12% of New South Wales State emissions for 2004.*

*It is important to note that these figures assume venting from the gas drainage holes and provide an over-estimate of the greenhouse emissions, particularly given that the Envirogen Pty Ltd plant has commenced construction and will collect methane from Longwalls 10 to 17 for use in the generation of electricity.*

### *Ecology*

*Five vegetation communities have been identified within the Application Area, namely spotted gum/grey box/ironbark woodland; bull oak woodland; riparian vegetation; grassland and regenerating vegetation. None of these communities are listed as endangered and there is no critical habitat listed in the locality. No threatened flora species listed under Threatened Species Conservation (TSC) Act 1995 were recorded within the Project Area during the flora surveys in February and December 2005 and January 2006 and no potential habitat will be removed as a result of the proposed longwall mining.*

*During the 2005 survey period (ERM, 2006b), only one threatened fauna species, Pomatostomus temporalis (grey-crowned babbler), was directly observed within the site. The eastern freetail bat is also reported to occur within the Project Area, with an additional four threatened species listed in the Schedules of the TSC Act 1995 (squirrel glider, grey-headed flying-fox, brown treecreeper and speckled warbler) being recorded in the regenerating woodland within 500m to the north-east. None of these threatened species are likely to be dependent on the limited amount of resources present within the Project Area.*

*It is highly unlikely that the proposal will significantly affect current disturbance regimes. The proposal will not fragment or isolate currently interconnecting or proximate areas of habitat or reduce the areal extent of the local vegetation communities. The impacts resulting from mining Longwalls 10 to 17 are unlikely to cumulatively increase the impacts on the native vegetation and associated habitat clearance already occurring in association with existing land uses. The proposed longwall mining is therefore unlikely to significantly impact on the lifecycle, health,*

*viability or habitat resource of these threatened species such that a local extinction would occur.*

***Cultural Heritage***

*Assessments of Aboriginal and historical cultural heritage within the Application Area involved a desktop investigation, consultation with the local Aboriginal community and a field survey.*

*Overall, the Project Area is characterised by a continuous low density background scatter of Aboriginal stone artefacts, with areas of discrete artefact concentration centred along Bettys Creek. Of the 23 Aboriginal archaeological sites were identified, 14 have already been the subject of salvage excavations in accordance with Section 90 consents. The remaining nine sites, five of which are registered on the Department of Environment and Conservation (DEC) database, are all artefact sites. These are durable site types and the predicted level of subsidence is not expected to cause significant disturbance.*

*No further archaeological investigation is required for the Aboriginal sites recorded within the Project Area. Gas drainage borehole drilling and subsequent remediation works are not planned to be undertaken within these sites.*

*Previous historical heritage studies conducted in the locality identified four historical heritage sites in the Project Area. RE31 was located within the Ravensworth Mine site and consisted of a number of timber fence posts, building stumps and gate posts that were interpreted as relating to shearing facilities. This site has been destroyed by subsequent mining activity undertaken by Xstrata. MOH2, a former occupation site and MOH3, a post and rail fence line, were both recorded within the Mt Owen mine extension area and are likely to be destroyed as a result of the Mt Owen extension. The fourth site, the original line of road from Singletons Ford to Muscle Creek (now Muswellbrook) also crosses the Longwall 10 to 17 Project Area. As the remnants of this road are not visible upon inspection, and subsequent activities (ie roads, railway line, farming etc) have been carried out over its previous alignment, it has no significant heritage value.*

*Prior to the commencement of gas drainage and mining of Longwall 14, an additional inspection of sites MOH2 and MOH3 will be carried out by an archaeologist to determine whether these sites remain extant. The results of the inspection, together with refined subsidence predictions for Longwalls 14 to 17 based on actual versus predicted subsidence in the preceding longwalls, will be used to determine whether further archival recording will be necessary at these sites.*

***Noise***

*This application refers to the continuation of current mining techniques, with no requirement for additional transport or processing facilities. Operational noise from the site will therefore remain at its current level, but will persist throughout the extended period involved with mining Longwalls 10 to 17.*

*Noise from the planned gas drainage boreholes, will be limited to that from the mine gas-fuelled generator. However, with the commissioning of the approved Envirogen facility, it is likely that future use of the gas-fuelled generators will be reduced. Free venting boreholes are not a source of noise.*

*Underground mining operations result in minimal noise impacts compared to open cut methods. Adjacent mines will be operating open cut mining methods simultaneously with the Glennies Creek mining of Longwalls 10 to 17, and so the area will already be subject to industrial noise impacts. Generally, contribution from GCC underground activities is negligible.*

***Socio-economic***

*The land surrounding GCC is used for both underground and open cut mining, meaning the visual amenity of the landscape has been previously extensively disturbed. Future open cut operations are also proposed for the area, which will lead to further modifications. Additional visual impacts from the project will be minimal as all aspects apart from gas borehole infrastructure will be underground.*

*GCC forms a part of the Singleton's vital coal mining industry. GCC currently employs 170 people, with the continuation of mining guaranteeing these jobs into the future. The mine is expected to produce approximately 9.39 million tonnes of marketable coal from the mining of Longwalls 10 to 17, which will continue to contribute significantly to local, regional and state economies.*

*GCCM is committed to its acceptance as a valued member and contributor to the community within the local area, Singleton Shire and the Hunter Region and its acceptance by the community in general as a legitimate land user, and has set a number of objectives to achieve this commitment.*

***PROJECT JUSTIFICATION***

*The proposed continuation of mining into Longwalls 10 to 17 at Glennies Creek Colliery can be justified economically, environmentally and socially as it would result in the following:*

- *retention of approximately 170 employees on site, plus contractors and many more indirect jobs created through flow-on effects;*
- *maximising the use of existing infrastructure and facilities;*
- *realisation of the economic potential of 9.39 Mt of marketable coal;*
- *minimal impacts on the physical or biological environment as the majority of impacts are limited to underground;*
- *payment of significant royalties to the State of NSW; and*
- *significant benefits to the local community through employment, goods and services and local expenditure.*

# 1 INTRODUCTION

## 1.1 BACKGROUND

The Glennies Creek Colliery is located approximately 12km north of Singleton in the Hunter Valley (*Figure 1.1*) and is managed by Glennies Creek Coal Management Pty Ltd (GCCM).

The Integra Coal project was formed in August 2006 through the integration of the Glennies Creek and Camberwell joint ventures, with both GCCM and Camberwell Coal Pty Ltd, the manager for the Camberwell Open Cut, now owned by Integra Coal Operations Pty Ltd (ICO).

The participants of ICO are:

- AMCI Holdings Australia Pty Ltd (AMCI), a large privately owned international producer and trader of metallurgical coal (61.2 %) - through its subsidiary companies AMCI (GC) Pty Ltd (36 %) and Maitland Main Collieries Pty Ltd (MMC) (25.2 %);

- Toyota Tsusho, a trading arm of the Toyota group, through subsidiaries Toyota Tsusho Mining (Australia) Pty Ltd (11.2 %), Navidale Pty Ltd (14 %) and Toyota Tsusho Corporation (Australia) Pty Ltd (2.8 %);

- Nippon Steel of Japan through is subsidiary NS Glennies Creek Pty Limited (3.6%);

- POSCO, a large Korean steel maker, through its subsidiary POS-GC Pty Ltd (3.6%);

- JFE Shoji, a Japanese trading house, through its subsidiary JS Glennies Creek Pty Ltd (1.8%); and

- JFE Steel of Japan, through its subsidiary JFE Steel Australia (GC) Pty Ltd (1 %).

By agreements dated 24 February 2007, the current owners of AMCI Holdings Australia Pty Ltd have agreed to sell the company to Rio Doce Australia Pty Limited (RDA). RDA is an Australian subsidiary of CVRD, a Brazilian mining company which ranks as the second largest mining company in the world. It is anticipated that the sale will be completed in mid to late April 2007, subject to certain conditions precedent being satisfied.

Notwithstanding the formation of ICO, the ownership of the underlying mining tenements and assets in the Glennies Creek Colliery and Camberwell Open Cut did not change as a result of the Integra joint venture. However, output from each mine is contributed for the benefit of all parties.

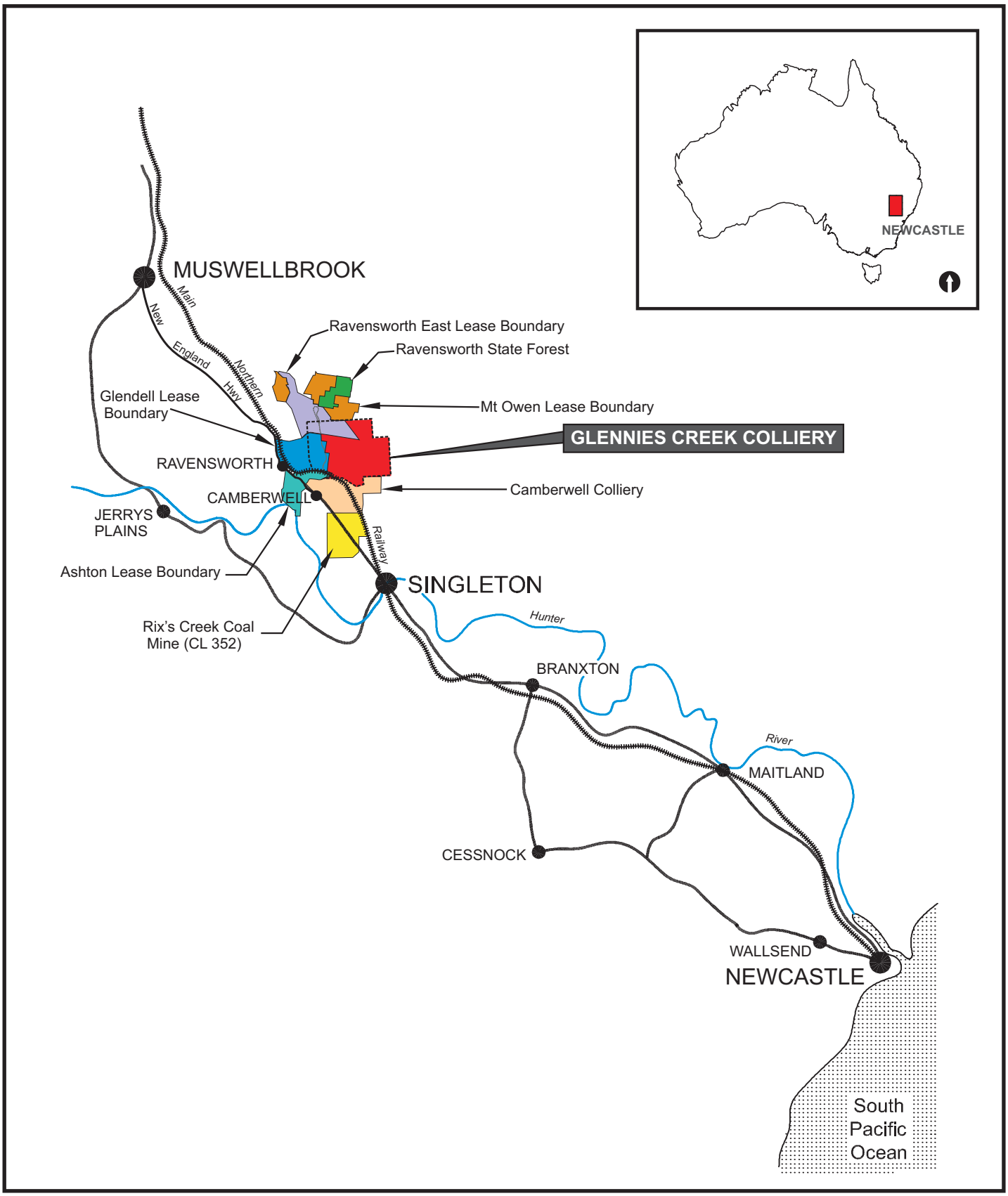


**Figure 1.1**

**Regional Setting**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_16 | | |
| Date: | 16/04/07 | Drawing size: | A4 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Integra Coal Operations Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

0 5 10 15m

Approximate Only

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Integra Coal Operations is the appointed Operator of the Glennies Creek Colliery in accordance with *Coal Mines Health and Safety Act 2002* and Coal Mines Health and Safety Regulations 2006.

The Glennies Creek Colliery (GCC) currently operates under development consents DA 105/90 (as modified) and 06-0057, which permit coal extraction from the Middle Liddell, Hebden and Barrett seams within the boundary of Coal Lease (CL) 382, and the use of the Coal Handling and Processing Plant (CHPP) and rail despatch facilities at the adjoining Camberwell Coal Mine.

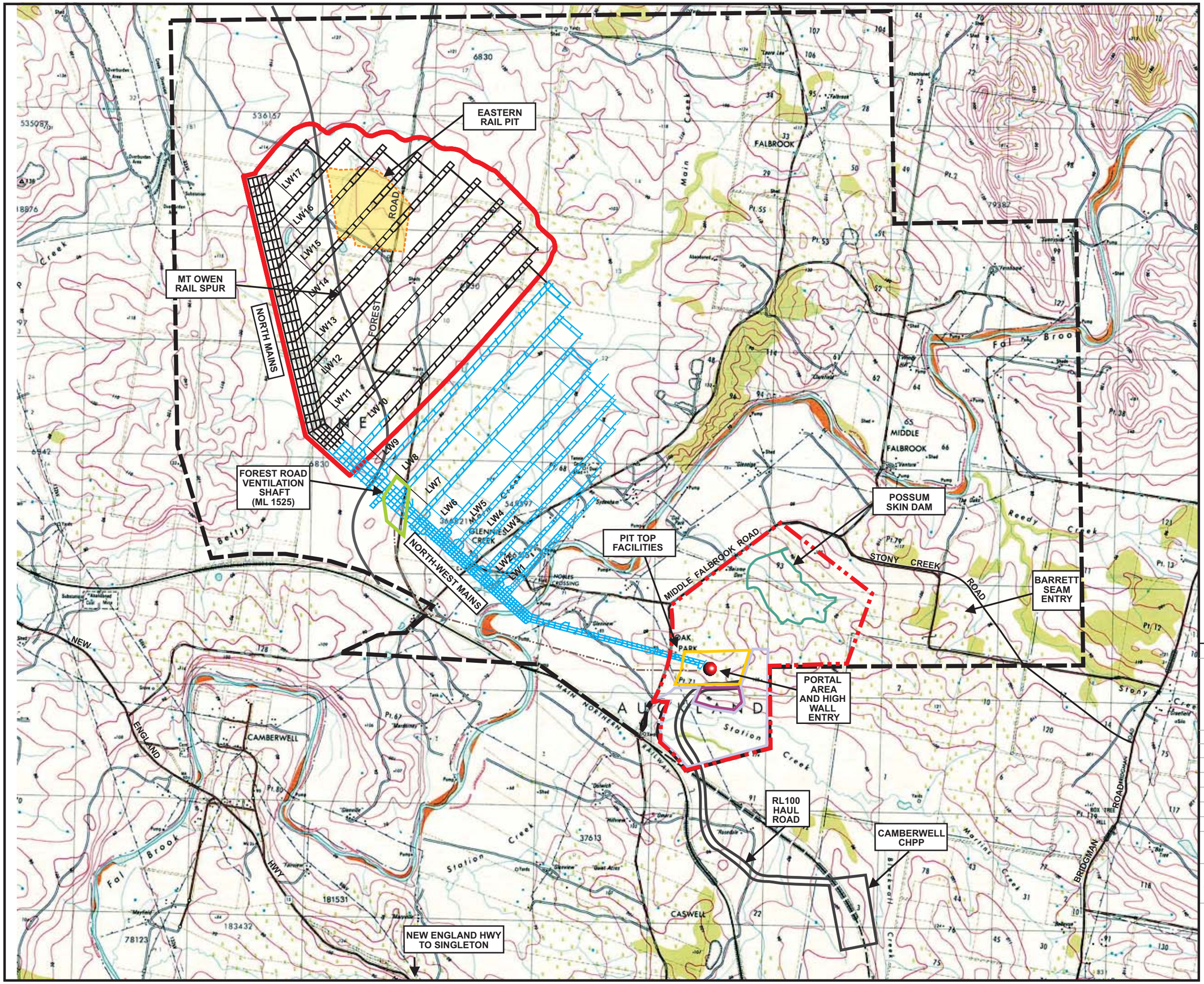
To date, mining at GCC has been confined to the Middle Liddell seam as shown on *Figure 1.2* and has involved:

- the development of the North-West Mains;
- the progressive development of the gateroads which delineate individual longwall panels;
- the completion of Longwall 1 to Longwall 6 extraction; and
- partial extraction of Longwall 7.

Each of these operations have followed receipt of S138 approvals under the *Coal Mine Regulations Act, 1982*. GCCM obtained Subsidence Management Plan (SMP) and S138 approvals for extraction of Longwalls 7 to 9 within the Middle Liddell seam in March and April 2006 respectively. Following completion of mining in Longwall 9, GCCM propose to progress coal extraction to Longwalls 10 to 17 within the Middle Liddell seam.

Mining within the Project Area requires only minimal surface infrastructure (gas drainage boreholes) and will not involve an increase in production rate or variation to mining methods.

The remaining underground operations, including future extraction of the Hebden and Barrett seams, are approved activities under the existing development consent, CL382 and the mining legislative regime. Nevertheless, in view of recent amendments to the *Environmental Planning and Assessment Act, 1979* (EP&A Act), Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by GCCM to prepare an application to bring the extraction of Longwalls 10 to 17 in the Middle Liddell seam, together with associated underground development and underground raw coal transport, under Part 3A of the EP&A Act. In addition to the Part 3A application for Longwalls 10 to 17, the Proponent is currently preparing an application for project approval for a small open cut mine to the north of the former Camberwell North Pit. A separate application under Part 3A of the EP&A Act in relation to the Glennies Creek Colliery surface facilities and activities which will support the proposed extraction, other than the gas drainage boreholes over Longwalls 10 to 17, was approved on 31 January 2007.




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- CL 382 Boundary
- ML 1525 Boundary
- ML 1518 Boundary
- ML 1551 Boundary
- ML 1437 Boundary
- Powerline to Ventilation Shaft

**Figure 1.2**
**Locality Plan**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Environ Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_01 | | |
| Date: | 12/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | 1:25,000 Topographic Series- Camberwell | | |
| Scale: | Refer to Scale Bar | | |

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0 250 500 750m

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ERM

In a meeting between the Department of Planning and GCCM representatives on 8 February 2006, Departmental representatives confirmed that the proposal would be capable of being classified as a Major Project to which Part 3A of the EP&A Act applies. The application is being made for the purpose of consistency with the Department of Planning's current direction for the management of coal resources, that is, notwithstanding s74 of the *Mining Act, 1992* which, under the Environmental Planning and Assessment Regulation 2000, will have application until 16 December 2010. The approval authority for this application will be the Minister for Planning.

## *1.2 HISTORY OF APPROVALS AND OPERATIONS*

A summary of the history, consents, approvals, leases and licences associated with GCC is provided in *Table 1.1,* and described below.

Extensive coal exploration in the vicinity of the GCC commenced in the mid 1970s, culminating in the lodgement of a Development Application (DA) for construction and operation of an underground mine in August 1990. The DA sought approval for a range of activities including:

- establishment of initial surface facilities and a box cut seam entry at a site approximately 2km east of the existing highwall entry (the Barrett Seam Entry) (*Figure 1.2*);
- construction and subsequent expansion of a modular Coal Handling and Preparation Plant (CHPP) on a site approximately 1km west of the existing Pit Top Area;
- construction of a rail loading facility and inclined drift centred adjacent to the CHPP; and
- run of mine (ROM coal extraction, initially using continuous miners (to approximately 0.55 Mtpa) and subsequently using longwall methods (to approximately 3 Mtpa).

Following a Commission of Inquiry in mid 1991 in which initial subsidence predictions were revised, Development Consent (DA 105/90) was granted on 1 November 1991 subject to 26 principal conditions. CL382 (*Figure 1.2*) was granted by the Minister for Mines (now the Minister for Primary Industries) on 12 November 1991.

Initial mining operations commenced in October 1996. However, economic circumstances dictated a postponement of major coal mining and processing infrastructure development until the latter part of the decade. In the interim, alternatives for progression into full-scale operations were investigated.

As a consequence of these investigations, in August 1998 MMC (the then major shareholder in the Glennies Creek Colliery) lodged a S96(2) (EP&A Act 1979) application and accompanying Statement of Environmental Effects with

the Department of Urban Affairs and Planning in which approval was sought from the Minister for Planning for amendments to DA 105/90 to enable:

(i) development of an underground entry to CL382 from the highwall within the mined-out North Pit of the adjoining Camberwell Coal Mine;

(ii) removal of extracted coal via the highwall entry and processing of 200 000t at Camberwell's CHPP;

(iii) despatch of the washed coal via Camberwell's train loading facility; and

(iv) development of site facilities on and adjacent to the former Oak Park School grounds.

The highwall entry, Camberwell CHPP and train loader and site facilities are shown in *Figure 1.3*.

This 1998 application sought approval to undertake items (ii) and (iii) for a maximum period of three years, a period which, at the time, was considered sufficient to allow the commencement of production from the mine and provide cash flow and time necessary for:

- a more detailed geological assessment of the coal resource;
- the design and acquisition of longwall mining equipment;
- the detailed design and construction of the previously-approved Glennies Creek CHPP; and
- the construction of the previously-approved Glennies Creek rail loop and train loading facility, and other infrastructure necessary for the Colliery to operate independently of Camberwell Mine.

The application to amend DA 105/90 was approved on 16 November 1998. Following the approval of MMC's application:

- the area now known as ML 1437 (*Figure 1.2*) was excised from the north-western corner of Camberwell's lease (CL 357) and issued to MMC; and
- a Pollution Control Licence (No 7622) was issued by the Environment Protection Authority. In December 1999, the Pollution Control Licence was converted to an Environment Protection Licence.

On-site activities, including the installation of limited support facilities and infrastructure within the Portal Area and in the vicinity of the former Oak Park Schoolhouse (*Photograph 1*), commenced in December 1998. The facilities and infrastructure installed during the development and assessment phase, particularly those within the Portal Area (*Photograph 1*), were positioned and constructed with the objective of supporting the mine's approved operational requirements and achieving appropriate environmental performance whilst minimising capital expenditure.

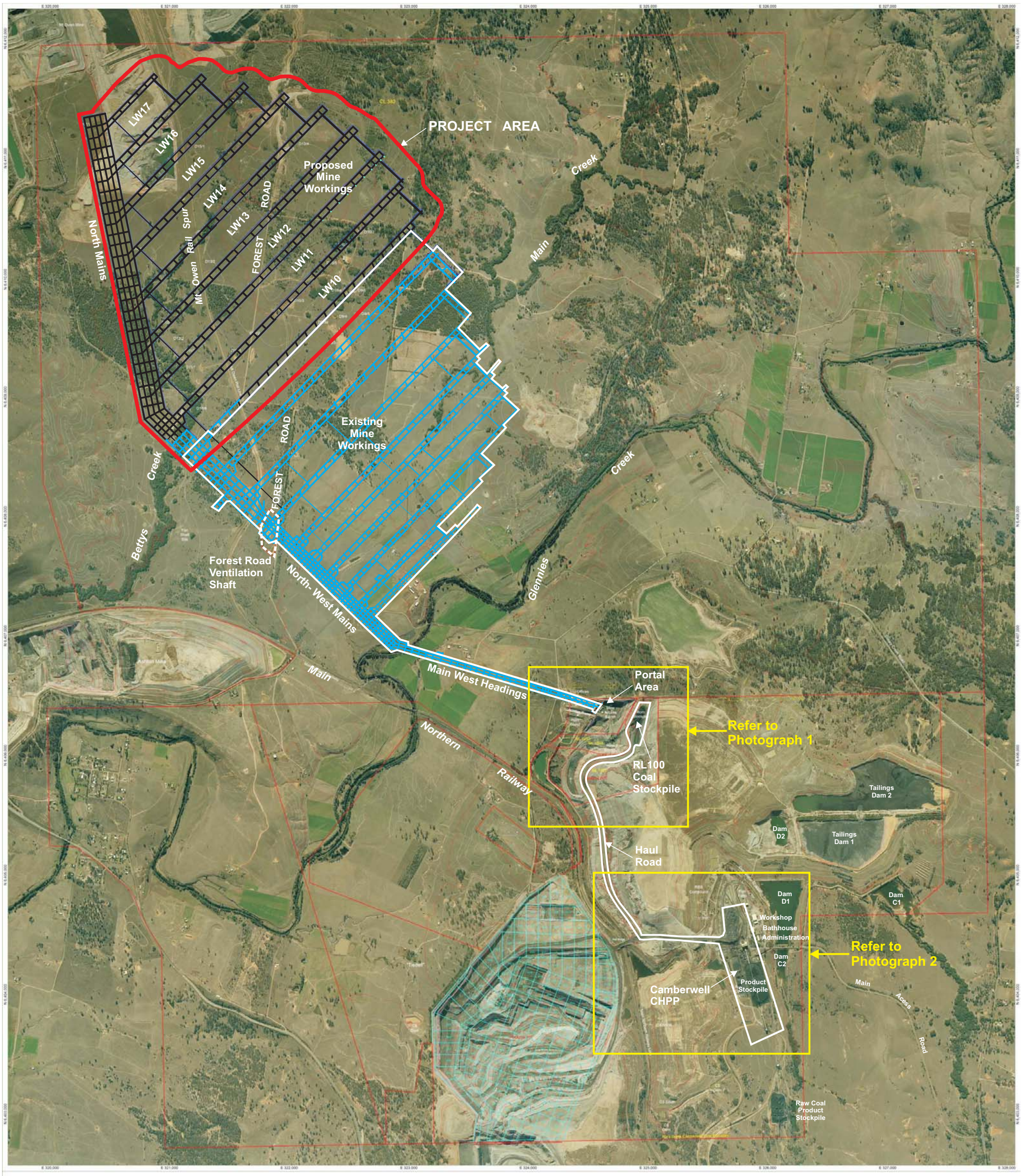


**Figure 1.3**

**Site Layout**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_15 | | |
| Date: | 03/04/07 | Drawing size: | A3 |
| Drawn by: | SP | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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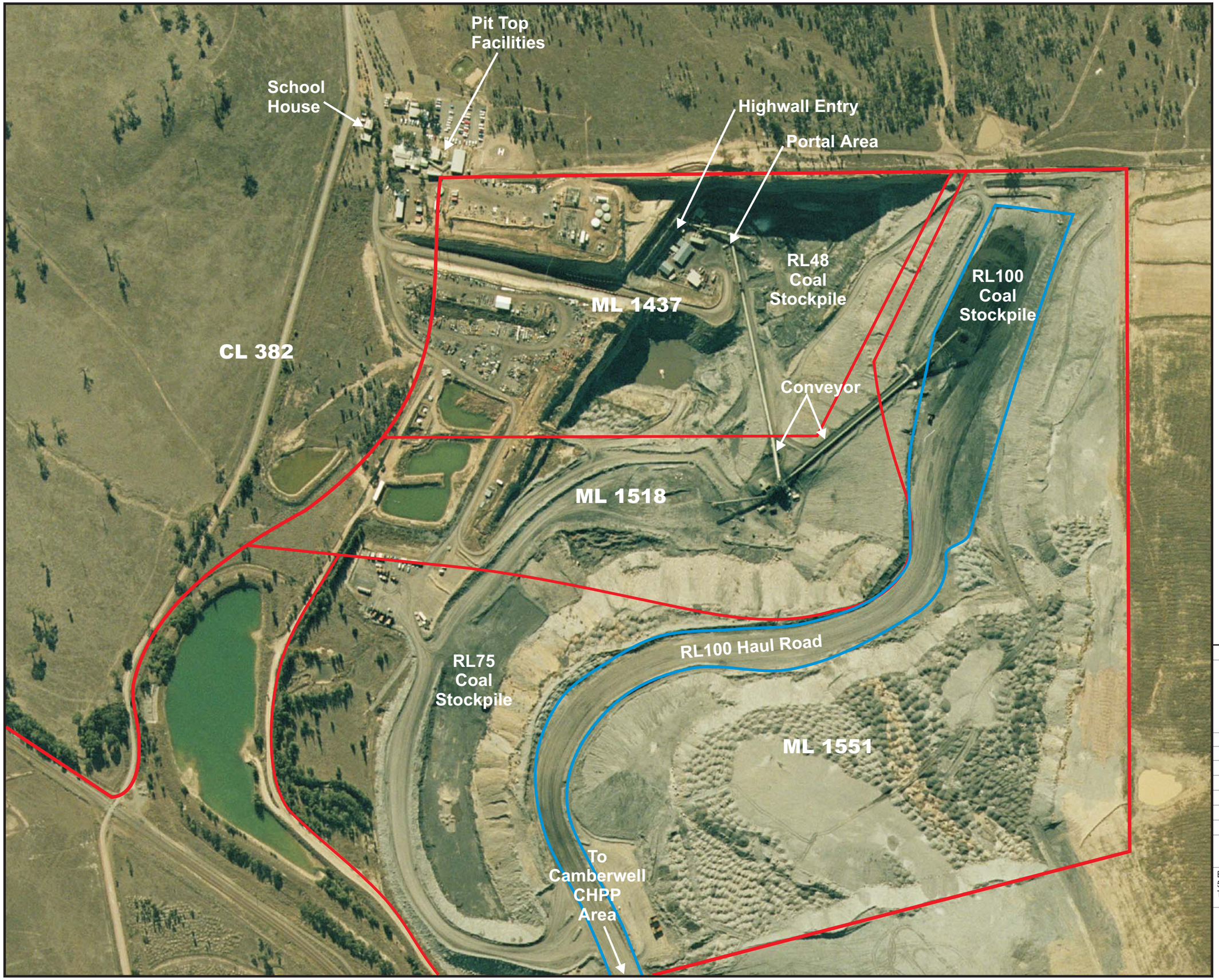


**Photograph 1**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_22 | | |
| Date: | 08/03/07 | Drawing size: | A3 |
| Drawn by: | SP | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |

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Underground development commenced in May 1999 and, over the following year, three underground roadways and associated cut-throughs were developed from the Portal Area to a distance approximately 1700m underground (Main-West Headings – *Figure 1.2*). Five roadways (the North-West Mains – *Figure 1.2*) and associated cut-throughs were then driven in a north-west direction. In December 2000, the north-east development of two and three heading maingate and tailgate roads commenced in preparation for the introduction of a longwall mining system.

Although the 1998 s96(2) application specified a limited duration for the preparation and despatch of Glennies Creek coal using Camberwell facilities, that document also identified a commitment by MMC to the ongoing review of its activities as a means of minimising impacts. This review process led to development of an agreement with Camberwell for the long-term preparation (washing), storage, and rail despatch of GCC coal using Camberwell's CHPP facilities. An application (DA DIA-105-90-M2) permitting the implementation of that agreement was approved on 18 December 2001.

Further amendments to DA 105/90 were made on:

- 25 June 2002, enabling the establishment of a ventilation shaft and associated facility off Forest Road (above the western extremity of the North-West Mains) and a private surface powerline to that facility (*Figure 1.2*). Construction of the ventilation shaft was completed in April 2003;

- 16 February 2005, enabling the upgrading of the Portal Area facilities, principally those pertaining to hydrocarbon management; and

- 1 November 2005, authorising continued use of the surface facilities and an increase in annual ROM coal production to a maximum of 4.5Mtpa; and

- 20 September 2006, authorising continued use of the surface facilities and an increase in annual ROM coal production to a maximum of 4.5Mtpa.

In addition to these modifications to DA 105/90, an application under Part 3A of the EP&A Act in relation to the Glennies Creek Colliery surface facilities and activities which will support the proposed extraction, other than the gas drainage boreholes over Longwalls 10 to 17, was approved on 31 January 2007.

Mining of Longwall 1 (*Figure 1.2*) commenced in August 2002 and operations have subsequently progressed from the developmental and viability assessment phase to a modern longwall mining operation. Coal extraction has been completed in Longwalls 1 to 6 and is currently being undertaken in Longwall 7. GCCM has both SMP and S138 (*Coal Mines Regulation Act 1982*) approvals in place for mining in Longwalls 7 to 9 inclusive. An SMP application for Longwalls 10 to 17 was submitted to the Department of Primary Industries (DPI) on 5 January 2007.

Over the life of the colliery, GCCM or its predecessors submitted a series of S138 applications for secondary extraction and Mining Operations Plans. The colliery is currently operating in accordance with a Mining Operations Plan accepted by DPI on 28 June 2006. Further plans will be submitted over the life of the colliery in accordance with Departmental requirements.

## *1.3 HISTORY OF THE MT OWEN RAIL SPUR*

The Mount Owen Rail Spur is owned by Xstrata Mt Owen (XMO) and overlies Coal Lease (CL) 382 and is likely to be affected by subsidence. In order to enable Integra's proposed mining to proceed, Xstrata and Integra have an agreement which provides for:

- XMO/Xstrata to assume sole responsibility for, and to carry out, all mitigation and repair works on the Rail Line so as to enable mining to occur at the Glennies Creek Colliery in the vicinity of the Rail Line. Xstrata may elect to relocate the Rail Line;
- cooperation between Xstrata and Integra to prepare a Rail Line Management Plan for LW 10-17; and
- Xstrata to support this application.

A Rail Line Management Plan for Longwalls 7 to 9 was approved by DPI on 13 December 2006, and it is expected that an application will shortly be made to modify certain aspects of that Management Plan in accordance with XMO/Xstrata's requirements.

GCCM is in the process of preparing a specific management plan for the Mt Owen Rail Spur for Longwalls 10 to 17, in cooperation with XMO/Xstrata, for submission to DPI. As was the case for the approved Rail Line Management Plan submitted to DPI in relation to Longwalls 7 to 9, the specific Rail Line Management Plan for Longwalls 10 to 17 will contain a series of Action Plans which will provide for the circumstances in which the Rail Spur can safely be used, by implementing the monitoring and mitigation measures itemised in the Action Plans, and in accordance with the *Rail Safety Act 2002* (RS Act).

## *1.4 NEED FOR THE PROJECT*

Approximately 9.39 million tonnes of marketable coal remain within the Middle Liddell Seam in CL382. GCCM aims to recover this reserve and to also ultimately realise the potential financial benefits from its investment through the underground extraction of coal within the Hebden and Barrett seams within CL382.

This project will enable continuation of existing operations at GCC and hence provide continued full time employment for approximately 170 people, as well as the engagement of varying numbers of contractors and casual employees at particular stages in operations. This employment will sustain the associated economic multiplier effects in the local region, while the product coal extracted from GCC will continue to contribute to the strength of the Australian coal export market.

*Table 1.1 Current Consents, Approvals, Leases and Licences*

| Issuing/Responsible Authority | Type of Lease, Licence, Approval | Date of Issue/ Registration | Expiry | Comments |
|---|---|---|---|---|
| Department of Primary Industries - Mineral Resources *1 | Coal Lease (CL) 382 | 12.11.1991 | 11.11.2012 | Varying surface exemptions |
| | Mining Lease (ML) 1437 | 28.04.1999 | 27.03.2011 | Part transfer of CL357 |
| | Mining Lease (ML) 1525 (Shaft) | 18.11.2002 | 17.11.2023 | Forest Road Ventilation Shaft Area (from 20m to 5m from surface) |
| | Sub-lease of MPL 343 | 04.02.2005 | | Under agreement with Glendell Tenements Pty Ltd. Overlies ML 1525 (-5m to surface) |
| | Exploration Licence 5824 | 19.03.2001 | 27.03.2011 | |
| | Mining Lease (ML) 1518 | 14.06.2004 | 27.03.2011 | Part transfer of CL 357 |
| | Mining Lease (ML) 1551 | 10.01.2006 | 27.03.2011 | Part transfer of CL 357 |
| | S138 Approvals | Various | 01.06.2009 | For LW1 to LW9; expiry date relates to LW7 to LW9. |
| | First Workings Approval | 05.01.2005 | | Under transitional provisions of SMP process. To complete MG7 and 8 and a portion of north-west mains. |

| Issuing/Responsible Authority | Type of Lease, Licence, Approval | Date of Issue/ Registration | Expiry | Comments |
|---|---|---|---|---|
| | Gas drainage | Various | Not Specified | Each hole to have a maximum life of five years. |
| | SMP approval for Longwalls 7 to 9 | 14.03.2006 | 01.03.2013 or expiry of CL382 | |
| Minister for Planning (or predecessor) | Development Consent 105/90 | 01.11.1991 | 11.11.2012 | See DA 105/90, Condition 2 |
| | S96(2) modification (105/90/M1) | 16.11.1998 | 11.11.2012 | For development of underground entries off Camberwell North Pit highwall; processing and dispatch of 200 000t coal using Camberwell CHPP/rail loader; site facility development on and adjacent to Oak Park School. Three year period of applicability sought. |
| | S96(2) modification (105/90/M2) | 18.12.2001 | 11.11.2012 | Long term use of highwall entries and Camberwell CHPP/ train loader; coal transportation by internal road initially and subsequently by overland conveyor. |
| | S96(2) modification (105/90/M3) | 28.06.2002 | 11.11.2012 | Forest Road Ventilation Shaft and facilities; overland power line to shaft. |
| | S96(1A) modification | 16.02.2005 | 11.11.2012 | Upgrading of Portal Areas facilities. |
| | S96 (2) modification (105/90/M4) | 20.10.2006 | 11.11.2012 | Increase in ROM coal production from 3.0Mtpa to 4.5Mtpa; installation of additional facilities and infrastructure; amendments to consent wording. |
| | Project Approval 06-0057 | 31.01.2007 | 01.01.2027 | Surface Facilities and Activities |

| Issuing/Responsible Authority | Type of Lease, Licence, Approval | Date of Issue/ Registration | Expiry | Comments |
|---|---|---|---|---|
| Department of Environment and Conservation - Environment Protection Authority | Environment Protection Licence 7622 | 31.12.1999 | Not Applicable Anniversary date: 31 December | Superseded Pollution Control Licence. Approved saleable coal production to 3.5 Mtpa. |
| Department of Natural Resources (DNR – or its predecessors) | Water Access Licences: | | | |
| | • 961 | 01.07.2004 | In perpetuity | For 150 Units |
| | • 960 | 01.07.2004 | In perpetuity | For 50 Units |
| | • 484 | 01.07.2004 | In perpetuity | For 3 Units |
| | • 485 | 01.07.2004 | In perpetuity | For 99 Units |
| | • 1172 | 01.07.2004 | In perpetuity | For 3 Units |
| | • 1173 | 01.07.2004 | In perpetuity | For 303 Units |
| | • 1242 | 01.07.2004 | In perpetuity | For 13 Units |
| | • 10095 | 01.07.2004 | In perpetuity | For 230 Units. Held jointly with Camberwell & RHA Pastoral Co. |
| | • 20BL167917 | 15.08.2000 | In perpetuity | Monitoring Bore |
| | • 20BL169571 | 07.03.2005 | In perpetuity | Test Bore |
| | • 20BL169573 | 07.03.2005 | In perpetuity | Test Bore |
| | • 20BL169574 | 07.03.2005 | In perpetuity | Test Bore |
| | • 20BL169862 | 26.09.2005 | In perpetuity | Dewatering of Mine Workings |
| | • 20BL169864 | 26.09.2005 | In perpetuity | Excavation of underground workings |

| Issuing/Responsible Authority | Type of Lease, Licence, Approval | Date of Issue/ Registration | Expiry | Comments |
|---|---|---|---|---|
| WorkCover Authority | Dangerous Goods Licence 35/034651 | 09.03.2005 | 09.03.2006 | For magazines for explosives, detonators & on-site diesel storage. Amendment to upgrade licence details regarding total diesel storage above 100kL submitted 17 November 2005. Acknowledgement received 09 March 2006. Security Management Plan and application to store and handle explosives plus updated notification of dangerous goods submitted June 2006. Licence renewal pending. |
| Singleton Shire Council | Building Approval 1/99 | 26.03.1999 | Nil | Muster area awning |
| | Building Approval 2/99 | 26.03.1999 | Nil | Bathroom / office complex |
| | Development Consent 90/2001 | 05.04.2001 | Nil | For new offices and bathhouse |
| | Development Consent 90/2001 (Mod) | 13.06.2001 | Nil | Alteration / additions to transportable office building |
| | Development Consent 719/2003 | 13.02.2004 | Nil specified | For Glennies Creek to Ashton Water Pipeline |
| | To use a Council Road (Forest Road) (under Roads Act) | 12.05.2004 | Nil | For Glennies Creek to Ashton Water Pipeline |
| | Approval to Demolish Existing Dwelling & Shed | 13.04.2005 | Nil | Dwelling & shed located at Lot 93 DP 752442 Middle Falbrook Road |
| | To use a Council Road (Forest Road) (under Roads Act) | 01.07.2005 | Nil | For use of Forest Road to access and service the Forest Road Ventilation Shaft Area |
| | Approval to Occupy Temporary Structure | 01.06.2005 | 31.05.2010 | Bathhouse 2 |
| | Approval to Occupy Temporary Structure | 01.06.2005 | 31.05.2010 | Office 4 |

| Issuing/Responsible Authority | Type of Lease, Licence, Approval | Date of Issue/ Registration | Expiry | Comments |
|---|---|---|---|---|
| | Approval to Occupy Temporary Structure | 01.06.2005 | 31.05.2010 | Induction Room |
| | Approval to Occupy Temporary Structure | 02.06.2005 | 01.06.2010 | Office 1 |
| | Approval to Occupy Temporary Structure | 02.06.2005 | 01.06.2010 | Office 2 |
| | Approval to Occupy Temporary Structure | 02.06.2005 | 01.06.2010 | Office 3 |
| | Approval to Occupy Temporary Structure | 21.07.2005 | 21.07.2010 | Conveyor Gantry |
| | Development Consent 473/2005 | 12.09.2005 | Nil | Approval to Erect Control Room |
| | Development Consent 703/2005 | 07.12.2005 | Nil | Approval to Erect Hydrocarbon Storage Shed |
| | Approval to Occupy Temporary Structure | 06.01.2006 | 05.01.2011 | Replacement for (middle) Bathhouse 2 – not yet installed |
| NSW Dam Safety Committee (DSC) | Possum Skin Dam concurrence | 24.12.2003 | | Dam life initially established by DSC as 8 years. Potential to extend life based on surveillance monitoring. |

*[1] Aggregate security of $4985 000 held by DPI.

## 1.5 PURPOSE AND STRUCTURE OF THE ENVIRONMENTAL ASSESSMENT

This Environmental Assessment has been prepared in accordance with the requirements of the EP&A Act 1979, the Environmental Planning and Assessment Regulation 2000, the requirements of the Director-General of the Department of Planning and is submitted to support the Major Project Application for development of first workings and mining of Longwalls 10 to 17 in the Middle Liddell seam at the Glennies Creek Colliery. The purpose of this Environmental Assessment is to describe the Project and its environmental impacts, to make a detailed assessment of those impacts and specified key issues and, where warranted, to identify any environmental safeguards or mitigation measures that are required to minimise those impacts. The structure of this Assessment is outlined below.

The *Executive Summary* has provided a brief overview of the project, key environmental issues and assessment results, and an outline of proposed environmental management procedures.

*Section 1, Introduction:* provides the background to the current proposal and identifies the need for the project.

*Section 2, Project Description:* provides a detailed description of the project, project alternatives and the inter-relationship between the proposed underground operations and other existing, approved and proposed operations at the Glennies Creek Colliery.

*Section 3, Statutory Context:* details approvals required and the statutory context in which the proposal must be considered.

*Section 4, Subsidence Assessment:* identifies methodologies and parameters used, and the outcomes from the subsidence impact assessments associated with Longwalls 10 to 17.

*Section 5, Environmental Risk Assessment:* identifies key environmental issues associated with subsidence of Longwalls 10 to 17.

*Section 6, Stakeholder Consultation:* identifies stakeholders engaged in the environmental assessment process; describes the methodology employed for stakeholder consultation and outlines issues identified during this process.

*Sections 7 to 13:* address environmental issues associated with the proposal, specifically land use and surface improvements; infrastructure, utilities, hydrology (ie surface and groundwater), air quality, ecology; heritage, greenhouse gases, hazard and risk and noise. Descriptions of the existing environment and assessments of potential impacts upon these features are provided, along with descriptions of measures that will be implemented to avoid, minimise, mitigate, offset, manage and/or monitor these impacts.

*Section 14, Socio-Economic Impact and Public Safety:* outlines issues relating to land use (also identified in *Sections 7* to *13*) and provides an economic justification of the project.

*Section 15, Statement of Commitments:* summarises the environmental management, mitigation and monitoring measures identified in *Sections 7* to *13*.

*Section 16, Project Justification and Conclusions:* provides a justification for the proposal with regard to the environmental impacts of the project, the suitability of the site, and the benefits of the project. This justification has been provided in regards to biophysical and socio-economic considerations and the principles of ecologically sustainable development.

# 2 PROJECT DESCRIPTION

## 2.1 PROJECT LOCATION AND EXISTING LAND USE

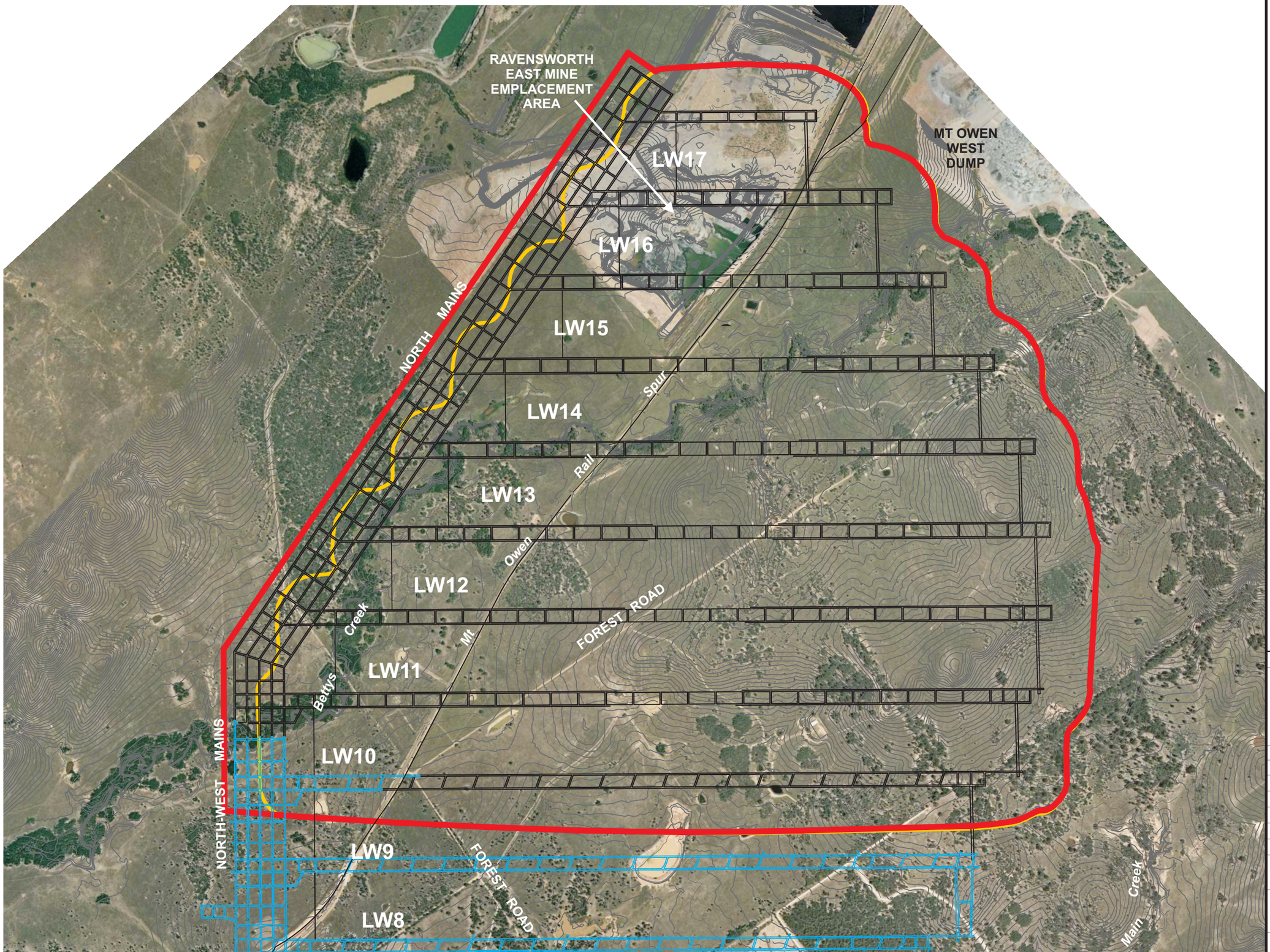
GCC is located in the Hunter Valley Coalfield of the Sydney Basin, approximately 12km north-west of Singleton, 4km east of the village of Ravensworth, 3km north-east of the village of Camberwell and 4km south of Ravensworth State Forest (*Figures 1.1* and *1.2*). The main access to the colliery is from Middle Falbrook Road, which is accessed from the New England Highway via Bridgman Road and Stony Creek Road. GCC lies within the Singleton Local Government Area.

This application applies to approximately 600ha wholly within CL382, and specifically the proposed Longwalls 10 to 17 and associated first workings in the Middle Liddell seam, including mains and gateroad development. The Project Area approximates the surface area defined by an angle of draw of 26.5° from the extraction limits of Longwalls 10 to 17 (Subsidence Impact Zone) and the area directly above the extent of the main roadways (*Figure 2.1*). The existing mains or access ways, conveyors and handling facilities established to enable the mining of Longwalls 1 to 9, will continue to be used to provide underground access for employees and materials to the Project Area, and for the transportation of coal extracted within the Project Area to the mine portal area in ML1437 (*Photograph 1*).

Longwalls 10 to 17 are referred to throughout this assessment and incorporate the surface area defined by an angle of draw of 26.5° from the extraction limits of Longwalls 10 to 17 and the area directly above the extent of the main roadways as defined by the Project Area boundary.

The Project Area is dominated by grazing pasture interspersed with areas of remnant open forest. *Figure 2.1* shows that the Project Area is gently undulating with elevations ranging from 85m to 134m Australian Height Datum (AHD). The ephemeral Bettys Creek (*Figure 2.1*) and associated alluvial flats traverse the northern and western portions of the Project Area and the ephemeral Main Creek is located to the south-east. There are some minor gullies and small ephemeral drainage lines present. The Project Area is also traversed by the privately owned Mt Owen Rail Spur which branches from the Main Northern Line north-west of the Glennies Creek Road railway crossing (*Figure 1.2)* and provides rail access to the adjoining Mt Owen Mine.

The majority of surface land within the Project Area is owned by subsidiaries of the mining company Xstrata, including Glendell Tenements Pty Ltd, Savage Minerals Ltd & Enex Foydel Ltd, Enex Ravensworth Pty Ltd and Xstrata Mount Owen (XMO). WE and AM Gardner own 2.2ha of land within the Project Area overlying Longwall 9. A summary of land parcels within the Project Area is provided in *Table 2.1* and ownership status is illustrated in *Figure 2.2*. The operating Mount Owen Mine, Ravensworth East Mine and the




**Legend**

- Project Area
- Subsidence Impact Zone
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Existing Contour (1m interval)

**Figure 2.1**

**Subsidence Impact Zone and Proposed Longwalls**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_02 | | |
| Date: | 10/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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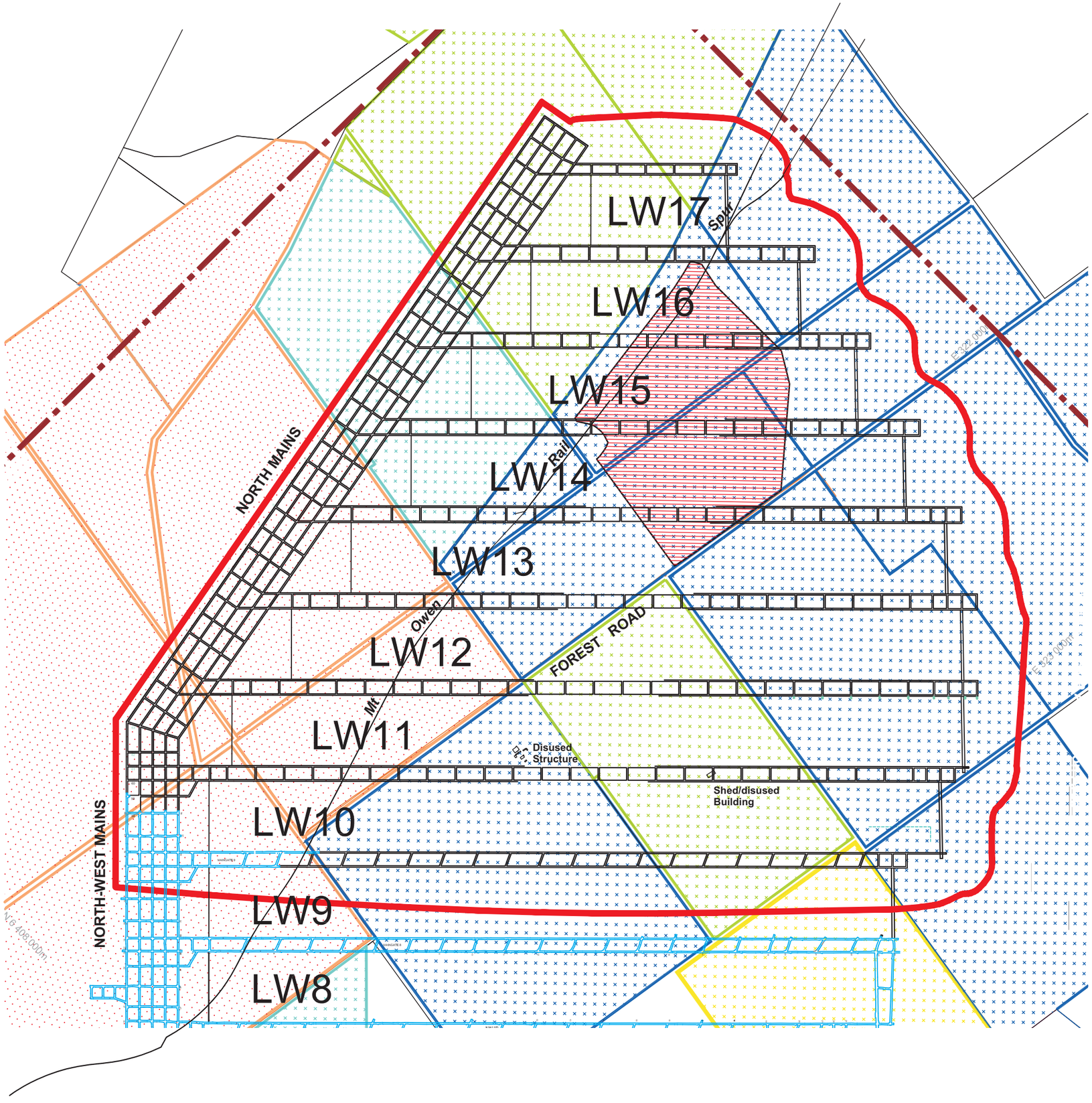


**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Lease CL 382
- Enex Ravensworth Pty Ltd
- Glendell Tenements Pty Ltd
- WE & AM Gardner
- Xstrata Mt Owen
- Savage Minerals/Enex Foydell
- Mt Owen Eastern Rail Pit

**Figure 2.2**

**Land Ownership**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_03 | | |
| Date: | 04/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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approved but yet to be commenced Glendell Mine (all currently owned by Xstrata) are in the vicinity of the Project Area (*Figure 5.1*).

***Table 2.1 Real Property Description***

| Lot Number | Deposited Plan Number | Landowner |
|---|---|---|
| 8 | 6830 | Savage Minerals Ltd & Enex Foydel Ltd |
| 10 | 6830 | Xstrata Mount Owen |
| 11 | 6830 | Enex Ravensworth Pty Ltd |
| 13 | 6830 | WE & AM Gardner |
| 17 | 6830 | Xstrata Mount Owen |
| 923 | 844 642 | Xstrata Mount Owen |
| 71 | 625 171 | Savage Minerals Ltd & Enex Foydel Ltd |
| 2 | 859 544 | Enex Ravensworth Pty Ltd |
| 3 | 859 544 | Enex Ravensworth Pty Ltd |
| 5 | 859 544 | Xstrata Mount Owen |
| 6 | 859 544 | Xstrata Mount Owen |
| 7 | 859 544 | Xstrata Mount Owen |
| 8 | 859 544 | Xstrata Mount Owen |
| 1 | 865 784 | Glendell Tenements Pty Ltd |
| Pt1 | 940 619 | Savage Minerals Ltd & Enex Foydel Ltd |
| and various roads and reserves | | |

## 2.2 *RESOURCE DESCRIPTION*

The coal seams and surrounding strata at GCC are assigned to the Foybrook Formation, a stratigraphic unit of the Late Permian Singleton Supergroup. The Foybrook Formation contains at least six named coal seams that commonly split and coalesce (*Figure 2.3*).

In CL382, the coals of the Foybrook Formation are preserved within the Rixs Creek Syncline, a north-south trending asymmetric fold that plunges to the north. Dips on the western limb of the syncline are up to 25°, while the eastern limb dips at a maximum of around 10°. In the north, the syncline is closed, with steep south-westerly dips and probably faulted ground, which is possibly an expression of thrusting at depth. Immediately to the east of GCC, the Hunter Thrust forms the eastern margin of the Sydney Basin. A sub-parallel structure, the 'Ellis Fault', has been inferred and forms the north-eastern boundary of the resource.

A number of lesser faults are known from mine workings and/or inferred from seismic surveys or drilling. Almost all the known faults are normal, with displacements of up to six metres. Some sub-horizontal/very low angle movement and strike-slip have been recorded, but do not cause any significant mining problems.

The coal seams within CL382 range in depth from the subcrop in the south-eastern corner to nearly 600m in the north-west. Coal seam thicknesses are up to 3.7m but are more commonly in the range 1m to 2.5m.

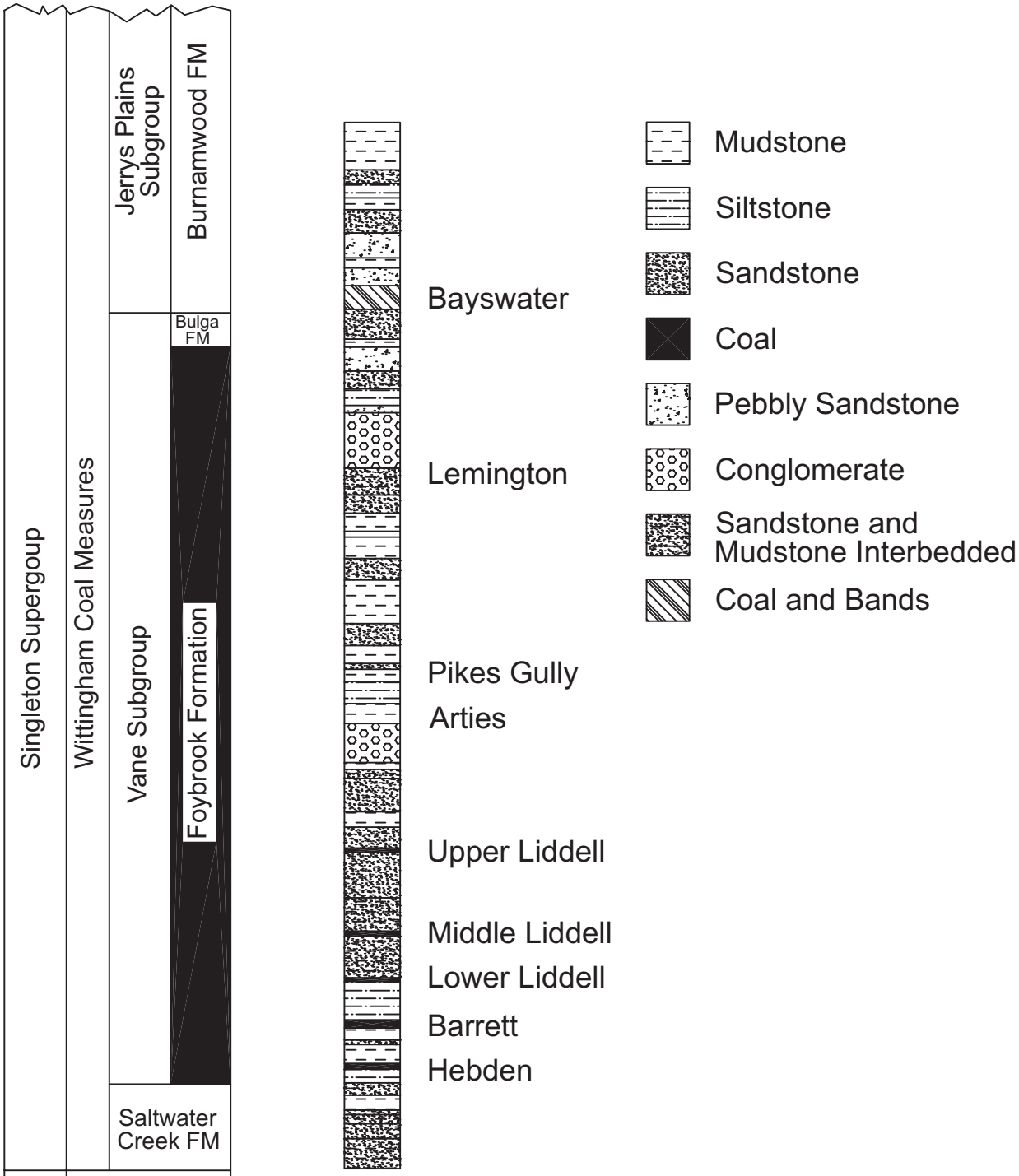


**Figure 2.3**

**Typical Stratigraphic Section of the Foybrook Formation**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_04 | | |
| Date: | 04/04/07 | Drawing size: | A4 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Not To Scale | | |

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**Photograph 2**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_23 | | |
| Date: | 03/04/07 | Drawing size: | A3 |
| Drawn by: | SP | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |

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The Foybrook Formation coals at GCC are bituminous, high-volatile, low sulphur and vitrinite-rich. Although the seams are banded, the coal itself has a low inherent ash and can be washed to meet export soft coking coal specifications. Plastimetric properties, notably fluidity, are excellent.

The Middle Liddell seam gas composition approximates 98% $CH_4$ and 2% $CO_2$, with the most recent data showing the in-situ gas content ranges between approximately $2m^3/t$ and $7m^3/t$ across the mining area at around 400m depth. Consequently, pre-drainage is not currently practiced. However, goaf drainage wells are employed to control gas levels in the longwall tailgate roadway as a result of emissions into the goaf from the overlying and underlying coal seams.

Roof and floor strata are variable but are generally moderately strong to strong. Coal strength is low, and well-developed cleat, sub-parallel to both mining directions, necessitates rib support. Stress conditions at current mining depths (in excess of 330m) are benign.

## *2.3 PROJECT OVERVIEW*

Project approval is being sought from the Minister for Planning for the progressive mining of Longwalls 10 to 17 and associated mains and gateroad development within the Middle Liddell seam. This would involve the extraction of approximately 15.4 Mt ROM coal over approximately five years, utilising the current system of extraction, namely continuous miner development supporting retreating longwall extraction.

In the event that Xstrata elects to relocate the Rail Spur, Integra has agreed that Longwall 17 will not be mined. In this case the amount of ROM coal to be extracted will be approximately 14.9 Mt.

Raw coal obtained from Longwalls 10 to 17 will then be subject to the following actions which are already approved and for which no further approval is sought as part of this application:

- transfer of coal from the active mining faces to the stockpiles within the Portal Area (*Photograph 1*) using the existing underground conveyor network and additional conveyors installed underground with the progressive development of the mine;

- transfer of the coal from GCC Portal Area stockpiles to the existing CHPP at the adjoining Camberwell Coal Mine, initially via an existing private haul road (known as the RL100 haul road – *Photographs 1* and *2*) and subsequently, by overland conveyor. Transfer of the coal by both of the methods are existing approved activities; and

- processing of ROM coals and despatch of product coal, land ancillary activities utilising existing facilities and processes.

## 2.4 PROJECT ACTIVITIES

### 2.4.1 Mining

Longwall extraction is a form of underground coal mining where adjacent panels of coal are separated by pillars of coal (chain pillars) that act as supports for the overlying strata. *First workings* comprise headings or roadways and interconnecting cut-throughs and are workings which establish access to and within the coal resource area. First workings do not result in surface subsidence.

The extraction of coal following the completion of the first workings is referred to as *secondary extraction* and may be achieved by partial extraction of the pillars of coal retained in the first workings or, as is the case at GCC, by longwall methods. The longwall method of secondary extraction uses an electrically powered mechanical shearer which passes back and forth across the width of the longwall panel cutting the coal. The coal is continuously removed from the working face by a series of conveyors which transfer the coal to the surface. As the face is cut away both the shearer and the longwalls hydraulic roof supports advance for the next shear, and the unsupported strata behind the longwall face collapses into the resulting void which is known as a goaf. The collapsing of the overlying strata results in surface subsidence.

*First Workings*

The proposed first workings for Longwalls 10 to 17 comprise an extension of the existing North-West Mains, the development of the North Mains and the development of gateroads for each of the Longwalls 10 to 17 (*Figure 2.1*). This development will be undertaken as a continuation of the current system using wide head (single pass) or narrow head (double pass) continuous miners with integrated roof and rib bolting rigs, with shuttle cars used to transport the coal from the continuous miners to the conveyor system. The headings, comprising the mains and gateroads (and associated cut-throughs), will be tunnels within the coal seam approximately 5.2m wide x 2.8m high. These headings will provide for personnel and material movement as well as mine ventilation.

*Secondary Extraction (Longwall Mining)*

Secondary extraction of the Middle Liddell seam within Longwalls 10 to 17 will use retreating longwall methods, a continuation of the current system of longwall extraction. The longwall extraction plan has been designed to maximise resource recovery, giving consideration to the geological constraints of the resource. The longwall equipment is capable of operating in the height range of 1.8m to 3.1m and of negotiating the expected geological conditions, including any sandstone channels. Consequently, the full Middle Liddell coal

seam, which ranges from 1.95m to 2.85m in thickness within the Project Area, will be extracted in each longwall panel.

The conceptual layout of Longwalls 10 to 17 is shown in *Figure 2.1* and their interrelationship with the existing workings, mains and portal area is shown on *Figure 1.2*. The panels would be orientated in a north-east/south-west direction, parallel with existing panels, with the mains being developed in a north-westerly direction (North-West Mains) and north north-westerly direction (North Mains).

Longwalls 10 to 17 are proposed to be 246m wide (rib to rib) and range in length from 472m (Longwall 17) to 2555m (Longwall 10) long (*Table 2.2*). The decision to increase longwall panel widths for Longwalls 7 to 17 as compared to earlier panels was made to maximise resource recovery and reduce the amount of development drivage (first workings) required over the life of the mine relative to longwall tonnes extracted.

The chain pillars separating the adjacent panels range from 42m to 48m wide with cut-throughs nominally at 100m centres.

***Table 2.2 Dimensions of Longwall Panels 10 to 17***

| Longwall Panel | Panel Width* (rib to rib) | Panel Length* |
|---|---|---|
| 10 | 246 m | 2,555 m |
| 11 | 246 m | 2,553 m |
| 12 | 246 m | 2,342 m |
| 13 | 246 m | 2,078 m |
| 14 | 246 m | 1,719 m |
| 15 | 246 m | 1,343 m |
| 16 | 246 m | 956 m |
| 17 | 246 m | 472 m |

* to nearest metre

Longwall extraction is the preferred method of bulk coal extraction at GCC as it has a proven history of safety and provides the greatest production and economic efficiencies when compared to other options. Giving consideration to coal quality, required production levels and current and forecasted economic parameters, it is the only method that can provide acceptable economic returns for extraction in the Project Area. Longwall mining of the Middle Liddell seam is not expected to adversely impact resource recovery in the underlying coal seams or in the remainder of CL382. This is important as the life of the mine plan for GCC involves extraction of the Hebden seam (which lies approximately 55 - 75m below the Middle Liddell seam) commencing in around 2012 ie on completion of longwall extraction in the Middle Liddell seam.

### *2.4.2 Gas Drainage Boreholes*

*Function*

Mine gas levels in the GCC underground workings have the potential to significantly affect the continuity of underground development and longwall mining. This has necessitated the use of gas drainage boreholes to drain or extract the mine gas which accumulates in the goaf areas. This gas can pose a problem for a mine in terms of safety and production loss as it may enter roadways from the open tailgate end of the longwall face or through leakage around seals. Gas in the GCC goaf originates from two sources, namely:

- coal seams below the Middle Liddell seam as the floor strata crack when subject to increased stress levels post extraction; and
- coal seams above the Middle Liddell seam as the roof strata cave and fall to fill the void left by the extracted coal.

*Operation*

The gas drainage boreholes are installed in the undisturbed strata in advance of the longwall face, are geologically logged to record local stratigraphy and coal seams, and routinely comprise:

- a 337mm diameter borehole with a 260mm grouted casing to approximately 100m below the surface; and
- a 250mm diameter borehole from approximately 100m below the surface to approximately 5m above the roof of the coal seam, cased with a 200mm floating steel casing.

Prior to the longwall face reaching each borehole, surface infrastructure is installed at the collar of the borehole. This includes a free venting stack complete with flame arrestors and a fire suppression system, lightning protection, monitoring and telemetry equipment and an 8m x 8m fenced enclosure.

Historically, following the retreat of the longwall face under the borehole and subsequent roof caving to expose the base of the borehole, gas has been allowed to vent to atmosphere via the free vent stack, with a gas extraction plant comprising a $CH_4$-fired generator, a 30kW electric motor and exhaust fan connected to the borehole, as required, to increase the volume of gas removed from the underground workings. Real-time gas monitoring and control systems are fitted to the plants and connected via radio link to the mine to allow monitoring of their performance and emissions of oxygen, carbon monoxide and methane, and to control exhaust fan operations and speed.

Once each gas drainage borehole is no longer effective in managing gas levels underground, usually once the subsequent longwall face has retreated some distance past the location of the borehole, the surface infrastructure is removed, the borehole is sealed with concrete, the pre-disturbance landform is re-established, soil is replaced and the area scarified, seeded and fertilised in accordance with the landowner's requirements. Once the approved Envirogen (Oaky) Pty Ltd gas powered electricity generation plant (currently under construction) is operational (projected for August 2007) and, subject to access agreements between Envirogen and the individual landowners, it is envisaged that the gas produced from the boreholes will be reticulated to that plant rather than venting to the atmosphere.

*Location*

Under normal operating circumstances, three to four boreholes are active at any given time, of which one or two are free venting and two are fitted with extraction equipment to remove gas from the active goaf and/or adjacent sealed goafs. The indicative location of these boreholes within the Project Area positioned from an ideal mining/engineering ventilation perspective can be seen in *Figure 2.4*. However, the ultimate locations of the individual boreholes will be determined on the basis of mine gas levels and operational experience in the adjacent mined panels, and to avoid specific surface features such as surface water drainage paths, areas of cultural heritage significance or areas of ecological sensitivity.

*Timeframe*

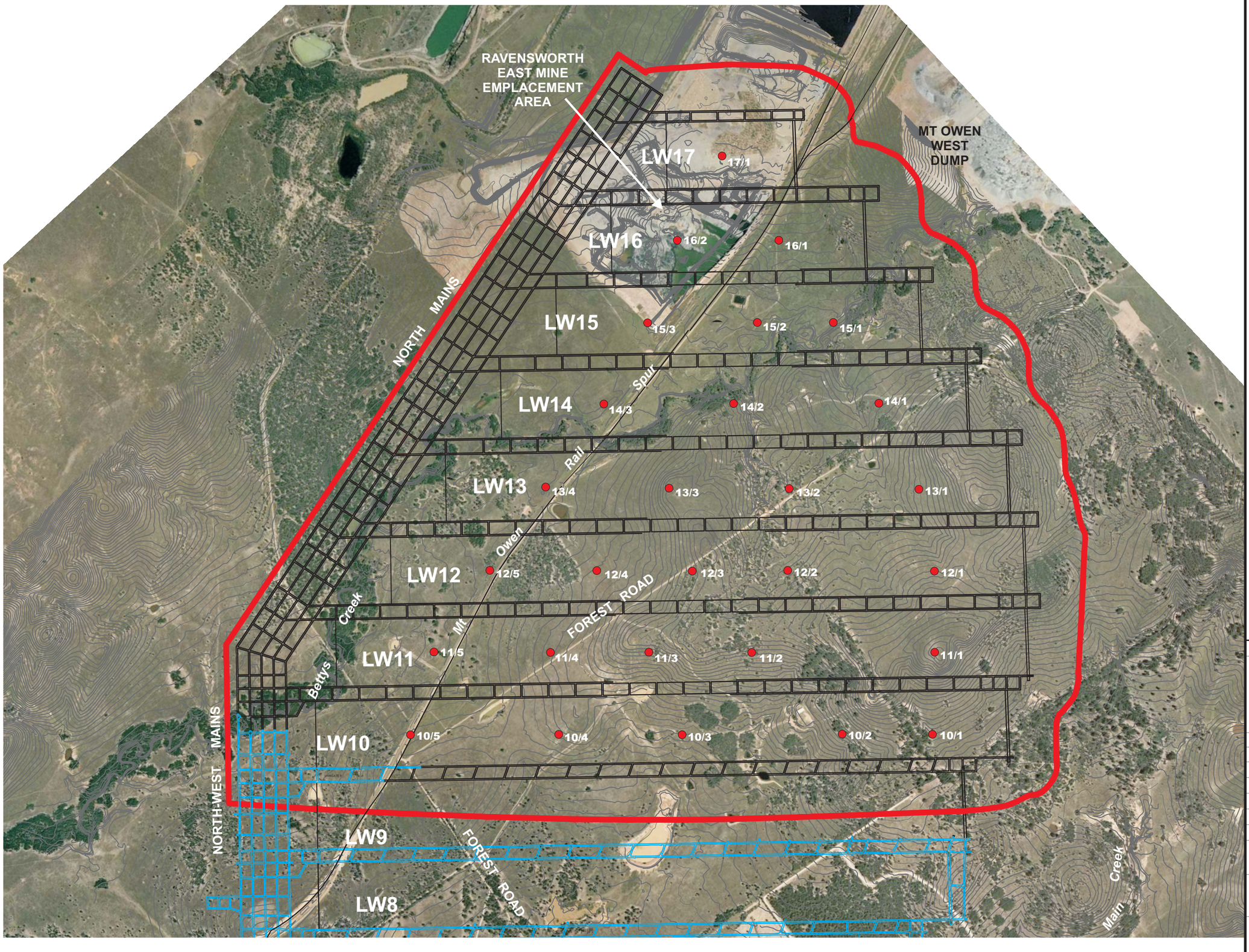
Gas drainage boreholes would be installed ahead of the advancing longwall panels. Site preparation and borehole drilling would be undertaken over approximately one week with the drill sump contents removed at the completion of the drilling and the sump filled. Installation of the fencing, vent stack and lightning arrestor would generally be completed in a subsequent week. Where gas extraction is to be used on a particular borehole a further day would be required to install the extractor fan assembly.

To date, each borehole has been in place for approximately 12 to 18 months and venting gas for a total of approximately six months.

### *2.4.3 Access and Transport*

Throughout mining of Longwalls 10 to 17, the primary access route to GCC will continue to be via the New England Highway, Bridgman Road, Stony Creek Road and Middle Falbrook Road (*Figure 1.2*).

Until the end of 2010, in accordance with existing practices and approvals, trucks will be used to haul up to 4 Mtpa of coal from GCC to the Camberwell CHPP (by the RL100 haulroad) (refer to *Figure 1.3* and *Photograph 2)*. Beyond




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- 8/1 Indicative Location of Gas Drainage Boreholes
- Existing Contour (1m interval)

**Figure 2.4**

**Indicative Location of Gas Drainage Boreholes**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_07 | | |
| Date: | 04/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

0 100 200 300m

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December 2010, routine transportation of coal from the GCC underground to the Camberwell CHPP will be by overland conveyor, with truck haulage undertaken only during periods of conveyor maintenance or in an emergency situation.

### *2.4.4 Infrastructure*

The existing approved Camberwell CHPP at the adjoining Camberwell Coal Mine will continue to process all coal produced from underground operations at GCC. No modifications or changes to the existing facilities are required as the CHPP has an approved capacity of 1200 tph or 8.5 Mtpa.

### *2.4.5 Coal Stockpiling*

The Glennies Creek Colliery currently operates three coal stockpile areas (RL 100, RL 48 and RL 75 – *Photograph 1*). Of these stockpile areas, the RL 100 stockpile area is the principal storage area. The RL 48 and/or RL 75 stockpile areas are used for emergency coal storage only, such as in the event of a failure in the surface conveyor system used to transport the coal to the RL 100 stockpile area, or at times where the RL 100 stockpile area reaches capacity due to, for example, extended periods of CHPP downtime. Haulage of coal from these stockpile areas is onto and along the RL 100 haul road (refer to *Figure 1.3)*.

Over the past two years, a maximum of 350 000t has been stored on the RL 100 stockpile area and 184 000t has been stored on the RL 75 stockpile area. The RL 48 stockpile area has not been used since the installation of the pre-treatment system. No additional coal stockpiles are included in this Application.

## *2.5 PROJECT TIMING*

Pending approval of the SMP (submitted to DPI on 5 January 2007) and based on the current rate of mining, it is anticipated that coal extraction in Longwall 10 will commence in April 2009 and extraction in Longwall 17 will be completed in June 2013 (refer to *Table 2.3*). However, as mine scheduling can be influenced by a number of variables, these dates are indicative only and in reality, achievement of the nominated milestones may occur before or after these dates.

Mains and gateroad development which is required prior to mining each longwall panel will be completed up to two years before the commencement of extraction in each longwall.

*Table 2.3 Proposed Mining Schedule for Longwalls 10 to 17*

| Longwall Panel | Estimated Start Date | Estimated Completion Date |
|---|---|---|
| 7 | Started May 2006 | May 2007 |
| 8 | June 2007 | April 2008 |
| 9 | May 2008 | March 2009 |
| 10 | April 2009 | February 2010 |
| 11 | March 2010 | January 2011 |
| 12 | February 2011 | November 2011 |
| 13 | December 2011 | August 2012 |
| 14 | September 2012 | April 2012 |
| 15 | May 2012 | October 2012 |
| 16 | November 2012 | March 2013 |
| 17 | April 2013 | June 2013 |

## 2.6 PROJECT ALTERNATIVES

### 2.6.1 Open Cut Mining

Open cut mining, though considered, is not a viable option for coal extraction within the Project Area, primarily due to the depth of cover above the Middle Liddell seam, which ranges from approximately 380 to 500m.

### 2.6.2 'Do-Nothing' Option

The 'do-nothing' option would leave a large reserve of quality coking coal unmined within the lease area. Leaving the coal in-situ would also be in breach of the Proponent's obligations under Condition 1(a) of CL382,

*"The registered holder shall extract as large a percentage of the coal in the subject area as is possible consistent with the provisions of the Coal Mines Regulation Act..."*

and fail to realise the potential economic and employment benefits of the resource. Furthermore, if mining does not continue, the associated contributions to industry within the Singleton region will cease. Similarly, a failure to continue coal extraction following the cessation of extraction in Longwalls 1 to 9 would not take advantage of the initial investment, established roadways and infrastructure, and the knowledge of local geological and mining conditions developed during the prior operations. Accessing resources at a later date would not be economically viable as significant costs associated with re-establishing infrastructure and services would have to be absorbed.

## 3 STATUTORY CONTEXT

The Department of Planning has confirmed that the project falls under the provisions of the State Environmental Planning Policy (Major Projects) 2005 as being a major project to which Part 3A of the *Environmental Planning and Assessment Act, 1979* applies. In accordance with the environmental assessment requirements provided by the Director-General, due consideration has been given to relevant State or Federal Legislation or State government technical and policy guidelines including:

- *Environment Protection and Biodiversity Conservation Act, 1999;*
- *Environmental Planning and Assessment Act, 1979;*
- *State Environmental Planning Policy (Major Projects) 2005;*
- *Mining Act, 1992;*
- *Coal Mines Regulation Act, 1982;*
- *Protection of the Environment Operations Act, 1997;*
- *Water Act 1912;*
- *Water Management Act 2000;*
- Environmental Planning and Assessment Regulation, 2000;
- State Environmental Planning Policy No. 11 – Traffic Generating Developments;
- State Environmental Planning Policy No. 33 – Hazardous and offensive Development;
- State Environmental Planning Policy No. 44 – Koala Habitat Protection;
- NSW State Government natural resource management strategies;
    - NSW State Rivers and Estuaries Policy;
    - NSW Wetlands Management Policy;
    - NSW Groundwater Policy Framework Document (General);
    - NSW Groundwater Quantity Management Policy;
    - NSW Groundwater Quality Protection Policy;
    - NSW Groundwater Dependent Ecosystem Policy;
- Guidelines for Fresh and Marine Water Quality (ANZECC);

- Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities;
- draft Guidelines for Aboriginal and Cultural Heritage Assessment and Community Consultation;
- NSW Heritage Manual;
- Hunter Regional Environmental Plan 1989; and
- Singleton Local Environmental Plan 1996.

The proposal is compliant with the various statutory requirements and the relevant provisions are outlined below.

## *3.1 COMMONWEALTH LEGISLATION*

### *3.1.1 Environment Protection and Biodiversity Conservation Act, 1999*

The *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) requires the approval of the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance. The EPBC Act also requires Commonwealth approval for certain actions on Commonwealth land.

Matters of national environmental significance under the Act comprise the following:

- world heritage areas;
- national heritage places;
- Ramsar wetlands of international importance;
- threatened species or ecological communities listed in the EPBC Act;
- migratory species listed in the EPBC Act;
- Commonwealth marine environments; and
- nuclear actions.

There are no world heritage areas, national heritage places, Ramsar wetlands or Commonwealth marine areas on or near the Project Area. Field surveys and desktop reviews of the relevant database have shown that there are no threatened ecological communities known to occur on the Project Area. The proposal does not involve a nuclear action nor is it expected to have a significant affect upon the health and viability of any threatened or migratory

species listed under the provisions of the Act. The project will not impact any areas of Commonwealth land. Accordingly the EPBC Act does not apply to this project.

## *3.2 NSW LEGISLATION*

### *3.2.1 Environmental Planning and Assessment Act, 1979 and Regulations, 2000*

The Project must be assessed in accordance with the *Environmental Planning and Assessment Act, 1979* (EP & A Act) and the Environmental Planning and Assessment Regulation 2000. Part 3A of the Act provides a streamlined assessment and approval process for development that is defined as a major project. Part 3A, section 75B, states that:

*"(1) This Part applies to the carrying out of development that is declared under this section to be a project to which this Part applies:*

*(a) by a State Environment Planning Policy"*

The proposal is identified as a Major Project in State Environment Planning Policy (Major Projects) 2005. The Minister for Planning is the approval authority.

Prior to its preparation, the Director-General of the Department of Planning was consulted to determine the issues that were to be addressed within this Environmental Assessment. A copy of the Director-General's requirements is included in *Annex A*.

Environmental planning instruments other than State Environmental Planning Policy (SEPPs), do not apply to the carrying out of a 'Major Project (Section 75R of the Act). However, the zoning of the land is relevant in accordance with Section 75J(3)(b) of the Act which states that the Minister cannot approve of projects which are wholly prohibited. The zoning of the site as defined within the Singleton LEP is discussed further in this *Section 3.6*. A discussion of the SEPPs applicable to the project is presented in *Section 3.3*.

### *3.2.2 Mining Act 1992 and Coal Mines Regulation Act 1982*

A Subsidence Management Plan was submitted to the Department of Primary Industries on 5 January 2007, prior to the requisite section 138 application under the *Coal Mines Regulation Act 1982*. The project involves the continuation of an existing approved mining operation covered by CL 382 issued under the *Mining Act, 1992*.

### *3.2.3 Protection of the Environment Operations Act, 1997*

An environment protection licence (No 7622) under the *Protection of the Environment Operations Act 1997* (PoEO) is held by GCCM which relates to "coal mining". The licence will apply to Longwalls 10 to 17 once extraction commences. The issues associated with Section 45 of the PoEO have been addressed in the environment protection licence (No 7622).

### *3.2.4 Water Act 1912*

*The Water Act 1912* addresses issues relating to water rights, water and drainage, drainage promotion, and artesian wells. Bettys Creek which flows above the proposed longwall mining activities will be diverted by Xstrata prior to the Mt Owen open cut mining activities extending into their Eastern Rail Pit (*Figure 5.1*) and is licensed to XMO under Part 2 of the *Water Act 1912*. Potential subsidence impacts on the Bettys Creek diversion resulting from GCC operations are addressed in *Section 8.3*.

No licences under the *Water Act 1912* are required for the continuation of longwall mining at GCC.

### *3.2.5 Water Management Act 2000*

The objects of the *Water Management Act 2000* are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

The proposal does not require the extraction of water from any Regulated River Water Source and no water sharing plans apply to the Project Area. Accordingly, there is no approval required.

The Director-General's Requirements require consideration of issues associated with water management. They have been investigated (GeoTerra, 2006 and WRM, 2007) and are discussed in *Section 8.* Most issues related to water management at GCC are a result of surface activities and facilities. The existing on-site mine water management system, including mine water storage, clean and dirty water separation, clean water release and runoff control will continue and will service the operation associated with the underground mining of Longwalls 10 to 17.

No additional licences are required under the *Water Management Act 2000* for works associated with the continuation of underground mining at GCC.

### *3.2.6 Threatened Species Conservation Act, 1995*

In NSW, threatened species, populations and ecological communities are protected by the *Threatened Species Conservation Act, 1995* (TSC Act). Section 5A of the EP&A Act specifies that in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats, seven factors must be taken into account along with any assessment guidelines. This assessment is referred to as the assessment of significance.

The area incorporating GCC has been extensively disturbed by land clearing and grazing and is largely cleared of native vegetation. Moreover, as the project seeks approval for an extension to underground mining activities, direct disturbance of surface vegetation or habitat will be minimal and restricted to removal of small areas of grassland to allow the installation of gas drainage wells (*Figure 2.4*) and associated accesses.

As discussed in *Section 11*, the proposal is not expected to significantly impact on any of those threatened species.

## *3.3 STATE ENVIRONMENTAL PLANNING POLICIES*

### *3.3.1 State Environmental Planning Policy (Major Projects) 2005*

State Environmental Planning Policy (Major Projects) 2005 identifies development to which the assessment and approval process of Part 3A of the EP&A Act applies.

Clause 6(1) of the Major Project SEPP identifies projects under Part 3A as development that, in the opinion of the Minister for Planning, is development of a kind listed in either Schedule 1, 2, 3 or 5 of the Policy. Schedule 1 includes the following:

*Mining*

*(1) Development for the purpose of mining that:*

*(a) is coal or mineral sands mining*

This project had been assessed by the Department of Planning under the provisions of the State Environmental Planning Policy (Major Projects) 2005 as being a major project to which Part 3A applies. As such, the Minister for Planning is the authority for the project.

### *3.3.2 State Environmental Planning Policy No 11*

The objectives of State Environmental Planning Policy No 11 – Traffic Generating Developments are to ensure that the Traffic Authority:

*(a) is made aware of, and*

*(b) is given an opportunity to make representations in respect of,*

*development referred to in Schedule 1 or 2.* Schedule 1 includes the following:

*Developments for the purpose of or being*

*(m) mining, petroleum and extractive industries.*

Forest Road (*Figure 1.2*), is a minor road classed as a "Rural Local 3 – Gravel Road", and traverses the Project Area above Longwalls 9 to 14, though the section over Longwalls 13 and 14 is not accessible to the public. Forest Road provides access to Ravensworth State Forest and to rural land in the area between Glennies Creek Road and the northern Ravensworth district. Some minor subsidence-induced damage and minor disturbance to vehicles using access lanes and Forest Road may occur. However, repairs will be undertaken promptly to rectify any subsidence impacts.

The current employment level of approximately 170 employees will remain unchanged and coal will continue to be transported by rail. Given the proposal is for the continuation of mining and does not involve an increase in the number of employees, the volume of coal processed each year or change the existing transport arrangements, the existing road and rail traffic generated by the Colliery will not increase. A traffic impact assessment is therefore not warranted as part of the Environmental Assessment.

### *3.3.3 State Environmental Planning Policy No 33*

State Environmental Planning Policy 33 – Hazardous and offensive Development (SEPP 33) aims to "ensure that in considering any application to carry out potential hazardous or offensive development, the consent authority has sufficient information to assess whether the development is hazardous or offensive and to impose conditions to reduce or minimise any adverse impact". The policy aims to ensure that the merits of a proposal are properly addressed before being determined, particularly in regard to off-site risk. The proposed development is not "potentially hazardous" as defined in SEPP 33 and consequently a preliminary hazard analysis is not required.

### *3.3.4 State Environmental Planning Policy No 44*

Schedule 1 of State Environmental Planning Policy 44 - Koala Habitat Protection (SEPP 44) identifies local government areas where koalas are known to occur. Singleton Shire is identified in Schedule 1 of the SEPP.

The Project Area does not constitute potential or core koala habitat as defined in SEPP 44. Furthermore, the proposed mining will result in minimal direct disturbance to vegetation or fauna habitat.

### *3.3.5 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*

This policy, which was gazetted on February 16, 2007, aims:

> *(a) to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State;*
>
> *(b) to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resource; and*
>
> *(c) to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.*

Under *Clause 19*, "Savings and Transitional – General", this Policy does not apply to the proposal as the application had been made before the commencement of the Policy. Notwithstanding, the proposed activities and the matters addressed in this environmental assessment, including compatibility with other landuses; natural resource management and environmental management; resource recovery, transport and rehabilitation, are consistent with those identified in this Policy.

## *3.4 STATE GOVERNMENT NATURAL RESOURCE MANAGEMENT POLICIES*

### *3.4.1 NSW State Rivers and Estuaries Policy*

This policy sets out six principles for sustainable management in relation to rivers and estuaries in NSW. The objectives of this policy have been addressed throughout this assessment.

### *3.4.2 NSW Wetlands Management Policy*

This policy aims to promote the conservation, sustainable management and wise use of NSW wetlands by all stakeholders for the benefit of present and future generations. No wetland ecosystems are present within the Project Area, so this policy is not relevant to the proposal.

### *3.4.3 NSW Groundwater Policy Framework Document – General*

This document was devised to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. Outcomes of this management are to:

- slow and halt, or reverse any degradation of groundwater resources;
- ensure long term sustainability of the systems ecological support characteristics;
- maintain the full range of beneficial uses of these resources; and
- maximise economic benefit to the region, state and nation.

Groundwater studies (see *Section 9*) detail that the shallow groundwater systems within the Project Area should not be adversely affected as a direct or indirect consequence of mining Longwalls 10 to 17. No registered groundwater extraction bores are located within or adjacent to the Project Area and, therefore, any temporary groundwater level depletion that may occur due to subsidence will not adversely affect any groundwater users in the area. No ecological systems within the Project Area rely on the groundwater for survival, while continuation of mining will result in maximisation of economic benefits for the region, state and nation.

### *3.4.4 NSW Groundwater Quality Protection Policy*

This Policy is a component of the NSW Groundwater Policy Framework Document. The Policy recognises potential threats to groundwater quality as industrial and urban waste burial, contamination from point and diffuse sources, and pumping-out of groundwater systems. The continuation of mining at Glennies Creek will involve none of the recognised threats and have no direct (or indirect) impact on groundwater quality.

### *3.4.5 NSW Groundwater Dependent Ecosystem Policy*

This Policy is a component of the NSW Groundwater Policy Framework Document. The Policy aims to achieve the protection, management and restoration of groundwater dependent ecosystems. However, since there are no groundwater dependent ecosystems within the Project Area, this policy is not relevant to the proposal.

### *3.4.6 ANZECC Guidelines for Fresh and Marine Water Quality (2000)*

The primary objective of the guidelines is based on ecologically sustainable development of water resources. The adoption of national guidelines provides a shared national objective while allowing flexibility of response to different circumstances at regional and local levels.

The guidelines are intended to provide government, industry, consultants and community groups with a sound set of tools that will enable the assessment and management of ambient water quality in a wide range of water resource types, and according to designated environmental values.

The proposed development of Longwalls 10 to 17 will not necessitate the extraction of water from, or discharge of any waters to, Bettys Creek. Further, the proposed underground mining is not expected to alter the water quality in Bettys Creek. Based on monitoring data, there are no beneficial aquifers in the Project Area, with highly brackish to saline water contained in the low permeability sandstone or coal seams. It is important locally only for use in coal washeries.

All sampling and testing procedures recommended as part of the monitoring programs will be conducted in accordance with these guidelines.

## *3.5 REGIONAL PLANNING INSTRUMENTS*

Section 75R(3) of the EP&A Act provides that environmental planning instruments, (other than SEPPs) do not apply to an approved project under Part 3A. The provisions of regional environmental plans and local environmental plans are therefore not legally relevant unless they wholly prohibit the proposed project (which is not the case for the subject project). Nonetheless, this assessment identifies and considers those environmental planning instruments which would apply to the project but for s75R(3).

### *3.5.1 Hunter Regional Environmental Plan 1989*

The Hunter Regional Environmental Plan 1989 provides a framework to guide and control growth and development in the region and regulates environmental planning matters of significance in the region. The aims of this plan include:

*(a) to promote the balanced development of the region, the improvement of its urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and man made features and so as to meet the needs and aspirations of the community; and*

*(b) to co-ordinate activities related to development in the region so there is optimum social and economic benefit to the community.*

The proposed continuation of mining is generally consistent with the aims of this Regional Environmental Plan.

## *3.6 LOCAL PLANNING INSTRUMENTS*

### *3.6.1 Singleton Local Environment Plan 1996*

The proposed development is on land zoned 1(a) Rural under the Singleton Local Environmental Plan (LEP) 1996. Mining is permissible within this zone with development consent.

The proposed continuation of mining is generally consistent with the objectives of the LEP and specifically meets objective (c) of the 1(a) Rural Zone. The objective is stated as follows:

> *(c) to allow mining where environmental impacts do not exceed acceptable limits and the land is satisfactorily rehabilitated after mining,*

The proposal is not inconsistent with any 1(a) Rural zone objectives.

### *3.6.2 Singleton Shire Council Erosion and Sediment Control Plan*

The objectives of the Erosion and Sediment Control Plan are to:

- prevent land from being degraded by soil erosion or unsatisfactory land and water management practices;
- protect streams and water ways from being degraded by erosion and sediment caused by unsatisfactory land and water management practices; and
- promote and protect biodiversity.

In accordance with the plan, a subsidence land management plan has been prepared and forms part of the separate SMP application.

# 4 SUBSIDENCE

Subsidence is a consequence of the collapse of the overlying unsupported strata into the goaf created by the advancing longwall face, with the magnitude of the subsidence depending on factors including the extracted coal seam thickness, overburden depth, panel geometry, pillar size, and the thickness and strength of the strata.

A subsidence assessment was undertaken by Strata Control Technology (SCT), with particular attention to the potential impacts of the proposed extraction of Longwalls 10 to 17 in the Middle Liddell seam (*Annex B*). The results of this assessment have been summarised below and have been used as the basis for the environmental risk and impact assessments.

## 4.1 SUBSIDENCE PREDICTIONS

### 4.1.1 Prediction Methodology

The method for predicting subsidence over Longwalls 10 to 17 was based on consideration of the sag subsidence over individual panels and the elastic compression of the chain pillars and surrounding strata. These two components were independently calculated based on panel geometry, pillar size and overburden depth taking into account the pillar loadings and the spans across individual panels. Total subsidence was then estimated by adding the two components together. This approach, though generally found to be conservative compared to measured subsidence, provides a broad-based estimate of the subsidence (SCT, 2007).

Experience at numerous sites in NSW indicates that maximum subsidence in single seam mining does not exceed 65 % of the seam thickness extracted if there were no chain pillars at all. Since the chain pillars are likely to support some proportion of the overburden load, the actual maximum subsidence is expected to be somewhat less than this maximum value (SCT, 2007).

Predictions of strains and tilts were based on the empirical relationships developed from the results of subsidence monitoring in the Southern Coalfield. SCT's experience at other sites in the Hunter Valley indicates that these predictions are likely to provide an upper limit on these subsidence parameters (SCT, 2007).

### 4.1.2 Predicted Subsidence Parameters

Full subsidence is likely to develop at any point only after several adjacent longwall panels have been mined. The final subsidence profile is likely to vary locally across each panel, being greater in the centre of each panel and less over the chain pillars, eg subsidence in the centre of Longwall 10 is

expected to be about 0.4m more than over the chain pillars separating Longwall 10 from Longwalls 9 and 11. This variation across individual longwall panels is expected to decrease in the later longwalls because of the increasing overburden depth and the associated compression of the retained pillars. For example, the predicted subsidence of 1.6m in the centre of Longwall 16 is only 0.1m more than over the chain pillars.

As the individual longwall panels are of subcritical width, ie maximum subsidence is only expected to develop following extraction from two or more subsequent longwall panels, any point on the surface is likely to experience up to three separate phases of subsidence as subsequent adjacent panels are mined. Hence, at the completion of Longwall 10, the subsidence of a point on the surface above Longwall 10 will not yet have reached its maximum: maximum subsidence above Longwall 10 will only occur after Longwalls 11 and 12 are mined. However, maximum tilts and strains are likely to develop over each individual longwall as they are mined.

A summary of the predicted subsidence values for Longwalls 10 to 17 is given in *Table 4.1*, together with the predicted and measured values for the previously mined Longwalls 1 to 6. *Figure 4.1* shows the predicted magnitude of subsidence over the Project Area.

*Vertical Subsidence*

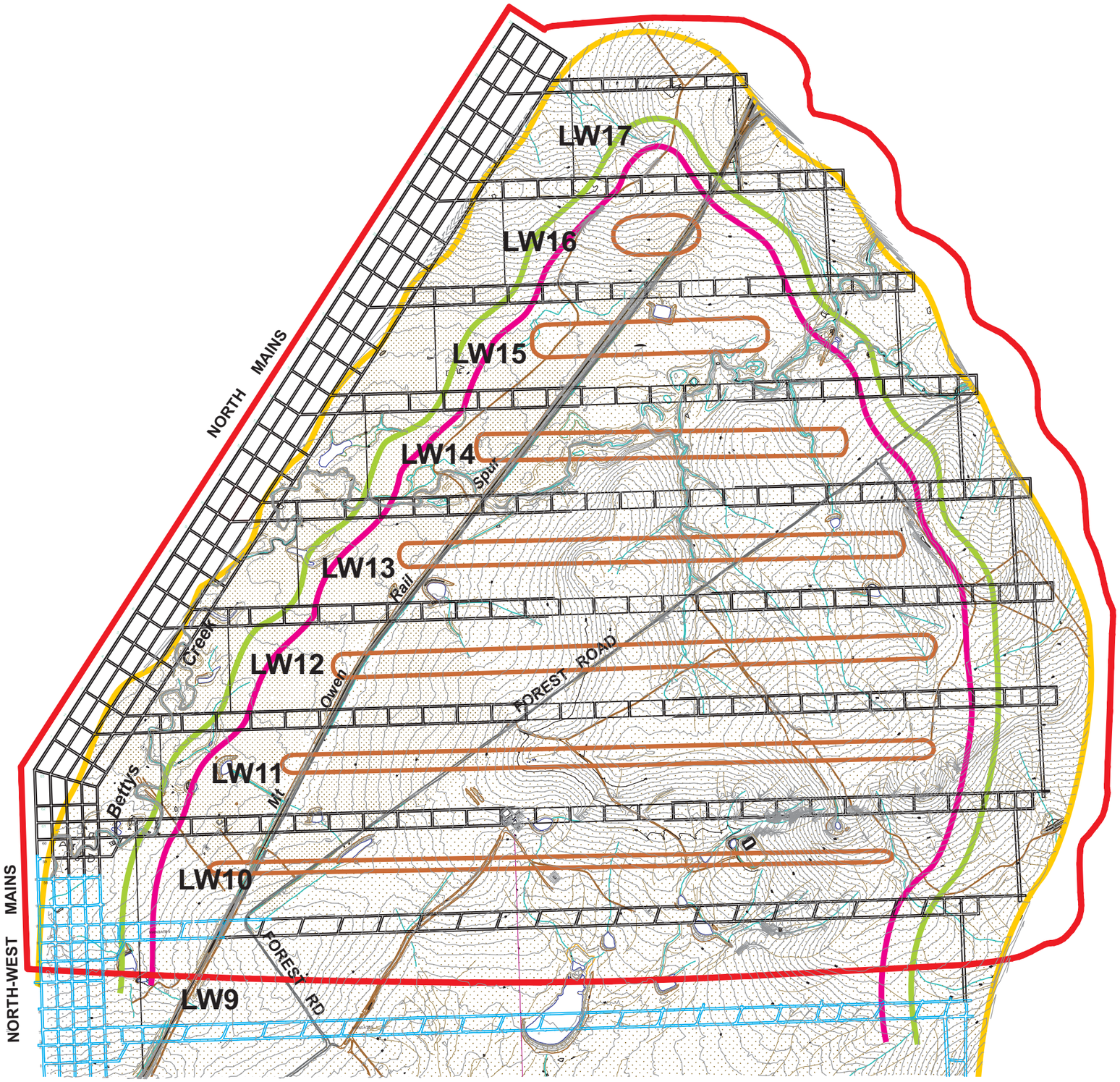
The maximum vertical subsidence predicted over Longwalls 10 to 16 is 1.6m, and 0.8m over Longwall 17. The 1.6m maximum subsidence value is determined from 65 % of the assumed 2.4m seam section mined.

As subsidence data becomes available from Longwalls 7, 8 and 9, the predicted magnitudes of maximum subsidence and other subsidence parameters over the remaining longwall panels will be refined.

*Tilt*

Tilt is the change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the distance between those points.

The term systematic tilt (and strain) refers to the essentially predictable tilt (and strain) that is caused by subsidence and which occurs generally and systematically across the subsidence area. Non-systematic tilts (and strains) occur as a result of surface topography and geological structure. These are localised effects that are largely unpredictable either because the presence or influence of geological structure is difficult to predict or because of the complex interactions of surface topography with mining direction and geological stratigraphy (SCT, 2007).




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)

Effective Limit of Subsidence

- 20mm

Final Subsidence Contours

- 0.5m
- 1.0m
- 1.5m

- Post Subsidence Contours (1m interval)

**Figure 4.1**

**Subsidence Troughs and Post Subsidence Contours**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_08 | | |
| Date: | 04/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

0 100 200 300m

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Systematic ground tilt within the Project Area is likely to be fairly regular and may increase with maximum subsidence. However, tilt would be expected to decrease as the overburden depth within the Project Area increases from 380m to 500m. An overburden depth of 380m was used to provide an upper limit on the values of systematic tilt, with a maximum value of 12mm/m predicted (SCT, 2007).

In the Southern Coalfield, non-systematic tilts have generally been less than 1.5 times the calculated maximum systematic tilts. The actual maximum tilt measured to date over Longwalls 1 to 6 is 7mm/m (SCT, 2007).

*Horizontal Strain*

Strain is calculated as the change in horizontal distance between two points on the ground, divided by the original horizontal distance between them. Compressive strains occur within a valley as the result of valley closure and are calculated as the decrease in horizontal distance over a 20m bay length, divided by the bay length. Tensile strains also occur adjacent to a valley as the result of valley closure, and are calculated as the increase in horizontal distance over a 20m bay, divided by the bay length.

An overburden depth of 380m was used to provide an upper limit on the maximum values of strain. On this basis, the maximum tensile strain in the Project Area is estimated to be 2mm/m and maximum compressive strain 4mm/m. However, for conservatism, the maximum strains expected have been upgraded to 6mm/m in tension and 9mm/m in compression (SCT, 2007).

It should be recognised, however, that these strain estimates represent the maximum systematic strains and tilts. Higher values of strain, in particular, may be observed in steeper terrain and in the vicinity of geological structures.

*Table 4.1 Predicted Subsidence Parameters and Comparison with Measured Values*

| LW | Predicted Maximum Subsidence (mm) | Actual Measured Subsidence (mm) | Predicted Maximum Tilt (mm/m) | Actual Measures Tilt (mm/m) | | Predicted Maximum Strain (mm/m) | | Actual Measured Strain (mm/m) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Tensile | Compressive | |
| 1 | <30 | - | - | - | - | - | | - |
| 2 | 760 | 870 | 7 | 3 - 5 | 3.4 | 5.2 | | 1 - 2 |
| 3 | 960 | 950 | 7 | 5 - 6 | 3.9 | 5.9 | | 2 - 3.5 |
| 4 | 820 | 750 | 7 | 5 - 6 | 3.3 | 5.1 | | 2 - 3 |
| 5 | 820 | 600 | 7 | 5 - 6 | 3.4 | 5.2 | | 2 - 3 |
| 6 | 1550 | 840 | 10 | 7 | 5.7 | 8.8 | | 2 - 3 |
| 7 | 1500 | - | 10 | - | 6.0 | 9.3 | | - |
| 8 | 1500 | - | 10 | - | 5.9 | 9.1 | | - |
| 9 | 1500 | - | 10 | - | 5.5 | 8.5 | | - |
| 10 | 1600 | - | 12 | - | 6 | 9 | | - |
| 11 | 1600 | - | 12 | - | 6 | 9 | | - |
| 12 | 1600 | - | 12 | - | 6 | 9 | | - |
| 13 | 1600 | - | 12 | - | 6 | 9 | | - |
| 14 | 1600 | - | 12 | - | 6 | 9 | | - |
| 15 | 1600 | - | 12 | - | 6 | 9 | | - |
| 16 | 1600 | - | 12 | - | 6 | 9 | | - |
| 17 | 800 | - | 12 | - | 6 | 9 | | - |

*Source: SCT (2007)*

### *4.1.3 Subsidence Management*

An SMP application has been submitted to the DPI which includes an assessment of the potential risks of subsidence, their likelihood and consequences (see *Section 5*). Results of the investigations undertaken in response to the risk assessment have been used to devise strategies to manage the subsidence impacts from Longwalls 10 to 17. Management of impacts will be achieved through prevention, mitigation and/or remediation of subsidence impacts as appropriate.

The existing program of subsidence monitoring (see *Section 4.1.4*) will be extended to include the Project Area in order to develop a better understanding of the dynamic subsidence behaviour at GCC. The monitoring of subsidence impacts on surface features will comprise three phases, starting with pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment. This will be followed by monitoring during mining within predicted subsidence impact zones to ensure the implementation of subsidence impact management processes. Finally, post-mining monitoring will be conducted to establish that no further subsidence impacts are likely and to allow the completion of subsidence impact management processes. The monitoring of specific surface features is discussed in the following sections of this assessment.

### *4.1.4 General Subsidence Monitoring over the Project Area*

In addition to the existing monitoring lines, subsidence monitoring lines within the Project Area (*Figure 4.2*) will be established in accordance with standard industry practices.

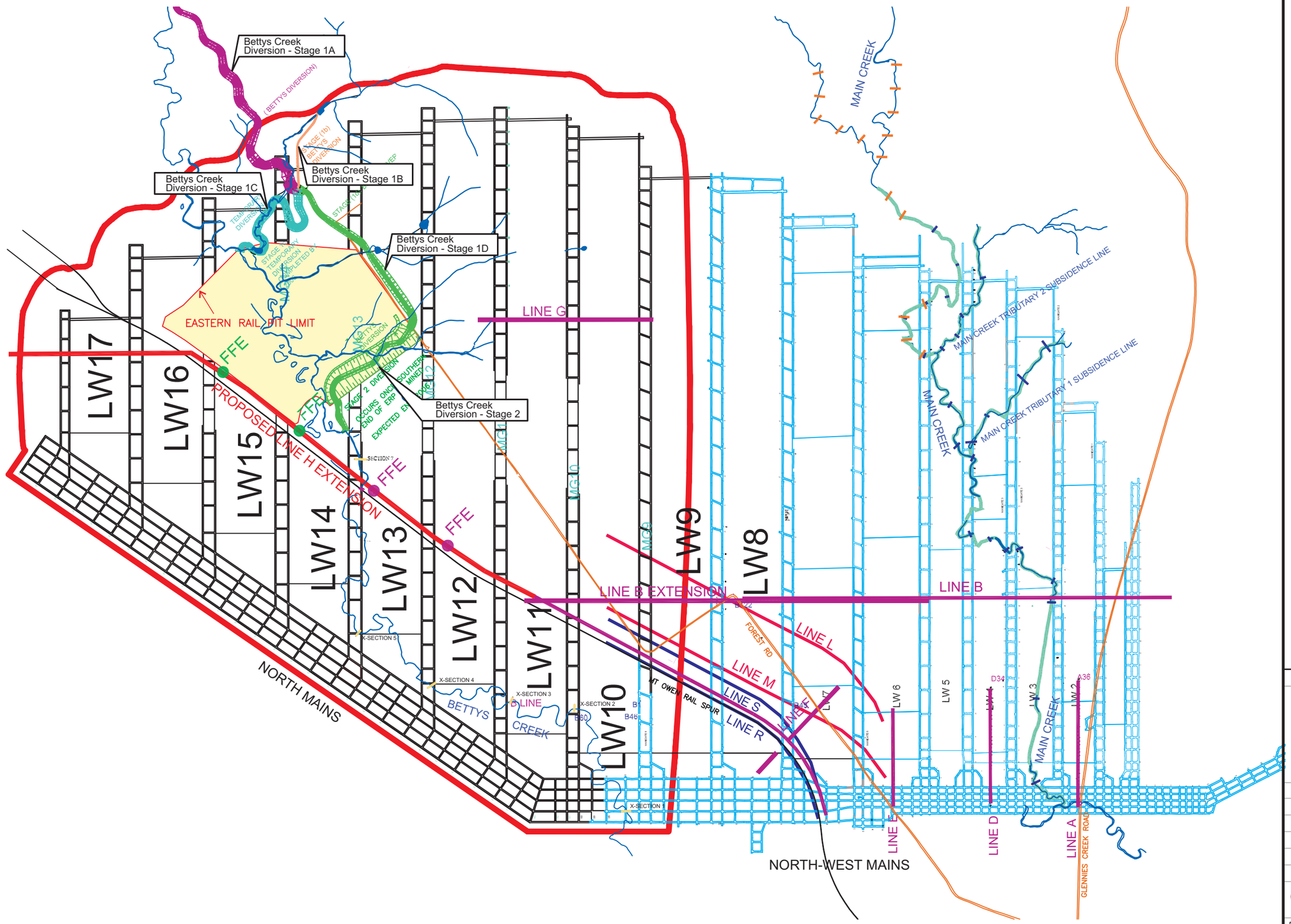
The subsidence monitoring lines have been positioned to measure the various subsidence parameters as a result of mining Longwalls 10 to 17. The existing and proposed monitoring lines will be resurveyed within three months of the completion of each longwall panel.

*Survey Details*

Subsidence monitoring within the Project Area will be achieved by ground survey using transects and monuments identified as follows and shown in *Figure 4.2*.

Line B. This previously installed line runs perpendicular to the longwall panels to an intersection point with Line H, adjacent to the Mt Owen Rail Spur. Line B consists of monuments placed at 15 to 20m centres (1/20$^{th}$ depth of cover).

Line G. This previously installed line runs through an area of steeper topography over Longwalls 10 and 11 in order to monitor subsidence effects on the locally steeper terrain. Line G consists of monuments positioned at 20m intervals.




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Existing x,y,z control line (20m spacing)
- Planned x,y,z control line (20m spacing)
- Proposed control line as per rail-line Maintenance Contract (XMO)
- FFE - Far Field Effects Control Station
- FFE Points
- Creek Lines Detail X-sections

**Figure 4.2**

**Subsidence Monitoring Transects**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_9 | | |
| Date: | 17/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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Line H. The previously installed portion of this line runs adjacent to the Mt Owen Rail Spur and consists of survey monuments placed at 15m intervals. The proposed Line H extension will continue running adjacent to the Rail Spur until it reaches Longwall 16, where it will deviate from the Rail Spur to traverse Longwalls 16 and 17 at 90 degrees. The Line H extension will consist of monuments placed at intervals of $1/20^{th}$ depth of cover or less. No monuments have been, or will be, placed within the Rail Spur easement.

Far Field Effects. The two existing far field effects monuments have been placed approximately 400m apart above Longwalls 12 and 13, adjacent to the Mt Owen Rail Spur. The two proposed far field effects monuments will also be placed approximately 400m apart above Longwalls 14 and 15.

The survey monuments comprise 500mm or 600mm Feno Marks placed flush to the ground to minimise the possibility of disturbance and injury to wildlife or stock. If Feno Marks cannot be used, other suitable substitute survey monuments shall be employed.

In all subsidence surveys, unless otherwise specified, survey best practice will be employed to achieve sub 0.010m accuracy in the 'x', 'y' and 'z' axes. This accuracy level conforms to the following classes as per the Intergovernmental Committee on Surveying and Mapping (ISCM) standards.

- EDM Class C;
- GPS Class C;
- Angles Class C; and
- Differential Levelling Class C.

# 5 ENVIRONMENTAL RISK ASSESSMENT

## 5.1 METHODOLOGY

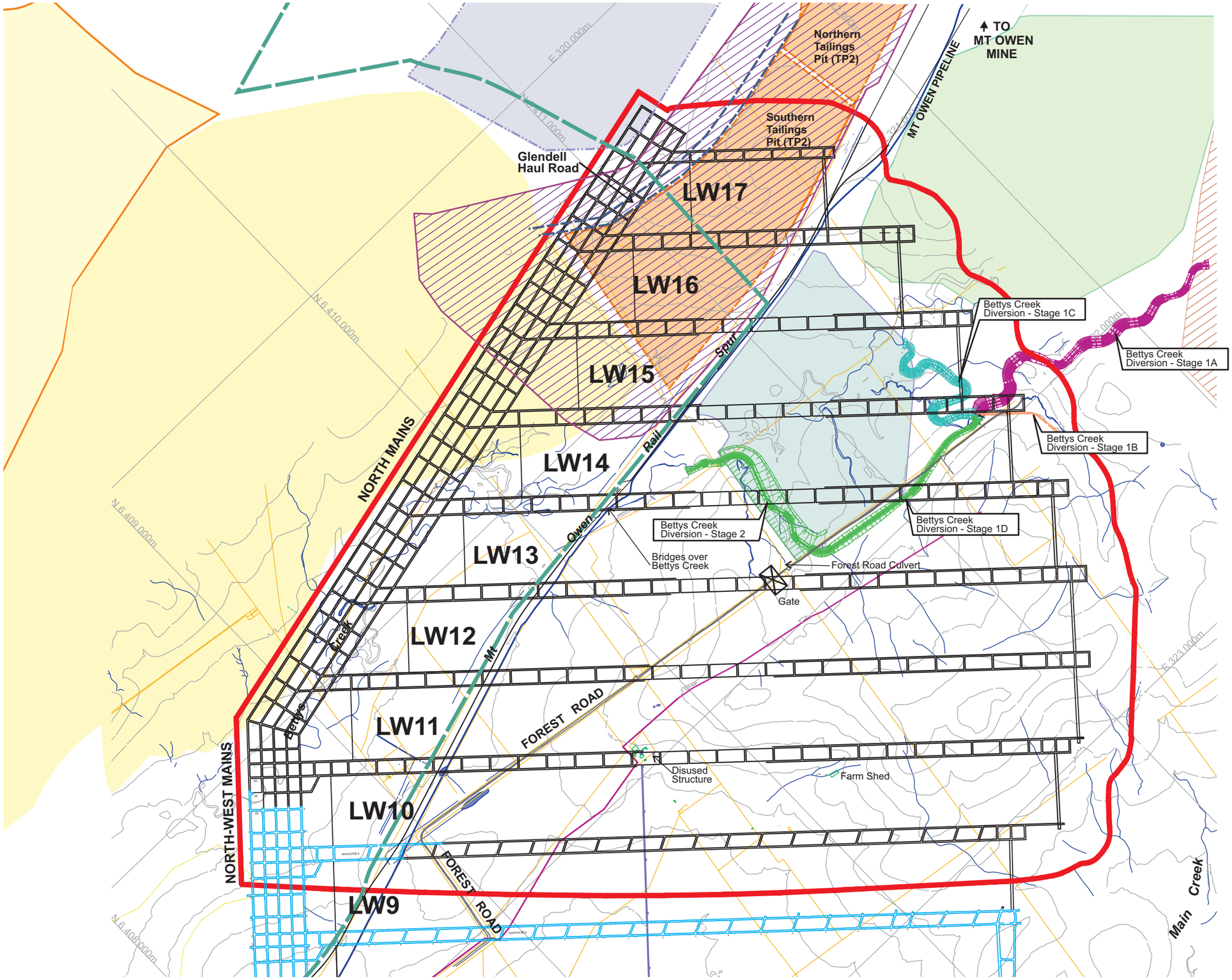
A risk assessment was undertaken during the preparation of the Longwalls 10 to 17 SMP (ERM, 2007) to identify the hazards, analyse the risks, determine the acceptability of risks and recommend additional controls related to the impact of subsidence across the Project Area. With the exception of the proposed gas drainage boreholes, the indirect consequences of subsidence are the principal risk of this Part 3A Application. Consequently, the outcomes of the risk assessment are directly applicable to this Application.

Applying the ranking system defined in *Table 5.1, Table 5.2* summarises the predicted subsidence impacts and qualitatively ranks each of the potentially impacted surface and sub-surface features by management priority. The various surface and sub-surface features referred to in *Table 5.2* are shown on *Figure 5.1*.

Where appropriate, *Table 5.2* also refers to the potential impact of the gas drainage boreholes.

## 5.2 RESULTS

A brief identification of potential temporary and long term impacts of the subsidence from the proposal and the results of the systematic risk assessment are presented in *Table 5.2*. Mitigation measures will ensure that there are no potentially significant residual impacts associated with the project. However, several activities could cause impacts that pose a moderate or low risk to environmental or social elements. These activities have been the primary focus of this Environmental Assessment.




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Waterway
- Fences
- Electricity Transmission Line
- Telstra Cable
- Mt. Owen Eastern Rail Pit
- Mt. Owen Extension
- West Dump
- Glendell Open Cut
- Glendell Emplacement Area
- Glendell DA Boundary
- Existing Buildings
- Ravensworth East Open Cut
- Ravensworth East Emplacement Area
- Ravensworth East Tailings Pit
- Existing Contours (1m interval)

**Figure 5.1**

**Surface Features Plan**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_05 | | |
| Date: | 11/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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## *Table 5.1 Risk of Potential Environmental and Social Impacts*

| | | CONSEQUENCE | | | | |
|---|---|---|---|---|---|---|
| | | **Insignificant** | **Minor** | **Moderate** | **Major** | **Catastrophic** |
| People | | *No injuries* | *First aid treatment* | *Medical treatment required* | *Extensive injuries* | *Death* |
| Environment | | *No environment effects* | *Could effect the environment* | *Water, soil or air likely to be affected for the short term* | *Water, soil or air affect badly. Damage or death to flora or fauna* | *Long term damage to water, soil or air; Damage or death to significant numbers of flora or fauna* |
| Equipment Damage | | *Under $K damage* | *$5K to $50k Damage* | *$50K to $100k Damage* | *$100K to $500K Damage* | *Above $500K Damage* |
| Production Loss | | *Less than one (1) day* | *One (1) days delay* | *Two (2) days delay* | *Less than one (1) week 7 greater than (2) days delay* | *Greater than one (1) weeks delay* |
| Likelihood | **Almost Certain** Is expected to occur in most circumstances | 15 | 10 | 6 | 3 | 1 |
| | **Likely** Will probably occur in most circumstances | 19 | 14 | 9 | 5 | 2 |
| | **Moderate** Might occur at some time | 22 | 18 | 13 | 8 | 4 |
| | **Unlikely** Could occur at some time | 24 | 21 | 17 | 12 | 7 |
| | **Rare** May occur in exceptional circumstances | 25 | 23 | 20 | 16 | 11 |

| RISK | Category I | Category II | Category III | Category IV |
|---|---|---|---|---|
| | (Low) | (Moderate) | ( High ) | ( Critical ) |

*Table 5.2 Summary of Predicted Subsidence Impacts and Management Priorities (Derived from ERM, 2007)*

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Infrastructure | Roads - Minor | 4 | Class I (Low) | Significant damage or service disruption to local roads. | Forest Road. Council road for 2.1 km then Crown Road. Singleton Shire Council and Department of Lands key stakeholders. | Neighbour includes Xstrata. Access to other neighbours is not applicable, as they do not use the road. GCCM will use the existing management plan and signage indicating mine subsidence area. Tension cracking would be the more important issue but has not been observed to date. There is a potential for some water ponding over the road, which may be a safety issue and should be considered. Refer to *Section 7.1.1.* |
| Infrastructure | Bridges | 2 | Class IV (Critical) | Significant damage or disruption to bridges/overpasses is anticipated. | Mt Owen Rail Spur and maintenance road bridges over Bettys Creek. No detailed design or construction information available so unclear of tolerance levels. | Key stakeholder is Xstrata. Management of the bridge will be addressed in the Rail Line Management Plan for Longwalls 10 to 17 which is to be prepared in cooperation with Xstrata and submitted to DPI. XMO/Xstrata has agreed to implement all mitigation, repair and management measures related to the Rail Spur. Management will require ongoing consultation with Xstrata. Refer to *Section 7.3.6.* |

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Infrastructure | Pipelines (water, gas….) | 3 | Class II (Moderate) | Significant damage or disruption to pipelines requiring major route realignment. | Water pipeline is associated with the Rail Spur easement. Provides clean water from Glennies Creek to Mt Owen CHPP. | GCCM will have experience from Longwalls 7 to 9 to provide further details for the management of Longwalls 10 to 17. Initial indications are that there will be less strain than originally predicted. Management of the pipeline will be addressed in the Rail Line Management Plan for Longwalls 10 to 17, which is to be submitted separately to DPI. GCCM will provide monitoring data and other subsidence information to XMO/Xstrata. Refer to *Section 7.3.9.* |
| Infrastructure | Powerlines | 3 | Class II (Moderate) | Significant damage or disruption to power & communications. | Powerline may be used in the future although currently it does not service any subscribers. | EnergyAustralia and Xstrata key stakeholders. Previously undermined with no observable impacts. In the event that the transmission line is damaged, repairs will be instigated as soon as practicable by GCCM, in consultation with EnergyAustralia. Refer to *Section 7.1.3.* |
| Infrastructure | Communications - Telstra etc | 3 | Class I (Low) | Significant damage or disruption to power & communications. | Telstra line is left in-situ - no current subscribers but required to keep active and serviceable. | Due to technical nature of the infrastructure, a management plan has been prepared in direct consultation with Telstra. All monitoring will be undertaken by Telstra. Refer to *Section 7.1.4.* |

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Infrastructure | Railway Communications Cables | 3 | Class II (Moderate) | Significant damage or disruption to power & communications. | Railway communication cable associated with the Rail Spur. No detailed design or construction information provided at this stage so unclear of tolerance levels. Impact/risk may decrease with that knowledge. | Key stakeholder is Xstrata. Management of the communication cables will be addressed in the Rail Line Management Plan for Longwalls 10 to 17 which is to be submitted separately to DPI. GCCM will provide monitoring data and other subsidence information to XMO/Xstrata. Refer to *Section 7.3.8.* |
| Infrastructure | Railways | 3 | Class IV (Critical) | Significant work required to safeguard Mt Owen Rail Spur. | Not a foregone conclusion that major work will be required but will require a detailed Management Plan to monitor and address issues if they arise. Experience of longwalls 7 to 9 will guide the plan. Not expecting any sudden movements. Rail maintenance road will be included within the Rail Line Management Plan and will include the installation of a speed reduction/warning signs. | Xstrata critical stakeholder. Consequence is primarily through disruption to service. Management be addressed in the Rail Line Management Plan for Longwalls 10 to 17 which is to be submitted separately to DPI. GCCM will provide monitoring data and other subsidence information to XMO/Xstrata. Refer to *Section 7.3.5.* |
| Infrastructure | Mt Owen Eastern Rail Pit | 4 | Class II (Moderate) | Significant work required to safeguard the Mt Owen Eastern Rail Pit mine infrastructure. | Eastern rail pit is expected to be finished before it is undermined. For the purposes of the EA, it is assumed that the final use of the pit will be either a tailings dam or back-filled. If a tailings pits or void of any kind some extra water may need to be pumped out of the underground working. | Xstrata key stakeholder. Management will require ongoing consultation with Xstrata. GCCM will provide monitoring data and other subsidence information to XMO/Xstrata. Refer to *Section 7.3.3.* |

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Infrastructure | Glendell Mine | 3 | Class II (Moderate) | Significant work required to safeguard the Glendell mine infrastructure. | A small proportion of the proposed Glendell workings overlay the Project Area. Xstrata has been consulted in this regard and detailed descriptions of the proposed workings within this area have been requested. Potential impacts and management measures cannot be determined until this information is available. | Xstrata key stakeholder. GCCM will provide monitoring data and other subsidence information to Xstrata, which they can consider and take into account in developing their Mine Operations Plan. No detail of the precise location of mine infrastructure for the proposed Glendell Open Cut Mine is available at this time, and therefore it is not possible to carry out a detailed risk assessment. Refer to *Section 7.3.2*. |
| Surface Drainage | River Flow and Flooding Patterns | 3 | Class II (Moderate) | Significant modification to flow patterns with increased flood risk. | Some increase extension of flooded area under 1:100 yr ARI to east of Bettys Creek from subsidence. This flow will be reduced as a result of the XMO Bettys Creek diversion. | If adverse effects on Bettys Creek due to subsidence are observed, the creek and/or diversion will be rehabilitated to an appropriate standard to return the creek, diversion channel and floodplain to a similar state as existed prior to subsidence. Based on the predicted consequences of subsidence, no specific mitigation measures are proposed for either the Bettys Creek main channel or floodplain. Refer to *Section 8.2*. |
| Surface Drainage | Farm Dam Impacts | 4 | Class I (Low) | Significant impacts to flows to farm dams (or structural impacts). | A total of twenty six (26) farm dams and natural billabongs have been identified within the Project Area. Observation of existing dams (Longwall 6) not showing subsidence effects. | GCCM will, in consultation with the relevant landowner, remediate any dam that is damaged by subsidence (or has its storage capacity reduced by more than 10 percent) to a condition similar to that prior to subsidence. Refer to *Section 8.5*. |

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Surface Drainage | Ponding on flat land | 5 | Class I (Low) | Significant ponding on flat land requiring drainage work to avoid ongoing damage. | An assessment of predicted post-subsidence topographic contours indicates that stream channel ponding is likely to occur within Bettys Creek over Longwalls 10 to 15. Outside of the stream channel there is not expected to be any significant ponding. | Should water begin to pond in an area outside of the creek, GCCM will carry out temporary or permanent earthworks to allow the water to drain away. Refer to *Section 8.4.* |
| Surface Drainage | Water Quality Impacts | 5 | Class I (Low) | Water quality (turbidity etc) substantially impacted (duration >1 year). | Based on existing conditions and observations over Longwalls 3 to 6, issues are not expected to arise in regards to water quality and no nick points are likely to develop. | It is unlikely that Bettys Creek water quality will be affected by Longwall Panels 10 to 17. Consequently, surface water controls to manage stream water quality are not considered necessary. Surface water monitoring is described in *Section 8.7.4.2*. |
| Groundwater | Groundwater Flow Patterns | 4 | Class I (Low) | Groundwater flows substantially impacted requiring relocation of water supply bores. | There are no beneficial users of the groundwater as salinity is too high. May be a reduction in standing water levels but based on surrounding impacts this is not critical. There are no groundwater dependant ecosystems. Major influences on the groundwater are/will be Xstrata open cuts. | Groundwater does not require any specific management measures and is addressed as part of the overall application. Refer to *Sections 8.7* and *9.* |
| Groundwater | Groundwater Quality | 5 | Class I (Low) | Water quality substantially impacted (duration >1 year). | No observable change in groundwater quality is expected. Xstrata pits and associated impacts will overwhelm any slight impacts as a result of subsidence. | Groundwater quality does not require any specific management measures and is addressed as part of the overall application. Refer to *Sections 8.7* and *9.* |

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Archaeology | Built Heritage Impacts | 5 | | Significant damage to historic/important buildings and structures requiring relocation. | Previous historical heritage studies identified four historical heritage sites in the Project Area. It is possible that these historical sites may have already been destroyed as they are located in areas of ongoing mining activity within the Mt Owen and Ravensworth leases. | Prior to the commencement of gas drainage and mining of Longwall 14, an additional inspection of sites RE31, MOH2 and MOH3 will be carried out by an archaeologist to determine whether these sites remain extant. Based on actual versus predicted subsidence in the preceding Longwalls, it will then be determined whether further archival recording will be necessary at these sites. Refer to *Section 12.* |
| Archaeology | Aboriginal Heritage Sites | 2 | Class II (Moderate) | Significant damage to important sites with limited opportunity to relocate/repair. | A large number of scatters noted within exposures and along Bettys creek. 14 of the 23 sites are covered by previous Section 90 permits associated with Mt Owen and Glendell operations. Three sites along Bettys Creek have been identified by others for conservation | No further archaeological investigation is required for the Aboriginal sites recorded within the Project Area. Gas drainage borehole drilling and subsidence remediation works will not be undertaken within these sites, or within 30m of Bettys Creek. Should these impacts be unavoidable, consultation will be undertaken with the Department of Environment and Conservation and the local Aboriginal community representatives. Refer to *Section 12.* |
| Ecology | Riparian Impacts | 3 | Class I (Low) | Flow/geomorphology changes substantially affects riparian community (>1km length). | Riparian impacts are expected to be limited in extent. Impacts due to flow changes from diversions are expected to be far greater than subsidence impacts. Previously undermined Main Creek with no observable riparian impacts. | Studies show minimal impact and no specific management measures are required. Refer to *Section 11.* |

| Planning Stage | Diagnostic Element | Score | Risk Class | Worst Case Risk Description | Status | Notes |
|---|---|---|---|---|---|---|
| Ecology | Iconic Species Impacts (eg large trees, grasslands) | 4 | Class I (Low) | Subsidence or gas drainage borehole installation significantly damages key habitats/iconic specimens (trees, frog habitat etc). | There are a number of threatened fauna species and their habitats recorded within the Project Area. Impact is expected to be minimal as habitats will not be removed, isolated or fragmented. The Mt Owen diversion and other open cut operations will have a much greater impact than subsidence. | Flora and fauna do not require any specific management measures and are addressed as part of the overall application. The exact location of the gas drainage boreholes will be determined in the field in consultation with an ecologist in order to avoid clearance of trees, shrubs and where possible areas dominated by native grasses. Refer to *Section 11.* |
| Public Access | Public Access | 2 | Class I (Low) | Multiple public access routes and difficult to control. | Other than Forest Road, access controls for private land are in place. Railway and maintenance road is accessible off Forest Road. | The risk assessment concluded that there was no need to restrict access as part of the SMP and Part 3A Applications. |

# 6 STAKEHOLDER CONSULTATION

Extensive consultation was undertaken between October 2005 and January 2007 during the development of the SMP for Longwalls 10 to 17, and addressed all aspects relevant to this 3A application, other than gas drainage boreholes. Additional follow-up consultation with the relevant Departments and key stakeholders as outlined within the Director-General's requirements was undertaken in October 2006 (refer to *Table 6.1*).

## 6.1 CONSULTATION PROCESS

The Guidelines for Best Practice Community Consultation in the New South Wales Mining and Extractive Industries (MCMPR, 2005) were applied during the consultation process. As well as this initial consultation, GCCM proposes that there will be regular subsidence management and consultation meetings with stakeholders during the mining of Longwalls 10 to 17. The stakeholders involved, and the frequency of these meetings, will be determined by the progress of subsidence and actual and predicted impacts on surface and sub-surface features.

Numerous communications between GCCM and XMO/Xstrata relevant to subsidence impacts on the Mt Owen Rail Spur and Water Pipeline have occurred since August 2004, while numerous communications have occurred between the same parties since December 2005 with respect to subsidence impacts on the Mt Owen Eastern Rail Pit, Mt Owen West Dump, Ravensworth East Tailings Pit and Glendell Open Cut.

The DEC Community Consultation Requirements Interim Guidelines were followed to ensure that the consultation process with indigenous groups was in compliance with DEC requirements. No additional archaeological surveys were undertaken for this Part 3A assessment as the entire Project Area was assessed during the preparation of the SMP (ERM, 2007).

Wonnarua Culture Heritage, Yarrawalk, Giwiirr Consultants, Aboriginal Native Title Elders Consultants, Hunter Valley Cultural Consultants and Wanaruah Local Aboriginal Land Council provided written notification of their interest in the project and were involved from the outset. Representatives of all six groups participated in the archaeological field work. Copies of the draft heritage assessment were sent to the six registered indigenous groups for their comment. The final version of the heritage report, incorporating comments from indigenous groups, was forwarded to DEC on 17 October 2006.

*Table 6.1 Summary of Consultation*

| Date | Stakeholder(s) Consulted | Consultation Method | Details |
|---|---|---|---|
| 10/10/05 | General Community | Newspaper advertisement | Advertisement placed in the Hunter Valley News inviting registration of interested indigenous groups for the Longwalls 10 to 17 SMP project (as per DEC Interim Guidelines). |
| 18/10/05 | Wanaruah Local Aboriginal Land Council, Registrar of Aboriginal Owners, NSW Native Title Services, Singleton Shire Council, Lower Wonnarua Tribal Council and DEC. | Letter | Letter sent informing of GCCM's intention to prepare an SMP application for Longwalls 10 to 17 and inviting registration of interested indigenous groups for the project (as per DEC Interim Guidelines). |
| 16/12/05 | Wonnarua Culture Heritage, Yarrawalk, Giwiirr Consultants, Aboriginal Native Title Elders Consultants, Hunter Valley Cultural Consultants and Wanaruah Local Aboriginal Land Council | Letter | Letter sent detailing the proposed methodology for the Longwalls 10 to 17 SMP survey for approval by the registered groups. |
| 21/12/05 | W Gardner, Glendell Tenements Pty Ltd, XMO, Xstrata, Telstra, EnergyAustralia, Singleton Shire Council, Department of Primary Industries, Department of Lands and Mine Subsidence Board | Letter | Letter sent to stakeholders informing of GCCM's intention to prepare an SMP application for Longwalls 10 to 17. |
| 23/12/05 | General Community | Newspaper advertisement | Advertisement placed in the Singleton Argus (local newspaper) informing of GCCM's intention to prepare an SMP application for Longwalls 10 to 17 (as per SMP Guidelines). |
| 29/12/05 | General Community | Newspaper advertisement | Advertisement placed in the Sydney Morning Herald (state newspaper) informing of GCCM's intention to prepare an SMP application for Longwalls 10 to 17 (as per SMP Guidelines). |
| 18/01/06 | W Gardner | Meeting | Formal Consultative Meeting 1 - Discussions regarding the Longwalls 10 to 17 SMP process, landowner concerns and subsidence management strategies. |

| Date | Stakeholder(s) Consulted | Consultation Method | Details |
|---|---|---|---|
| 15/6/06 | K Mills (SCT), M Baggott (WorleyParsons), S Westgate (AAR), D O'Brien (Xstrata), G Robinson (Xstrata), T Morris (XMO), N Ogden (Xstrata), A Falvey (PB), D Bajic (Barclay Mowlem), J Fisher (Thiess), T Howitt (Teal) and G Mostyn (PSM). | Meeting | Initial conclave meeting held at Xstrata's Bulga offices with stakeholders and technical experts to discuss the development of the Rail Line Subsidence Management Plan for Longwalls 7 to 9. |
| 21/6/06 | K Mills (SCT), M Baggott (WorleyParsons), A Falvey (PB), D Bajic (Barclay Mowlem), T Howitt (Teal) and A Waddington (MSEC). | Meeting | Technical meeting held in Sydney where subsidence and rail experts discussed subsidence predictions and potential impacts regarding the Rail Spur over Longwalls 7 to 9. |
| 22/6/06 | SD O'Brien (Xstrata), G Robinson (Xstrata), D Mellows (Xstrata) and S McPhee (Jim Knowles Group). | Risk Assessment Scoping Session | Meeting held at Xstrata's Bulga offices to determine the scope for the Rail Spur risk assessment for Longwalls 7 to 9. |
| 27/6/06 | K Mills (SCT), M Baggott (WorleyParsons), D O'Brien (Xstrata), T Morris (XMO), A Falvey (PB), D Bajic (Barclay Mowlem), T Howitt (Teal), A Waddington (MSEC), G Queenan (Thiess), B Butcher (Thiess), S LeBars (Thiess), M Fowler (PSM), W Stoddart (PN), J Green (PN), D Stewart (ARTC) and S McPhee (Jim Knowles Group). | Risk Assessment (Day 1) | Rail Spur risk assessment held at the Mid City Motor Inn in Singleton for Longwalls 7 to 9. |
| 29/06/06 | W Gardner, XMO, Xstrata, Telstra, EnergyAustralia, Singleton Shire Council, Department of Primary Industries, Department of Lands and Mine Subsidence Board. | Letter | Letter inviting stakeholders to the presentation of the draft SMP for Longwalls 10 to 17. |

| Date | Stakeholder(s) Consulted | Consultation Method | Details |
|---|---|---|---|
| 5/7/06 | K Mills (SCT), M Baggott (WorleyParsons), D O'Brien (Xstrata), G Robinson (Xstrata), T Morris (XMO), A Falvey (PB), D Bajic (Barclay Mowlem), T Howitt (Teal), G Queenan (Thiess) and B Butcher (Thiess). | Risk Assessment (Day 2) | Rail Spur risk assessment held at the Mid City Motor Inn in Singleton for Longwalls 7 to 9. |
| 7/7/06 | M Baggott (WorleyParsons), D O'Brien (Xstrata), G Robinson (Xstrata), T Morris (XMO), A Falvey (PB), D Bajic (Barclay Mowlem), T Howitt (Teal), A Waddington (MSEC), G Queenan (Thiess), B Butcher (Thiess), S LeBars (Thiess), M Fowler (PSM), W Stoddart (PN), J Green (PN) and D Stewart (ARTC). | E-mail | Draft copy of the Rail Spur risk assessment table sent to attendees via e-mail for review and comment regarding Longwalls 7 to 9. |
| 7/07/06 | Trevor Wells (XMO) and Nigel Charnock (XMO) | Presentation | Formal Consultative Meeting 3 - Presentation to stakeholders of Longwalls 10 to 17 SMP management strategies and overview of application. |
| 10/7/06 | D O'Brien (Xstrata), G Li (DPI), R Ramage (DPI). | Meeting | Meeting with DPI representatives held at Glennies Creek Colliery offices to discuss the Rail Line Management Plan for Longwalls 7 to 9. |
| 10/07/06 | W Gardner, Xstrata, Telstra, EnergyAustralia, Singleton Shire Council, Department of Primary Industries, Department of Lands and Mine Subsidence Board. | Letter | Additional invitation for all stakeholders to a second presentation for Longwalls 10 to 17 SMP given that a number of key stakeholders were unable to attend on the 7/07/06. |
| 11/7/06 | D O'Brien (Xstrata) | E-mail | Draft of the Rail Line Management Plan document sent to Xstrata via e-mail for review and comment in regards to Longwalls 7 to 9. |
| 12/7/06 | G Queenan (Thiess) and B. Butcher (Thiess). | E-mail | Draft of the Rail Line Management Plan document sent to Thiess via e-mail (at suggestion from Xstrata) for review and comment in regards to Longwalls 7 to 9. |

| Date | Stakeholder(s) Consulted | Consultation Method | Details |
|---|---|---|---|
| 13/7/06 | D O'Brien (Xstrata) | Meeting | Meeting at Sebel Kirkton Park to go through comments on the draft Rail Line Management Plan document from G. Robinson and D. O'Brien in regards to Longwalls 7 to 9. |
| 13/07/06 | Department of Planning | Part 3A Major Project Application | Major Project Application, Project Outline and Preliminary Environmental Assessment submitted to the Department of Planning for the continuation of longwall mining within Longwalls 10 to 17 (including installation of gas drainage boreholes) at Glennies Creek Colliery. |
| 17/07/06 | Glen Robinson (Xstrata), Mark Nolan (DPI), Brendan Behringer (SSC), Les Morgan (SSC) and Garry Moore (MSB). | Presentation | Formal Consultative Meeting 3 – Additional presentation to stakeholders of Longwalls 10 to 17 SMP management strategies and overview of application. |
| 18/07/06 | Wonnarua Culture Heritage, Yarrawalk, Giwiirr Consultants, Aboriginal Native Title Elders Consultants, Hunter Valley Cultural Consultants, Wanaruah Local Aboriginal Land Council, DEC and NSW Native Title Services. | Letter and draft copy of archaeology report | A draft copy of the Longwalls 10 to 17 SMP archaeology report was sent to all registered indigenous groups for comment (as per DEC Interim Guidelines). |
| 4/08/06 | Department of Planning | Part 3A Major Project Application - Public Exhibition | Major Project Application, Project Outline and Preliminary Environmental Assessment received by the Department of Planning and placed on public exhibition via the Departments website. Preliminary Environmental Assessment addresses the continuation of mining within Longwalls 10 to 17 in the Middle Liddell seam, including the installation of gas drainage boreholes. |
| 24/10/06 | W Gardner, XMO, Xstrata, Telstra, EnergyAustralia, Singleton Shire Council, Department of Primary Industries, Department of Environment and Conservation, Department of Natural Resources, Hunter-Central Rivers CMA and Mine Subsidence Board. | Letter | Informing stakeholders of the intent to submit a Part 3A application for Longwalls 10 to 17 and inviting any additional comments or concerns not raised within the SMP process for inclusion in the preparation of this assessment. |

| Date | Stakeholder(s) Consulted | Consultation Method | Details |
|---|---|---|---|
| 25/10/06 | Bob Corbett (AMCI), Joanne Woodhouse (ERM), Ken Mills (SCT), Andrew Dawkins (GeoTerra) and Fergus Hancock (DWE). | Meeting | A meeting was conducted to clarify issued raised in DWE (formally DNR) consultation letter provided with the DGR's for Longwalls 10 to 17, particularly the requirement for predictive modelling. |
| 5/01/07 | W Gardner, Glendell Tenements Pty Ltd, XMO, Xstrata, Telstra, EnergyAustralia, Singleton Shire Council, Department of Lands Wonnarua Culture Heritage, Yarrawalk, Giwiirr Consultants, Aboriginal Native Title Elders Consultants, Hunter Valley Cultural Consultants, Wanaruah Local Aboriginal Land Council, DEC and NSW Native Title Services. | Letter | Letter sent to stakeholders informing of GCCM's submission of the SMP application for Longwalls 10 to 17. |
| 5/01/07 | Department of Primary Industries (Minerals), Department of Primary Industries (Fisheries), DEC, Department of Natural Resources, Dam Safety Committee, Mine Subsidence Board and Sydney Catchment Authority. | Letter | Letter and copies of the final Longwalls 10 to 17 SMP sent to all members of the Interagency Subsidence Management Plan Review Committee. |
| 09/01/07 | General Community | Newspaper advertisement | Advertisement placed in the Singleton Argus (local newspaper) informing of GCCM's submission of the Longwalls 10 to 17 SMP application (as per SMP Guidelines). |
| 09/01/07 | General Community | Newspaper advertisement | Advertisement placed in the Sydney Morning Herald (state newspaper) informing of GCCM's submission of the Longwalls 10 to 17 SMP application (as per SMP Guidelines). |

DPI - Department of Primary Industries; XMO – Xstrata Mount Owen; MSB – Mine Subsidence Board; SSC – Singleton Shire Council; CMA – Catchment Management Authority

## 6.2 RESULTS OF CONSULTATION

### 6.2.1 Summary of Views and Perceptions

*Table 6.2* summarises stakeholders' views and concerns pertaining to the Project Area as communicated through the combined SMP and Part 3A community consultation process. *Table 6.2* also details management responses to the issues, as appropriate.

With adequate management measures in place, the potential subsidence impacts identified by the stakeholders and GCCM would not have high risk levels. Potential impacts of the proposed gas drainage boreholes were also identified as being low risk.

*Table 6.2 Summary of Stakeholders' Views and Concerns*

| Stakeholder | Views/Concerns Raised | Management Response |
|---|---|---|
| **W. Gardner** | Potential subsidence-related damage to fences. | GCCM and MSB, in consultation with the landowner, will manage any subsidence-related impacts on farm fences. In the event that any farm fence suffers damage due to subsidence-related impacts, remedial repairs will be carried out as soon as practicable by GCCM, in consultation with the landowner. Should subsidence-related damage to a fence risk unplanned stock movements and the damage is such that immediate repairs are not possible, GCCM will supply and install temporary electric fencing in consultation with the landowner (refer *Section 7.2.3*). |
| **Xstrata** | Potential for surface cracking. | There is no specific monitoring regime in place for surface cracking, other than on Forest Road. It is anticipated that landowners and GCCM personnel will carry out opportunistic visual inspections as the longwalls are extracted. The likelihood of personal injury due to surface cracking is reduced as the majority of surface area within the Longwalls 10 to 17 Project Area is located on private property, there is limited general public access and historically there has been no surface cracking detected as a result of subsidence at Glennies Creek Colliery (refer to *Section 14.2*). |
| | Potential impact of subsidence on aquifers. | Addressed in the Surface Water and Groundwater Study (refer to *Sections 8* and *9; Annex C*). There are no beneficial aquifers within the Project Area. |
| | Potential impact of subsidence on 1:100 year flood levels. | Subsidence will increase the left and decrease right overbank flows downstream of the Mt Owen Rail Spur for the 100 Year ARI design flood. However, the change is unlikely to cause major channel erosion in the short or long term (refer to *Section 8.2.4*). |
| | Potential impact of subsidence on Forest Road. | GCCM and MSB, in consultation with Singleton Shire Council and Department of Lands, will manage any subsidence-related impacts on Forest Road, with the management processes dependent on the level of impact and the consequences of the impact. Section *7.1.1* of this EA provides a description of the proposed management and monitoring procedures. |
| | Potential impact of subsidence on threatened species. | Addressed in the Flora and Fauna Assessment (*Section 11* and ERM, 2006b; *Annex E*). Subsidence will not impact any threatened species, habitat resources or lifecycle processes such that a local extinction would |

| Stakeholder | Views/Concerns Raised | Management Response |
|---|---|---|
| | | occur. |
| | Potential impact of subsidence on dams. | GCCM will, in consultation with the relevant landowner, remediate any dam that is damaged by subsidence (or has its storage capacity reduced by more than 10 percent) to a condition similar to that prior to subsidence. Should water be lost from a dam to the extent that livestock are impacted, an alternative water supply will be provided by GCCM, in consultation with the landowner. Section *8.5* of this EA provides a description of the proposed management and monitoring procedures. |
| | Potential impact of subsidence on Bettys Creek. | Based on the predicted consequences of subsidence, no specific mitigation measures are proposed for either the Bettys Creek main channel or floodplain. If adverse effects on Bettys Creek due to subsidence are observed, the creek will be rehabilitated to an appropriate standard to return the creek and floodplain to a similar state as existed prior to subsidence. *Section 8.2.7* of this EA provides a description of the proposed monitoring procedures. |
| | Potential impact of subsidence on XMO's Bettys Creek diversion. | On the basis that the proposed Bettys Creek diversion schedule is achieved, the XMO diversion (described in *Section 8.3*) will be unaffected by subsidence for approximately 3.5 years after its construction. Throughout this period, the stability and operation of the channel can be monitored to provide baseline data. If adverse effects due to subsidence are observed, the diversion will be rehabilitated to an appropriate standard to return the diversion channel to a similar state as existed prior to subsidence. |
| | Potential impact of subsidence on Mt Owen Eastern Rail Pit. | Where the Eastern Rail Pit is backfilled and rehabilitated prior to undermining as indicated within the Mt Owen EIS (Umwelt, 2003), the proposed longwall mining will not create a risk for either GCCM or XMO operations (Umwelt, 2004d). In the event that approval is received for the use of the Eastern Rail Pit for tailings emplacement, vertical subsidence may make it necessary to build up the level of embankment control structures if the dam is close to full (SCT, 2007). Management will require ongoing consultation with XMO. GCCM will provide monitoring data and other subsidence information to XMO/Xstrata. |

| Stakeholder | Views/Concerns Raised | Management Response |
|---|---|---|
| | Potential impact of subsidence on Glendell operations. | No detail of the precise location of mine infrastructure for the proposed Glendell Open Cut Mine is available and it is not possible to carry out a detailed risk assessment at this time. GCCM will provide monitoring data and other subsidence information to XMO/Xstrata which they can consider and take into account in developing their Mine Operations Plan. Under its agreement with MMC, Glendell has assumed responsibility for managing the impact of subsidence on the proposed overburden storage area. The edges of this dump would be expected to experience vertical subsidence up to about 1.5m. Some lateral dilation of the dump slopes would also be expected and surface cracking may be evident near the top of the slope. |
| | Potential impact of subsidence on Ravensworth East Tailings Pit (TP2). | Without specific detail of the embankment geometries, it is difficult to be precise about the likely impacts. If this pit is filled with tailings, the critical impacts from subsidence are likely to be differential vertical subsidence with the potential for tailings to overtop perimeter embankments. These impacts, if they occur, would appear capable of being managed through control of the tailings level and building up perimeter bunds. GCCM will cooperate with Xstrata/XMO by providing them with relevant monitoring data to enable them to develop their plans and appropriate management strategies. |
| | Potential impact of subsidence on Mt Owen Rail Spur. | A specific management plan for the Mt Owen Rail Spur will be submitted to DPI separately and will be based on the approved Rail Line Management Plan for Longwalls 7 to 9. The Plan will be prepared in cooperation with Xstrata and will contain a series of Action Plans which will provide for the circumstances in which the Rail Spur can safely be used, by implementing the monitoring and mitigation measures itemised in the Action Plans, and in accordance with the RS Act. GCCM will commit to undertake each step for which it or its contractors have responsibility and control, together with a further commitment to seek to ensure the implementation of the management plan and the actions of others who (by reasons of ownership of infrastructure or the land, or their contractual obligations) are ultimately responsible for that action item. Xstrata has agreed to take responsibility for, and to carry out, all mitigation repair and management measures required in relation to the Rail Spur. |
| | Potential impact of subsidence on Mt Owen pipeline. | Prior to undermining the Mt Owen Rail Spur a specific management plan incorporating the water pipeline will be developed based on previous experience and the outcomes of monitoring over Longwalls 7 to 9. The development of the management plan at a later stage will allow more detailed and appropriate monitoring strategies to be developed as a result of previous experience. |

| Stakeholder | Views/Concerns Raised | Management Response |
|---|---|---|
| | That GCCM do not have current development consent or approval to mine. | GCCM denies this assertion. A description of the planning approval pertaining to Longwalls 10 to 17 is provided in Section *1.2* of this report. |
| | That individual property management plans should be developed for each property within the Project Area. | GCCM are of the opinion that all stakeholder-identified subsidence-related issues are addressed within this application, with a number of the issues being common to multiple stakeholders. As such there is no benefit in having individual property management plans. |
| **Indigenous Groups** | Wish to be involved in the archaeology assessment. | The DEC Community Consultation Requirements Interim Guidelines were followed to ensure that the consultation process with indigenous groups was satisfactory. All registered groups participated in the survey and were given the opportunity to provide comments and recommendations for the Heritage assessment. |
| **Telstra** | Potential impact of subsidence on telecommunications infrastructure. | A specific management plan addressing the Telstra Assets has been developed in consultation with Telstra. All monitoring will be undertaken by Telstra at the completion of each longwall panel. |
| **EnergyAustralia** | Potential impact of subsidence on electricity transmission lines. | GCCM, in consultation with EnergyAustralia, will manage any subsidence-related impacts on the transmission line, with the management processes implemented dependent on the level of impact and the actual and potential consequences. In the event that the transmission line is damaged, repairs will be instigated as soon as practicable by GCCM, in consultation with EnergyAustralia. *Section 7.1.3* of this EA provides a description of the proposed management and monitoring procedures. |
| **Department of Lands** | Potential impact of subsidence on Forest Road. | GCCM and MSB, in consultation with Singleton Shire Council and Department of Lands, will manage any subsidence-related impacts on Forest Road, with the management processes dependent on the level of impact and the consequences of the impact. *Section 7.1.1* of this EA provides a description of the proposed management and monitoring procedures including a response action matrix. |
| **Singleton Shire Council** | Potential impact of subsidence on Forest Road. | GCCM and MSB, in consultation with Singleton Shire Council and Department of Lands, will manage any subsidence-related impacts on Forest Road, with the management processes dependent on the level of impact and the consequences of the impact. *Section 7.1.1* of this EA provides a description of the proposed |

| Stakeholder | Views/Concerns Raised | Management Response |
|---|---|---|
| | | management and monitoring procedures including a response action matrix. |
| **Department of Natural Resources** | Surface and Groundwater Monitoring | During the consultation meeting on 25/10/2006 with DWE representatives, it was agreed that:<br>• the surrounding Xstrata operations have substantially more drawdown than GCCM and without all of the raw data from these mines, modelling cannot be accurately undertaken;<br>• standard MODFLOW modelling could be undertaken but would not provide realistic data and would not account for the goaf, vertical movement or horizontal movement; and<br>• no groundwater dependant ecosystems have been identified within the Project Area and approved XMO diversion of Bettys Creek would have a much greater effect on the Bettys Creek environment that the proposed Longwalls 10 to 17.<br>GeoTerra proposed the use of the Winton Gale style of groundwater modelling, to be completed following the submission EA but prior to mining Longwall 10. Fergus Hancock (DWE) indicated that this approach was acceptable provided that the scope and aims were clearly outlined in the EA (refer to *Section 9.2*) and the statement of commitments (refer to *Section 15*).<br><br>Based on recent discussions with DWE, MODFLOW modelling has been undertaken for inclusion within this assessment (refer to *Section 9.2*). The results of this modelling will be refined using the more accurate Winton Gale approach and submitted to the DoP for approval prior to mining Longwall 10, and will be based on specific data collected during the mining of Longwalls 8 and 9. |

| Date | Stakeholder(s) Consulted | Consultation Method | Details |
|---|---|---|---|
| 1/02/06 | Michael Lloyd (DPI), Gang Li (DPI), Mark Nolan (DPI) and Ray Ramage (DPI) | Meeting | Discussions regarding the scope of the Longwalls 10 to 17 SMP application and some guidance on the SMP process |
| 2/02/06 | Wonnarua Culture Heritage, Yarrawalk, Giwiirr Consultants, Aboriginal Native Title Elders Consultants, Hunter Valley Cultural Consultants and Wanaruah Local Aboriginal Land Council. | Letter | Letter sent to confirm the Longwalls 10 to 17 SMP survey on 14/02/06 |
| 6/02/06 | Wanaruah Local Aboriginal Land Council | Letter | Letter sent to confirm the Longwalls 10 to 17 SMP fieldwork on 14/02/06 and inductions on 13/02/06 |
| 8/02/05 | Glen Robinson (Xstrata), Trevor Wells (XMO), Tony Morris (XMO) and Nigel Charnock (XMO). | Meeting | Formal Consultative Meeting 1 - Discussions regarding the Longwalls 10 to 17 SMP process, landowner concerns and subsidence management strategies. |
| 26/04/06 | Glen Robinson (Xstrata) | Letter | Response to concerns raised as a result of Formal Consultative Meeting 1 regarding the Longwalls 10 to 17 SMP. |
| 26/05/05 | Glen Robinson (Xstrata), Trevor Wells (XMO) and Nigel Charnock (XMO). | Meeting | Formal Consultative Meeting 2 - Further discussions regarding the Longwalls 10 to 17 SMP process, landowner concerns and subsidence management strategies. |
| 29/05/06 | Glen Robinson (Xstrata) | Letter | Formal request for additional information in regards to the proposed Glendell workings within the Longwalls 10 to 17 SMP Project Area as per Formal Consultative Meeting 2. |
| 13/06/06 | W. Gardner | Meeting | Formal Consultative Meeting 2 - Further discussions regarding the Longwalls 10 to 17 SMP process, landowner concerns and subsidence management strategies. |

# 7 INFRASTRUCTURE AND UTILITIES

## 7.1 PUBLIC UTILITIES

### 7.1.1 Roads

The only public road identified within the Project Area is the secondary Forest Road (*Figure 5.1*) that heads in a general northerly direction to the east of the Mt Owen Rail Spur and traverses the area above Longwalls 9 to 14. It is a single lane gravel thoroughfare typical of many rural access roads in Singleton Shire, and provides limited access to rural land in the area between Glennies Creek Road and the northern Ravensworth district. There is a locked gate limiting access from near the northern edge of Longwall 12. The road beyond this gate is controlled by Mt Owen Mine.

Forest Road is maintained by Singleton Shire Council as a Shire road for a distance of approximately 2.1 km from its intersection with Glennies Creek Road. Beyond this point, the road becomes a Crown road. The Shire section of road has table drains on either side; no culverts, bridges or causeways and the current road conditions limit traffic speeds to approximately 40 – 50km/h. The Crown road section degenerates to little more than a track, showing little evidence of maintenance. There is a pipe culvert on the Crown road section where the road crosses Bettys Creek (*Figure 5.1*) above Longwall 13. Forest Road is presently used predominantly by persons servicing the mining and cattle grazing industries. Currently there are no inhabited dwellings serviced by the road.

Hard surfaces, such as roads, are likely to display perceptible tension cracking, compression humps and local changes in grade, both along and across the road. Changes in surface elevation due to vertical subsidence may impact the grade of Forest Road and the effectiveness of water drainage away from the road surface. However, based on observations of the agricultural land over Longwall 6 that has been undermined, it is unlikely that the serviceability of the road will be significantly affected, with the formation of compression humps and/or subsidence cracks not expected to present a level of hazard that is inconsistent with the nature of the road. Remediation would be expected to be within the scope of normal maintenance.

The installation and operation of the gas drainage boreholes will not impact Forest Road.

*Monitoring*

The monitoring of subsidence impacts will comprise three phases.

- pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment;

- monitoring within the predicted subsidence impact zone during mining to allow the implementation of any required subsidence impact management processes. This will include documented daily visual inspections of the potentially affected section of Forest Road when the longwall face is approaching within 50m, and continuing until the face is 200m past (or completed). Documented weekly visual inspections will also be undertaken when the longwall face is approaching within 150m, and continuing until the face is 500m past (or completed); and

- post-mining monitoring to establish that no further subsidence impacts are likely and to allow the completion of subsidence impact management processes. This will include a documented visual inspection of the potentially affected section of Forest Road once the second subsequent longwall face has retreated a minimum of 500m past (or is complete). A joint inspection by Singleton Council's Manager Works and a representative of Glennies Creek Coal Management will be undertaken once the second subsequent longwall panel is complete.

*Management*

GCCM and Mines Subsidence Board (MSB), in consultation with Singleton Shire Council and Department of Lands, will manage any subsidence-related impacts on Forest Road, with the management processes dependent on the level of impact and the consequences of the impact.

Prior to the undermining of Forest Road, signs will be erected by GCCM at points on the road at the edge of the Longwall 10 to 17 subsidence impact zone in order to warn road users of the potential hazards of cracks, dips, humps and water ponding. Similar signage is already in place for Longwalls 7 to 9 and it is planned that these signs will be relocated to encompass the area of potential subsidence impact from Longwalls 10 to 17 as longwall mining advances. The signs also display a contact phone number to enable subsidence impacts to be reported to GCCM by road users.

GCCM will provide Singleton Shire Council, the Department of Lands and landowners who border Forest Road with a monthly update of the location of the longwall face relative to the road, and the estimated progress of the longwall during the following month. This will ensure that stakeholders are aware of impending potential subsidence impacts on the road.

After completing the post-mining inspection of Forest Road, if required, the road will be restored to a similar standard as existed prior to mining, with any

subsidence-related remedial repair works required to the Crown road portion of Forest Road as a result of subsidence impacts being carried out at the expense of GCCM and MSB: the Crown portion of Forest Road is not currently maintained by the Department of Lands.

Any instance of subsidence-related damage to Forest Road will be managed as per the Forest Road Action Response Matrix (*Table 7.1*).

### *7.1.2 Culverts*

Other than on mine-constructed and maintained roads accessing mining facilities on private land, there is only one pipe culvert within the Project Area. This culvert is located where Forest Road crosses Bettys Creek above Longwall 13 (*Figure 5.1*). Public access is restricted to the culvert as the relevant section of road is located to the north of the locked gate. The road beyond this gate is controlled by the Mt Owen Mine.

The pipe culvert is eroding where the discharge on the downstream side is under-cutting the road formation. This erosion has been on-going and is likely to continue irrespective of mining. Some form of remedial action is likely to be required by XMO before the culvert is impacted by Longwall 13 (SCT, 2007).

Although mining is expected to temporarily flatten current stream channel gradients by up to 1 in 100, this change is unlikely to be significant in terms of halting the ongoing erosion at this culvert (SCT, 2007). The pipe culvert will be included with the Forest Road monitoring programs as discussed in *Section 7.1.1.1*.

The installation and operation of the gas drainage boreholes will not impact the pipe culvert.

*Table 7.1 Forest Road Action Response Matrix*

| | Area Affected | | | |
|---|---|---|---|---|
| **Nature of Impact** | **Full Road Width** | **Half Road Width** | **Road Edge** | **Road Shoulder / Easement** |
| **Surface Cracking >100mm wide** | **HIGH** | **HIGH** | MODERATE | **LOW** |
| **Surface Cracking 20 – 100mm wide** | MODERATE | MODERATE | **LOW** | **LOW** |
| **Surface Cracking <20mm wide** | MODERATE | **LOW** | **LOW** | **LOW** |
| **Water Ponding** | **HIGH** | MODERATE | **LOW** | **LOW** |
| **Other Subsidence Impacts eg. humps, dips etc.** | MODERATE | **LOW** | **LOW** | **LOW** |

**HIGH:**

- Barricade affected area.
- Erect warning signs on both sides of the hazard.
- Notify Singleton Shire Council or Department of Lands immediately and seek instructions on how to proceed.
- If the full roadway width is affected, ensure a person remains at the barricade until instructions received from Singleton Shire Council or Department of Lands.
- Document inspection results and all actions on Subsidence Inspection Form – Forest Road.

MODERATE:

- Erect warning signs on both sides of the hazard.
- Notify Singleton Shire Council or Department of Lands during work hours on the next business day and seek instructions on how to proceed.
- Document inspection results and all actions on Subsidence Inspection Form – Forest Road.

**LOW:**

- Notify Singleton Shire Council or Department of Lands during work hours on the next business day and seek instructions on how to proceed.
- Document inspection results and all actions on Subsidence Inspection Form – Forest Road.

### *7.1.3 Electricity Transmission Lines and Associated Plants*

The Project Area is traversed by an aerial electricity transmission line. This line, an 11 kV local supply line suspended on wooden poles, originates from the Glennies Creek Road line (*Figure 5.1*). EnergyAustralia (Muswellbrook office) has advised that the line does not currently service any subscribers but remains energised.

Ground tilt due to subsidence may impact on aerial transmission lines by causing increased sag or tension in the lines when poles tilt towards, or away, from each other. Depending on their location relative to the longwall panels, the poles may also lay over in a direction at an angle to the run of the lines.

Longwalls 2 to 7 have previously undermined the eastern extent of the 11kV transmission line with no adverse subsidence impacts. SCT (2007) indicates that the general industry experience of undermining similar structures typically does not affect the serviceability of the powerlines supported on single poles. As such, interruptions to electricity supply would not be expected. EnergyAustralia have indicated that they have no serious concern in relation to the predicted minor tilting that may occur due to subsidence. In any event the line does not currently service any consumers.

*Monitoring*

The monitoring of subsidence impacts will comprise three phases.

- pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment. This will comprise documented visual inspections of the transmission line to record pre-mining status, including condition and tilt of the poles;

- monitoring within the predicted subsidence impact zone during mining to allow the implementation of subsidence impact management processes as required. This will include documented weekly visual inspections of the potentially affected sections of the transmission line (including sections above the previous two longwall panels) when the longwall face is approaching within 150m, and continuing until the face is 500m past (or completed). Any additional monitoring by EnergyAustralia representatives will be undertaken at a frequency determined by EnergyAustralia; and

- post-mining monitoring to establish that no further subsidence impacts are likely and to allow the completion of subsidence impact management processes. This will include a documented visual inspection of the potentially affected sections of the transmission line once the second subsequent longwall face has retreated a minimum of 500m past (or is complete). A documented visual inspection of the potentially affected sections of the transmission line will also be undertaken once the second subsequent longwall panel is complete.

Visual inspections of the transmission line through the various phases will be recorded on a Subsidence Inspection Form and include photographic records. In the event that the line suffers damage due to subsidence-related impacts, remedial repairs will be carried out as soon as practicable by GCCM, in consultation with EnergyAustralia.

*Management*

GCCM, in consultation with EnergyAustralia, will manage any subsidence-related impacts on the transmission line, with the management processes implemented dependent on the level of impact and the actual and potential consequences.

GCCM will provide EnergyAustralia with a monthly update of the location of the longwall face relative to the transmission line, and the estimated progress of the longwall during the following month. This will ensure that EnergyAustralia are aware of impending potential subsidence impacts on their asset. The final notification will be provided at the completion of Longwall 10 as requested by EnergyAustralia.

In the event that the transmission line is damaged or in the event that damage appears to be likely, repairs will be instigated as soon as practicable by GCCM, in consultation with EnergyAustralia. This may require the placement of individual conductors in sheaves during the period of mining to prevent overloading of the conductor fixing points and/or timber cross-members.

### *7.1.4 Telecommunication Assets*

Telecommunication lines owned and operated by Telstra have been identified within the Project Area. The Telstra assets within the area comprise local distribution cabling and associated pits, conduit and elevated joints supporting this network (see *Figure 5.1*). The cabling comprises a 10 pair and 6 pair/0.64 cable and has a total length of approximately 3000m from its junction with a main cable on the southern side of Glennies Creek Road to its termination point. The cable runs along Forest Road from Glennies Creek Road, leaving Forest Road where it makes a ninety degree turn to the west and subsequently traverses agricultural land to its termination point above Longwall 13.

The 10 pair and 6 pair/0.64 cable is relatively robust in construction, comprising a buried grease-filled cable with a polyethylene sheath and jointed in both elevated joints and plastic and asbestos/cellulose pits. The cable has been generally installed in relatively uniform soil types with no surface evidence of the trench line being ripped into rock.

Telstra have advised that there are currently no subscribers to the telecommunications line beyond the GCCM ventilation fan site on Forest Road. Telstra also advises that there are no fibre optic cables within the Project Area.

Estimated subsidence movements are likely to develop gradually as mining proceeds. It is likely that subsidence movements will begin to become apparent as each longwall face approaches within 150m of the Telstra cable and infrastructure, and will not cease until the face is approximately 500m past (or complete, whichever is earlier). However, most of the estimated movements would be expected in the interval between directly undermining the assets and the progression of the longwall face 300m past the Telstra assets (or longwall completion, whichever is earlier) (SCT, 2005).

There is some vulnerability to cable damage as a result of the predicted subsidence and development of surface cracks. However, this risk is mitigated by:

- the cable being relatively robust in construction, consisting of a grease filled cable within a polyethylene sheath;
- the cable being installed in uniform soils, with no surface evidence of the trench line being ripped into rock; and
- the minor consequence to loss of service since the last service is the ventilation shaft south of the Project Area.

The proposed gas drainage boreholes will be positioned such that they do not impact any telecommunication assets.

As there are no current subscribers on the line beyond the GCCM ventilation fan site, the impact of damage to the infrastructure would not result in a loss of service to any customer.

*Monitoring*

Prior to mining, line testing on the spare pairs in the 10 and 6 pair cable across the Project Area will establish the baseline condition of the cable, with the test being repeated at the completion of each longwall panel. If significant surface subsidence is observed during routine monitoring, physical inspection of the network will be undertaken. All monitoring will be undertaken by Telstra or their sub-contractors.

*Management*

GCCM will provide Telstra with a monthly update of the location of the longwall face relative to the Telstra cable, and the estimated progress of the longwall during the following month. This will ensure that Telstra is aware of impending subsidence impacts on their assets.

## 7.2 FARM LAND AND FACILITIES

### 7.2.1 *Agricultural Utilisation or Agricultural Suitability of Farm Land*

NSW Agriculture's Agricultural Land Classification system has been used to classify the agricultural suitability of the land within the Project Area. All lands within the Project Area have been delineated as Class 3 lands, ie "grazing land or land well suited to pasture improvement". ERM has further subdivided the Class 3 lands into 3p (pastures) or 3c (cultivation), both of which are present in the area (ERM, 2006b).

Surface cracking is likely to be less perceptible on agricultural land than on hard, bare surfaces such as roads. Adverse short term impacts to small areas of pasture are possible as a result of temporary subsidence-induced ponding. However, GCCM proposes to drain any such ponds. Assuming that this drainage occurs soon after ponding, few long term affects are predicted and it is not expected to significantly impact the use of the land for livestock grazing.

### 7.2.2 *Farm Buildings/Sheds*

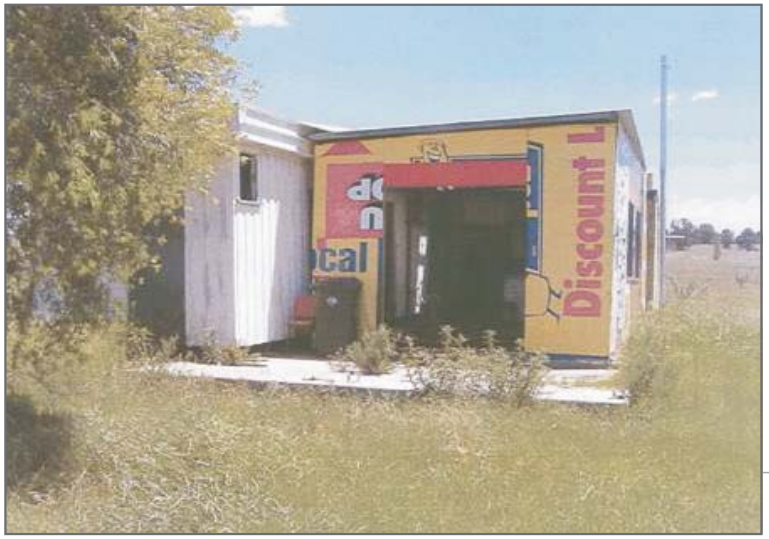
A steel framed farm building is located over Longwall 10. The structural framing for this building is founded on individual concrete footings and it has an earth floor. Currently the shed is empty, although XMO/Xstrata indicate that it is used for storage.

Subsidence movements on the farm shed would range up to about 250mm vertically and 200mm horizontally from one end of the building to the other for maximum tilts and strains. SCT (2007) suggests that 25mm of closure or stretching at the eaves line relative to the floor could be expected and it is likely that this level of movement would result in visible impacts to the cladding and the framing which would be stretched, but not necessarily rendered unserviceable. Given the lightweight nature of the structure, the two management options that would seem most viable, would be to:

- leave the shed in place and monitor its behaviour with a view to repairing it or totally replacing it if it became unserviceable; or
- disassemble it and reconstruct it again after subsidence is complete with temporary cover provided for storage in the interim.

The decision as to which option will be adopted will be determined in consultation with XMO/Xstrata prior to the commencement of mining Longwall 10.

A disused structure founded on a concrete slab is located over Longwalls 10 and 11 and is understood to be earmarked for demolition before undermining. This abandoned dwelling is not built to contemporary standards for residential dwellings (refer to *Photograph 3* and *4*) and has not been assessed as a residence. If it is still standing when undermined, subsidence may cause




**Photograph 3**

Disused Dwelling over Longwalls 10 and 11.

**Photograph 4**

Farm Shed over Longwall 10.

minor cracking and tilting of the concrete slab. Other subsidence movements would not be expected to significantly change the current status of the structure.

*Monitoring and Management*

The monitoring of subsidence impacts on the farm buildings, if still standing, will comprise three phases, ie subject to the landowner permitting access.

- pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment;
- monitoring within the predicted subsidence impact zone during mining to allow the implementation of subsidence impact management processes as required. This will include documented monthly visual inspections of the buildings when the longwall face is approaching within 150 metres and continuing until the face is 500m past (or completed); and
- post-mining monitoring to establish that no further subsidence impacts are likely and to allow the completion of subsidence impact management processes. This will include a documented visual inspection of the buildings once the second subsequent longwall panel is complete.

Visual inspections of the buildings through the various phases will be recorded on a Subsidence Inspection Form and include photographic records. In the event that any farm building suffers damage due to subsidence-related impacts, remedial repairs will be carried out as soon as practicable by GCCM and MSB in consultation with the landowner, in order to return the buildings to their status as recorded during the pre-mining monitoring.

GCCM and MSB, in consultation with the landowner, will manage any subsidence-related impacts on farm buildings. The management processes employed will depend on the level of impact and the consequences of the impact.

GCCM will provide landowners with a monthly update of the location of the longwall face and the estimated progress of the longwall during the following month. This will ensure that landowners are aware of impending potential subsidence impacts on the buildings.

### *7.2.3 Fences and Gates*

As the land within the Project Area is predominantly used for grazing, there are a number of fences that traverse the area. These include those dividing landholdings into paddocks, boundary fencing between neighbouring landholdings and along Forest Road and the Mt Owen Rail Spur as shown on *Figure 5.1.* The fences are predominantly of a multiple wire strand type with a combination of timber and steel posts. There are also a number of farm gates at various locations in the fence lines.

Fences within the Project Area are expected to experience the full range of subsidence movements, although specific subsidence predictions for individual fences and gates are dependent on their location relative to the individual longwall panels.

Relative horizontal movements of up to 250mm may be experienced along sections of fence up to 300m long. This level of relative movement may be sufficient to cause wires on well maintained fences to become over tensioned or slack enough to compromise stock control (SCT, 2007). However, given the poor condition of the majority of fences within the Project Area, relative movements of up to 250mm would not cause any change in their current level of serviceability.

Farm gates may also be adversely impacted by subsidence movements. There is potential that movement of a gate's hinge or hitching post may result in the gate being unable to open or close fully. GCCM has previously undermined farm fences and gates (Longwalls 1 to 6) with only minor repairs required. Consequently, significant loss of gate serviceability is not expected.

*Monitoring*

The monitoring of subsidence impacts will comprise three phases, subject to the landowner permitting access.

- pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment;

- monitoring within the predicted subsidence impact zone during mining to allow the implementation of subsidence impact management processes as required. This will include documented weekly visual inspections of the potentially affected sections of fence lines when the longwall face is approaching within 150 metres and continuing until the face is 500m past (or completed); and

- post-mining monitoring to establish that no further subsidence impacts are likely and to allow the completion of subsidence impact management processes. This will include a documented visual inspection of the potentially affected sections of fence lines once the second subsequent longwall panel is complete.

Visual inspections of farm fences and gates throughout the various phases will be recorded on a Subsidence Inspection Form and include photographic records.

*Management*

GCCM and MSB, in consultation with the landowner, will manage any subsidence-related impacts on farm fences, with management processes implemented dependant on the level of impact and the consequences of that impact.

In the event that any farm fence suffers damage due to subsidence-related impacts, remedial repairs will be carried out as soon as practicable by GCCM, in consultation with the landowner. If the landowner wishes to carry out the repairs themselves, GCCM will reimburse them for reasonable time and costs expended in completing the repairs.

Should subsidence-related damage to a fence risk unplanned stock movements and the damage be such that immediate repairs are not possible, or there is a risk of unplanned stock movements whilst repairs are carried out, GCCM will supply and install temporary electric fencing in consultation with the landowner.

## *7.3 INDUSTRIAL ESTABLISHMENTS*

### *7.3.1 Ravensworth East Pit*

The Ravensworth East mining lease extends across Longwalls 14 to 17 on the western side of the Mt Owen Rail Spur (*Figure 5.1*) while the Ravensworth East Open Cut extends into the very north-western corner of the Project Area, but does not extend over the Longwall 17 goaf. In accordance with the latest Mt Owen Annual Environmental Management Report (AEMR) dated 1 August 2005 – 31 July 2006, the estimated remaining mine life for the Ravensworth East mine was nine years (until 2015). The subsidence impacts on the Ravensworth East Open Cut are likely to be insignificant and imperceptible for all practical purposes because it is largely outside the Project Area.

Development of the Ravensworth East mine has included the excavation of two shallow box cuts (tailings pits) up to 35m below the surface. The northern pit was completed in August 2004 and placement of tailings from the Mt Owen CHPP has commenced. Mining in the southern pit (TP2) was completed in May 2005 (Mt Owen AEMR, 2005) and has been partially backfilled. The Mt Owen EIS (Umwelt, 2003) and the latest Mt Owen Complex Mine Operations Plan (MOP) (January 2006), indicate that TP2 is located within the north-western portion of the Project Area, over Longwalls 15 to 17.

The Mt Owen Complex MOP (2006) has identified the southern tailings pit as an emplacement area until 2010, with the 'Staged Mining and Rehabilitation Plan as at Year 2010' identifying the southern portion of TP2, ie above

Longwalls 15 to 17, as 'proposed future tailings emplacement area – subject to Section 126 Application' (Mt Owen MOP, 2006). The proposed GCC operations will not undermine the southern portion of TP2 until late 2011 but, in the absence of a Section 126 Approval, the final use of the southern section at that time cannot be confirmed.

XMO will be required to obtain further approval if TP2 is to be filled with tailings (Mt Owen Complex MOP, 2006) and such an application would need to be assessed in the light of all information available at that time, including this application and the SMP (if approved). In this event, there are possible impacts on the tailings pit. For example, if this pit is filled with tailings, the critical impacts from subsidence are likely to be differential vertical subsidence with the potential for tailings to overtop perimeter embankments. These impacts, if they occur, would appear capable of being managed through control of the tailings level and building up perimeter bunds to reflect the projected vertical subsidence. However, in the absence of specific detail of the embankment geometries, it is difficult to be precise about the likely impacts. However, SCT (2007) considers that there would not appear to be any impediment to managing these impacts.

*Management*

XMO will be responsible to manage any subsidence-related impacts on the Tailings Pit (TP2), since XMO has control of, and responsibility for, the operation of the pit and its rehabilitation on the completion of mining. On the basis of the assessment carried out by SCT (2007), the likely management measures involve building up the level of the embankment control structures if the tailings dam is close to full. In this regard, GCCM will cooperate with XMO/Xstrata by providing them with relevant monitoring data to enable them to develop their plans and appropriate management strategies.

*Monitoring*

It is anticipated that XMO/Xstrata will carry out regular visual inspections of the tailings pit in accordance with their operational obligations, and that they will notify GCCM of any detected damage or impact due to subsidence. Any additional visual inspections of the tailings pit undertaken by GCCM during the mining of Longwalls 10 to 17 will be recorded on a Subsidence Inspection Form and any detected damage or impact will be photographed, recorded and provided to XMO.

### *7.3.2 Glendell Open Cut and Haul Road*

The approved but as yet undeveloped Glendell Open Cut is located outside of the Project Area on the western side of Bettys Creek (see *Figure 5.1*). No detail of the precise location of mine infrastructure for the proposed Glendell Open Cut Mine is available and it is not possible to carry out a detailed risk

assessment at this time. It is understood that XMO is currently seeking a modification of the development consent and are proposing to commence works in late 2007 (J Watson – XMO, *pers. comm.*).

The latest Glendell "Application to Carry out Open Cut Mining Operation", dated February 1998, which expired in 2004, shows an overburden dump overlying Longwalls 14, 15 and 16. This has been confirmed through consultation with Xstrata representatives, with the proposed location of the overburden dump shown in *Figure 5.1*. The edges of this dump would be expected to experience vertical subsidence although given the location of the dump as indicated within the Glendell Application to Carry out Open Cut Mining Operation (1998) and confirmed through consultation, vertical subsidence would be expected to be around 0.5m. Some lateral dilation of the dump slopes would also be expected and surface cracking may be evident near the top of the slope. Inspection and filling of any open cracks would be recommended at the completion of Longwalls 14 to 16.

Glendell has accepted liability for subsidence-induced damage which might be caused to its overburden dump under the terms of a Mining Purposes Lease Application (MPLA) Agreement with Maitland Main Collieries (MMC) dated 13 February 1996. In response to MMC agreeing to withdraw its objection lodged with DPI to Glendell's application for Mining Purposes Leases to enable the emplacement of overburden on that land, Glendell agreed to:

> *indemnify MMC against all claims costs demands losses or expenses suffered by Glendell for which MMC would otherwise be liable in connection with damage to the emplacement due to subsidence arising out of or in connection with MMC's underground mining activities carried out under CL382 on the Land provided that the mining is carried out by MMC in accordance with approvals from the Department of Mineral Resources.* (clause 4)

Managing and repairing any subsidence damage to the overburden dump is therefore the responsibility of Glendell.

The Glendell haul road traverses the north-western corner of the Project Area (*Figure 5.1*), although it does not cross any of the longwall panels. The haul road will enable the Mt Owen CHPP to receive and process ROM coal from both Ravensworth East and Glendell Mines. The haul road will be approximately 30m wide and constructed from overburden (Umwelt, 2003).

This Environmental Assessment has been prepared on the basis of the approved plans, it being assumed that any proposed changes:

- would need to be the subject of further planning approval;
- would need to be assessed by Glendell/Xstrata; and
- considered by the approval body having regard to all information available at that time, including this application and the SMP (if approved).

In addition, it is assumed that the leaseholders must obtain acceptance of a Mine Operations Plan prior to commencing the Glendell Open Cut Mine, and that any such application would need to be considered having regard to all information available at that time.

### *7.3.3 Mt Owen Eastern Rail Pit*

The Mt Owen Eastern Rail Pit (*Figure 5.1*) is located above Longwalls 13 to 16 and will mine the shallow Piercefield (Ravensworth) Seam to 35m below the surface on the eastern side of the Mt Owen Rail Spur.

Mining in the Eastern Rail Pit is described in the Mt Owen EIS (Umwelt, 2003) and was approved by the Minister for Planning on 8 December 2004. Mining will continue for approximately three years with backfilling of the pit as mining progresses. Overburden from the initial mining area of the Eastern Rail Pit will be placed within the West Dump (*Figure 5.1*). The current understanding based on the Mt Owen EIS (2003), the latest Mt Owen Mine Operations Plan (MOP) dated January 2006 and ongoing consultation between XMO and GCCM, is that work on the Eastern Rail Pit commenced in August 2006 and is expected to be completed in March 2007. By comparison, extraction of Longwall 13 is projected to commence mid 2010.

The approved rehabilitation plan for the Eastern Rail Pit involves backfilling to ground level and reshaping to approximate the pre-mining contours. However, during the consultation undertaken with XMO/Xstrata as part of the preparation of the SMP Application for Longwalls 10 to 17, XMO/Xstrata indicated that the final use of the Eastern Rail Pit may be a tailings dam, although this has not been confirmed and does not as yet have planning approval.

This assessment assumes that the Eastern Rail Pit will either be backfilled with waste rock as approved, or tailings. However, it is also assumed that any proposed future changes will need to be the subject of further approval (as acknowledged in the Mt Owen Complex MOP dated January 2006) and that such changes would need to be assessed by XMO/Xstrata and considered by the approval body having regard to all information available at that time, including this application and the SMP (if approved).

Where the Eastern Rail Pit is backfilled and rehabilitated prior to undermining as indicated within the Mt Owen EIS (Umwelt, 2003), the proposed longwall mining will not create a risk for either GCCM or XMO operations (Umwelt, 2004d).

In the event that approval is received for the use of the Eastern Rail Pit as a tailings emplacement, the positive back pressure provided by the tailings would be likely to reduce the potential for slope instability as a consequence of subsidence, while water inflows into the overburden are likely to be reduced by sealing of cracks by tailings material, ie as observed at other sites where tailings dams have been undermined. Vertical subsidence may,

however, make it necessary to build up the level of embankment control structures if the pit is close to full (SCT, 2007).

The Eastern Rail Pit requires Bettys Creek to be diverted prior to mining. Excavation of the pit, construction of the dump and the three stage stream diversion (*Figure 5.1*) has commenced and will significantly affect Bettys Creek through removal and filling of the natural channel. Stage 3 of the diversion will divert flows around Pit C from Bettys Creek to Main Creek by the end of 2007. Stage 3 is located approximately 2km north of the Project Area.

The XMO/Xstrata developments over Bettys Creek will overwhelm any adverse changes that may occur from subsidence over Longwalls 13 to 16. Whilst the creek bed over Longwalls 10 to 13 will not be directly mined by XMO/Xstrata, open cut mining and the associated stream diversion will cause downstream changes in creek flow, sediment transport and stream water quality.

*Management*

GCCM has prepared a subsidence management plan for the Eastern Rail Pit, on the basis of consultation with Xstrata, which was submitted as part of the SMP. GCCM will receive and consider any technical comments from Xstrata on that management plan and, if considered appropriate, may seek amendment of the management plan to give effect to those comments.

### *7.3.4 Mt Owen West Dump*

The Mt Owen Complex Mining Operations Plan (MOP) dated January 2006 indicates that the area of the West Dump overlying the Project Area will be rehabilitated in 2009/2010 and no specific monitoring programs or management strategies would be required. Subsidence impacts would be similar to those expected over the surrounding agricultural land and would be limited to minor surface cracking.

In the event that rehabilitation has not been completed, there would be expected to be some potential for instability of the rock slopes due to subsidence, although it is anticipated that these would be manageable (SCT, 2007). GCCM will provide monitoring data and other subsidence information to XMO/Xstrata to ensure that appropriate monitoring strategies can be developed where required.

### *7.3.5 Mt Owen Rail Spur*

Approximately five kilometres of the Mt Owen Rail Spur traverses the Project Area. The Rail Spur, which is owned by XMO/Xstrata and operated by Thiess, is used to transport coal from the Mt Owen Mine to Newcastle.

The Rail Spur branches from the Main Northern Railway Line north-west of the Glennies Creek Road level crossing and proceeds in a northerly direction to Mt Owen Mine (*Figures 1.2* and *5.1*). MSB has advised that XMO/Xstrata has not provided the requisite plans required for approval and accordingly the Rail Spur is not currently approved for any compensation for mining-induced damage. However, it may still be open to XMO/Xstrata to submit the certified plans of the Rail Spur to the MSB, in order to attract compensation in respect of future damage.

Waddington and Barbato (2004) report that, "*from an engineering standpoint, there are no insurmountable problems in regard to undermining railways and there are no reasons why mining cannot be safely carried out beneath railways, so long as adequate plans for the management of the mining impacts and appropriate financial guarantees are put in place before mining*". In addition it would appear, from Waddington and Barbato's paper, that cross tilt can vary from design by up to 21mm/m before there is a need for speed restrictions.

According to SCT (2007), vertical subsidence movements are not expected to be significant with maximum grades over short distances of 1 in 100 being within the capacity of normal rail operations.

As maximum anticipated strains of 6mm/m in tension and 9mm/m in compression may have the potential to cause buckling of rails, a management system developed in co-operation with the rail authority would be required to relieve stresses in the line. Waddington and Barbato report that this can be achieved using line force transducers and, when stresses need to be relieved, by cutting, realigning, re-tensioning and welding the rails. The anticipated frequency at which restressing of the rails is required would need to be determined on the basis of ongoing monitoring over Longwalls 7 to 9.

The development of the Eastern Rail Pit on the eastern side of the rail formation and the Ravensworth East tailings emplacement on the western side (assuming the emplacement is cut down into the natural ground) has the effect of forming an embankment in natural rock between the two excavations. Mining subsidence would be expected to cause lateral movement of this rock embankment with potential to cause additional vertical movements at the level of the rail track. While changes in track geometry associated with additional vertical movements are not expected to compromise the movement of trains, inclusion of monitoring and review of this issue in the rail management plan is recommended (SCT, 2007).

SCT (2007) indicated that the Rail Spur is likely to remain serviceable throughout the period of mining with frequent monitoring, with only infrequent restressing of the rails likely to be required. Detailed subsidence impacts on the Rail Spur are provided in *Annex B*.

As described in *Section 1.3*, Xstrata and Integra have agreed that:

- XMO/Xstrata will assume sole responsibility for, and to carry out, all mitigation and repair works on the Rail Spur so as to enable mining to occur at the Glennies Creek Colliery in the vicinity of the Rail Spur;

- Xstrata and Integra will cooperate to prepare a Rail Line Management Plan for LW 10-17; and that

- Xstrata will support this application for mining at GCC.

GCCM is in the process of preparing a specific management plan for the Mt Owen Rail Spur for Longwalls 10 to 17, in cooperation with Xstrata, which will be submitted to DPI. XMO/Xstrata has been given adequate notice (2 January 2007) of GCCM's intention to mine Longwalls 10 to 17 in the vicinity of the Rail Spur, has been provided all relevant information and has access to GCCM personnel when required for assessment purposes to select the most appropriate option for management of the rail spur. GCCM will assist this process wherever possible. As was the case for the approved Rail Line Management Plan submitted to DPI in relation to Longwalls 7 to 9, the specific Rail Line Management Plan for Longwalls 10 to 17 will contain a series of Action Plans. These Action Plans will include detailed monitoring and mitigation measures in accordance with the *Rail Safety Act 2002* (RS Act).

### *7.3.6 Bridges over Bettys Creek*

The Mt Owen Rail Spur incorporates a concrete rail bridge over Bettys Creek above the chain pillar between Longwalls 13 and 14. The articulated structure of the bridges with deck beams supported on pile caps is such that the peak horizontal and tilt movements are likely to be accommodated without undue difficulty. The structural details of the bridge would need to be inspected to confirm how much relative movement can be accommodated. However it is generally anticipated that the dual bridge structure would be able to be undermined without unduly affecting its serviceability (SCT, 2007).

Vertical subsidence is not expected to impact on the serviceability of the bridge over Bettys Creek because the surrounding ground would also be lowered by a similar amount. However, the subsidence trough developed would have the effect of lowering the level of the bridge deck relative to flood levels in Bettys Creek.

Management of the rail bridge over Bettys Creek will be addressed in the Rail Line Management Plan for Longwalls 10 to 17 which is to be submitted to the DPI separately. Management measures to address subsidence impacts on the rail bridge over Bettys Creek will be implemented by XMO/Xstrata and the relevant authorities with responsibilities related to the Rail Spur.

### *7.3.7 Rail Maintenance Road*

A maintenance road runs parallel to the Rail Spur allowing access for monitoring and maintenance purposes. It is a private, single lane road formed from native material and surfaced with a gravel pavement. The drainage consists of parallel table drains on either side of the pavement. The maintenance road also incorporates a concrete bridge over Bettys Creek above the chain pillar between Longwalls 13 and 14, adjacent to the rail bridge.

Subsidence is not expected to significantly affect the serviceability of the unsealed rail maintenance road. If cracks or compression humps develop, crack filling and regrading may be required. Inspections associated with maintaining the serviceability of the Rail Spur are expected to identify areas where any remediation is likely to be required (SCT, 2007).

Management of the rail maintenance road, including the concrete bridge, will also be addressed in the Rail Line Management Plan for Longwalls 10 to 17. Management measures to address subsidence impacts on the rail maintenance road will be implemented by XMO/Xstrata and the relevant authorities with responsibilities related to the Rail Spur.

### *7.3.8 Buried Rail Communications Cable*

There are three types of cable which run parallel to the Mt Owen Rail Spur: power, signalling control and communications. These cables are owned, operated and maintained by the Australian Rail Track Corporation (ARTC). The depth of burial, though unknown, could vary from approximately 0.5m to greater than 1.0m. All of the cables are of the PVC insulated copper type.

The cables will be subject to some subsidence movement. If sufficiently large and/or concentrated, the induced strains could result in damage to the cable or the movement could result in the cables being pulled from junction boxes. Should such damage occur, the signalling system is designed to fail to safe, turning signals to red which may delay train movements.

Detail of the cable and measurements of the subsidence movements from the Longwall 7 monitoring program are expected to be sufficient to determine whether an alternative, above ground communication system is required to bypass the section of cable being undermined.

Management of the buried rail communication cables will be addressed in the Rail Line Management Plan for Longwalls 10 to 17. Management measures to address subsidence impacts on the rail communication cables will be implemented by XMO/Xstrata and the relevant authorities with responsibilities related to the Rail Spur.

### *7.3.9 Mt Owen Water Pipeline*

The Mt Owen water pipeline runs parallel to the Mt Owen Rail Spur. It is buried to a depth of approximately 500mm to 700mm within the Rail Spur easement (*Figure 5.1*). The welded polyethylene pipeline carries clean water from a pumping station adjacent to the Main Northern Railway bridge on Glennies Creek to the Mt Owen Mine CHPP for use in coal processing.

The pipeline has an external diameter of 355mm and ratings of PN8 at the delivery end, PN10 through the central section and PN12 at the pump station end. The wall thicknesses of the three grades of pipe are nominally 22mm, 27mm and 34mm, for the PN8, PN10 and PN12 grades respectively. Back calculation of the working pressures indicates the working stress for the polyethylene is nominally 5.5Mpa, giving axial load capacities of 13t, 15t and 18t. Assuming an elastic modulus of 0.5 to 1GPa (indicated in material property handbooks for polyethylene), the safe working strain would be approximately 0.5 to 1% (5mm/m to 10mm/m) (SCT, 2007).

The Mt Owen CHPP Manager is currently responsible for the pipeline and advises that the clean water pumping system is currently operated for approximately one day every three weeks, with an expectation that the usage will increase to one day per fortnight in the near future.

According to calculations by SCT (2007), the safe working strain for the pipeline would be approximately 5mm/m to 10mm/m (0.5 to 1%). Predicted strains from subsidence are 5 to 6mm/m (0.5 to 0.6%) along the length of the pipeline which suggests that the pipe would approach its safe working strain in axial tension and compression.

Peng (1992) reports findings from Kratzsch (1983) that show a sand matrix is capable of generating 5t/m of axial load in 300mm diameter pipelines without bituminous coating. SCT (2007) states that if the predicted strain is concentrated at one or two cracks, and the ground is capable of generating 5t/m, the ground movements would be able to generate sufficient axial load to overstress the pipe every 6 – 8m.

On the basis of these calculations, it would appear that the pipe is likely to remain serviceable, particularly for the level of strain generally expected. However, if subsidence movements are concentrated at large cracks or compression humps, there is a potential for the pipeline to become overloaded (SCT 2007). It was also noted by SCT (2007) that subsidence cracks have not yet been observed on the surface at the Glennies Creek Colliery, so the potential for large cracks to develop over Longwalls 10 to 17 would appear limited.

Management of the pipeline will be addressed in the Rail Line Management Plan for Longwalls 10 to 17. Management measures to address subsidence impacts on the Mt Owen water pipeline will be implemented by XMO/Xstrata and the relevant authorities with responsibilities related to the Rail Spur.

# 8 SURFACE WATER

The Project Area lies within the catchments of Main and Bettys Creeks.

A surface water assessment was undertaken by WRM (2007), with particular attention to potential impacts of the proposal (*Annex D*). Assessments have been based on previous subsidence observations from mining of Longwalls 1 to 7, as well as subsidence predictions for Longwalls 10 to 17 (as discussed in *Section 4*).

## 8.1 MAIN CREEK

Main Creek (*Figure 8.1*), an ephemeral fourth order Schedule 2 stream (DLWC, 2000), lies to the east of the Project Area. It has a catchment area of approximately 1750 ha and flows into Glennies Creek approximately 3.5km upstream of the Glennies Creek and Hunter River confluence.

The headwaters of two small tributaries of Main Creek rise within the Project Area near the Main Creek and Bettys Creek watershed and flow in a southerly direction. The tributaries are moderately vegetated with some headward erosion and bank undercutting. The main tributary over Longwalls 9 to 11 dissipates into colluvium or is regulated by ten small to medium sized dams, each currently with low to moderate water levels (GeoTerra 2007).

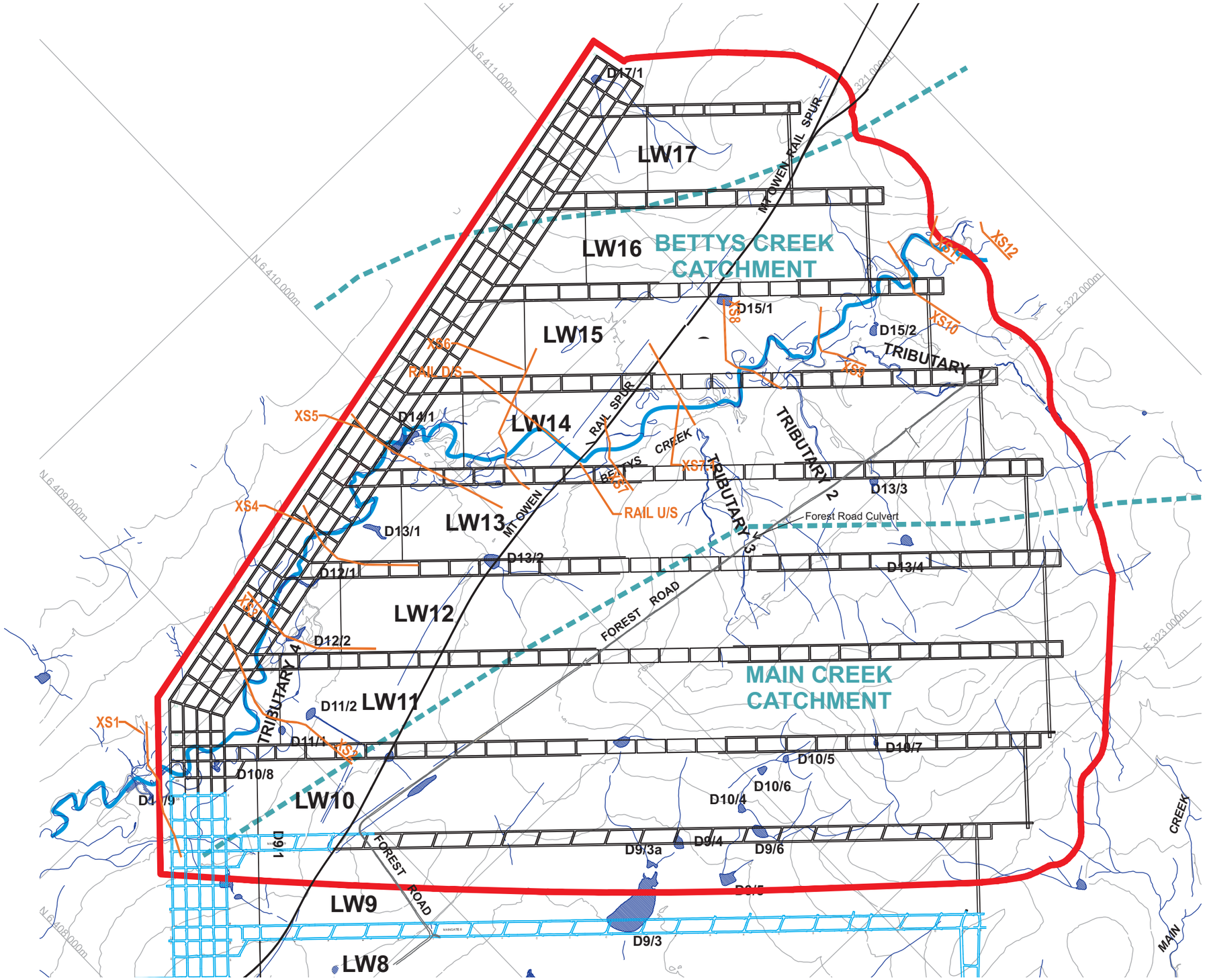
84 hectares (14%) of the Project Area is located within the Main Creek Catchment. Although the subsidence impact zone extends into the Main Creek catchment, no impact is expected on Main Creek itself or its drainage network (WRM, 2007).

## 8.2 BETTYS CREEK

Bettys Creek (*Figure 8.1*), is a fourth order, ephemeral, Schedule 1 or 2 stream (Department of Land and Water Conservation (DLWC), 2000) and traverses the Project Area over Longwalls 10 to 15. It has a meandering watercourse incised 2m to 3m below the general floodplain. The Bettys Creek channel and its tributaries have not been undermined to date.

Bettys Creek extends from Ravensworth State Forest southwards to the confluence of Bowmans Creek and Swamp Creek. In its current state, Bettys Creek has prolonged periods without flow with small permanent and semi-permanent waterholes typically of moderate to high salinity. Bettys Creek flows into Bowmans Creek approximately 5.9 km upstream of the confluence of Bowmans Creek and the Hunter River.

In the upper sections of Bettys Creek, over Longwall 15, the creek is typically a Schedule 1 stream (DIPNR, 2005) characterised by a shallow V-shaped channel up to 50m wide with little to no floodplain and bed slopes of the




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Bettys Creek
- Waterway
- Surveyed Dam
- Existing Contour (1m interval)
- Catchment Areas
- XS1 Cross Section

**Figure 8.1**

**Location of Dams and Waterways**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_06 | | |
| Date: | 12/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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order of 0.6% to 1%. As the creek traverses Longwalls 14 to 10, it becomes a Schedule 2 stream (DIPNR, 2005) with the bed slope decreasing to about 0.3% to 0.6%. Within this area, the main channel becomes more sinuous and floodplain width increases (GeoTerra, 2007).

Bettys Creek has three main tributaries which drain from the Bettys Creek/ Main Creek watershed and a smaller overbank meander channel. Tributaries 1, 2 and 4 (*Figure 8.1*) are well vegetated with limited erosion, whilst tributary 3 has extensive bed and bank erosion, principally due to the effect of increased streamflow from the Forest Road culvert (GeoTerra 2007).

### *8.2.1 Water Quality*

Mt. Owen Mine has monitored water quality in Bettys Creek at a location upstream of the Project Area since 1992 (Umwelt, 2003). This data indicates that the Bettys Creek upstream water quality is neutral to alkaline, with pH ranging from 6.2 to 9.4. Electrical Conductivity values have ranged from 81µS/cm to 18,000µS/cm.

Monitoring indicates that during dry periods, Bettys Creek is highly saline due to groundwater seepage. One groundwater seepage area was observed within the Project Area, with a small (<10m long) pool of saline water present over Longwall 14. This is located near where the proposed XMO Stage 2 diversion (*Figure 5.1*) will re-enter Bettys Creek (GeoTerra 2007).

Alluvial groundwater in the vicinity of Bettys Creek is relatively brackish (8,600 to 14200µS/cm), whilst groundwater within coal measures over Longwalls 10 to 17 is brackish to saline (12840 to 19,500µS/cm) and is not suitable for domestic or agricultural use (WRM, 2007). It is suitable locally only for use in coal washeries (GeoTerra, 2007).

Stream water quality can be affected by a reduction in stream flows, increased saline groundwater recharge and the dissolution of minerals (generally iron hydroxides) which can precipitate on groundwater seepage into a stream. It is anticipated that no significant change to the water quality in Bettys Creek will occur due to extraction of Longwalls 10 to 17 as there should be no observable gain or loss of groundwater baseflow to the streams (WRM, 2007).

### *8.2.2 Bed Slope and Differential Settlement*

The bed slope of approximately 600m of Bettys Creek along Longwall 15 is likely to increase from approximately 0.4% under current conditions to 0.6% after subsidence. The bed slope between Longwall 14 and the Mt Owen Rail Spur is unlikely to significantly change as subsidence is relatively consistent at 1.0m to 1.5m across the main channel and floodplain. Downstream of the Mt Owen Rail Spur, the creek bed slope will reduce from 0.3% under current conditions to 0.05% over 350m as the channel drains out of the subsidence area (WRM, 2007).

Differential settlement of about 1m to 1.5m will occur between the left overbank and the adjacent main channel downstream of the Mt Owen Rail Spur, which could change the nature of floodplain flows. There will generally be little differential settlement along the first order streams (WRM 2006).

### *8.2.3 Stream Flow, Erosion and Sedimentation*

Subsidence is not anticipated to adversely affect the stability of the bed or banks of Bettys Creek or its tributaries. The lack of potential adverse effects is primarily due to the low predicted subsidence trough development and the high degree of bed and bank stabilisation afforded by the Casuarina trees, particularly from exposed roots in the bed and banks.

The predicted levels of subsidence will increase the stream gradient and erosive capacity of flows over the upstream and downstream section of troughs over each panel. However, the increase is not anticipated to be outside the creeks ability to maintain stability.

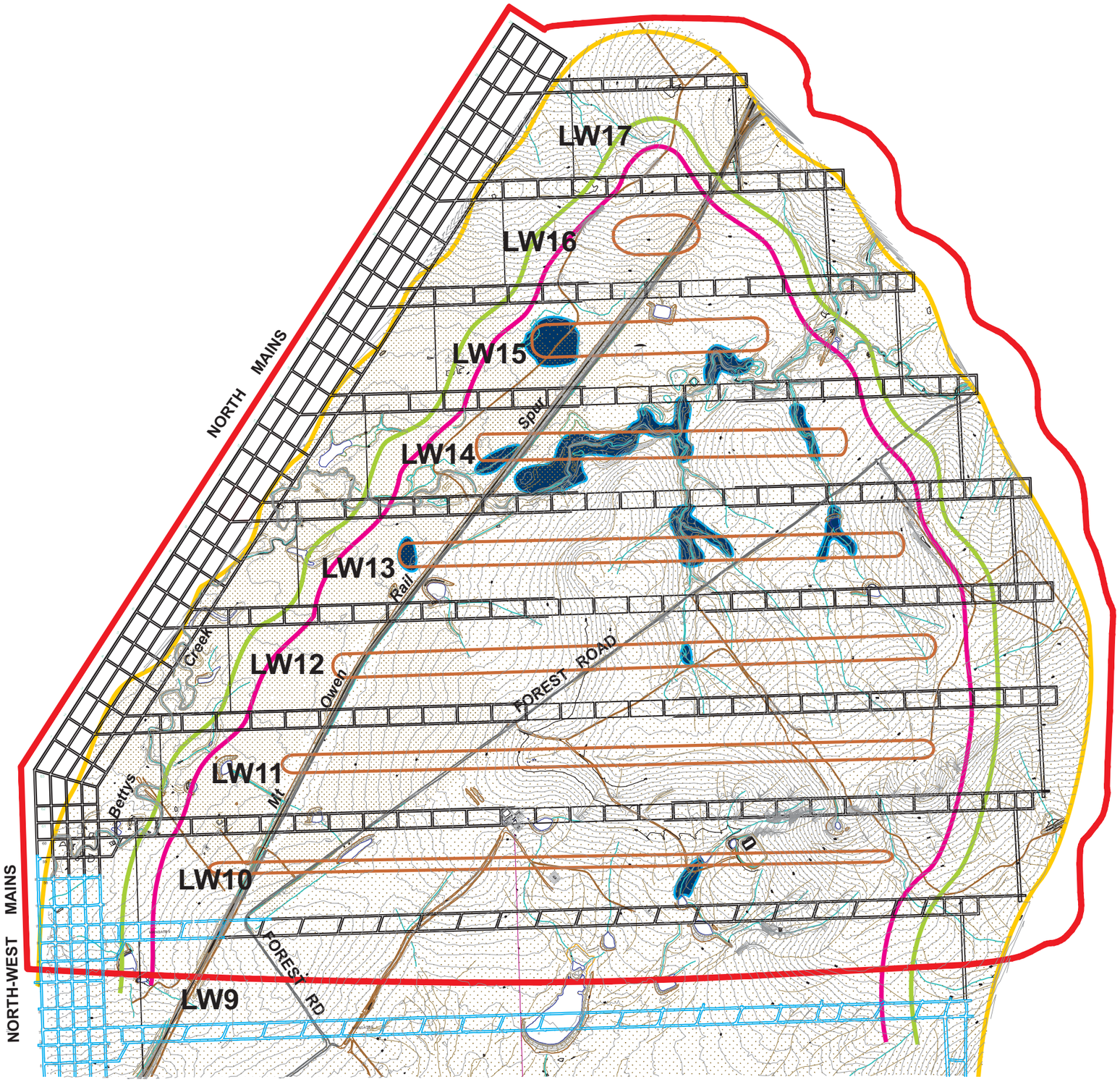
Subsidence will increase channel velocities, shear stresses and stream powers between cross-section 9 and cross-section 11 (*Figure 8.3*) as the creek drains into the subsidence area. This may increase channel erosion in this area. Decreased channel velocities, shear stresses and stream powers will occur between the railway line and cross-section five and also between cross-section 1 and cross-section two where the main channel drains out of the mine subsidence area. Increased sediment deposition may occur in these areas (WRM, 2007).

It is noted that the velocities, shear stresses and stream powers are not very significant for the one year ARI event for either the existing or post-subsidence conditions. It is also noted that the range of velocities, shear stresses and stream powers for both existing and post-subsidence conditions are generally similar, thereby indicating that any increased erosion and sedimentation will not be significant (WRM, 2007).

### *8.2.4 Flooding*

Due to the relatively flat topography within the channel of Bettys Creek over Longwalls 10, 11, 13, 14 and 15, there are and will be areas which are prone to ponding after significant rainfall (*Figure 8.2*) and, according to GeoTerra (2006), subsidence could also alter overbank flows. Additional obvious post-subsidence ponding is not anticipated in the elevated central and north-eastern sections of the Project Area (GeoTerra 2006).

Downstream of the Mt Owen Rail Spur, the differential settlement between the left and right overbank floodplains is predicted to cause a reduction in the left overbank flows and an increase in the right overbank flows and resultant flood extents (*Figure 8.3*). However, the overbank flows for both existing and post-subsidence conditions for the 100 year ARI flood are generally less than




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Effective Limit of Subsidence
  - 20mm
- Final Subsidence Contours
  - 0.5m
  - 1.0m
  - 1.5m
- Areas at Risk of Ponding
- Post Subsidence Contours (1m intervals)

**Figure 8.2**

**Land Prone to Ponding**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_17 | | |
| Date: | 10/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

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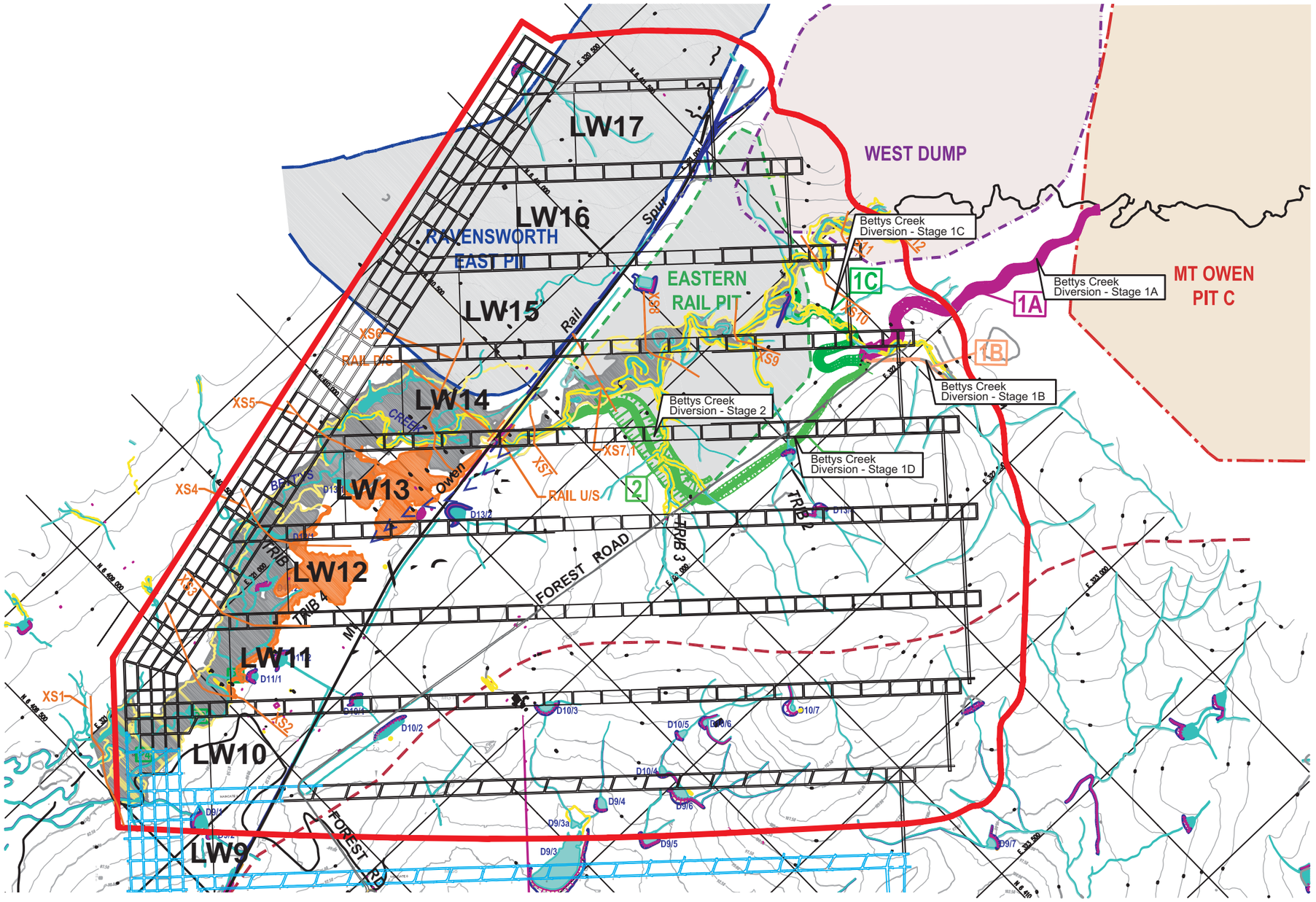


**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Dam (D6/1)
- 1:100 ARI Pre Subsidence Flood Extent (Before)
- 1:100 ARI Post Subsidence Flood Extent
- Watershed
- Cross Section (XS1)
- Secondary Flow Path

**Figure 8.3**

**Land Prone to Flooding**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_18 | | |
| Date: | 11/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | GeoTerra GC10 28-02-07 | | |
| Scale: | Refer to Scale Bar | | |

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0.5m deep. The existing and post-subsidence flood extents do not change upstream of the Mt Owen Rail Spur between cross-section 12 and cross-section 7 (*Figure 8.3*). The Mt Owen Railway Bridge is not likely to be overtopped for existing or post-subsidence conditions in 100 year ARI events (WRM, 2007).

The predicted change is unlikely to cause major channel erosion in the short or long term because 100 year ARI flow depths are generally less than 0.5m and overbank flood velocities are generally less than 0.5m/s (WRM, 2007).

### *8.2.5 Summary of Subsidence Impact*

GeoTerra (2007) considers that there may be some indirect loss of stream flow in Bettys Creek due to subsidence cracking through:

- lowering of the coal measures watertable;
- reduction in spring seep flow to the creek; or
- reduction in overland runoff due to interception and infiltration into cracked soil.

GeoTerra (2006) also considers that the following outcomes are likely to occur within Bettys Creek as a consequence of subsidence, particularly downstream of the proposed XMO Bettys Creek diversion.

Stream water quality, flow volumes and creek stability are not anticipated to be adversely affected due to extraction of Longwalls 10 to 17. However, some additional ponding may occur in subsidence troughs within the creek.

No significant erosion or bedload sediment transport has been observed to date in Bettys Creek over Longwalls 10 to 17 due to the stabilising effect of the riparian vegetation. Post-subsidence erosion and deposition rates are not expected to significantly increase as the existing and post-subsidence stream velocity, shear stress and stream power are similar, and not sufficiently high to cause erosion.

Subsidence will increase the left and decrease right overbank flows downstream of the Mt Owen Rail Spur for the 100 Year ARI design flood. However, the change is unlikely to cause major channel erosion in the short or long term.

### *8.2.6 Management*

If adverse effects on Bettys Creek due to subsidence are observed, the creek and/or diversion will be rehabilitated to an appropriate standard to return the creek, diversion channel and floodplain to a similar state as existed prior to subsidence. This may include, but is not limited to, draining ponded areas, re-establishing drainage paths or diverting surface water flows from areas of potential ponding. Based on the predicted consequences of subsidence, no specific mitigation measures are proposed for either the Bettys Creek main channel or floodplain.

### *8.2.7 Monitoring*

Cross-sections across Bettys Creek will be established approximately 100m apart prior to mining Longwall 10 to allow the measurement of any valley closure. Each cross-section will have survey monuments placed approximately 10m apart and will extend a minimum of 20m beyond the defined edge of the creek channel.

A detailed monitoring program will assess whether changes in the channel or floodplain occur due to subsidence. Any changes that require remediation would be likely to become noticeable following storm events.

Water level loggers, along with flow gauging and sediment deposition monitors, will be installed in the creek at the Mt Owen Rail Spur bridge and downstream of Longwall Panel 10, to monitor changes in the creek due to weather variations, XMO/Xstrata operations and subsidence.

## *8.3 BETTYS CREEK DIVERSION WORKS*

The proposed Mt Owen operations and the diversion of the upper catchment of Bettys Creek into Main Creek will substantially reduce Bettys Creek flows across the Project Area. Stage 1 and Stage 2 diversion of flows will be in constructed channels around the West Dump and Eastern Rail Pit, discharging back into Betty Creek downstream of the Eastern Rail Pit (refer to *Figure 5.1*). Stage 3 diversion will divert flows around Pit C from Bettys Creek to Main Creek by the end of 2007. Stage 3 is located approximately 2km north of the Project Area.

On the presumption that the proposed Bettys Creek diversion schedule is achieved, the diversion will be unaffected by subsidence for approximately 3.5 years after its construction. Throughout this period, the stability and operation of the channel can be monitored and appropriate management and mitigation measures developed.

GeoTerra (2006) predicts that the following subsidence impacts are likely to occur within the area of the proposed Bettys Creek diversion:

- the Stage 2 diversion in the backfilled Eastern Rail Pit may be adversely affected in terms of channel stability and integrity. However, the channel is anticipated to be in operation for approximately 3.5 years before it is undermined by Longwall 13. This will enable assessment of its inherent stability and operation;

- subsidence will have no impact on the shear stresses and stream power at the bend between the east-west and north-south sections of the Stage 2 diversion, as well as at the bend on the downstream end of Stage 1D diversion;

- a significant reduction in stream flow will be observed following XMO's Stage 3 diversion of flows from Bettys Creek to Main Creek;

- following the XMO Stage 3 diversion, it is possible that Bettys Creek could silt up (aggrade) over time if there is insufficient flow to flush out any high sediment loads draining in from the first order streams; and

- mine subsidence could potentially increase rates of erosion along the upper 800m of the Stage 2 diversion channel as the diversion drains into the mine subsidence area and channel gradients decrease.

### *8.3.1 Management*

If adverse effects on Bettys Creek due to subsidence are observed, the creek and/or diversion will be rehabilitated to an appropriate standard to return the creek, diversion channel and floodplain to a similar state as existed prior to subsidence. This may include, but is not limited to, draining ponded areas, re-establishing drainage paths or diverting surface water flows from areas of potential ponding. Based on the predicted impacts as a consequence of subsidence, no specific mitigation measures are proposed for either the Bettys Creek main channel or floodplain.

## *8.4 LAND PRONE TO INUNDATION*

Temporary or permanent ponding of water in flat areas following heavy rain or flooding is a perceptible effect of subsidence. An assessment of predicted post-subsidence topographic contours indicates that stream channel ponding is likely to occur within Bettys Creek over Longwalls 10 to 15 (*Figure 8.2*). Due to the relatively flat topography overlying the south-western portion of the Project Area, there are areas which are prone to post-subsidence ponding after significant rainfall (*Figure 8.2*). Observable surface ponding following longwall mining is not anticipated in the elevated central and north-eastern portions of the Project Area.

Should water begin to pond in an area outside of the creek, GCCM will carry out temporary or permanent earthworks to allow the water to drain away. If earthworks are not possible within a short time frame, eg due to legislative requirements or access restrictions, a strategy of pumping water from the ponded area will be assessed by GCCM in consultation with the landowner(s).

## *8.5 DAMS*

Twenty six farm dams and natural billabongs have been identified and assessed within the Project Area. The location of each of the dams, and the dam numbering system, are indicated in *Figure 8.1*. None of the dams appear to be spring fed and each is typically constructed from local material without significant design or engineering. The dams are used primarily for stock watering.

*Table 8.1* summarises the details of each dam accessible within the Project Area. For conservatism, the estimated storage capacities identified in *Table 8.1* have assumed no freeboard and ignored any existing cracking, tunnelling or sedimentation which may limit current storage capacity.

The overall gradient of the undulating dam catchments is greater than the predicted subsidence-induced terminal tilts and therefore mining is not expected to modify catchment areas. There is likely be a reduction in overland runoff due to interception and infiltration into cracked soil however it is not predicted to measurably reduce runoff to dams due to the plastic nature of the soils.

Subsidence and strain may cause movement and cracking of dam walls that could lead to their destabilisation, with either gradual leakage or more instantaneous loss of water leading to localised downstream inundation and increased siltation and erosion of receiving watercourses.

Subsidence-related cracking may potentially exacerbate the erosive potential of the dam walls while tensile strain may lead to a loss of water through the perforated dam floor even though the dam wall may remain intact. Tilting could also reduce the storage capacity of a dam though lowering of the spill point.

The risk assessment (see *Section 5*) addressed the potential likelihood and consequence of a dam wall or floor failure, with a ranking of the risks used to assist in preparing a management strategy for Longwalls 10 to 17. The risk ranking was based on the assumed scenario of a dam wall or floor cracking, with the consequential effects on a landholder's ability to water stock, as well as the potential effort required to re-establish the water supply conditions to those prior to subsidence.

*Table 8.1 Summary of Accessible Dams within the Project Area.*

| Dam | Landowner | Construction | Water Supply | Estimated Capacity (ML) | Surface Area (at capacity) ($m^2$) | Dam Size |
|---|---|---|---|---|---|---|
| 9/1 | Xstrata | Earth wall in gully | Overland runoff | 1.55 | 1845.37 | Small |
| 9/2 | Xstrata | Earth wall in gully | Overland runoff | 0.18 | 386.16 | Small |
| 9/3 | Xstrata | Earth wall in gully | Overland runoff | 29.11 | 19,618.52 | Large |
| 9/3A | Xstrata | Earth wall | Overland runoff | 0.83 | 2514.72 | Small |
| 9/4 | Xstrata | Earth wall in gully | Overland runoff | 0.91 | 1134.38 | Small |
| 9/5 | Xstrata | Earth wall in gully | Overland runoff | 1.73 | 2117.17 | Small |
| 9/6 | Xstrata | Earth wall in gully | Overland runoff | 2.45 | 1716.70 | Small |
| 10/1 | Xstrata | Earth wall | Overland runoff | 0.76 | 1061.50 | Small |
| 10/2 | Xstrata | Earth wall | Overland runoff | 1.27 | 2302.65 | Small |
| 10/3 | Xstrata | Earth wall | Overland runoff | 1.88 | 1856.73 | Small |
| 10/4 | Xstrata | Earth wall in gully | Overland runoff | 0.35 | 811.22 | Small |
| 10/5 | Xstrata | Earth wall in gully | Overland runoff | 0.29 | 615.71 | Small |
| 10/6 | Xstrata | Earth wall in gully | Overland runoff | 0.47 | 395.17 | Small |
| 10/7 | Xstrata | Impoundment on top of hill | - | 0.96 | 724.11 | Small |
| 11/1 | Xstrata | Earth wall | Overland runoff | 0.37 | 842.91 | Small |
| 11/2 | Xstrata | Earth wall | Overland runoff | 0.50 | 1098.59 | Small |
| 12/1 | Xstrata | Dammed channel | Overland runoff | - | - | Small |
| 12/2 | Xstrata | Dammed channel | Overland runoff | - | - | Small |
| 13/1 | Xstrata | Dammed channel | Overland runoff | - | - | Small |
| 13/2 | Xstrata | Earth wall in gully | Overland runoff | 3.28 | 3078.80 | Small |
| 13/3 | Xstrata | Earth wall in gully | Overland runoff | 0.59 | 1089.83 | Small |
| 13/4 | Xstrata | Earth wall in gully | Overland runoff | 0.77 | 1200.89 | Small |
| 14/1 | Xstrata | Low wall bunded gully | Overland runoff | 1.48 | 4115.93 | Small |
| 15/1 | Xstrata | Earth wall | Overland runoff | - | - | Small |
| 15/2 | Xstrata | Earth wall in gully | Overland runoff | - | - | Small |
| 17/1 | Xstrata | Potentially removed by Ravensworth Mine | - | - | - | Small |

*Sources: GeoTerra 2006; Pegasus 2006.*

The large farm dam (Dam 9/3 - *Figure 8.1)* is most at risk from dam wall failure and/or floor leakage due to its large size and location above the chain pillar between Longwalls 8 and 9. This dam is susceptible to ground tilt following mining of Longwall 9, which is likely to cause some loss of storage capacity and potentially some overtopping or spillway losses if the dam is full at the time. Ground strains associated with mining both Longwall 8 and Longwall 9 would also have potential to cause cracks which may initiate erosion. The majority of subsidence will occur soon after mining Longwall 9, which is part of an approved SMP application. If no adverse effects occur soon after mining Longwall 9 is completed, it is not anticipated that Dam 9/3 will undergo significant effects from mining Longwalls 10 to 17 (GeoTerra, 2006).

The likelihood of subsidence-induced impacts on the small farm dams is dependent on each dam's location relative to the longwall panels. Surface cracking associated with mining-induced subsidence may initiate erosion points that could subsequently expand by tunnelling. This may compromise the water holding capacity of the dam and cause release of stored water if tunnels form.

### *8.5.1 Monitoring*

The monitoring of subsidence impacts will comprise three phases, ie subject to the landowners permitting access. Details of survey program are outlined in *Section 8.2.7* and summarised below.

- pre-mining monitoring to establish a baseline for subsequent monitoring and impact assessment. This initial survey of each accessible dam will aim to establish the shape, wall height, level of the spillway (if present), depth, storage capacity, pH and EC;

- monitoring within predicted subsidence impact zones during mining to allow the implementation of any required subsidence impact management processes. This will involve documented weekly visual inspections of potentially affected dams (including dams above the previous two longwall panels) when the longwall face is approaching within 150m, and continuing until the face is 500m past (or is complete); and

- post-mining monitoring to verify that any perceptible subsidence and subsidence-related impacts have ceased and to document the post-subsidence specifications of each accessible dam.

Visual inspections of dams through the various stages will be recorded on a Subsidence Inspection Form and will include a photographic record.

### *8.5.2 Management*

GCCM will provide the affected landowners with a monthly update of the location of the longwall face relative to the farm dams on their properties, and the estimated progress of the longwall during the following month. This will ensure that the landowners are aware of impending potential subsidence impacts on their individual dams.

Following undermining, GCCM will, in consultation with the relevant landowner, remediate any dam that is damaged by subsidence (or has its storage capacity reduced by more than 10 percent) to a condition similar to that prior to subsidence. Should water be lost from a dam to the extent that livestock are impacted, an alternative water supply will be provided by GCCM, in consultation with the landowner.

Prior to undermining Dam 9/3, temporary signs will be erected by GCCM downstream of the dam to warn of the potential risk of sudden flooding. These signs will be installed prior to the longwall face progressing within 150m of the dam, and will remain in place until the second subsequent longwall is complete.

## *8.6 HUNTER RIVER SALINITY TRADING SCHEME*

The proposed development of Longwalls 10 to 17 will not necessitate the extraction of water from, or discharge of any waters to, Bettys Creek. Further, the proposed underground mining is not expected to alter the water quality regime in Bettys Creek. Hence, the proposed mining would not be affected by the Hunter River Salinity Trading Scheme (WRM, 2007).

## *8.7 EXISTING WATER MANAGEMENT STRATEGY AND SURFACE WATER CONTROLS*

### *8.7.1 Existing Water Management Strategy*

For management purposes, water within the various areas of surface disturbance associated with the Glennies Creek Colliery are classified as "clean" or "dirty" depending on the nature of the catchment and its potential to contain physical or chemical contaminants. By definition, "clean" water comprises rainfall runoff from catchments or surfaces which are undisturbed or relatively undisturbed by mining or mining-related activities, while "dirty" water comprises rainfall runoff or seepage from disturbed catchments or water which has come into contact with mine spoil or water that could potentially contain chemical contaminants such as fuel. Water pumped from underground workings also falls into the dirty water category.

Both clean and dirty surface runoff within the combined Camberwell operations / Glennies Creek surface facilities and portal areas, and any dirty water pumped from the underground workings is managed through the existing integrated Glennies Creek/Camberwell water management system, a system which has evolved to reflect to physical, operational and management links between both operations. The system design has been based on maintaining a balance between the total containment of all dirty water inflows and direct rainfall and evaporation losses and water exports in coal, as well as export to neighbouring mines, other than Camberwell, whenever possible.

Existing sources of dirty water within the integrated system include:

- Camberwell Open Cut comprising the former North Pit which now incorporates the GCC Portal Area, and the South Pit;
- GCC surface facilities external to the former Camberwell North Pit;
- Coal Handling and Processing Plant (CHPP) and stockpile area;
- seepage from the Camberwell North Pit emplacement (including tailings dams);
- groundwater seepage into the GCC underground and existing open cut voids; and
- direct rainfall on dirty water dam surfaces.

Dirty water losses for the combined operations include:

- dust suppression water in the Camberwell Open Cuts;
- dust suppression at the CHPP and stockpile areas;
- dust suppression at GCC, both around the surface facilities and underground;
- water in despatched coal;
- tailing interstitial water;
- evaporation from impoundments; and
- export to neighbouring mines, including Ashton and, at times, Rixs Creek.

The Portal Sump, a void retained within the spoil dumped at the down-dip end of the former Camberwell North Pit excavation, is the net repository for all dirty water, and also the primary point for the distribution of operational water requirements throughout the GCC and Camberwell operations and to neighbouring mines.

Notwithstanding the operational integration of GCC and Camberwell and the recognition that dirty water management must consider the entire operation within the constraint of total containment, the primary objective is to preserve production from the underground. Since GCC is accessed through portals in the former Camberwell North Pit highwall, the dirty water management system must:

- ensure total containment of dirty water within the Portal Sump, Possum Skin Dam, Dirty Water Dam and Tailings Dams (*Figure 1.3*) up to a prescribed design period;
- prevent flooding of the portal; and
- within these constraints ensure a reliable water supply for mining-related purposes.

The existing on-site mine water management system, including mine water storage, clean and dirty water separation, clean water release and runoff control will continue and will service any operations associated with the underground mining of Longwalls 10 to 17.

### *8.7.2 Gas Drainage Boreholes*

'Dirty' water management at gas drainage boreholes differs during construction and operational phases. During drilling, all 'dirty' water is collected in a constructed sump which is pumped out on completion and the contents removed from the borehole site. During its operational phase, the nature of the 'dirty' water controls employed is dependent on the borehole location relative to adjacent drainage lines or creeks, the site's exposure to run-on waters, the nature of downstream vegetation cover and hence its ability to filter any sediment from the runoff and/or the availability of adjacent existing storages. To-date, no additional 'dirty' water containment structures have been required.

As has been the case with gas drainage boreholes developed to date at GCC, each of the proposed gas drainage boreholes over Longwalls 10 to 17 would be positioned to avoid drainage lines and maximise the natural filtration capacity of the vegetation in downslope areas. Surface disturbance would be minimised around each site consistent with operational requirements, and standard water management safeguards would be adopted during the construction and operational phases.

### *8.7.3 Bettys Creek Diversions*

The surface water controls associated with the Bettys Creek diversions are not the responsibility of GCCM and therefore are not addressed in this assessment. The impacts of the proposed underground mining on these diversion works are discussed in *Section 8.3*.

### *8.7.4 Longwall Panels 10 to 17 Subsidence Impact Zone*

The predicted mine subsidence will have some impact on the existing drainage characteristics of those sections of the main channel and floodplain of Bettys Creek which will be unaffected by Mt Owen's creek diversion activities as well as the proposed Mt Owen creek diversion. With respect to floodplain flows, the impact is expected to be moderate and unlikely to cause major channel erosion in the short or long term. Similarly, the impact on the main channel is expected to be moderate and is unlikely to substantially change existing rates of channel erosion or degradation (WRM, 2007).

*Management*

Given that much of the Bettys Creek catchment upstream of the proposed underground mine extension area will be diverted as part of the Mt Owen operations, no specific mitigation measures are necessary for either the Bettys Creek main channel or the floodplain. However, a monitoring program has been developed to assess whether changes in Bettys Creek main channel or floodplain occur following runoff events. If changes do occur, remediation measures will be designed and implemented (WRM, 2007). This monitoring program is outlined in *Section 8.7. 2.*

### *8.7.5 Contingency Measures and Dirty Water Containment*

The Glennies Creek and Camberwell mines already have management plans in place which deal with matters relating to the operation and maintenance of the surface water management system in order to ensure both containment of 'dirty' water, ie to ensure that dirty water is not discharged into downstream receiving waters (WRM, 2007) and flood protection for the underground mine access portals.

Based on a detailed investigation undertaken by PSM Australia Pty Ltd, in which a range of conservative assumptions were used to assess the existing integrated water management system, it was concluded that the integrated Glennies Creek/Camberwell dirty water management system allows total containment of the dirty water without disruption to the Glennies Creek underground or Camberwell South Pit operations. For extreme events (greater than ARI 50), temporary storage in the South Pit or Glennies Creek open cut (if approved and operational) may be required for the temporary storage of dirty water to prevent flooding of the underground workings. It is noteworthy, however, that as the Portal entries lie approximately 35m below the lowest potential discharge point from the former Camberwell North Pit, even in the event of flooding of the portals/underground workings, the potential for off-site discharges of the dirty water would be negligible. Possum Skin Dam which is operated as a storage and evaporimeter was designed for and is operated to ensure no spill up to the ARI 100 year event.

The proposed monitoring program described in *Section 8.2.7* is designed to identify any adverse impacts of mine subsidence on surface water flows early. This will enable any contingency and remedial measures to be undertaken as appropriate and as soon as practicable to ensure total containment of dirty water (WRM, 2007).

## *8.8 WATER BALANCE*

The overall water balance for the integrated Glennies Creek and Camberwell mine (including the proposed underground mine extension) is summarised below based on WRM (2007).

### *8.8.1 Underground Mine Supply and Demand*

Data available on underground mine dewatering show that groundwater inflows around 2,000$m^3$/d were observed during initial development of the underground mine. However, over time this rate has continued to decline to an average dewatering rate of about 800$m^3$/d to 1200$m^3$/d (average about 1000$m^3$/d). This rate approximates the current operational water supply requirement (1000$m^3$/d) for the underground mine (PSM, 2007 in prep; WRM, 2007).

While the possibility of underground mine expansion intersecting stronger seepage sources remains, the more extensive the underground mining becomes, the less likely that a significant new source will be encountered due to the dewatering of surrounding material that has already occurred (PSM, 2007 in prep; WRM, 2007).

For the water balance calculations, it has been assumed that the Glennies Creek underground mining activities will produce 200$m^3$/d of 'new' seepage water into the water management system (WRM, 2007).

### *8.8.2 Annual Water Balance*

The overall water balance for the combined Glennies Creek underground and Camberwell open cut operations both with and without the proposed Glennies Creek Open Cut are shown in *Tables 8.2* and *8.3*.

*Table 8.2* ***Water Balance for combined Glennies Creek and Camberwell operations, with the proposed Glennies Creek Open Cut***

| Parameter | Volume | |
|---|---|---|
| | m3/day | ML/Year |
| **Water Supply** | | |
| Rainfall Deep Percolation | 1700 | 620 |
| Underground Mining (net) | 200 | 73 |
| Regional Groundwater | 100 | 37 |
| Camberwell Open Cut | 3,250 | 1,186 |
| Proposed Glennies Creek Open Cut | 600 | 219 |
| Total Supply | **5850** | **2135** |
| | | |
| **Water Demand** | | |
| Coal Handling and Processing Plant (net) | 3500 | 1277 |
| Possum Skin Dam Evaporation | 500 | 183 |
| Haul Road Dust Suppression | 900 | 328 |
| Dirty Water Dam Evaporation | 250 | 91 |
| Export to Other Mines | 700 | 256 |
| Total Demand | **5850** | **2135** |

*Source: WRM, 2007*

*Table 8.3* ***Water Balance for combined Glennies Creek and Camberwell operations, without the proposed Glennies Creek Open Cut.***

| Parameter | Volume | |
|---|---|---|
| | **m3/day** | **ML/Year** |
| **Water Supply** | | |
| Rainfall Deep Percolation | 1700 | 620 |
| Underground Mining (net) | 200 | 73 |
| Regional Groundwater | 100 | 37 |
| Camberwell Open Cut | 3250 | 1186 |
| Total Supply | **5250** | **1916** |
| | | |
| **Water Demand** | | |
| Coal Handling and Processing Plant (net) | 3000 | 1095 |
| Possum Skin Dam Evaporation | 500 | 183 |
| Haul Road Dust Suppression | 1200 | 438 |
| Dirty Water Dam Evaporation | 250 | 91 |
| Export to Other Mines | 300 | 109 |
| Total Demand | **5250** | **1916** |

*Source: WRM, 2007*

The following is of note in regards to the water inflow calculations (WRM, 2007):

- tailings dam seepage has been considered and quantified in the context of CHPP make up water estimation, therefore is not double counted as separate water source;

- on-site direct rainfall and surface runoff inflow has been included in the inflow calculations for the North Pit sump, Camberwell Open Cut storage and the proposed new Glennies Open Cut pit as appropriate;

- rainfall deep percolation into the Camberwell North Pit sump is a highly transient quantity and is both significant and difficult to quantify. Based on two different methods of analysis, it has been estimated that around 1676$m^3$/day (on average) would flow into the sump. A value of 1700 $m_3$/day has been adopted for the water balance calculations;

- regional groundwater inflows to the pits are considered to be small. It has been estimated that the net inflow to the proposed Glennies Creek Open Cut would vary from about 116.5 $m^3$/day in the early stages to about 44 $m^3$/day towards the end of pit life. An average total inflow value of 100 $m^3$/day has been conservatively assumed for the water balance calculations;

- the total 'new water' contribution (by seepage and pumping direct rainfall and runoff) from the proposed Glennies Creek to the portal sump has been estimated to average about 571 $m^3$/day. A value of 600$m^3$/day has been adopted for the water balance calculations; and

- direct rainfall and runoff into Campbell Open Cut storage has been estimated to yield, on average, about 3250$m^3$/day.

Detailed calculations undertaken for the CHPP water circuit indicate that about 3000$m^3$/day make up water would be required to meet the CHPP water demand. Make up water is required to compensate for the following losses:

- water exported in coal - ~860$m^3$/day;

- tailings dam interstitial storage - ~1250$m^3$/day; and

- net evaporation loss from the tailings dam - ~860$m^3$/day.

Possum Skin Dam evaporation loss has been estimated to average 493 $m_3$/day. A value of 500 $m^3$/day has been adopted for water balance calculations. Evaporation from dirty water dams has been estimated to average about 250 $m^3$/day. The current haul road (2.3$km^2$) plus coal ROM stockpile area (0.5$km^2$) dust suppression water demand has been estimated at 1200$m^3$/day. The operation of the proposed Glennies Creek Open Cut (if approved) would increase this demand by a further 200 $m^3$/day.

GCCM has contractual arrangements to export excess water to neighbouring Ashton and Newpac, with facilities currently in place. Dirty water from the portal sump has been pumped to Rixs Creek as required and as available for many years. Direct measurement of flows has only occurred in recent times. An indicative mean flow is 1000$m^3$/d. Ashton Coal Operations has agreed to take 500 to 900ML/a[(21)]. As a daily rate this range equates to 1370 to 2460 $m^3$/d.

Therefore, any excess water from the combined operations can be easily exported from the site to maintain adequate freeboards in the underground mine portal sump and within the Possum Skin Dam.

# 9 GROUNDWATER

This chapter is based on a report prepared by GeoTerra Pty Ltd and is provided in full in *Annex C.*

## 9.1 EXISTING HYDROGEOLOGY

There are two types of aquifer systems within the Project Area, namely:

- the unconsolidated alluvium associated with Bettys Creek; and
- the basement coal measures comprising a variable sequence of aquicludes (mudstones and shales), aquitards (sandstones) and low yielding aquifers (coal seams).

There are no registered groundwater bores in either the alluvial or basement coal measures aquifers within the Project Area. Details and results of groundwater studies are included in *Annex C* and summarised in the following sub-sections.

Neither the coal measures nor creek alluvium are listed as vulnerable aquifers under the current Aquifer Risk Assessment Report (DLWC, 1998). However, they are covered by the State Groundwater Policy (DLWC, 1997), Groundwater Quality Protection Policy (DLWC, 1998) and Groundwater Dependent Ecosystem Policy (DLWC, 2002). Information relating to both systems has been gained through site specific and regional observations.

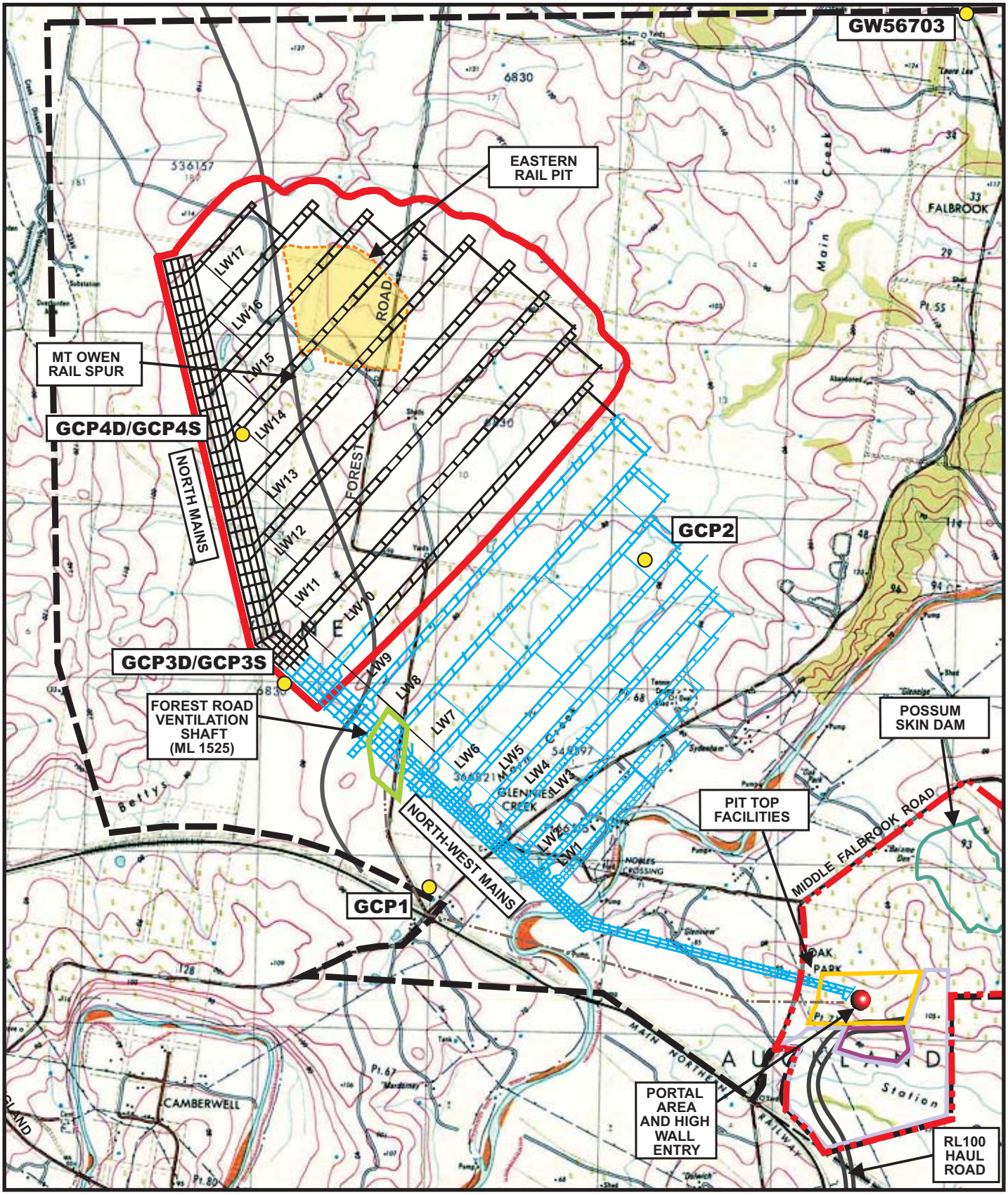
### 9.1.1 *Bettys Creek Alluvium*

Groundwater in the alluvium occurs predominantly in a basal gravel sequence or within overlying sands with a saturated thickness ranging from 5m to 7m (Geoterra, 2005).. The local water table has a shallow hydraulic gradient both towards Bettys Creek and in a downstream (southerly) direction resulting from interaction of rainfall recharge in weathered bedrock and direct infiltration through alluvium.

Alluvium in minor tributaries typically exhibits a shallower more silty profile and reduced saturated thickness. Basal gravels of 1m to 2m thickness are noted to depths of 5m to 8m close to Bettys Creek.

The high salinity water associated with Bettys Creek (see *Section 8.2.1*) supports no groundwater dependent ecosystems and is important locally only for stock water supply or use in coal washeries.

Piezometers have been installed in the alluvium of Main Creek to the south-west of Longwall 2 and over Longwall 6 as shown on *Figure 9.1*. Dual nested piezometers were installed between 5.4m and 48.6m deep into the alluvium and coal measures near Bettys Creek over the maingate south-west of




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- CL 382 Boundary
- ML 1525 Boundary
- ML 1518 Boundary
- ML 1551 Boundary
- ML 1437 Boundary
- Powerline to Ventilation Shaft
- Monitoring Piezometer or Bore

**Figure 9.1**

**Monitoring Piezometer/ Bore Locations**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_20 | | |
| Date: | 16/04/07 | Drawing size: | A4 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | 1:25,000 Topographic Series- Camberwell | | |
| Scale: | Refer to Scale Bar | | |

0 250 500 750m

Approximate Only

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

Longwall 10 and over the chain pillar between Longwalls 13 and 14 in April 2005 (Geoterra, 2005). Monitoring in these piezometers provides pre-mining baseline data of the groundwater level and water chemistry along Bettys Creek.

The nearest registered bore with an extraction licence is along Main Creek approximately 2.5 kilometres north-east of Longwall 9 (GW056703 – *Figure 9.1*) with a depth of 23m (Geoterra, 2005).

### *9.1.2 Coal Measures*

The coal measures are an assemblage of aquifers, aquitards and aquicludes, with very low intrinsic or intergranular hydraulic conductivities. Groundwater flow is generally confined to the coal seams (aquifers) where cleats provide enhanced secondary permeability. Sandstones and tuffs provide a measure of porous storage with very low transmitting capacity, while mudstones, siltstones and shales impede vertical and horizontal flows (MER, 2003).

The coal measures aquifer is generally low yielding, with the highest yields from coal seams or igneous intrusions. Based on available monitoring records, it is interpreted that groundwater levels are currently reduced due to the effect of the drought along with the effect from open cut and underground mining in the area.

No geological structures have been interpreted within the Project Area and any small faults or dykes that may be present are not anticipated to be of a size sufficient to enable loss of stream flow into the underground workings if they are dislocated by subsidence. Isolated inflows of up to 20 l/sec were observed during installation of the Forest Road ventilation shaft and during installation of one gas drainage well on Longwall 6. To date, an average dewatering rate of about 800$m^3$/d to 1200$m^3$/d (average about 1000$m^3$/d) has been observed (PSM, 2007 in prep; WRM, 2007).

Groundwater quality in the coal measures is poor due to terrestrial salts. Water quality varies regionally both within and between coal seams, due to the complexities of groundwater flow, interaction of surface and groundwaters and the sampling regime. Based on monitoring data, there are no beneficial aquifers in the Project Area, with highly brackish to saline water contained in the low permeability sandstone or coal seams. It is important locally only for use in coal washeries.

### *9.1.3 Groundwater Levels*

Monitoring of GCP1 (churchyard piezometer – *Figure 9.1*) in the alluvium of Main Creek since January 2002 indicates standing water levels have fallen 5.57m, which coincides with the lack of rainfall recharge due to the ongoing drought. The water level in GCP2 (*Figure 9.1*), which is located in a backfilled

pit in the alluvium of Main Creek over Longwall 6, has fallen by 0.57m, whilst piezometers in Bettys Creek alluvium (GCP3S and GCP4S – *Figure 9.1*) have fallen by 0.96m and 1.38m respectively since April 2005.

Groundwater levels in the coal measures (GCP3D – *Figure 9.1*) have fallen by 4.42m in the same period, whilst GCP4D – *Figure 9.1* has risen by 5.64m. The rise in GCP4D is anomalous and requires ongoing monitoring of water levels and chemistry to ascertain the integrity of the piezometer data, as it is possible that shallow alluvial water may be leaking into the coal measures.

### *9.1.4 Groundwater Chemistry*

Both the coal measures and alluvial groundwater are Cl>Na>Mg dominant. Long term monitoring within GCP1 indicates the Main Creek alluvial aquifer contains brackish water with between 3110µS/cm and 3720µS/cm, whilst GCP3S, GCP4S, GCP3D and GCP4D can reach 19 500µS/cm, which is too saline for stock use.

### *9.1.5 Impacts from Surrounding Mines*

The existing open cut mines within the locality have already had a significant impact on the local and regional groundwater. Subsidence effects on groundwater caused by the continuation of underground mining within Longwalls 10 to 17 will be significantly overshadowed as a consequence of the excavation of the 270m deep Mt Owen Open Cut, and to a lesser degree by the Ravensworth East and Mt Owen Eastern Rail Pits. Groundwater level and water quality monitoring in the GCCM piezometers will enable an assessment of subsidence effects within the vicinity of Longwalls 10 to 13 prior to mining and following completion of the proposed open cuts.

Groundwater modelling indicates that excavation of Mt Owen Pit C, Ravensworth East and the Mt Owen Eastern Rail Pit could reduce the groundwater levels within the coal measures over Longwalls 10 to 17 by between 10m to 40m (five years after Pit C commences), with up to 120m of drawdown 21 years after Pit C starts. The degree of depressurisation within the Project Area depends on both radial distance from the three pits and timing of their excavation. Overburden removal in Pit C commenced in 2005.

Mining the 35m deep Ravensworth East Pit will lower the shallow coal measures piezometric surface close to the pit. The Ravensworth East Pit may not have a significant effect on shallow alluvial groundwater in Bettys Creek, although there may be partial dewatering of the channel alluvium with partial recovery following pit backfill and re-saturation.

Water levels have declined in five of the six deep piezometers monitored near the Mt Owen Mine, with the rate of decline suggesting a depressurisation zone extending 1km to 2km from the existing Mt Owen operations. Excavation of the 270m deep Mt Owen Pit C will further lower the

piezometric surface in a 4km drawdown area, which in turn, will lower groundwater levels over the Ravensworth East, Mt Owen Eastern Rail Pit and GCCM mining areas. Backfilling of Pit C followed by resaturation of the filled void will partially restore the groundwater table over an extended period (MER, 2003).

Additional nearby mines that may currently be affecting groundwater levels in the vicinity of the GCC underground operation are the Ashton Coal Operations Pty Ltd Barrett and Arties pits (HLA Envirosciences 2001), which are excavating the Barrett Seam approximately 1.5km south-west of Longwalls 10 to 17, and the Camberwell open cut which is approximately 2.2km south-east of the GCC Longwall 1. However, both MER (2003) and Geoterra (2007) consider that the Camberwell pit may be sufficiently distant to have no observable effect on the Longwall 10 to 17 mining area.

The approved Ashton Underground Longwalls 1 to 4 are in the Pikes Gully seam, south-east of Camberwell village, and mining here will reduce the piezometric surface in the overlying and regional overburden and may also influence the groundwater systems over the GCCM longwall operation (P Dundon, 2006; GeoTerra, 2007).

The proposed Glennies Creek Coal open cut, located to the north of the Camberwell open cut, will reduce the piezometric surface in the overlying and regional overburden, and may also influence groundwater systems over the area of the GCC longwall operations (AGE, 2006; GeoTerra, 2007).

## *9.2 GROUNDWATER MODELLING AND MONITORING*

### *9.2.1 Introduction and Model Parameters*

Preliminary FEFLOW groundwater modelling has been carried out by Golder Associates Pty Ltd in association with Geoterra Pty Ltd (*Annex C*) and represents the Longwall 10 to 17 Project Area based on reasonable and representative assumptions, despite limited data availability. The model is, however, highly flexible and can be modified in response to new interpretations or further data that emerges as the project develops.

Current and proposed coal mines incorporated into the model include the Camberwell Open Cut and the proposed Glennies Creek Open Cut to the south, Barretts Open Cut and Ashton Underground to the south-west, Ravensworth and Eastern Rail Open Cuts to the north-west, and Mt Owen Open Cut to the north.

The model boundaries were placed along the Camberwell Anticline to the west, the contact zone between Singleton Coal Measures and Wallaringa Formation to the east and the boundary between the Singleton Coal Measures and Mulbring Siltstone to the southeast. All boundaries were set as no-flow

boundaries due to their structural characteristics and very low hydraulic conductivity characteristics.

Subsidence alters the hydraulic characteristics of the mined and overlying strata. The actual distribution of hydraulic conductivities within the Longwall 10 to 17 subsidence area are not accurately known at this stage, in the model it was assumed that hydraulic conductivity within the underground following extraction of Longwall 17 increases to approximately $1x10^{-2}$ m/sec, to allow for essentially unrestricted groundwater movement within the extracted and collapsed workings and in the goaf up to approximately 150m above the seam.

The horizontal and vertical hydraulic conductivity of the subsided overburden used in the model was based on an assumed vertical gradation of:

- goaf development along with bed sagging, and brittle vertical / horizontal connected fracturing to 150m above the seam;
- bed sagging with increased horizontal conductivity in a plastic deformation zone without increased post subsidence vertical conductivity from 150m above the seam to 20m beneath the alluvial / colluvial surface layer (ie 28mbgl); and
- no change in hydraulic conductivity within the subsided, unconfined, unconsolidated alluvium and colluvium from surface to 8m below ground level.

Two cases were modelled, with the parameters used for each presented in *Table 9.1*. Case 1 used the higher end of hydraulic conductivity and storativity values quoted in available reports for the surrounding mines. Case 2 used the lower quoted values.

***Table 9.1 Hydraulic Conductivities used in the FEFLOW Model***

| Unit | Horizontal Conductivity (m/s) | Vertical Conductivity (m/s) | Specific Yield (-) /Specific Storage (1/m) |
|---|---|---|---|
| **Case Study 1** | | | |
| Alluvium | 5.8 x 10-5 | 2.9 x 10-5 | 0.25 / - |
| Weathered Sandstone | 5 x 10-8 | 5 x 10-9 | 0.03 / 1 x 10-5 |
| Fresh Sandstone /Shale | 5 x 10-9 | 5 x 10-10 | 0.03 / 1 x 10-5 |
| Arties and Middle Liddell Seams | 6 x 10-7 | 6 x 10-8 | 0.03 / 1 x 10-5 |
| Hebden and Barrett Seams | 2 x 10-7 | 2 x 10-8 | 0.03 / 1 x 10-5 |
| **Case Study 2** | | | |
| Alluvium | 5.8 x 10-5 | 2.9 x 10-5 | 0.25 / - |
| Weathered Sandstone | 5.0 x 10-8 | 5.0 x 10-9 | 0.005 / 5 x 10-6 |
| Fresh Sandstone /Shale | 5.0 x 10-9 | 5.0 x 10-10 | 0.005 / 5 x 10-6 |
| Arties and Middle Liddell Seams | 1.0 x 10-7 | 1.0 x 10-8 | 0.03 / 5 x 10-6 |
| Hebden and Barrett Seams | 8.0 x 10-8 | 8.0 x 10-9 | 0.03 / 5 x 10-6 |

*Source: Golder Associates (2007)*

Rainfall recharge was assumed to occur and was applied to the model along the alluvial channels and coal seam outcrops. The applied rate of recharge was set to 8mm/year along the alluvium and to 2mm/year along the coal outcrops. The post-subsidence fracturing of the surface was assumed to attract the recharge of 10mm/year.

For each of the two modelled cases a quasi "current state" model was developed. The model was set up to represent the current situation of dewatering of the nearby mines; Mt Owen Open Cut Pits, Ashton Open Cut Pit, Glennies Creek Underground and Camberwell Open Cut Pits and then underwent crude calibration focused on matching measured (or previously modelled) groundwater inflow rates into Glennies Creek Underground and Mt Owen Open Cut Pit with the current model results.

The next step involved running two predictive scenarios for a five year timeframe; one with and one without the proposed Longwall 10 to 17 operation to assess the net impact of the proposed works on the surrounding hydrogeological environment. In each of the predictive scenarios it was assumed that during the next five years, Mt Owen Open Cut Pit C will progress further south, Ravensworth Open Cut Pit and Glennies Creek Open Cut Pit will reach their maximum depths, and the rest of the modelled operations will continue the dewatering processes at the current level.

### *9.2.2 Groundwater Modelling Results*

The FEFLOW model indicates the main groundwater depressurisation will occur in the confined Middle Liddell Seam, as well as the overlying goaf and highly fractured overburden. The reduction in groundwater head depressurisation with increasing height in the stratigraphy, results from the change from brittle to ductile sagging of the overburden and the resultant variation in fracture development and connection.

No registered bores and wells will be observably affected by groundwater depressurization following extraction of Longwalls 10 to 17. No active registered groundwater extraction bores are located in the Longwalls 10 to 17 modelled drawdown area and therefore, no adverse effects are anticipated on groundwater users extracting from the coal measures overburden.

No observable adverse effects are anticipated on Glennies Creek, Main Creek or Bettys Creek and/or their associated alluvial groundwater systems.

### *9.2.3 Future Modelling*

As confirmed with the Department of Natural Resources, conventional groundwater modelling such as the FEFLOW methodology adopted does not integrate the ground deformations that are recognised to occur as a result of longwall mining and which are known to impact on groundwater behaviour.

Consequently, these standard modelling techniques alone are not appropriate to determine the impacts of subsidence.

Dr Winton Gale has developed an integrated approach to ground deformation/groundwater modelling using FLAC, a finite difference numerical modelling code (refer to *Annex B*). This approach is based on characterisation of the overburden strata using a range of geophysical and other testing techniques. The in-situ stresses are typically determined from borehole breakout measurements in exploration holes and overcoring stress measurements conducted underground where available. Ground deformations are typically confirmed using surface extensometers located over the centre of the longwall panels to determine the height and nature of fracturing as the longwall approaches and passes under the extensometer. Multiple piezometer strings installed into exploration boreholes have proved useful for determining the impact of longwall mining on groundwater behaviour (SCT, 2007b).

GCCM propose that this more refined numerical modelling be undertaken for Longwalls 10 to 17 to provide a basis for integrating the various field measurements into a more cohesive model which would allow the impacts of various mining geometries on subsidence and groundwater behaviour to be assessed and evaluated more fully (SCT, 2007b). This technique, which has been found to be very successful within NSW, will be initiated prior to mining Longwall 10.

## *9.3 LOCAL IMPACTS*

### *9.3.1 Local Groundwater Users*

No registered groundwater extraction bores are located within or adjacent to the Project Area and, therefore, any temporary groundwater level depletion that may occur due to subsidence will not adversely affect any groundwater users in the area. In addition, there are no groundwater dependent ecosystems within the Project Area.

Groundwater level and water quality monitoring will enable an assessment of subsidence effects within the vicinity of Longwalls 10 to 13 prior to mining and following completion of the XMO/Xstrata pits.

### *9.3.2 Bettys Creek Alluvium*

No significant alluvial aquifers are present over Longwalls 10 to 17, with only shallow (<12m deep) alluvium located along Bettys Creek. Groundwater levels, stream flows, ground surface subsidence and crack monitoring over Longwalls 1 to 7 under Main Creek (which has a similar alluvial aquifer system to Bettys Creek) has not indicated any direct observable effect on the shallow alluvial system.

No measurable adverse effect is anticipated on the Bettys Creek alluvial system or stream baseflow through increased subsurface aquifer hydraulic permeability changes or coal measure groundwater level reduction. This is primarily due to:

- the lack of observed subsidence effects in Main Creek, which has similar levels of subsidence to the proposed Longwall 10 to 17 subsidence zone;
- the single groundwater seepage area observed within Bettys Creek does not currently maintain flow in Bettys Creek; and
- the seepage area is within the area affected by the proposed Eastern Rail Pit and Bettys Creek Diversion. These activities will have a substantially greater effect on stream baseflow compared to that generated by subsidence.

There may, however, be some loss of stream flow in Bettys Creek due to subsidence cracking through:

- lowering the coal measures water table;
- reduction in spring seep flow to the creek; and/or by
- reduction in runoff due to interception and infiltration into cracked soil, although once the soil profile is saturated after heavy rain, runoff is not anticipated to be reduced.

Subsidence-induced cracking within the sandy clay stream sediments is not anticipated to adversely affect the alluvial groundwater system, and it is not anticipated that a loss of alluvial groundwater will occur if cracking enables enhanced vertical or lateral connection to adjacent strata. The degree of loss will relate to the balance of upstream inflow from the creek compared to vertical or lateral outflow from the alluvium.

### *9.3.3 Shallow Coal Measures*

Based on experience in similar mining environments and alluvial systems in the Hunter Valley, the shallow coal measures within the Project Area will not be measurably affected by subsidence.

Previous observations as well as research projects (ACARP, 2000, 2003, 2006-in prep) indicate post-mining hydraulic conductivity increases and depressurisation of shallow coal measures (within 50m of the surface) may reduce standing water levels by up to 15m directly over the mined longwalls.

Soil and shallow bedrock cracking have been observed to extend to around 20m below surface, occurring as faceline or ribline cracks, whilst the degree of permeability change relates to the original nature of crack development, followed by the degree of permeability reduction on re-closing of post subsidence fractures. Soil profiles may be restored to near their original permeability/porosity through soil remobilisation into the cracks by either natural or assisted processes, such as deep ripping.

### *9.3.4 Deeper Coal Measures Overburden*

Cracking of the coal measures will significantly enhance the vertical and horizontal permeability and lower the standing watertable, with increased interconnection of aquifers, aquicludes and aquitards in the cracked horizon. However, due to the depth of cover, the anticipated depth of surface cracking (approximately 20m), the anticipated height of goafing above the extracted seam (approximately 30 to 60m) and past experience over Longwalls 1 to 7, it is not expected that water will enter workings from above the goaf.

Horizontal displacement may occur up to 1.5km from a panel edge (Strata Engineering, 2003). However, as the closest registered extraction bore lies 2.7km from the Project Area, it is unlikely to be measurably affected by subsidence in isolation from the effect of XMO/Xstrata open cut pit dewatering.

The actual presence and hydraulic nature of faults within the study area is not known at this stage and has not been assessed in the FEFLOW model. If the hydraulic conductivity of the faults is higher than the surrounding pre-subsidence strata, they may act as water conduits resulting in higher inflows to the workings. By contrast, if the hydraulic conductivities of the faults are lower than the overburden, they may act as pre-subsidence barriers which could result in lower than estimated inflow rates into the underground.

In any case, following extraction and subsidence of Longwalls 10 to 17, it is assumed that fracture propagation up to 150m above the workings and in the top 20m of overburden beneath the surface will override the influence of any faults that may be present in those depth intervals.

### *9.3.5 Middle Liddell Seam*

Groundwater levels within the Middle Liddell Seam aquifer will be drawn down to seam floor level, with the overburden being significantly affected within the goaf and overlying highly fractured strata between 30m and 60m above the workings. Partial dewatering will occur above the highly fractured zone, which is within dilated strata that may extend between 100m and 150m above the workings.

However, based on investigations to date, there are no aquifers that provide a beneficial use or sustain groundwater dependent ecosystems in the 20mm subsidence zone.

### *9.3.6 Local Streams*

It is not anticipated that stream flow in Bettys Creek, Main Creek or Glennies Creek will be observably reduced based on the modelled response to subsidence over Longwalls 10 to 17.

### *9.3.7 Groundwater Quality*

No adverse effect on the Bettys Creek stream, alluvial or coal measures water quality Longwalls 10 to 17 is anticipated.

Alluvial groundwater in Bettys Creek is relatively brackish, whilst the coal measures are brackish to saline and are not suitable for domestic or agricultural use, with the groundwater system having a low beneficial use.

### *9.3.8 Mine Water Supply, Underground Inflows and Groundwater Extraction*

Water supply for the mine originates from:

- seepage into the underground workings;
- seepage into the Camberwell Open Cut, which is now part of the Integra Coal Pty Ltd group of operations (including the Glennies Creek underground);
- incident rainfall on dirty water catchments which report to the sump within the Camberwell Open Cut; and
- return flows from the coal handling and preparation plant and tailings system.

GCC also hold licences for the extraction of water from Glennies Creek, albeit that no water has been pumped from that source since 2002.

Groundwater flow to the underground workings reached up to 2000$m^3$/day during the initial main headings and longwall development, but has reduced to around 300$m^3$/day (approximately 110ML/yr) up to and including extraction of Longwall 7 (PSM, 2007 in prep).

GeoTerra (2007) concludes that due to the depth of cover (375m to 500m), the anticipated depth of surface cracking (approximately 20m), the height of goafing above the extracted seam (approximately 65m) and past experience over Longwalls 1 to 7, it is not expected that extraction of Longwalls 10 to 17 will significantly add water make to the workings from lithologies above the goaf.

However, for conservatism in the overall water balance, PSM (2007, in prep) have nominated an additional total inflow of up to 500$m^3$/day to the proposed Longwalls 10 to 17 may occur as the underground mine expands (PSM, 2007 in prep), with pumping data being collected to better define the potential inflows.

GCC is licensed by the DWE (20BL169862) with an annual entitlement to extract 450ML of groundwater. The current extraction rate of 300$m^3$/day (0.3ML/day), as well as the potential additional 200$m^3$/day (to 0.5ML/day) is not anticipated to exceed the annual extraction entitlement of 450ML/yr (WRM, 2007).

No additional groundwater bores are used to extract any water out of the workings or overlying aquifers.

## *9.4 REGIONAL AND CUMULATIVE IMPACTS*

### *9.4.1 Alluvial and Shallow Coal Measures*

Drawdown within the Quaternary alluvium of Bettys Creek and the underlying shallow coal measures due to subsidence over Longwalls 1 to 17 will interact with the regional drawdown generated through extraction of the Mt Owen, Eastern Rail and Ravensworth East Pits. The reduced stream flow over Longwalls 9 to 17 and the reduced alluvial recharge effects due to extraction of Mt Owen Pit C and the diversion of Bettys Creek around the Eastern Rail Pit will have a cumulative effect on the alluvial system and shallow coal measures. This impact will be greater than any stream flow and groundwater level drawdown that would be imposed solely through Longwall 10 to 17 subsidence.

### *9.4.2 Deep Coal Measures*

Coal measures have progressively depressurised since mining at Mt Owen commenced in late 1993. Prior to that time, dewatering of shallow coal measures had been initiated through mining in the Ravensworth East (old Swamp Creek) pit and had affected areas to the east towards Mt Owen. Historical underground operations at Liddell Colliery (in the Liddell seams) may also have marginally affected water levels in the Ravensworth East area, although measured levels suggest the impact was negligible (MER, 2003).

Drawdown within the deeper coal measures due to subsidence over Longwalls 10 to 17 will interact with the regional drawdown generated through extraction of the Eastern Rail, Ravensworth East, Mt Owen Pits A to C, Ashton and Camberwell Open Cuts, as well as the proposed Glennies Creek Open Cut and the Ashton underground workings.

Drawdown due to subsidence over Longwalls 10 to 17 will combine with the drawdown effect from the regional mines and is considered to be insignificant in comparison to the impacts from these surrounding mines. The GCCM underground operations will not affect the beneficial use of the groundwater system to either water users or the environment.

### *9.4.3 Regional Groundwater Recovery*

Re-saturation of the Longwall 1 to 17 workings will be minimised through post extraction dewatering to surface as it is planned to extract the directly underlying Barrett and Hebden Seams.

In addition, ongoing and proposed open cut and underground mines within the Longwall 1 to 17 drawdown area will still be in operation at the end of mining Longwall 17. It is therefore not possible to assess the potential modelled groundwater level recovery without sufficient data from these additional effects.

# 10 AIR QUALITY AND GREENHOUSE GASES

## 10.1 DUST

The existing air quality in the vicinity of the Glennies Creek Colliery is determined primarily by its proximity to large open cut mines such as Camberwell, Rixs Creek, Ashton, Ravensworth East and Mt Owen, with the air quality experienced at individual residences dependent on the proximity to one or more of major emission sources and the relationship between the source, the receiver and the dominant wind directions. Underground mining activities, such as at the Glennies Creek Colliery, which have only limited areas of surface exposure, along with agricultural activities and vehicle movements on unsealed roads, are only minor contributors.

With the exception of gas drainage borehole installation activities, the continuation of underground mining into Longwalls 10 to 17 will not generate surface dust emissions. The existing RL100 ROM coal stockpile, while lying close to the natural land surface, is located 35m below the adjacent constructed and unrehabilitated landform within the former Camberwell North Pit. As such, the area is shielded from the south south-easterly summer winds which would potentially disperse particulates towards the nearest residences, particularly those on Glennies Creek Road. A boom spray is situated above the stockpile area to mitigate dust if necessary, but with a moisture content of over 12%, the ROM stockpiles have never been observed as a source of dust.

Approximately 16m$^3$ of drill cuttings will be removed during the development of each gas drainage borehole. Although these works have the potential to generate some dust in the absence of appropriate measures, emissions are controlled by:

- soil stripping when moist either naturally or through the application of water;
- use of cyclones or other dust collectors on the drill rig (when percussion drilling is employed); and
- vehicle speed restrictions on access tracks to 30kph.

As has been the case to date, the material excavated while developing gas drainage boreholes over Longwalls 10 – 17 will be transferred to the Portal Area (see *Figure 1.2* and *Photograph 1*) for disposal in areas awaiting final landform creation. The Portal Area lies within a void ranging from 40m to 90m below the surrounding natural and/or man-made surfaces and acts as a dust control measure through the reduced potential for wind erosion.

EASTERN RAIL PIT

MT OWEN RAIL SPUR

NORTH MAINS

FOREST ROAD VENTILATION SHAFT (ML 1525)

NORTH-WEST MAINS

PIT TOP FACILITIES

POSSUM SKIN DAM

BARRETT SEAM ENTRY

PORTAL AREA AND HIGH WALL ENTRY

RL100 HAUL ROAD

CAMBERWELL CHPP

NEW ENGLAND HWY TO SINGLETON

D9 D10 D11 D3 D7 D4

HV3(TSP) PM10(2) HV2(TSP) HV1(TSP) PM10(1)

LW17 LW16 LW15 LW14 LW13 LW12 LW11 LW10 LW9 LW8 LW7 LW6 LW5 LW4 LW3 LW2 LW1

FALBROOK MIDDLE FALBROOK CAMBERWELL CASWELL OAK PARK

MIDDLE FALBROOK ROAD STONY CREEK ROAD BRIDGMAN ROAD NEW ENGLAND HWY MAIN NORTHERN RAILWAY

Main Creek Glennies Creek Station Creek Reedy Creek Stony Creek Martins Creek Fal Brook

**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- CL 382 Boundary
- ML 1525 Boundary
- ML 1518 Boundary
- ML 1551 Boundary
- ML 1437 Boundary
- Powerline to Ventilation Shaft
- Deposited Dust Gauge
- High Volume Sampler

**Figure 10.1**

**Air Quality Monitoring Sites**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Environ Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_21 | | |
| Date: | 12/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | 1:25,000 Topographic Series- Camberwell | | |
| Scale: | Refer to Scale Bar | | |

N

0 250 500 750m

Environmental Resources Management Australia Pty Ltd
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ERM

Given the proximity of the Glennies Creek Colliery and Camberwell Coal Mine, and the extensive air quality monitoring network maintained by Camberwell which encircles both operations, the Department of Environment and Conservation (EPA) has acknowledged that an air quality monitoring programme targeting deposited dust and particulates from GCC, independent of Camberwell, is not warranted: the monitoring data collected is effectively recording the cumulative impacts of all mining operations within and surrounding GCC. *Figure 10.1* identifies the locations of the seven deposited dust gauges (D3, D4, D5, D7, D9, D10 and D11) and three high volume sampler sites (HV1, HV2 and HV3) maintained by Camberwell. Additionally, in August 2005, GCCM installed two $PM_{10}$ monitors (one to the south-east and one to the south-west of the GCC / Camberwell surface activities) (*Figure 10.1*).

Deposited dust and TSP results obtained for the 2001 to 2006 period (*Tables 10.1* and *10.2*) show that since 2002 cumulative air quality results for the area were predominantly below prescribed criteria. The initial year of $PM_{10}$ monitoring has also shown routine compliance with the nominated criterion, with average levels of less than 20 $\mu g/m^3$ recorded. When exceedances occurred in individual months, wind directions at the time revealed that the impact of GCCM's activities on the levels would have been minimal. The results of these programs reinforce the minimal impacts of the underground GCCM operation on dust levels in comparison to its open cut neighbours.

***Table 10.1 Dust Deposition Rates Summary (September 2000 – May 2006) ($g/m^2$/month)*[1]***

| Averaging Period | D3 | D4 | D5 | D7 | D9 | D10 | D11 |
|---|---|---|---|---|---|---|---|
| 2001 | 2.6 | 2.4 | 1.7 | 5.0 | 1.8 | 2.1 | 2.4 |
| 2002 | 2.6 | 2.6 | 1.9 | 4.3 | 2.9 | 2.7 | 3.3 |
| 2003 | 1.9 | 2.5 | 1.5 | 4.0 | 2.0 | 2.4 | 2.4 |
| 2004 | 3.6 | 2.0 | 1.5 | 3.4 | 2.0 | 2.4 | 3.2 |
| 2005 | 1.4 | 2.1 | 1.4 | 2.8 | 2.0 | 1.9 | 3.2 |
| 2006 | 2.4 | 1.6 | 1.9 | 3.0 | 2.3 | 2.1 | 3.5 |
| Average: | 2.4 | 2.2 | 1.7 | 3.8 | 2.2 | 2.3 | 3.0 |

Note: For monitoring sites, see *Figure 10.1.*

***Table 10.2 TSP Data Summary (September 2003 – May 2006) ($\mu g/m^3$)***

| Averaging Period | HV1 – Lambkin Average | HV2 – Dulwich Average | HV3 – Hardy Average |
|---|---|---|---|
| 2001 | 34 | 91 | 56 |
| 2002 | 49 | 96 | 74 |
| 2003 | 46 | 89 | 56 |
| 2004 | 44 | 83 | 53 |
| 2005 | 48 | 88 | 47 |
| 2006 | 40 | 80 | 52 |
| Average: | 44 | 88 | 56 |

Note: For monitoring sites, see *Figure 10.1.*

In order to satisfy air quality criteria (Condition 3.1 of EPL 7622), and to minimise environmental impacts, GCCM employs a range of control measures as identified in the approved Revised Air Quality Management Plan for the Colliery. The measures employed for the underground operations include:

- application of water at dust generation sources;
- water sprays on the underground coal transport system; and
- filters/scrubbers on operational equipment.

## *10.2 ENERGY CONSUMPTION AND GREENHOUSE GASES*

Mining of Longwalls 10 to 17 will produce approximately 15.8 Mt ROM coal over the projected mine life of approximately five years, plus first workings.

When discussing greenhouse gas (GHG) emissions, reference has been made to both carbon dioxide ($CO_2$) emissions and carbon dioxide equivalent ($CO_2$-e) emissions. $CO_2$-e allows the conversion of non $CO_2$ greenhouse gases to $CO_2$-e by multiplying their global warming potential. For example, methane has a global warming potential of 21, therefore one tonne of methane is equivalent to 21 tonnes of $CO_2$.

This assessment has been based on the methodologies outlined in the Australian Greenhouse office (AGO) Factors and Methods Workbook (2006), and the Greenhouse Gas Protocol (2004). The assessment has also been prepared having regard to the NSW Greenhouse Plan (NSW Greenhouse Office, 2004).

The AGO workbook provides current greenhouse gas emission factors for Australian Organisations to estimate their emissions. The workbook adopts the emissions categories of the GHG Protocol (2004) that lists three scopes of greenhouse emissions for accounting and reporting:

- Scope 1 covers direct emissions from sources within the boundary of the operation as a direct result of its activities. These emissions mainly arise from:
    - the generation of energy, heat, steam and electricity, including carbon dioxide and products of incomplete combustion (methane and nitrous oxide);
    - manufacturing processes;
    - transportation of materials, products, waste and people such as the use of vehicles owned and operated by the reporting organisation;
    - fugitive emissions: intentional and unintentional GHG releases such as methane emissions from coal mines; and

- on-site waste management such as emissions from company owned and operated landfill sites.

- Scope 2 covers indirect emissions from the combustion of purchased electricity, steam or heat produced by another organisation. Scope 2 emissions result from the combustion of fuel to generate the electricity, steam or heat and do not include emissions associated with the production of fuel; and

- Scope 3 includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation. The GHG Protocol provides that reporting Scope 3 emissions is optional.

However, the amended Director General's Requirements for the proposal (dated 25 January 2007) require this environmental assessment to include a quantitative analysis of greenhouse emissions associated with the combustion of the product coal and a qualitative assessment of the impacts of these emissions on the environment.

The main sources of energy use and greenhouse gas emissions from the proposed continuation of mining into Longwalls 10 to 17 will include electricity consumption, methane released from coal and rock strata; and carbon dioxide, nitrous oxide and methane generated by diesel powered equipment.

Consistent with the methodologies described, Scope 3 emissions are not required in the GHG calculations for this assessment. However, emissions resulting from the rail transport of the mined coal have been included, to add to the comprehensiveness of this assessment.

Scope three emissions that have not been included in this assessment include:

- transport and disposal of waste generated at the mine;

- employee business travel;

- employees commuting to and from work;

- extraction, production and transport of other purchased materials and goods;

- out-sourced activities;

- sea transport of product coal; and

- emissions from land clearing.

Emissions from sea transport of the export product coal have not been included as the exact destination, route and distance is not known. Emissions from land clearing have been excluded from the assessment given that

vegetation clearing will be limited to the gas boreholes with no net loss predicted.

### *10.2.1 Slow Oxidation and Spontaneous Combustion*

Coal and other carbonaceous materials exposed to the atmosphere during mining operations are subject to oxidation. At ambient temperatures, such oxidation occurs slowly, and generates approximately 380 kJ heat per mol oxygen. If the rate of heat generation is greater than the rate of heat loss, the temperature of the material will rise and, if unchecked, could result in spontaneous combustion which would produce CO, $CO_2$ and small quantities of $CH_4$ at a much higher rate than slow oxidation.

The Glennies Creek Colliery has a Spontaneous Combustion Management Plan which was submitted to (and approved by) DMR as part of the S.140 (CMRA 1982) approval process. GCC coal has been identified as having a medium propensity for spontaneous combustion.

Controls implemented by GCCM in accordance with the Spontaneous Combustion Management Plan in order to reduce the potential for spontaneous combustion include the following:

- real time gas monitoring sensors at strategic locations in roadways. This system monitors CO (an early indicator of spontaneous combustion) as well as other gases, and results are displayed on the colliery computer system. The gas monitoring software has certain trigger levels for various gas concentrations which, when reached, activate alarms on site and report to an external monitoring firm if not acknowledged within a specified time frame. This software also allows the storage and trending of monitoring data;

- tube bundle gas monitoring system which samples the atmosphere in both sealed areas and general body roadways. As with the real-time monitoring, the tube bundle gas monitoring software has trigger levels for various gas concentrations which activate internal or external alarms and allows storage and trending of monitoring data;

- a regime of weekly atmosphere bag sampling through seals from goaf areas. These samples are then analysed off site by a laboratory using a gas chromatograph. This system allows the detection of further indicators of spontaneous combustion including $H_2$, $C_2H_4$ and $C_2H_6$;

- weekly pressure monitoring of seals to measure differential pressure across seals;

- weekly seal inspections by deputies using a check sheet;

- the sealing of goaf areas using high quality seals, well supported with secondary roof and rib support, to minimise oxygen ingress into the goaf;

- full seam extraction by the longwall mining equipment;
- visual inspections of surface stockpiles; and
- ventilation management system including the use of pressure balance chambers on final seals to minimise oxygen ingress into the goaf.

For underground mines, due to very low occurrence of spontaneous combustion, greenhouse gas emissions from these processes can be considered to be negligible (Energy Strategies Report, 2000) and have therefore been excluded from this assessment.

### *10.2.2 On-site Energy Consumption*

The project energy use estimates are based on the estimated consumption of diesel fuel (kL) and electricity (kWh) on site using the following multipliers:

- diesel-consumption was multiplied by 38.6 GJ/kL to calculate the total energy of diesel consumed.
- electricity-consumption rate was multiplied by 0.0036 to convert kWh to gigajoules.

These figures were then added together to arrive at the total energy in GJ consumed by the Project. This figure was divided by either ROM or saleable coal production during the life of the Project to arrive at energy use indices of 0.055GJ/t ROM coal and 0.091GJ/t saleable coal. These indices are lower than the industry average for saleable coal produced by the underground mining industry which is reported to be 0.22GJ/t (AGSO, 2000).

The electricity consumption figure of 13.6 kWh/t ROM coal produced was based on two years data and is a conservative estimate given that as operations progress, kWh/t ROM would significantly reduce (Country Energy, 2006). ROM coal production during the 2004/05 and 2005/06 which were used to determine this energy index were 1.57 Mt and 2.02 Mt respectively.

### *10.2.3 On-site Greenhouse Emissions*

Coal not only releases methane into the surrounding strata while underground but continues to desorb or leak methane to the atmosphere once brought to the surface. This residual gas is released during storage, washing, crushing and transport.

Coal mining accelerates the release of seam gas from the coal by reducing the confining pressures that slow the migration of gas. This rate increase depends on a variety of factors, including seam permeability, porosity, pore pressure, cleat jointing, gas content and type, depth of cover, stress regimes and time.

Exploration of the Middle Liddell Seam revealed gas contents of 2 to 7$m^3$ per tonne, containing 75 to 95% methane. To calculate methane emissions for the seam, average values of 4.5$m^3$ gas per tonne with 85% methane content was employed, resulting in 3.825$m^3$ methane per tonne (ROM). As a standard, methane emission rates from coal are calculated using kilograms per tonne as an indicator, so the above cubic metre measurements of methane are multiplied by 0.672 to convert to kilograms (AGO, 1997). This results in 2.57kg methane per tonne coal.

Onsite greenhouse gas emissions were calculated using emission factors taken from the Australian Greenhouse Office (AGO, 2006), to convert fuel usage and electricity into $CO_2$-e. These factors were:

- 3.0kg $Co_2$-e/litre for diesel usage – based on full fuel cycle analysis; and
- 1.068kg $CO_2$-e/kWh of electrical energy used in NSW.

Note also that methane contribution to the onsite $CO_2$-e total is effected by its global warming potential of 21.

The estimated annual greenhouse gas emissions associated with energy consumption from the mining operation, plus methane emissions from the coal seam are dominated by methane emissions at 77.59%. Emissions from the generation of electricity used on site make up 21.60% of the total.

Using the above figures and emission factors, the average onsite greenhouse gas emissions for Longwalls 10 to 17 are estimated at 174 627 t /year ($CO_2$-e).

It is important to note that these figures assume venting from the gas drainage holes and provide an over-estimate of the greenhouse emissions, particularly given that the Envirogen Pty Ltd plant has commenced construction and will collect a portion of the total methane for use in the generation of electricity (refer to *Section 10.4.2*).

### *10.2.4 GHG emissions from the combustion of coal*

*Table 10.3* outlines the estimated greenhouse gas emissions generated by the combustion of coal extracted from Longwalls 10 to 17. The emissions have been calculated based on an average coal gross energy content of 30 GJ/t and emission factor of 90.2, taken from the AGO Workbook (2006) for coal used in steel.

*Table 10.3 Greenhouse Gas Emissions from Burning Saleable Coal*

| Year | Saleable Coal Produced (tonnes/year) | $CO_2$-e from Combustion (tonnes/year) |
|---|---|---|
| First workings | 680 000 | 1 840 080 |
| 1 | 1 650 000 | 4 464 900 |
| 2 | 1 688 000 | 4 567 728 |
| 3 | 1 738 667 | 4 704 832 |
| 4 | 1 704 583 | 4 612 603 |
| 5 | 1 928 750 | 5 219 198 |
| **TOTAL** | **9 390 000** | **25 409 340** |
| **Annual Average** | | **4 234 890** |

### *10.2.5 GHG Emissions from the Transport of Coal to Newcastle Port*

Coal extracted from Longwalls 10 to 17 is to be exported internationally via ships from Newcastle Port. Exact destinations of the product are as yet unknown, so routes and distances are not available for calculating GHG emissions from this phase of product transport. This assessment will therefore examine emissions from the trains used to transport the coal from the mine to the harbour, prior to export.

Coal is hauled from the mine using diesel freight trains, which have a capacity of 7600 tonnes of coal. For the purposes of this assessment, a $CO_2$-e emissions rate for rail transport of 12.3g/net tonne-km was used, taken from a report commissioned by QR Network Access (2002). Project saleable coal figures were used for this calculation, with a distance to Newcastle Port of 90km. *Table 10.4* below shows a figure of 10 395t $CO_2$-e was assessed for coal haulage over the total life of the project, totalling approximately 1732 t $CO_2$-e per annum over the six years covering first workings and approximately five years of secondary workings.

*Table 10.4 $CO_2$-e resulting from Rail Transport of Saleable Coal to Newcastle Port*

| Year | Product Coal produced (tonnes/year) | $CO_2$-e from transport of product coal (tonnes/year) |
|---|---|---|
| First workings | 680 000 | 753 |
| 1 | 1 650 000 | 1827 |
| 2 | 1 688 000 | 1869 |
| 3 | 1 738 667 | 1925 |
| 4 | 1 704 583 | 1887 |
| 5 | 1 928 750 | 2135 |
| **TOTAL** | **9 390 000** | **10 395** |
| **Annual Average** | | **1732** |

### *10.2.6 Summary*

*Table 10.5 Project Greenhouse Gas Emissions*

| Mining Stage | Emissions Source | Annual Average $CO_2$-e (t) | Project Total CO2-e (t) | Annual Average $CO_2$-e as % of Global Emissions |
|---|---|---|---|---|
| Extraction and Processing | Electricity | 37 716 | 226 296 | |
| | Diesel | 1421 | 8525 | |
| | Methane | 135 490 | 812 942 | 0.0001 |
| Transport to Harbour | Diesel | 1732 | 10 395 | |
| Combustion of Product Coal | Coal | 4 234 890 | 25 409 340 | 0.016 |
| **TOTAL** | | **4 411 250** | **26 467 498** | **0.017** |

*Note: Global emission figure used is CO2-e emissions from burning fossil fuels (IEA, 2006)*

*Table 10.5* shows that total annual emissions from mining, transporting and burning coal from Longwalls 10 to 17, would result in an average total of 4 411 250 t $CO_2$-e annually, which represents approximately:

- 0.78% of the Australian annual total GHG emissions (National Greenhouse Gas Inventory, AGO, 2004); and
- 0.017% of annual Global GHG emissions from burning fuel (IEA 2006).

When $CO_2$-e emissions from the Project are broken down to separate coal combustion figures from other project emissions, *Table 10.5* reveals that operation of the mine and associated rail transport contributes only 0.0001% of Global emissions, while the remaining majority of 0.016% can be attributed to the burning of the product coal offsite.

## *10.3 IMPACT ASSESSMENT*

Current scientific consensus suggests that the release of greenhouse gases into the atmosphere via human activities such as coal mining and combustion contributes to the process of climate change. This is a process which involves alterations to the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (http://www.ipcc.ch/pub/gloss.pdf 2006).

It is estimated that since 1751, approximately 305 billion tonnes of carbon have been released to the atmosphere from the consumption of fossil fuels, with half of these emissions having occurred since the mid 1970s (http://cdiac.ornl.gov/trends/emis/tre_glob.htm). The mining operations and combustion of coal resulting from mining Longwalls 10 – 17 will contribute to these emissions, the potential impacts of which extend beyond climate, also influencing global ecology, sea levels, and water supply and distribution as discussed below.

### *10.3.1 Climate Change*

Scientists estimate that the temperature at the Earth's surface increased by 0.6°C over the 20th century. Projections of future warming suggest a global increase of 1.4°C to 5.8°C by 2100 (http://www.pewclimate.org/global-warming-in-depth/environmental_impacts).

Projections for Australia are for a hotter climate with more frequent extreme events. Warming of 0.4-2 $^{o}$C by 2030 and 1-6 $^{o}$C by 2070 is projected, with more hot days over 35 $^{o}$C and a reduction in the number of frost days. Climatic changes predicted for Australia also include an increase in the frequency and duration of extreme events such as heavy rains, cyclones, floods, and droughts (http://www.csiro.au/resources/psrs.html#4).

Coal from Longwalls 10 to 17 when extracted, transported and combusted, represents approximately 0.78% of the Australian annual total GHG emissions and 0.017% of annual Global GHG emissions from burning fossil fuels. Whilst it is recognised that this will contribute to the impact of climate change, it is not of a scale that will significantly alter the frequency and duration of extreme climate events.

### *10.3.2 Ecology*

Many of Australia's unique ecosystems will be vulnerable to the effects of climate change given their limited geographical ranges, and limited capacity to adapt. The Great Barrier Reef, for example, will most likely be subjected to increased levels of bleaching as a consequence of warmer sea temperatures. Wetlands may be impacted from salt intrusion from rising sea levels, while declining rainfall may place stress on riverine environments (http://www.greenhouse.gov.au/impacts/biodiversity.html). These and other ecosystems may suffer significant and irreversible damage from climate change. It is acknowledged that some systems and species may become more vulnerable as a result of climate change, and some may become extinct (http://www.greenhouse.gov.au/science/guide/pubs/chapter4.pdf).

The extraction, rail transport and combustion of coal from Longwalls 10 to 17 represents approximately 0.78% of the Australian annual total GHG emissions and 0.017% of annual Global GHG emissions from burning fuel. Whilst it is recognised that this will contribute to the impact of climate change, it is not of a scale that will significantly alter threatened species habitats and will not result in the extinction of any viable local threatened species, populations or ecological communities.

### *10.3.3 Sea Level Rise*

Sea levels rose about 1.8 mm per year over the second half of the 20th century (http://www.csiro.au/org/pss2.html#3), while a rise in sea level of nine to 88 cm is estimated by 2100.

Coastal and intertidal ecosystems will be especially vulnerable to the impacts of sea level rises, with research suggesting that globally, about 20% of coastal wetlands could be lost due to sea level rise by the year 2080 (http://www.greenhouse.gov.au/science/guide/pubs/chapter4.pdf).

Human settlements on coastal areas globally may also be threatened by the rising sea levels, with erosion or inundation resulting in loss of land, property and infrastructure. Extreme weather events such as cyclones and severe waves may be generated, impacting on coastal communities and possibly resulting in injury or loss of life.

Coal from Longwalls 10 to 17, when extracted, transported and combusted, represents approximately 0.78% of the Australian annual total GHG emissions and 0.017% of annual Global GHG emissions resulting from burning fossil fuels. Whilst it is recognised that this will contribute to the impact of climate change, it is not of a scale that will significantly alter the frequency and duration of extreme climate events.

### *10.3.4 Rainfall*

Studies predict climate change will effect rainfall patterns and variability across different regions of the world including Australia. An increase in global average precipitation is expected in the 21st century, but modelling shows that changes will not be globally uniform.

Australian studies suggest that mid-latitudinal regions will experience reductions in rainfall and an increased incidence of drought, with decreases in winter-spring rainfall (June–November) over the southern half of the continent expected. The chances of summer-autumn rainfall (December-May) are expected to generally increase, especially in the north of the continent. Climate change predictions also project an increase in the extremes of flood and drought, while higher average temperatures will potentially increase evaporation levels (http://www.greenhouse.gov.au/science/guide/pubs/chapter4.pdf).

The extraction, rail transport and combustion of coal from Longwalls 10 to 17 represents approximately 0.78% of the Australian annual total GHG emissions and 0.017% of annual global GHG emissions from burning fuel. Whilst it is recognised that this will contribute to the impact of climate change, it is not of a scale that will significantly alter the frequency and duration of extreme climate events such as drought.

## 10.4 MONITORING AND ABATEMENT MEASURES

### 10.4.1 Air Quality Monitoring

GCCM operates an extensive programme to monitor air quantity and quality within its underground workings and exhausting from the ventilation shaft and gas drainage boreholes.

Monitoring methods utilised during the reporting period comprised:

- hand held monitors – for $CH_4$, CO, $O_2$ levels throughout the workings;
- TROLEX electronic monitors – for $CH_4$ and CO levels at all panel returns and the ventilation shaft;
- electronic sensors – for $CH_4$, CO and $O_2$ on operating gas drainage borehole extraction plants;
- tube bundle monitoring – for $CH_4$, CO, $O_2$ and $CO_2$ at various locations underground including return airways, sealed goafs and the active goaf; and
- bag sampling – for $CH_4$, CO and $O_2$, $H_2$, $C_2H_6$, $C_2H_4$ and $N_2$ at selected locations, with analysis by gas chromatography.

As outlined previously, given the proximity of GCCM and Camberwell Coal Mines, the DEC has determined that continuing to source data from the extensive air quality monitoring network which circles both operations and is maintained by Camberwell, will be suitable for the provision of air quality data to GCCM. An agreement is in place whereby Camberwell provides air quality data relevant to GCCM's operations as requested. Monitoring equipment maintained by Camberwell includes dust gauges and high volume air samplers.

### 10.4.2 Greenhouse Mitigation Strategies

As an underground mine, GCCM will remove methane via the ventilation system and therefore has the opportunity to investigate the feasibility of methane drainage and re-use.

Once the approved Envirogen (Oaky) Pty Ltd gas powered generation plant (currently under construction) is operational and, subject to access agreements between Envirogen and the individual landowners, it is envisaged that the gas produced from the boreholes will be reticulated to that plant rather than venting or exhausting to the atmosphere. The presents an opportunity to reduce emissions of greenhouse gases by using waste coal mine gas to generate electricity. It is currently expected that the plant will be commissioned in the third quarter of 2007.

To further ensure that greenhouse gas generation is minimised for this project, GCCM as part of Integra Operations, is registered as a member of Greenhouse Challenge Plus. This is an initiative established to enable Australian companies to form working partnerships with the Australian Government to improve energy efficiency and reduce greenhouse gas emissions (http://www.greenhouse.gov.au/challenge). Similarly, GCCM as part of the AMCI group of companies is a participant in the Energy Efficiency Opportunities programme. This Federal Government programme encourages large energy-using businesses to improve their energy efficiency. It does this by requiring businesses to identify, evaluate and report publicly on cost effective energy savings opportunities (http://www.industry.gov.au).

Additionally, GCCM has prepared an Energy Savings Action Plan as required under the *Energy Administration Amendment (Water and Energy Savings) Act, 2005*. This Plan involves determining current energy use at the mine, undertaking a management review and detailed technical review, and assessing and identifying energy savings measures. The following actions have been identified under the Plan and are either being undertaken currently, or will be undertaken in the future.

- diesel efficiency considerations will be included in assessments of new mobile and fixed equipment - the less diesel used, the less greenhouse gas emitted during combustion;

- electrical efficiency consideration will be included in assessments of new mobile and fixed equipment - the less electricity used, the lower the emitted greenhouse gas level per tonne of coal produced;

- energy audits will be held when practicable to ensure that the mine is using best practice techniques to minimise energy use and is operating at optimum energy levels.;

- ensuring equipment will be maintained to retain high levels of energy efficiency;

- greenhouse awareness training will be held at induction to make employees aware of the science of global warming and detailed efforts to minimise emissions;

- an inventory of emissions and sinks will be developed and maintained; and

- emissions and abatement strategies will be reported annually.

Existing dust and greenhouse mitigation and monitoring programs will be continued throughout the remaining life of GCC, including Longwalls 10 to 17 in the Middle Liddell Seam.

# 11 ECOLOGY

## 11.1 INTRODUCTION

Flora and fauna was assessed within the Project Area, with particular attention to potential impacts of the proposal. This section provides a summary of study findings and outlines management measures that will be employed to mitigate identified potential impacts. The full flora and fauna assessment is presented in *Annex E*.

The purpose of the flora and fauna assessment was to:

- identify and describe the conservation significance of vegetation communities, fauna habitats and flora and fauna species occurring within and adjacent to the Project Area;
- assess the type and degree of impacts of the proposal on flora and fauna, including any threatened species, populations and ecological communities likely to occur in the Project Area; and
- identify mitigation measures to avoid or minimise the extent of impacts of the proposal on flora and fauna.

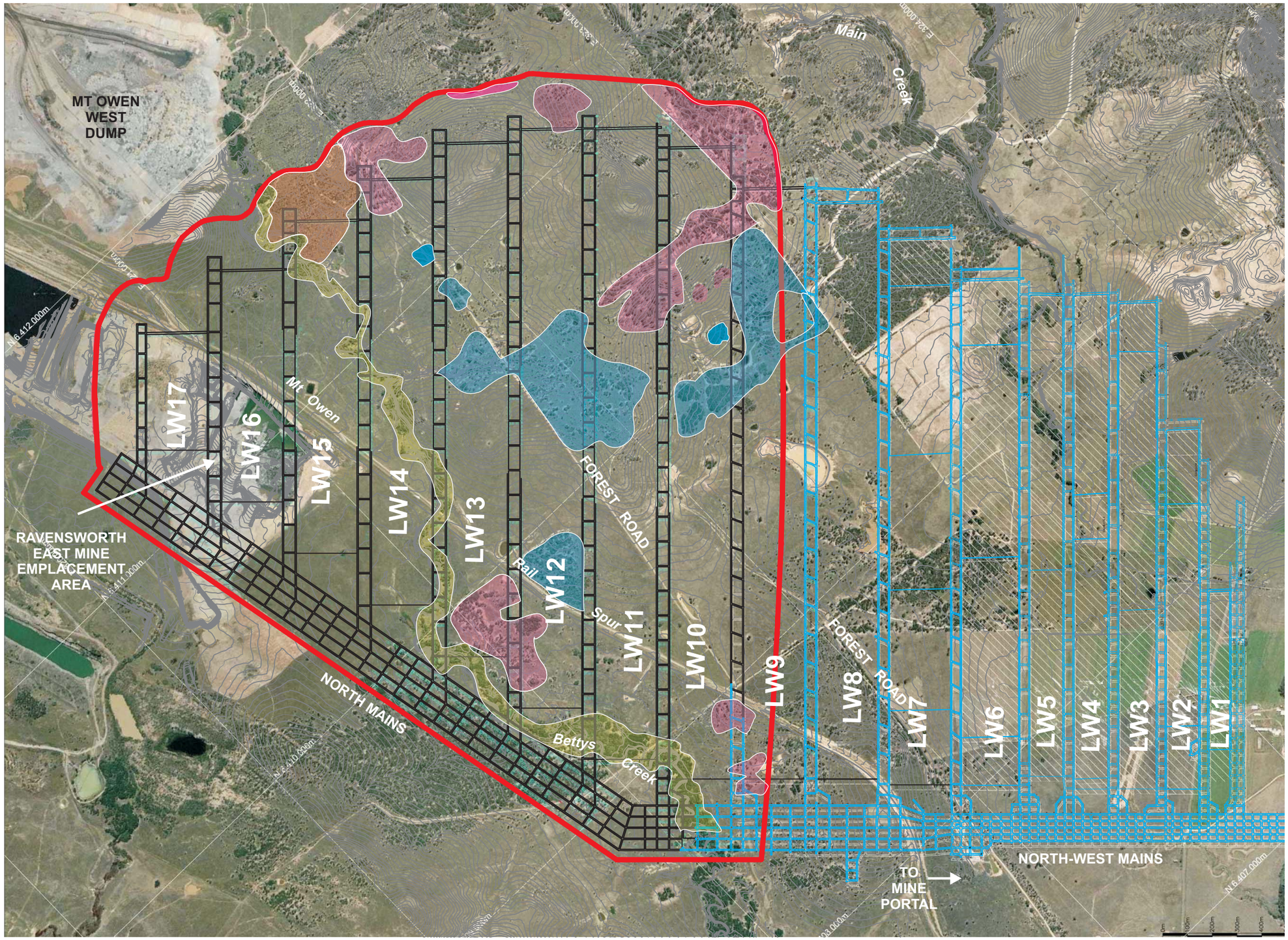
## 11.2 RESULTS

The Project Area has been considerably disturbed by land clearing and grazing, with most of the area cleared of native forest. Five vegetation communities were identified within the Project Area (see ERM, 2006b) and are described below (refer to *Figure 11.1*).

### 11.2.1 *Spotted Gum/Grey Box/Ironbark Woodland*

Isolated remnants of this community totalling approximately 46 ha were identified and characterised by a dominance of *Corymbia maculata* (spotted gum), *Eucalyptus moluccana* (grey box), *Eucalyptus crebra* (narrow-leaved ironbark) and *Eucalyptus fibrosa* (broad-leaved ironbark). The canopy cover varied between 20 % and 60 % and 15m to 25m in height. These remnants showed evidence of previous disturbance and appeared to be regenerating. The shrub layer was relatively sparse and the groundcover varied in density in response to the canopy cover.

The spotted gum/grey box/ironbark woodland identified within the Project Area is consistent with the Central Hunter spotted gum/grey box/ironbark forest. The Draft Hunter Remnant Vegetation Project has described the Central Hunter spotted gum/grey box/ironbark forest as regionally significant as the extant community is approximately 18 306 ha from a modelled range of 46 753 ha, ie approximately 61 % has been cleared (Peake 2005).




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Existing Contour (1m interval)
- Riparian Vegetation (Open Forest Habitat)
- Regenerating Vegetation (Open Forest Habitat)
- Spotted Gum/Grey Box/Ironbark (Open Forest Habitat)
- Bull Oak Woodland (Casuarina Woodland Habitat)
- Pasture

**Figure 11.1**

**Vegetation Communities within Project Area**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_10 | | |
| Date: | 05/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

0 100 200 300m

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53 Bonville Avenue, Thornton, NSW 2322
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### *11.2.2 Bull Oak Woodland*

The bull oak woodland covers an area of approximately 48 ha in the central and eastern portions of the Project Area and was characterised by dense stands of *Allocasuarina luehmannii* (bull oak) to a height of 15m. Also scattered throughout were specimens of *Eucalyptus crebra* (narrow-leaved ironbark) and *Casuarina glauca* (swamp oak).

The shrub layer was generally absent with very sparse groundcover resulting from dense layers of casuarina needles. Commonly occurring groundcover species were three-awn speargrass, red grass, wallaby grass and short hair plume grass. The common weed, tiger pear, was also noted.

### *11.2.3 Riparian Vegetation*

This vegetation community covers an area of approximately 30 ha and was identified along the margins of Bettys Creek. *Casuarina glauca* (swamp oak), *Angophora floribunda* (rough-barked apple) and *Eucalyptus tereticornis* (forest red gum) dominated the canopy layer. The shrub and groundcover species were similar to those identified within the adjacent woodland communities and included species such as mulga fern, blackthorn, three-awn speargrass and tiger pear.

The riparian forest is likely to be a remnant of Central Hunter riparian forest. The Draft Hunter Remnant Vegetation Project has described the Central Hunter riparian forest as regionally significant as the extant community is approximately 436 ha from an estimated former range of 14 142 ha, ie approximately 98.9 % has been cleared (Peake 2005).

### *11.2.4 Grassland*

The grassland community occurs over approximately 466 ha of the Project Area. Common pasture species identified included slender ratstail grass, speargrass, shorthair plumegrass, paspalum, fireweed, native bluebell and common couch. These areas have been highly disturbed as a result of previous clearing and grazing.

### *11.2.5 Regenerating Vegetation*

The regenerating vegetation community within the Project Area covers approximately 10ha and included plantings of the commonly occurring species identified within the locality, including *Corymbia maculata* (spotted gum), *Eucalyptus crebra* (narrow-leaved ironbark) and *Eucalyptus fibrosa* (broad-leaved ironbark). A range of Acacia species were also noted and included species such as *Acacia concurrens, A. parvipinnula* and *A. filiformis* as well as *Casuarina glauca, Pultenaea retusa* and *Dodonaea viscosa*.

### *11.2.6 Threatened Flora*

No threatened flora species listed under *Threatened Species Conservation* (TSC) Act 1995 were recorded within the Project Area during the flora surveys in February and December 2005 and January 2006, although potential habitat is available for *Diuris tricolour* (tricolour diuris), *Eucalyptus glauca* (slaty redgum) and *Thesium australe* (austral toadflax). *Ozothamnus tessellatus* is also reported to occur in the northern remnant of Ravensworth State Forest to the north of the site, while *Bothriochloa biloba* was recorded to the south of the site and in the vicinity of the Forest Road Ventilation Shaft site during previous surveys (Umwelt, 2003A; Geoff Cunningham Natural Resource Consultants 2001a, 2001b). The proposed mining of Longwalls 10 to 17 is unlikely to impact any of these species.

*Bothriochloa biloba* is no longer listed as a vulnerable species under Schedule 2 of the TSC Act and the known distribution and abundance of *B. biloba* is such that it is not likely to become endangered. This species is, however, listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) 1999 and has therefore still been assessed as a threatened species.

The exact location of the gas drainage boreholes will be determined in the field in consultation with an ecologist to avoid clearance of threatened flora or their habitat.

Hunter lowland redgum forest has been identified to the north of the Project Area and is listed as an endangered ecological community in Schedule 2 of the *Threatened Species Conservation Act, 1995.* It is likely that this represents the western limit of the community's distribution in the Hunter Valley. However, it is not a high quality representation, is outside the Project Area and will not be impacted by the project.

## *11.3 FAUNA*

### *11.3.1 Habitat Assessment*

Three broad habitat types were found within the Project Area as shown on *Figure 11.1*, namely open forest (76 ha), Casuarina woodland (48 ha) and pasture (466 ha). Both the open forest as shown on *Figure 11.1* and Casuarina woodland habitats are well represented in the nearby Ravensworth State Forest, with the myrtaceous tree species providing a seasonal foraging resource for nectivorous birds and mammals. The variety of tree species would also provide suitable feeding/foraging resources for foliage dependant fauna species and insectivorous birds. The grasses and sedges within the groundcover across the entire site provide seeds and stems for granivorous and herbivorous species.

The forested portions of the site have a moderate layer of leaf litter (up to five centimetres deep) that provides shelter for reptiles and small ground-dwelling mammals. The moderate cover of fallen logs and rocks within the forested portions also provides shelter for small ground-dwelling mammals and reptiles as well as foraging substrate for the *Pomatostomus temporalis* (grey-crowned babbler). The Project Area contains a large number of mature eucalypt trees which provide hollows and stags capable of providing shelter and breeding habitat for many bird, arboreal mammal and microchiropteran bat species.

Bettys Creek, tributaries of Main Creek and several dams provide habitat for aquatic birds and amphibians. These aquatic habitat resources vary from permanent to ephemeral and provide habitat for a large number of species.

### *11.3.2 Fauna Assessment*

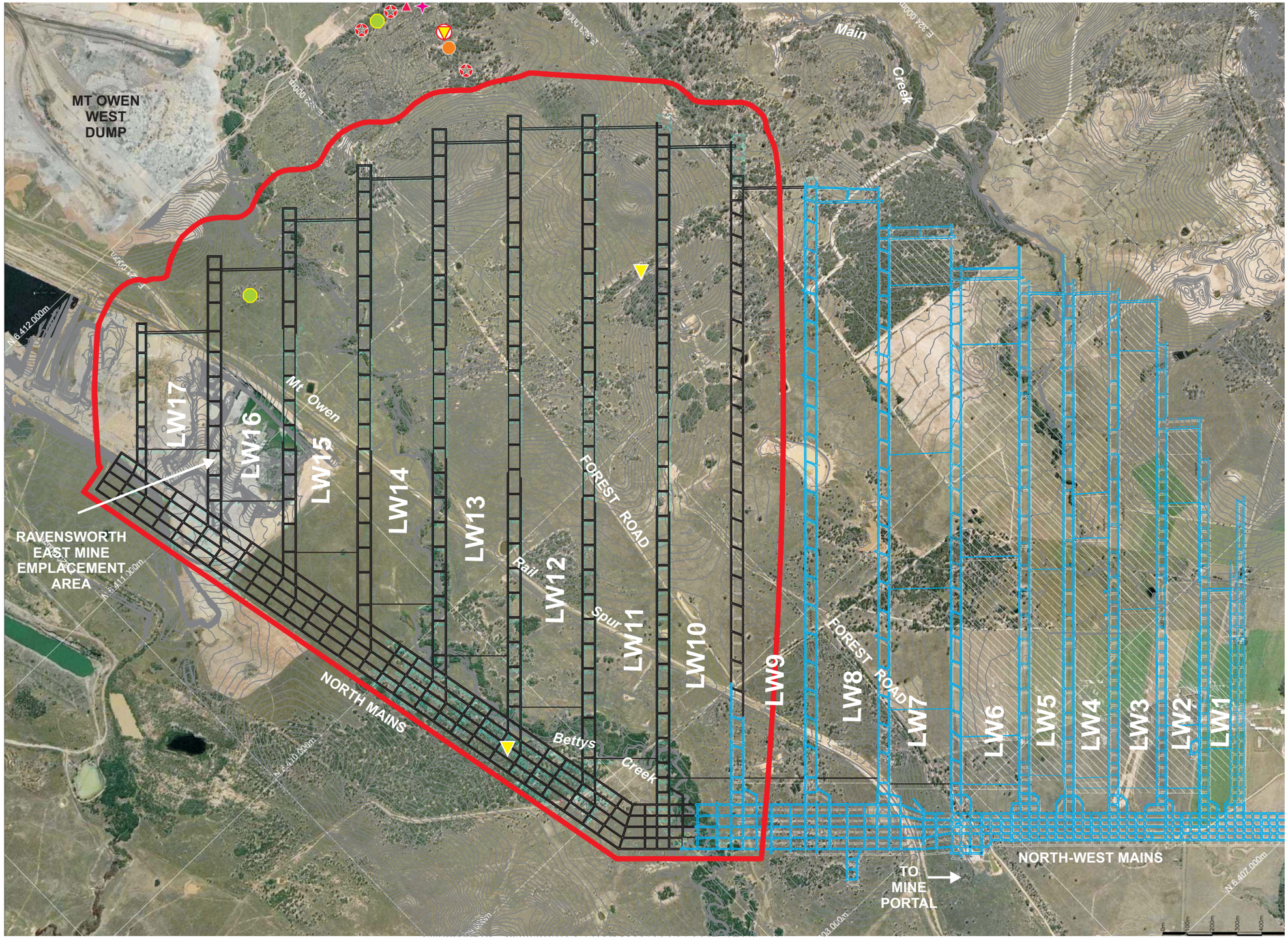
During the 2005 survey period (ERM, 2006b), only one threatened fauna species, *Pomatostomus temporalis* (grey-crowned babbler), was directly observed within the site. Five individuals were observed foraging within the fallen timber in the open forest over the northern portion of Longwall 11 as shown on *Figure 11.2*. Further surveys in 2006 recorded this species on the western side of Bettys Creek above Longwalls 12 and 13 (*Figure 11.2*).

Grey-crowned babblers live in a structured and co-ordinated group of five to twelve individuals and may have a home range as large as 12 hectares (Frith 1982). The group forages over most of the territory for half to three quarters of the day, spending most of its time rummaging on the ground through leaf litter, probing into the soil and turning over small objects (Slater 2001). They inhabit open woodland dominated by mature Eucalyptus trees with regrowth, tall shrubs and an intact shrub layer for breeding and foraging. Grey-crowned babblers eat a range of food items and roost at night in a dormitory very similar to their nests.

No green and golden bell frog calls or sightings were recorded during the targeted surveys which were undertaken when this species was known to be calling elsewhere (ERM, 2005).

The literature review component of the flora and fauna assessment (ERM, 2006b) indicated that the eastern freetail bat is also reported to occur within the Project Area, with an additional four threatened species listed in the Schedules of the TSC Act 1995 (squirrel glider, grey-headed flying-fox, brown treecreeper and speckled warbler) being recorded in the regenerating woodland within 500m to the north-east (see *Figure 11.2*).

A review of relevant studies including the Mt Owen Mine Environmental Impact Statement, and the Department of Environment and Conservation (DEC) and Department of the Environment and Heritage (DEH) databases, identified a number of threatened fauna species that have been recorded within the Project Area or are known to occur within the locality, as shown in *Table 11.1*.




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Existing Contour (1m interval)
- Grey-headed Flying Fox (Umwelt 2003)
- Eastern Freetail Bat (Umwelt 2003)
- Grey-crowned Babbler (ERM 2005, 2006)
- Grey-crowned Babbler (Umwelt 2003)
- Brown Treecreeper (Umwelt 2003)
- Squirrel glider (Umwelt 2003)
- Speckled Warbler (Umwelt 2003)

**Figure 11.2**

**Threatened Species Recorded within Project Area**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_11 | | |
| Date: | 05/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

0 100 200 300m

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*Table 11.1 Threatened Fauna in the Project Area or known to occur in the Locality*

| Scientific Name | Common Name | TSC Act | EPBC Act |
|---|---|---|---|
| *Tyto novaehollandiae* | masked owl | V | - |
| *Ninox connivens* | barking owl | V | - |
| *Melithreptus gularis gularis* | black-chinned honeyeater | V | - |
| *Erythrotriorchis radiatus* | red goshawk | E | V |
| *Climacteris picumnus* | brown treecreeper | V | - |
| *Stagonopleura guttata* | diamond firetail | V | - |
| *Pyrrholaemus sagittatus* | speckled warbler | V | - |
| *Lathamus discolor* | swift parrot | E | E |
| *Pomatostomus temporalis* | grey-crowned babbler | V | - |
| *Xanthomyza phrygia* | regent honeyeater | E | E |
| *Chalinolobus dweryi* | large-eared pied bat | V | V |
| *Miniopterus australis* | little bentwing-bat | V | - |
| *Miniopterus schreibersii oceanensis* | eastern bentwing-bat | V | - |
| *Myotis adversus* | large footed myotis | V | - |
| *Scoteanax rueppellii* | greater broad-nosed bat | V | - |
| *Mormopterus norfolkensis* | eastern freetail-bat | V | - |
| *Petaurus norfolcensis* | squirrel glider | V | - |
| *Dasyurus maculatus* | tiger quoll | V | E |
| *Petrogale penicillata* | brush-tailed rock-wallaby | E | - |
| *Phascolarctos cinereus* | koala | V | - |
| *Pseudomys oralis* | Hastings River mouse | V | - |
| *Pteropus poliocephalus* | grey-headed flying-fox | V | V |
| *Litoria aurea* | green and golden bell frog | E | V |
| *Mixophyes iterates* | southern barred frog | V | V |

*Status in NSW as per Schedules 1 and 2 of TSC Act: E = Endangered; V = Vulnerable. Status as per EPBC Act: E = Endangered; V = Vulnerable.*

For the purpose of this assessment, all of the above species except for the koala, brushtail rock wallaby, red goshawk and southern barred frog have been considered likely to use resources on site based on habitat requirements. An assessment of significance is included in *Annex E* and summarised in *Section 11.5*.

## *11.4 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE*

The Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) requires approval for actions that may have a significant impact on matters of national environmental significance or Commonwealth land. There are no World Heritage properties, National Heritage Places, Ramsar wetlands, Commonwealth marine areas or nuclear actions on or near the site.

Seven migratory bird species have been identified as potentially occurring within ten kilometres of the site. These include two wetland species which have not been included in this assessment, as no suitable habitat is provided on site. The terrestrial migratory birds that may occasionally use the site as foraging habitat are shown in *Table 11.2*.

*Table 11.2 Terrestrial Migratory Birds potentially using the Project Area*

| Scientific Name | Common Name |
|---|---|
| *Haliaetus leucogaster* | white-bellied sea-eagle |
| *Hirundapus caudacutus* | white-throated needletail |
| *Monarcha melanopsis* | black-faced monarch |
| *Myiagra cyanoleuca* | satin flycatcher |
| *Rhipidura rufifrons* | rufous fantail |

While the species identified in *Table 11.2* may occasionally forage on the site, the proposal will not result in the removal of any significant area of habitat. Furthermore, the distribution of vegetation communities is not confined to the site.

As these species are wide-ranging with generalist habitat requirements, it is unlikely that the proposal will:

1. substantially modify, destroy or isolate an area of important habitat of the migratory species;

2. result in harmful invasive species becoming established in the site; or

3. disrupt the life cycle of an ecologically significant proportion of a population of the species.

Whilst Commonwealth listed ecological communities, threatened species and migratory species have been recorded or are considered likely to occur within the Project Area (refer to *Tables 11.1* and *11.2*), the assessment of significance under state legislation concludes that these will not be placed at risk of extinction by the proposal. However the evaluation of impacts did not consider *Bothriochloa biloba* as it is no longer listed under State legislation. Assessment of the proposal impacts on *B. biloba* against the Commonwealth significant impact criteria (*Annex E*) found that the proposal is not likely to have a significant impact on that species.

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

## *11.5 IMPACT ASSESSMENT*

### *11.5.1 Subsidence Impacts*

*Flora*

There is a possibility that trees which already have a steep lean in the direction of subsidence-induced tilt will fall as a result of the additional 12mm/m tilt. Conversely any trees leaning away from the subsidence-induced tilt would be straightened. However, it is unlikely that any isolated falls that may occur would significantly alter vegetation community composition. Tilt will not affect shrubs, herbs or grasses, as they are too short to exert significant leverage on root systems.

Subsidence-related ponding within the channel of Bettys Creek is anticipated over Longwalls 10, 11, 13, 14 and 15. While ponding may substantially affect any vegetation growing in the areas concerned, GCCM proposes to drain any such ponds on the creek flats. Assuming that this drainage occurs soon after ponding, few long-term affects are predicted.

There have been no groundwater dependent ecosystems identified over Longwalls 10 to 17, although a series of small dams and billabongs supporting aquatic vegetation exist across the Project Area. Anecdotal evidence suggests that these dams are not groundwater fed and lowering of the water table will not directly impact any aquatic vegetation.

All plant communities to be undermined are more than 2.45m above the predicted groundwater table, based on data available from piezometers within the middle of Longwall Panel 6 and on the north-western corner of Longwall 9 (GeoTerra, 2005). As the maximum predicted subsidence is 1.6m, plant communities would not be inundated or subsided into the groundwater.

Farming, grazing and the surrounding open cut mines have resulted in native vegetation clearance. The minor impacts predicted as a result of mining Longwalls 10 to 17 will not significantly increase the effects of the surrounding native vegetation clearance and associated impacts.

*Fauna*

The proposed longwall mining is not likely to isolate or reduce the extent of the local vegetation communities and fauna habitat types present. The proposal will not remove fallen timber, which provides a foraging resource for the grey-crowned babbler or habitat for other species.

Bats may roost in existing rock cracks and a number of burrowing animals such as wombats are known to occur within the locality and, although subsidence may widen or close these fissures and burrows, it is not possible to quantify the likelihood or number of crack closures or burrow collapses.

Whilst subsidence could threaten roosting and shelter sites, similar habitat is common within the local area. In some cases, cracking may actually increase the total roosting and shelter habitat for threatened species within the site. Furthermore, soils above Longwalls 10 to 17 are dominated by unconsolidated materials and the likelihood of surface cracking is minimal.

The underground mining within Longwalls 10 to 17 will cause little change to surface water regimes. As indicated by GeoTerra (2007) (see *Annex C*), Bettys Creek stream water quality, flow volumes and creek stability are not anticipated to be adversely affected. However, some additional ponding may occur in subsidence troughs within the creek. Accordingly, aquatic animals (including the green and golden bell frog which is known to occur within the locality, albeit not identified within the site) are unlikely to be affected by subsidence. It is also noteworthy that the aquatic habitats above Longwalls 14 to 17 will already have been altered as a result of the Mt Owen Eastern Rail Pit and the Bettys Creek diversion prior to undermining and any potential subsidence-related impacts.

*Surface Drainage*

In general, subsidence may cause surface cracking and a consequent reduction in yield from soaks and springs. However, it is unlikely there will be significant changes to the way groundwater is released to receiving watercourses. Surface cracking over Longwalls 10 to 17 is unlikely to be perceptible.

Dams across the site do not need draining ahead of mining and, although they have the potential to crack, they have relatively low aquatic habitat value. Impacts from the underground mining of Longwalls 10 to 17 are therefore unlikely to significantly impact upon this habitat resource such that a local population of threatened species would be placed at risk of extinction.

Farming, grazing and surrounding open cut mines have resulted in native vegetation and associated habitat clearance. The minor impacts of the Glennies Creek Longwall Panels 10 to 17 are unlikely to cumulatively increase the effects of the surrounding native vegetation and habitat clearance.

## *11.6 GAS DRAINAGE BOREHOLE IMPACTS*

The proposal includes the installation of between one and five gas drainage boreholes along each longwall panel, for a total of 28 boreholes within the Project Area, over the life of the operation. The exact location of the boreholes will be determined in the field in consultation with an ecologist in order to avoid clearance of trees, shrubs and where possible areas dominated by native grasses.

Disturbance associated with each gas borehole will be minimal (approximately 8m by 8m) and at any one time there will only be three or four boreholes operational. The installation and fencing of the boreholes will

necessitate the clearing of a total of approximately 0.2 hectares of grassland over the life of the operation. Once each borehole is no longer required, its area of impact will be rehabilitated.

## *11.7 CONCLUSION*

It is highly unlikely that the proposal will significantly affect current disturbance regimes. The proposal will not fragment or isolate currently interconnecting or proximate areas of habitat or reduce the areal extent of the local vegetation communities. The impacts resulting from mining Longwalls 10 to 17 are unlikely to cumulatively increase the impacts on the native vegetation and associated habitat clearance already occurring in association with existing land uses.

No threatened flora species have been recorded within the Project Area and no potential habitat will be removed as a result of the proposed longwall mining. None of the identified threatened bird or mammal species are likely to be dependent on the limited amount of resources present within the Project Area. Migratory species are wide-ranging with generalist habitat requirements and the recorded vegetation communities are not confined to the site. The proposed longwall mining is therefore unlikely to significantly impact on the lifecycle, health, viability or habitat resource of these threatened or migratory species such that a local extinction would occur.

No endangered populations or ecological communities have been recorded within the Project Area, and at present there is no critical habitat listed in the locality. Consequently, the proposal will not impact upon these features.

# 12 CULTURAL HERITAGE

## 12.1 INTRODUCTION

An assessment of Aboriginal and historical cultural heritage at the site is presented in *Annex F*. This section provides a summary of study methodology and results, and outlines management measures that will be employed to mitigate the identified potential impacts.

## 12.2 METHODOLOGY

### 12.2.1 Desktop Investigation

A search of the Department of Environment and Conservation 'Aboriginal Heritage Information Management System' (AHIMS) was undertaken for an area approximately 9km by 12km, centred on the Project Area in order to identify previously-recorded locations of sensitive and potentially culturally significant sites in the vicinity of the proposal. Previous archaeological investigations in the region were also reviewed.

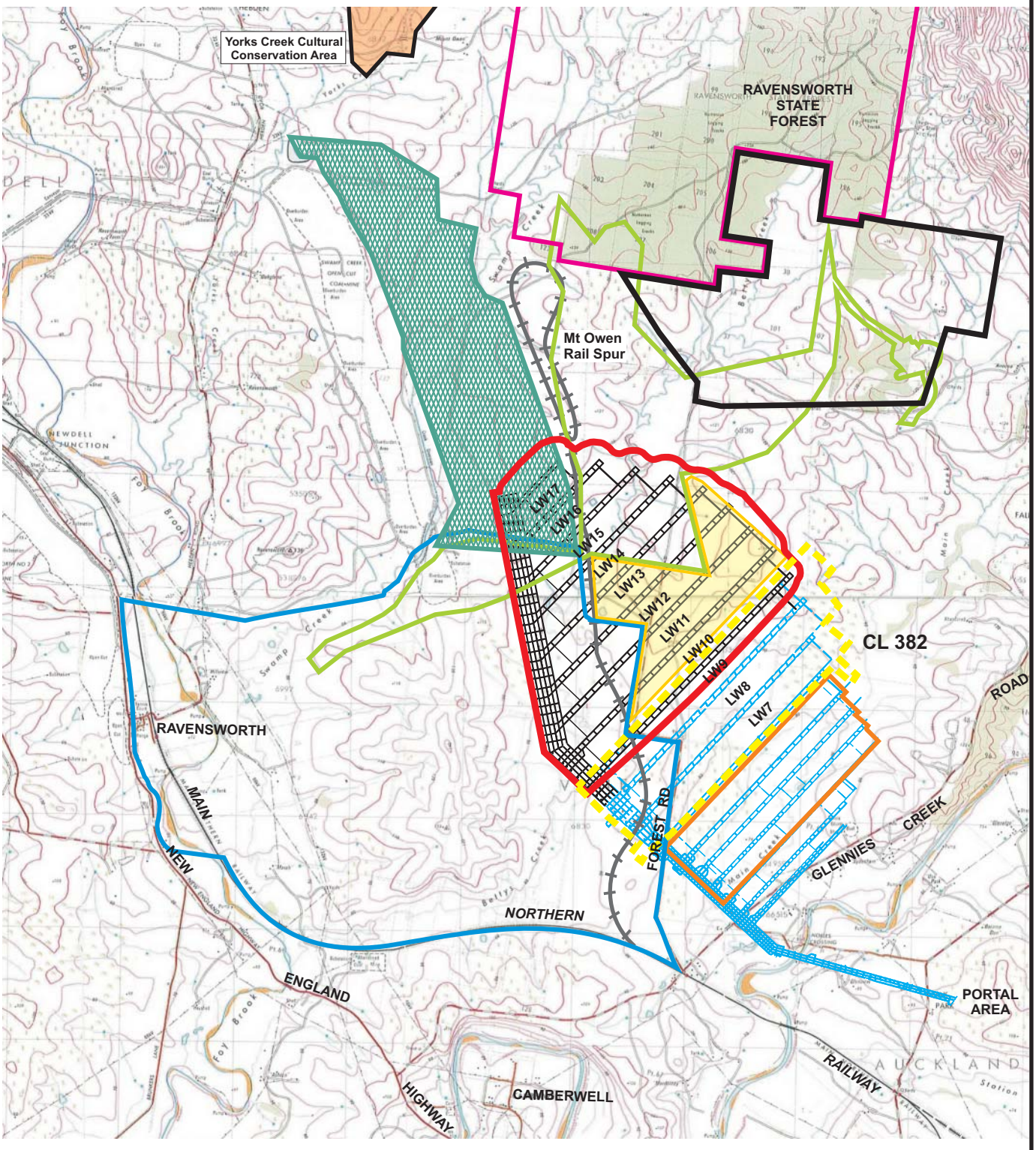
### 12.2.2 Consultation

Consultation with the local Aboriginal community was carried out in accordance with the Department of Environment and Conservation (2004) Interim Community Consultation Requirements guidelines. Details of the consultation process are provided in the cultural heritage assessment in *Annex F* and *Section 6.1.*

### 12.2.3 Field Survey Methodology

Cultural heritage investigations were conducted over portions of the Project Area in 2006 as part of the SMP for Longwalls 10 to 17. A field survey of the portion of the Project Area not previously surveyed was undertaken on 14 February 2006 to identify and record any Aboriginal sites/objects and historic heritage items present (*Figure 12.1*). The decision not to resurvey the entire Project Area was undertaken in consultation with the Department of Environment and Conservation.

Two archaeologists and one representative from each of the six registered Aboriginal groups listed were present, along with an additional voluntary representative from Aboriginal Native Title Elders Consultants. All landforms within the survey area were sampled. As ground visibility was limited by vegetation coverage, the survey focused on areas of exposure and enhanced visibility. Due to the archaeological sensitivity of Bettys Creek, the section of




**Legend**

- Glendell Project Area
- Resource Planning 1993 Project Area
- Mt Owen Survey Area
- ERM 1998
- ERM 2005
- Main Creek (Umwelt 2004b) Project Area
- Resource Planning 1991
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- 2006 Survey Area

**Figure 12.1**

**Location of Archaeology Survey Area**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_12 | | |
| Date: | 10/04/07 | Drawing size: | A4 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | LPI 1:25 000 Topo Camberwell Sheet | | |
| Scale: | Refer to Scale Bar | | |

0 500m 1 1.5km

Approximate Only

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Bettys Creek and associated alluvial flats within the survey area were surveyed in their entirety.

## *12.3 RESULTS*

### *12.3.1 Aboriginal Archaeological Context*

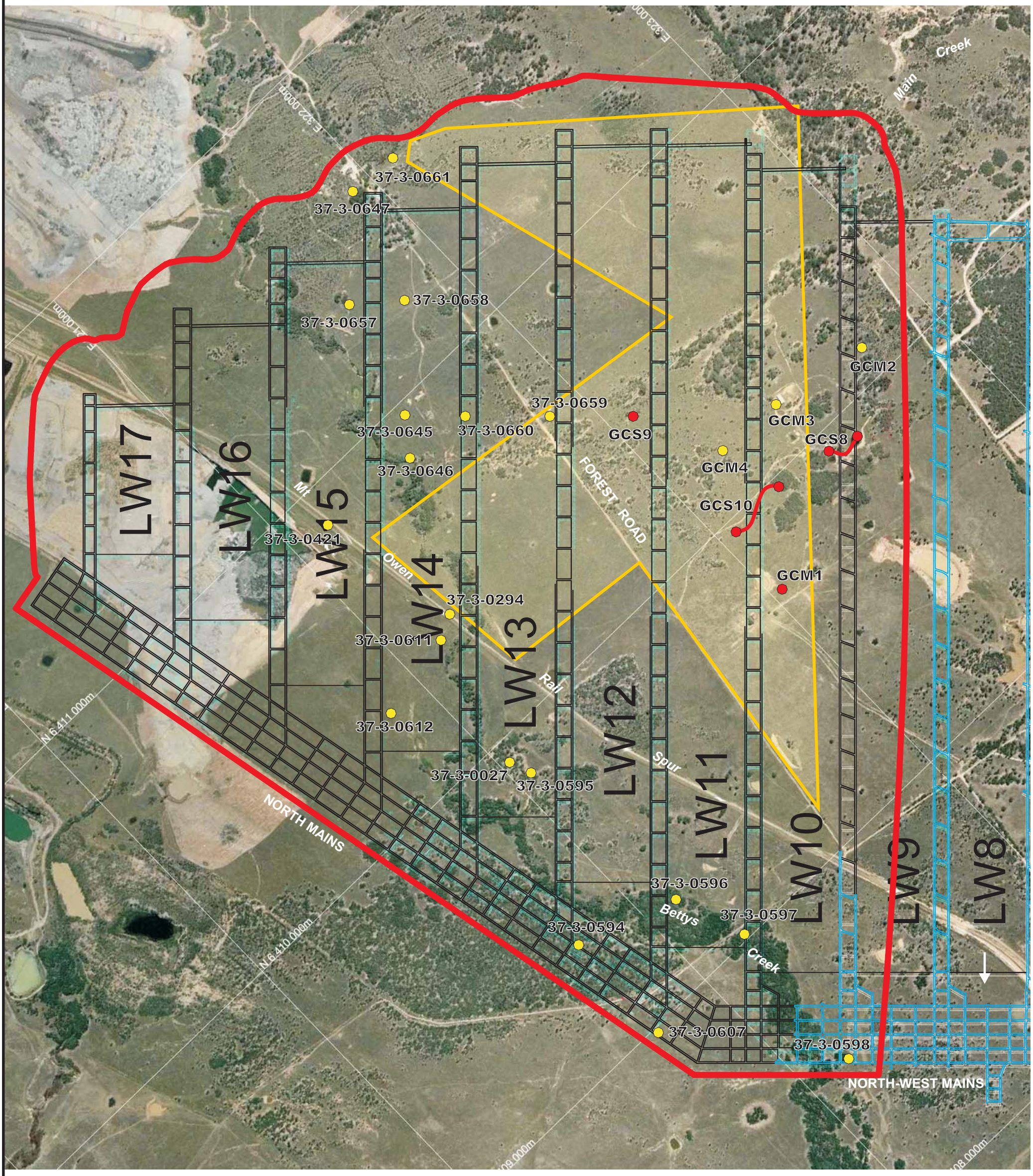
Within the Project Area, 23 archaeological sites were identified. Of these, 14 have already been the subject of salvage excavations in accordance with Section 90 consents. The remaining nine sites, five of which are registered on the DEC database, are all artefact sites. Sites 37-3-0294, 37-3-0611 and 37-3-0612 (*Figure 12.2*) were assessed as being of low significance and, along with site 37-3-0027, are close to Bettys Creek or its tributaries. These sites are to be managed under an Aboriginal Heritage Management Plan currently in preparation for the Glendell Mine. Site 37-3-0421 was assessed as being of low to medium significance and it was indicated that the proposed test excavations within the Ravensworth East mine lease (as conducted by ERM in 2002) would mitigate any impacts at this site. The four unregistered sites are described below.

*GCS 8 (322278E 6409792N) Isolated Artefact*

GS 8 (*Figure 12.2*) was recorded by ERM in 2005 as containing a single mudstone flake on a drainage depression through a slope. The mudstone artefact was not relocated during the February 2006 survey. However, a single piece of mudstone heat shatter was present in an erosion exposure associated with a dam fed by a drainage depression. The heat shattered piece was outside the survey area although is likely to be part of the original site based on the evidence of erosion since the original survey. Visibility and exposure in the area surrounding the site were relatively high due to high levels of erosion.

*GCS 9 (321887E 6410261N) Isolated Artefact*

GCS 9, (*Figure 12.2*) (previously identified by ERM, 2005), was relocated and consists of a yellow mudstone flake within an area of exposure on a track above a minor drainage line that extends outside the Project Area. GCS 9 is located on a crest with gently undulating surrounding slopes and has been disturbed by the use of the track and the construction of a fence nearby. Visibility on the track was high at 70 %, although visibility within the surrounding area was constrained by vegetation coverage. The potential for additional artefacts was considered to be low as no other artefacts were visible in the track or the area of exposure at the nearby fenceline.




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Survey Area (ERM 2006)

**Aboriginal Heritage Sites**

- GCS — ERM 2005 Survey
- GCM — ERM 2006 Survey
- 37-3-0612 — AHIMS Database Results

**Figure 12.2**

**Location of Aboriginal Heritage Sites**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_13 | | |
| Date: | 03/04/07 | Drawing size: | A3 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

0 25 50 75m

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ERM

*GCS 10 (321874E 6409806N) Artefact Scatter*

GCS 10 (*Figure 12.2*) was originally recorded by ERM in 2005 as containing 11 mudstone artefacts (of which seven were recorded as heat shatter). The site is on a vehicle track that runs from upper to lower slopes to vacated farm buildings on the south-eastern boundary of the study area.

During the current study (February 2006 survey), four mudstone artefacts were recorded at three locations on the track moving downslope from the original site location towards the farm buildings. Although the vehicle track is not used frequently, sheetwash erosion is active, resulting in the removal of the topsoil and the exposure of the B horizon in areas. Despite good visibility along the track, no additional artefacts were identified. These artefacts identified during the 2006 survey are assessed as being part of the original site (GCS 10) identified in 2005.

*GCM 1 (321873E 6409558N) Isolated Artefact*

This mudstone flaked piece was present in an erosion exposure to the south-west of a small dam (not surveyed) near the disused structure in the eastern portion of the survey area. The site was heavily disturbed due to the earthworks associated with the construction of the dam. Although the area of visibility surrounding the artefact was approximately 40m by 10m, no other artefacts were present.

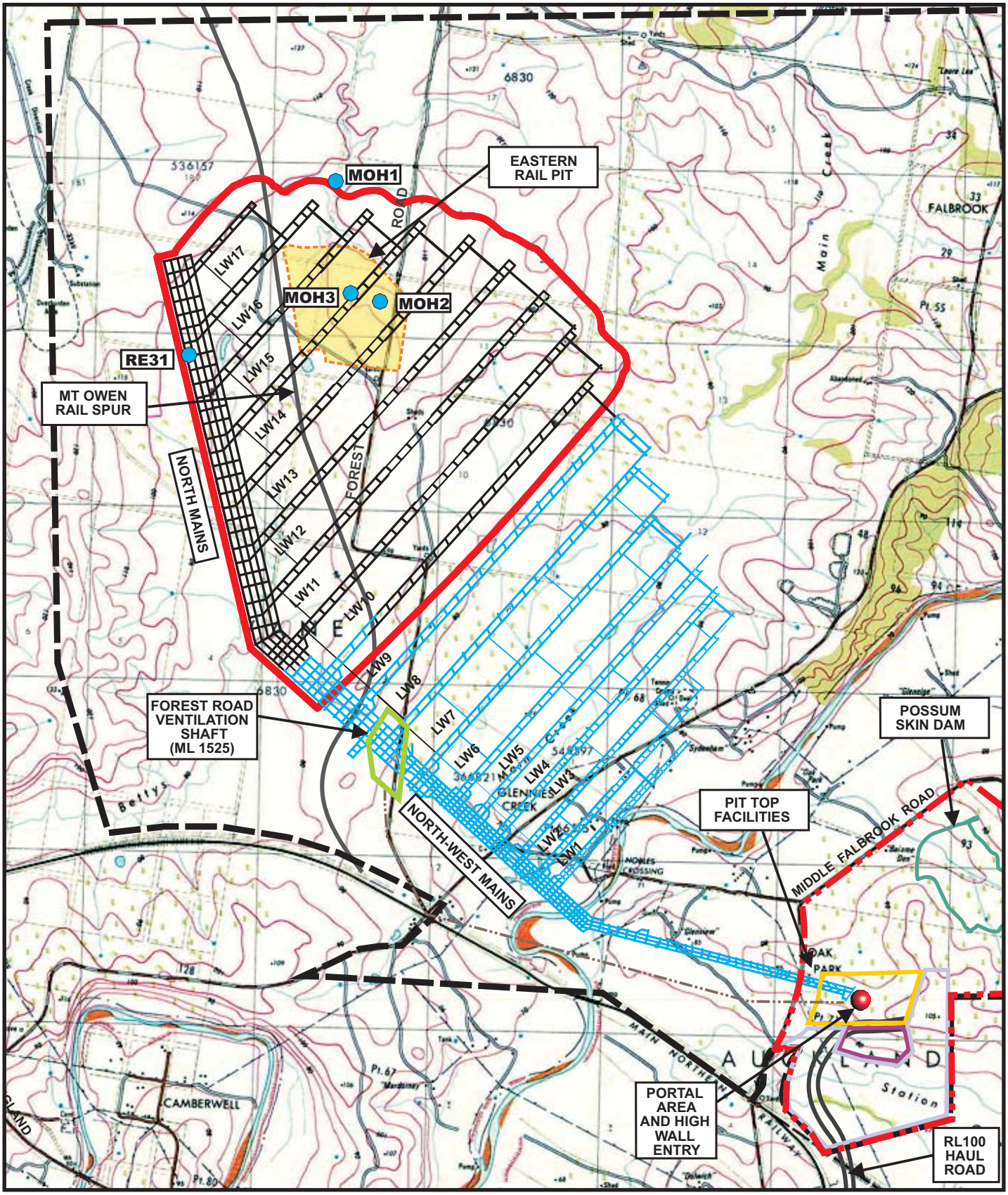
### *12.3.2 Historical Cultural Context*

European settlement of the lower Hunter Valley is believed to have commenced in around 1813 (Perry 1963). Historical landuse of the Project Area has entailed agricultural activities including grazing and farming, with a gradual shift towards industrial activities since the discovery of coal deposits in the 1820s. Since the late 1960s, the coal mining industry has been the economic base of the area.

Previous historical heritage studies conducted in the locality identified seven historical heritage sites, four of which are in the Project Area and described below. The heritage sites within the Project Area are shown on *Figure 12.3*.

RE31 was located within the Ravensworth Mine site and consisted of a number of timber fence posts, building stumps and gate posts that were interpreted as relating to shearing facilities. This site (in conjunction with other farm buildings) had moderate significance and has been destroyed by subsequent mining by Xstrata.

MOH2, a former occupation site and MOH3, a post and rail fence line, were both recorded within the Mt Owen mine extension area. Both sites have local significance and are likely to be destroyed as a result of the Mt Owen extension.




**Legend**

- Project Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- CL 382 Boundary
- ML 1525 Boundary
- ML 1518 Boundary
- ML 1551 Boundary
- ML 1437 Boundary
- Powerline to Ventilation Shaft
- Historical Heritage Site

**Figure 12.3**

**Location of Heritage Sites**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_14 | | |
| Date: | 16/04/07 | Drawing size: | A4 |
| Drawn by: | JD | Reviewed by: | JW |
| Source: | 1:25,000 Topographic Series- Camberwell | | |
| Scale: | Refer to Scale Bar | | |

0 250 500 750m

Approximate Only

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ERM

The original line of road from Singletons Ford to Muscle Creek (now Muswellbrook) also crosses the Longwall 10 to 17 Project Area. This portion of road was in use by 1825 and originally surveyed by Robert Dixon in 1833. As the remnants of this road are not visible upon inspection, and subsequent activities (ie roads, railway line, farming etc) have been carried out over its previous alignment, it has no significant heritage value.

No other sites of historic significance were identified during the field survey (ERM 2006a).

## *12.4 IMPACT ASSESSMENT*

### *12.4.1 Aboriginal Archaeological Sites*

Subsidence-related surface cracking, ponding and alterations to watercourse and landform morphology, together with direct impacts that may occur in association with gas drainage borehole drilling and subsidence remediation activities, have the potential to disturb surface and sub-surface artefacts within the Project Area. All sites recorded within the Project Area are stone artefact scatters or isolated finds. These are durable site types and the predicted level of subsidence is not expected to cause significant disturbance.

Within the survey area Sites GCS 9, GCS 10 and GCM 1 are unlikely to be impacted by the subsidence or any associated ponding, surface cracking and erosion. Site GCM 8 is close to a dam and may be affected by cracking that may occur in the dam wall. *Figure 12.2* shows four sites Glennies Creek C (37-3-0027), MORL2 (37-3-0294), Bettys Creek 22 (37-3-0612) and Bettys Creek 21 (37-3-0611) close to Bettys Creek or its tributaries which are likely to be impacted by any alterations to creek morphology or remediation work that may occur in the vicinity. However, the section of Bettys Creek within the Project Area will be realigned as a component of Mt Owen operations prior to the mining of Longwall 10. All other recorded sites within the Project Area have been the subject of prior surface collections or archaeological salvage.

Subsidence and possible subsidence remediation are unlikely to impact upon any undetected low density artefact scatters within the Project Area. The drilling of gas drainage boreholes, changes in creek morphology or subsidence remediation works along Bettys Creek may impact upon the potential archaeological deposits in these locations. While disturbance will diminish the research potential of such deposits, the research value of sites along Bettys Creek has already been realised as part of previous mitigation measures and salvage activities.

### *12.4.2 Historic Heritage Sites*

The historical heritage sites within the Project Area are likely to be impacted by the proposed underground mining. The structures that comprise these sites are likely to be damaged by subsidence and the associated tilts and strains. However, as these sites were recorded in 1999 and 2003 and are located in areas of ongoing mining activity within the Mt Owen and Ravensworth leases, surveys could not be carried out in this area for the purposes of this application. It is possible that these historical sites may have already been destroyed.

## *12.5 MITIGATION MEASURES*

No further archaeological investigation is required for the Aboriginal sites recorded within the Project Area. Gas drainage borehole drilling and subsidence remediation works will not be undertaken within these sites. Should these impacts be unavoidable, consultation will be undertaken with the Department of Environment and Conservation and the local Aboriginal community representatives.

No further archaeological investigation is required in relation to the potential archaeological deposits located within 30 metres of Bettys Creek. Should gas drainage borehole drilling or subsidence remediation work be necessary within the area of potential archaeological deposit, the Aboriginal community will be consulted regarding any proposed works.

Prior to the commencement of gas drainage and mining of Longwall 14, an additional inspection of sites RE31, MOH2 and MOH3 (*Figure 12.3*) will be carried out by an archaeologist to determine whether these sites remain extant. The results of the inspection, together with refined subsidence predictions for Longwalls 14 to 17 based on actual versus predicted subsidence in the preceding longwalls, will be used to determine whether further archival recording will be necessary at these sites.

# 13 NOISE

## 13.1 INTRODUCTION

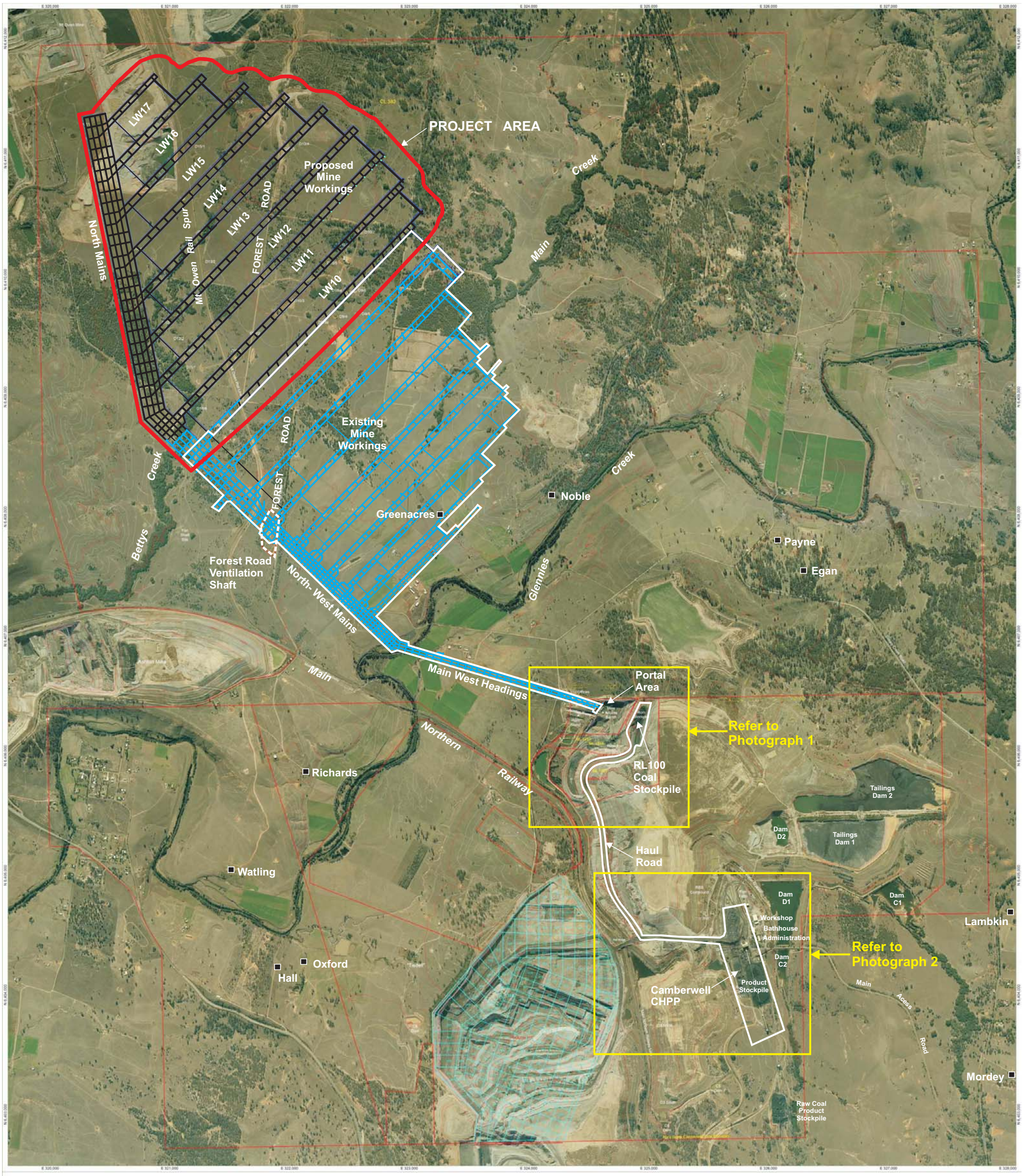
As is the case with air quality, the noise environment at various receiver locations in the vicinity of the Glennies Creek Colliery is dominated by large scale open cut coal mines. Generally, contribution from GCC underground activities is negligible.

Notwithstanding, the following noise criteria are directly or indirectly identified within the various approvals applicable to the Colliery, or in association with specific aspects of Colliery operations. There are no noise limits specified within Environment Protection Licence 7622:

- colliery EIS – noise limits attributable to the Colliery activities should not exceed ambient noise levels by more than 5 dB(A). In consultation with the EPA, ambient noise levels were established at seven residences in 1999, ie within three months of commencement of coal extraction operations.
- SOEE for Forest Road ventilation shaft construction and operation – $L_{Aeq\ (15\ minute)}$ intrusiveness criterion of 35 dB(A) and $L_{Aeq\ (15\ minute)}$ amenity criteria of 50 dB(A) during day-time; 45 dB(A) during evening and 40 dB(A) during night-time;
- DA 105-90 (Modification dated 20 September 2006) – Condition 6(ix) - $L_{Aeq\ (15\ minute)}$ ventilation shaft operational noise not to exceed 41 dB(A) at the Mordey and Noble residences (*Figure 13.1*), 30 dB(A) at the Lambkin, Watling, Oxford, G. Hall and Richards residences (*Figure 13.1*) and 36 dB(A) at the Egan and Payne residences (*Figure 13.1*) under defined meteorological conditions; and
- DA 06_0057 – Schedule 3, Condition 7. Noise from the surface facilities (including the Forest Road Ventilation Shaft) is not to exceed 38dB(A) at the Mordey, Noble, Lambkin, Donnellan, Hardy and Noble residences; 39dB(A) at the Watling, Oxford, G. Hall, Proctor, Richards and Burgess residences and 36dB(A) at the Egan, Payne and Moore residences under wind speeds up to 3m/s at 10m above ground level or temperature inversion conditions up to 3°C/100m.

This application refers to the continuation of current mining techniques, with no requirement for additional transport or processing facilities. Operational noise from the site will therefore remain at its current level, but will persist throughout the extended period involved with mining Longwalls 10 to 17.

Noise from the gas drainage boreholes, following installation, is currently limited to that from the mine gas-fuelled generator. However, with the commissioning of the approved Envirogen facility, it is likely that future use of the gas-fuelled generators will be reduced. Free venting boreholes are not a source of noise.




**Legend**

■ Nearby Residences

**Figure 13.1**

| | | | |
|---|---|---|---|
| Client: | Integra Coal Operations Pty Ltd | | |
| Project: | Env. Assessment Glennies Creek Part 3A | | |
| Drawing No: | 0047481hv_EA_rev_24 | | |
| Date: | 10/04/07 | Drawing size: | A3 |
| Drawn by: | SP | Reviewed by: | JW |
| Source: | Glennies Creek Coal Management Pty Ltd | | |
| Scale: | Refer to Scale Bar | | |

**Location of Nearby Residences**

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53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

N

0 500 1000m

ERM

Underground mining operations result in minimal noise impacts compared to open cut methods. Adjacent mines will be operating open cut mining methods simultaneously with the Glennies Creek mining of Longwalls 10 to 17, and so the area will already be subject to industrial noise impacts.

## *13.2 NEAREST RESIDENCE*

A disused structure founded on a concrete slab and adjacent structures are located over Longwalls 10 and 11 and are understood to be earmarked for demolition before undermining. This principal structure, a metal shed and sea container believed to have previously been occupied, is not built to contemporary standards for residential dwellings (refer to *Photograph 1* and *2*) and, consequently, the consideration of this structure as a residence in terms of noise assessment is inappropriate. The nearest residence to surface-based noise generating activities is "Greenacres" (*Figure 13.1*), at a distance of some 1400m from the closest proposed gas drainage borehole. Boreholes have been installed as close as 350m to that residence in the past with noise not being an issue.

Reference is not made to the assessment of noise impacts of activities beyond Glennies Creek Colliery, eg coal haulage to and processing at the Camberwell CHPP or rail noise as these are approved activities under existing development consents.

## *13.3 INSTALLATION OF BOREHOLES*

Drilling of gas drainage boreholes at the Glennies Creek Colliery is a short-duration activity using a truck-mounted drill rig, with the noise generated being no different from drilling exploration holes or water bores, ie activities regularly undertaken in the local area. It is less noisy than blast-hole drilling which is a continuous activity at the local open cut mines such as Mt Owen, Ashton and Camberwell.

Fraccing, a process whereby compressed air is injected down boreholes to fracture the coal seam in an attempt to encourage increased gas flow, is not used at the Glennies Creek Colliery.

## *13.4 ASSESSMENT OF NOISE IMPACTS*

Previous noise monitoring at nearby residences, primarily undertaken by Global Acoustics Pty Ltd, and noise predictions conducted by Richard Heggie Associates Pty Ltd, has shown that noise from the Glennies Creek Colliery facilities and routine coal mining, pre-treatment, pushing, loading and transportation activities is generally inaudible at the nearest residences, and when audible, comply with project-specific noise criteria.

It is also noteworthy that exploration drilling is a routine activity undertaken within the local area and one with which local residents are familiar. Furthermore, as access to land incorporating the nearest privately owned residences would be required, an access agreement would need to be formulated. Such an agreement would provide an opportunity to negotiate some form of compensation for any potential noise impacts.

In order to verify that the noise emissions from drilling would satisfy the existing consent criteria at the nearest residence, Global Acoustics Pty Ltd have modelled the likely noise levels. Using a sound power level of 113dB, a distance of 1400m; flat paddock terrain, a temperature of 10°C and a relative humidity of 80% (with no wind or inversion conditions), the received LAeq is 16dB(A), primarily as a consequence of ground and atmospheric absorption of frequencies above 125Hz. The noise assessment criteria with respect to gas drainage borehole installation would range from 38 to 40 dBA during the day (GCCM, 2006): gas drainage borehole installation is not undertaken during night-time periods.

Based on measured noise levels from truck-mounted exploration drills similar to those used for gas drainage borehole establishment, the distance to the nearest residence, the short duration of the drilling program (less than five weeks in any one campaign) and the limitation of hours of construction and installation, Global Acoustics consider that the noise emissions from these construction activities should satisfy the intrusiveness criterion of the surrounding residences. Consequently, further quantitative assessment of noise is not warranted.

## *13.5 ONGOING NOISE MONITORING*

GCCM have developed a noise monitoring program which includes a noise monitoring protocol for evaluating compliance against the noise impact criteria outlined in *Table 13.1*.

***Table 13.1 Noise Impact Assessment Criteria dB(A) LAeq(15min)***

| *Location* | *Day/Evening/Night* |
|---|---|
| *Mordey, Lambkin, Donellan, Hardy, Noble* | *38* |
| *Watling, Oxford, G. Hall, Proctor, Richards, Burgess* | *39* |
| *Egan, Payne, Moore* | *36* |

*Notes:*

*The noise criteria do not apply to residences within the Zone of Affectation for the Camberwell coal mine (Dulwich and Tisdell), or to properties where the Proponent and the affected landowner have reached a negotiated agreement in regard to noise, and a copy of the agreement has been forwarded to the Director-General and DEC.*

*Noise from the project is to be measured at the most affected point or within the residential boundary, or at the most affected point within 30 metres of a dwelling*

*(rural situations) where the dwelling is more than 30 metres from the boundary, to determine compliance with the LAeq(15minute) noise limits in the above table. Where is can be demonstrated that direct measurement of noise from the project is impractical, the DEC may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy. The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels were applicable.*

*The noise emission limits identified in the above table apply under meteorological conditions of:*

- *wind speeds of up to 3 m/s at 10 metres above ground level; or*
- *temperature inversion conditions of up to 30C/100m.*

The noise monitoring is conducted in accordance with DEC 'Industrial Noise Policy' (INP) guidelines and Australian Standard AS 1055 'Acoustics, Description and Measurement of Environmental Noise'. The duration of each measurement is 15 minutes. Statistical data must be one-third octave.

The Noise Monitoring Program includes triggers and actions to be taken in the event of measured exceedances of the impact assessment criteria, complaints, exceedance reporting and annual reporting within the Colliery's AEMR.

# 14 SOCIO-ECONOMIC IMPACT AND PUBLIC SAFETY

## 14.1 SURROUNDING LAND USE

The land surrounding GCC is used for both underground and open cut mining, meaning the visual amenity of the landscape has been previously extensively disturbed. Future open cut operations are also proposed for the area, which will lead to further modifications. Land above the Project Area is also used for agriculture. The Mt Owen Rail Spur cuts across the Project Area, as well as Forest Road, providing access to the Mt Owen Mine.

Several farm dams and an ephemeral creek are located within the Project Area. Bettys Creek, which flows across the Project Area, is to be subjected to modification in the future as part of approved activities at the Mt Owen Mine.

## 14.2 PUBLIC SAFETY AND SITE SECURITY

The public safety hazards identified through the risk assessment process for the Longwalls 10 to 17 Project Area included:

- farm dams failing;
- surface cracking (excluding Forest Road);
- damage to Forest Road;
- livestock escape onto Forest Road;
- downed electricity transmission lines; and
- damage to the Mt Owen Rail Spur.

### 14.2.1 *Farm Dams Failing*

Subsidence-related impacts on a farm dam could potentially induce a dam wall failure resulting in a release of stored water. The large farm dam (9/3) (refer to *Figure 8.1*) is most at risk from dam wall failure and/or floor leakage due to its large size and location above the chain pillar between Longwalls 8 and 9. Should a person be present on the downstream side of the dam and a failure of this type occurred, there is a limited potential for personal injury. The management process and monitoring regime for farm dams is detailed in *Section 8.5.*

### *14.2.2 Surface Cracking (Excluding Forest Road)*

Subsidence-related surface cracking could pose a hazard for persons traversing an area on foot, on a motorbike or in a vehicle and for stock. Should a person step, ride or drive into a surface crack there is a limited potential for personal injury. However, the likelihood of personal injury due to surface cracking is limited because:

- the majority of surface area within the Longwalls 10 to 17 Project Area is located on private property and there is limited general public access;
- historically there has been no significant surface cracking (> 20mm) detected as a result of subsidence at Glennies Creek Colliery; and
- landowners will be advised of the planned progression of the mine, thereby enabling the removal of stock and ensuring they are aware of areas of potential hazard.

There is no specific monitoring regime in place for surface cracking, other than on Forest Road. It is anticipated that landowners and GCCM personnel will carry out opportunistic visual inspections as the longwalls are extracted.

Management of any surface cracks detected would involve the ripping of ground in the vicinity to fill cracks and remove the hazard. Ongoing consultation with the landowners will also assist in managing any impacts as a result of surface cracking.

### *14.2.3 Damage to Forest Road*

Subsidence-related impacts on Forest Road, including surface cracking, formation of humps and dips and changes to drainage patterns could pose a hazard for persons travelling along the road in a vehicle, on a motorbike or on a bicycle. The road is used predominantly by persons servicing the mining and cattle grazing industries. Currently there are no inhabited dwellings serviced by the road. Should a person travelling along Forest Road drive or ride into a surface crack or ponded water there is a potential for personal injury.

GCCM and MSB, in consultation with Singleton Shire Council and Department of Lands, will manage any subsidence-related impacts on Forest Road, with the management processes dependent on the level of impact and the consequences of the impact. *Section 7.1.1* of this assessment provides a description of the proposed management and monitoring procedures including a response action matrix.

### *14.2.4 Livestock Escape onto Forest Road*

Subsidence-related impacts on the fences bordering Forest Road may allow livestock movement onto the road which could pose a hazard for motorists or cyclists. Should a person travelling along Forest Road impact, or be forced to swerve to avoid livestock, there is a potential for a motor vehicle accident and personal injury.

The likelihood of personal injury due to subsidence-related damage to farm fences resulting in livestock escaping onto Forest Road and causing a motor vehicle accident is reduced as a result of the following (as identified in the subsidence risk assessment):

- Forest Road is a relatively low speed road with existing potholes; and
- Forest Road is a low traffic road with its use generally limited to mining and agriculture-related personnel.

GCCM and MSB, in consultation with the landowner, will manage any subsidence-related impacts on farm fences. In the event that any farm fence suffers damage due to subsidence-related impacts, remedial repairs will be carried out as soon as practicable by GCCM, in consultation with the landowner. Should subsidence-related damage to a fence risk unplanned stock movements and the damage is such that immediate repairs are not possible, GCCM will supply and install temporary electric fencing in consultation with the landowner.

### *14.2.5 Downed Electricity Transmission Lines*

The electricity transmission lines traversing Longwall 10 are located in a corridor cleared of trees and shrubs. Subsidence-related impacts on these lines could result in the energised lines toppling and coming into contact with a person or igniting a grass fire. Should a person be contacted by an energised line or be in the vicinity of a triggered fire, there is a potential for personal injury.

The likelihood of personal injury due to subsidence-related damage to the transmission lines is reduced as a result of the following (as identified in the subsidence risk assessment):

- the transmission line traverses private property and there is limited general public access;
- to date there have been no significant subsidence-related impacts on the transmission lines as a result of undermining by previous longwalls at GCC; and
- the transmission line is located in a corridor cleared of trees and underbrush.

GCCM, in consultation with EnergyAustralia, will manage any subsidence-related impacts on the transmission line, with the management processes implemented dependent on the level of impact and the actual and potential consequences. In the event that the transmission line is damaged, repairs will be instigated as soon as practicable by GCCM, in consultation with EnergyAustralia. *Section 7.1.3* of this assessment provides a description of the proposed management and monitoring procedures.

### *14.2.6 Damage to Mt Owen Rail Spur*

Subsidence related impacts on the Mt Owen Rail Spur could result in the line becoming unsafe for trains and result in a derailment. Should a train become derailed there is a potential for personal injury to train drivers and/or persons close to the site of the derailment.

Xstrata Mount Owen (XMO) has agreed that it will assume responsibility for the specific monitoring regime and management processes required to ensure the ongoing safe operation of the Mt Owen Rail Spur.

A similar monitoring regime to that contained in the Rail Line Management Plan for Longwalls 7 to 9 is considered appropriate, and will be specified in the Rail Line Management Plan for LW 10 to 17 which is to be submitted separately to the DPI as part of the SMP.

The likely management processes relevant to public safety include:

- monthly notification to XMO/Xstrata of mining progress relative to the Rail Spur;
- provision of subsidence predictions and actual survey data when it becomes available; and
- provision of personnel to attend risk assessments and technical meetings as required by XMO/Xstrata.

### *14.2.7 Site Security*

Site security at GCC is addressed through fencing around the Pit Top facilities and maintaining only one main access to the site. The presence of appropriate safety and directional signage ensures visitors are aware that unauthorised access is prohibited, and that all visitors should report to the main office. Site visitors are signed in and out of the facility and are escorted around the site by mine personnel. Appropriate inductions are required for all visitors, while closed circuit television cameras monitor the carpark for added security.

Security for the individual gas drainage boreholes and infrastructure is afforded by their presence on private land which requires access through farm gates, their visual unobtrusiveness, their location within a fenced and locked

compound area and the radio link to the GCC control room which identifies if there are any operational problems.

### *14.3 ECONOMIC JUSTIFICATION*

Coal mining contributes significantly to the economy of the Singleton Local Government Area (LGA). Over 70 million tonnes of coal is produced each year by mines in the LGA (*www.singleton.nsw.gov.au*). The industry is the single largest employer, employing 16 % of the population and bringing with it a vast array of support industries (*http://www.singletontourism.com.au*).

GCC forms a part of the Singleton LGA's vital coal mining industry. GCC currently employs 170 people, with the continuation of mining guaranteeing these jobs into the future. The mine is expected to produce approximately 9.39 million tonnes of marketable coal from the mining of Longwalls 10 to 17, which will continue to contribute significantly to local economy.

GCCM is committed to its acceptance as a valued member and contributor to the community within the local area, Singleton Shire and the Hunter Region and its acceptance by the community in general as a legitimate land user, and has set the following objectives to achieve this commitment.

- Promotion of local employment - GCCM currently injects in excess of $20M per annum via wages and oncosts into the community. Approximately 75 % of Company employees reside in the Singleton/Cessnock/Maitland area.

- preferential support of local businesses – GCCM currently spends more than $30M per annum on contractor employment and contract-related activities (eg equipment overhauls, coal transportation and washing), the majority of which is to companies in the Newcastle / Hunter region;

- the promotion of local employment and support of local businesses also provides additional positive economic impacts through consumption- and production-induced flow-on effects;

- provision of support to local community and charitable groups including schools and sporting clubs;

- maintaining a long-term presence in the local area, thereby providing continuity of employment and community support;

- maintaining an honest, open and free exchange of information between the Company and the community through community consultation; and

- undertaking its activities in a manner which seeks to minimise impacts upon local land uses, land users, community services or infrastructure or environmental values.

As members of the local community, mine employees or contractors and those persons who benefit economically through the presence of the Colliery, also contribute socially and economically through their involvement in community, sporting, educational and social organisations and expenditure of varying components of their disposable incomes.

The Glennies Creek Colliery also currently contributes in excess of $15M annually in the form of Royalties, taxes, fees and charges and generates in excess of $100M annually in export earnings.

# 15 STATEMENT OF COMMITMENTS

*Table 15.1* lists the commitments that GCCM already adopts to manage the environmental issues related to its underground mining operations, or would adopt for the additional works associated with mining Longwalls 10 to 17. These commitments outline Integra's proposed environmental management, mitigation and monitoring measures.

*Table 15.1 Statement of Commitments*

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| **Environmental Management** | | |
| Obtain and/or comply with all conditional requirements in all approvals, licences and leases. | Comply with all commitments recorded in *Table 15.1*. | Ongoing |
| | Comply with all conditional requirements included in the:<br>• Planning Approval;<br>• Environment Protection Licence;<br>• Mining Leases;<br>• SMP or s138 Approvals; and<br>• any other approvals. | Ongoing |
| Conduct all operations in accordance with all relevant documentation. | Undertake all activities in accordance with any current Mining Operations Plan, environmental procedures, safety management plan or site-specific documentation. | Ongoing |
| **Operating Hours** | | |
| All construction activities to be undertaken within the approved operating hours. | Vegetation clearing/soil removal - 7:00am to 6:00pm/7 days<br>Construction activities- 7:00am to 10:00pm/7days<br>Construction materials delivery - 7:00am to 10:00pm/7 days<br>Gas drainage borehole construction – 7.00am to 10.00pm Monday to Saturday and 8.00am to 10.00pm on Sundays. | As required |
| All operational activities to be undertaken within the approved operating hours. | Coal conveying and stockpiling - 24 hours/7 days<br>Use of surface amenities/workshops and offices - 24 hour/7 days | Ongoing |

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| **Stakeholder Consultation** | | |
| Undertake ongoing stakeholder consultation during the mining of Longwalls 10 to 17. | Monthly notification to key stakeholders of mining progress (formal and informal). | Monthly during operation |
| | Regular meetings with stakeholders. | To be determined by the progress of subsidence and actual and predicted impacts. |
| | Free call environment hotline. | Ongoing |
| | Community Complaints Register maintained. | Ongoing |
| **Subsidence Monitoring** | | |
| Ensure minimal subsidence impacts over the Project Area. | Existing and proposed monitoring lines will be resurveyed at the completion of each longwall, particularly Monitoring Lines B , G, H and far field effects. | Within three months of the completion of each longwall |
| | A summary of subsidence monitoring results and accompanying analyses will be reported to the Principal Subsidence Engineer. | Within four months of the completion of each longwall panel. |
| | Monitoring results and analyses will also be included within the mine's Annual Environmental Management Report (AEMR). | Annual |
| Ensure minimal subsidence impacts on natural features. | Monitoring of subsidence impacts on Bettys Creek and surface drainage in accordance with the Longwalls 10 to 17 Subsidence Management Plans. | Ongoing |
| Ensure minimal subsidence impacts on public utilities. | Monitoring of subsidence impacts on Forest Road, electricity transmission lines and Telstra cable in accordance with the Longwalls 10 to 17 Forest Road, electricity transmission lines and Telstra cable Subsidence Management Plans. | Ongoing |

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| Ensure minimal subsidence impacts on farm infrastructure. | Monitoring of subsidence impacts on farm fences, gates and dams in accordance with the relevant Longwalls 10 to 17 farm fence and farm dam Subsidence Management Plans. | Ongoing |
| Ensure minimal subsidence impacts on archaeology. | Monitoring of subsidence impacts on recorded archaeological sites in accordance with the Longwalls 10 to 17 Cultural Heritage Subsidence Management Plan. | Ongoing |
| Ensure minimal subsidence impacts on other mine infrastructure. | Monitoring of subsidence impacts and/or provision of relevant data on the Xstrata owned infrastructure overlying the Project Area. | Ongoing |
| **Ecology** | | |
| Minimise impact to native flora and fauna. | Minimise area of vegetation disturbance during the installation of the gas drainage boreholes. | Activity period |
| | Pre-clearance inspections of locations for the boreholes during the summer flowering period of *Bothriochloa biloba* to avoid impacting directly on any individual plants. | Prior to installation of boreholes |
| **Cultural Heritage** | | |
| Minimise impact to recorded Aboriginal heritage sites. | All recorded sites will be identified on the plan used to define borehole locations, will be clearly identified in the field and protected from the impacts of any gas drainage borehole drilling or subsidence remediation works that may occur. Should these impacts be unavoidable, consultation will be undertaken with the Department of Environment and Conservation and the local Aboriginal community. | Ongoing |

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| | Should gas drainage borehole drilling or subsidence remediation work be necessary within 30m of Bettys Creek, the Aboriginal community will be consulted regarding any proposed works and may wish to take the opportunity to salvage any artefacts. | As required |
| Minimise impact to recorded European heritage sites. | Prior to the commencement of gas drainage and mining of Longwall 14, an additional inspection of sites RE31, MOH2 and MOH3 (*Figure 12.2*) will be carried out by an archaeologist to determine whether these sites remain extant. The results of the inspection and further subsidence predictions for Longwalls 14 to 17 will be used to determine whether further archival recording will be necessary at these sites. | Prior to Longwall 14 |
| **Hydrology** | | |
| Monitor changes in the creek due to weather variations, XMO/Xstrata operations and subsidence. | Cross-sections across Bettys Creek will be established approximately 100m apart to allow the measurement of any valley closure. | Prior to mining Longwall 10 |
| | A detailed monitoring program will assess whether rapid changes in channel or floodplain form occur due to subsidence following storm events that may require remediation. | Ongoing |
| | Water level loggers along with flow gauging and sediment deposition monitors will be installed in the creek at the Mt Owen Rail Spur bridge and downstream of Longwall Panel 10, outside the 20mm subsidence area, to monitor changes in the creek due to weather variations, XMO/Xstrata operations and subsidence impacts. | Ongoing |
| If adverse effects on Bettys Creek due to subsidence are observed, the creek and/or diversion will be rehabilitated to an appropriate standard. | In the event of subsidence impacts, the creek, diversion channel and floodplain will be rehabilitated to a similar state as existed prior to subsidence. This may include, but is not limited to, draining ponded areas, re-establishing drainage paths or diverting surface water flows from areas of potential ponding. | As required |

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| Ensure minimal subsidence impacts to farm dams. | Restore any dam that is damaged by subsidence or has its storage capacity reduced by more than 10 percent to a condition similar to the dam's pre-subsidence condition. Should water be lost from a dam to the extent that livestock are impacted, an alternative water supply will be provided by GCCM. | As required |
| Ensure minimal subsidence impacts to surface water regimes. | Should water begin to pond in an area, GCCM will carry out temporary or permanent earthworks to allow the water to drain away as requested by the relevant landowner.<br>Prepare and implement a Bettys Creek monitoring and management plan to the satisfaction of the Department of Water and Energy prior to subsiding Bettys Creek. The plan will be audited on completion of longwall mining. | As required<br>Prior to subsiding Bettys Creek. |
| Ensure minimal subsidence impacts to groundwater. | Detailed ground deformation/groundwater modelling will be undertaken prior to mining Longwall 10 using the Dr Winton Gale's FLAC code. Following the quantification of any impacts, appropriate management and mitigation measures will be developed.<br>Annual verification of actual seepage volumes and bore water levels versus predictions.<br>Obtain all necessary licenses and comply with licence conditions.<br>Verification of geomechanical model predictions for each longwall including reassessment of predictions should verification analysis vary significantly from predictions. These procedures will be developed in compliance with the Groundwater Management Plan required by licence 20BL169862. The plan and licence conditions will be audited at completion of longwall mining. | Modelling to be undertaken prior the Longwall 10. Monitoring will be ongoing. |
| Conduct all operations in accordance with the existing surface water management plan. | The existing on-site mine water management system, including mine water storage, clean and dirty water separation, clean water release and runoff control will continue. On going monitoring will refine the current water balance estimates. | Ongoing |

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| | All monitoring results will be reported in the AEMR and distributed to the relevant government agencies. | Annually |
| **Noise** | | |
| Ensure minimal noise disturbance during installation of gas drainage boreholes and general operational activities. | Undertake routine noise monitoring as identified in the various approvals and licences for Glennies Creek Colliery. | Ongoing |
| | The results of these monitoring programs will be presented in the Annual Environmental Management Reports (AEMR). | Annually |
| **Air Quality and Greenhouse Gas** | | |
| Ensure that greenhouse gas generation is minimised for this project. | An inventory of emissions and sinks will be developed and maintained. | Ongoing |
| | Greenhouse awareness training will be held at induction to make employees aware of the science of global warming and detailed efforts to minimise emissions. | As required |
| | Energy audits will be held when practicable to ensure that the mine is using best practice techniques to minimise energy use and is operating at optimum energy levels. | As required |
| | Consider electrical efficiency in assessments of new mobile and fixed equipment. | Ongoing |

| Desired Outcome | Existing or Proposed Actions | Timing |
|---|---|---|
| | Existing dust and greenhouse mitigation and monitoring programs will be continue throughout the life of the project. | Ongoing |
| | Ensure soil is moist before stripping (gas drainage boreholes). | As required during installation of gas drainage boreholes |
| | Considerate diesel efficiency in assessments of new mobile and fixed equipment | Ongoing |
| | Regular maintenance and servicing of machinery and equipment ensuring equipment will be maintained to retain high levels of energy efficiency | Ongoing |
| | To the extent practicable, assisting Envirogen in the utilization of methane from gas drainage boreholes | Following plant commissioning |
| | Emissions and abatement strategies will be reported annually | Ongoing |
| | Promote local employment and support local business | Ongoing |

# 16 PROJECT JUSTIFICATION AND CONCLUSIONS

## 16.1 PROJECT JUSTIFICATION

The proposed continuation of mining into Longwalls 10 to 17 at Glennies Creek Colliery can be justified economically, environmentally and socially as it would result in the following:

- retention of approximately 170 employees on site, plus contractors and many more indirect jobs created through flow-on effects;
- maximising the use of existing infrastructure and facilities;
- realisation of the economic potential of 9.39 Mt of marketable coal;
- minimal impacts on the physical or biological environment as the majority of impacts are limited to underground;
- payment of significant royalties to the State of NSW; and
- significant benefits to the local community through employment, goods and services and local expenditure.

## 16.2 ECOLOGICALLY SUSTAINABLE DEVELOPMENT (ESD)

Australia's National Strategy for Ecologically Sustainable Development (DEH 1992) defines ESD as, "*using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased*".

ESD is defined in the EP&A Act by incorporating the definition which appears in the *Protection of the Environment Administration Act 1991* (POEA Act).

The main thought behind ESD is that future generations should have a natural environment as good as or better than the one inherited. The aim of applying ESD to large resource developments is the integration of profitable business with environmental responsibility, in partnership with the community, to ensure long term sustainable outcomes.

In summary, the POEA Act, lists the following four principles of ESD:

- the precautionary principle;
- social equity, including intergenerational equity;
- conservation of biological diversity and ecological integrity; and

- improved valuation and pricing of environmental resources, including incentive mechanisms.

An analysis of these principles as they relate to the Glennies Creek Colliery application is presented as follows.

### *16.2.1 The Precautionary Principle*

The Precautionary Principle states that, "*if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*" (POEA Act).

To apply this Principle, decisions should be guided by evaluation to avoid serious or irreversible environmental damage and an assessment of options (these are discussed in *Section 2.6*).

This proposal is for the continuation of longwall mining Glennies Creek Colliery. The five years of experience gained since the GCC longwall mining operation commenced in 2002, as well as that gained from a long history of longwall mining in the region, means that a strong background of scientific fact and experience lie behind the operation. The impacts of the mining have been assessed, and measures to prevent environmental degradation will be implemented as appropriate during operations.

### *16.2.2 Social Equity and Intergenerational Equity*

The POEA Act, defines Social Equity and Intergenerational Equity as the present generation ensuring that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The health and diversity of the environment to which this application applies will be minimally impacted by this proposal. The drilling and installation of gas drainage boreholes will cause negligible and reversible damage to the surface ecology, and there will be no other direct impacts to the local flora and fauna from the mining of Longwalls 10 to 17. Minimal land disturbance will result from subsidence, but this will not directly affect the ecosystems on the surface. Similarly, the productivity of the land will not be affected by the proposal.

Approved mining operations by other companies are proposed to take place on the surface above the Project Area, which may substantially affect the land during this project period, and beyond.

### *16.2.3 Conservation of Biological Diversity and Ecological Integrity*

This principle of ESD means that the conservation of biological diversity and ecological integrity should be a fundamental consideration when planning and carrying out activities. Biological diversity refers to the variety of all life forms – the different plants, animals and micro-organisms, the genes they contain, and the ecosystems of which they form a part (DEH, 1996).

Potential impacts on biodiversity and ecological integrity are expected to be minimal as underground mining will cause little surface disturbance. The impacts of the gas drainage borehole drilling are expected to be negligible, and disturbance to flora and fauna will be avoided where possible during their installation and removal. No local populations of threatened flora or fauna are likely to be placed at risk of extinction and it is not expected that subsidence will seriously affect the biodiversity or ecological value of this site.

### *16.2.4 Improved Valuation and Pricing of Environmental Resources*

This principle requires that environmental factors be included in the valuation of assets and services (EA Act). This would result in intergenerational equity, as improved valuation and pricing of resources is paramount in conserving the natural environment for future generations. This principle's aim is that the environment be considered in the planning and costing of projects, so it is no longer considered a free resource.

A vital part of the process when assessing the viability of a project is the inclusion of costings relating to:

- environmental assessments;
- environmental studies and monitoring;
- environmental management plans; and
- site remediation.

The inclusion of these components in the project results in the environment being a vital consideration through all phases of the operation, from planning through to decommissioning and rehabilitation of the site.

## GLOSSARY OF TERMS

| | |
|---|---|
| **Alluvial** | Soil that contains clay, silt, sand or gravel deposited by running water. |
| **Angle of draw** | The angle between the vertical and the line joining the edge of the mining void with the limit of vertical subsidence, usually taken as 20mm. |
| **Project Area** | The surface area that is likely to be affected by the proposed underground mining. As a minimum it is defined by the depth of cover, angle of draw of 26.5° and the limit of the proposed extraction area. |
| **Community** | Anyone who is interested in or affected by issues associated with the proposed mining project. |
| **Depth of Cover** | The depth of the roof of the coal seam from the ground measured in metres. |
| **Emission Factor** | An expression for the rate at which a pollutant is generated as a result of some activity, divided by the level of that activity. |
| **FEFLOW** | A finite element groundwater modelling package developed by WASY Institute for Water Resources Planning and Systems Research in Berlin, Germany. |
| **Goaf** | The mined out area into which the immediate roof strata break. |
| **Habitat** | An area or areas occupied or periodically occupied by a species, population or ecological community and includes any biotic or abiotic component. |
| **Haul Road** | Road used in a mine for haulage of rock from the mining area to the processing or stockpile area and for general site access. |
| **Hydrogeology** | The study of groundwater and the related geologic aspects of surface waters. |
| **Longwall Mining** | A high capacity underground mining method which utilises a mechanical shearer to cut the coal. The loosened coal falls onto a conveyor for removal from the mine. |
| **Major Project** | An activity as defined under the State Environment Planning Policy (Major Projects). |

| | |
|---|---|
| **Riparian** | Associated with drainage lines. |
| **Strain** | Strain is calculated as the change in horizontal distance between two points on the ground, divided by the original horizontal distance between them. |
| **Subsidence** | Mining-induced movements and deformations of the ground surface where the vertical downward surface movements are greater than 20mm, or the potential impacts on major surface infrastructure and/or natural features may be significant, notwithstanding that the vertical downward surface movements are less than 20mm. |
| **Tilt** | Tilt is the change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the distance between those points. |
| **Threatened Species** | A plant or animal identified in the TSC Act or EPBC Act as extinct, critically endangered, endangered, or vulnerable. This term may be extended to encompass threatened species, populations or ecological communities. |
| **Tributary** | A stream or river that flows into a larger river or lake. |
| **Vertical Subsidence** | Vertical downward movements of the ground surface caused by underground coal mining. |

**ABBREVIATIONS**

| | |
|---|---|
| **ADH** | Australian Height Datum |
| **AEMR** | Annual Environmental Management Report |
| **AGO** | Australian Greenhouse Office |
| **AMCI** | AMCI Holdings Australia Pty Ltd |
| **CHPP** | Coal Handling and Preparation Plant |
| **CL** | Coal Lease |
| **$CO_2$** | Carbon Dioxide |
| **$CO_2$-e** | Carbon Dioxide equivalent |
| **DA** | Development Application/Approval |
| **DMR** | Department of Mineral Resources |
| **DNR** | Department of Natural Resources |
| **DoP** | Department of Planning |
| **DPI** | Department of Primary Industries |
| **DWE** | Department of Water and Energy |
| **EA** | Environmental Assessment |
| **EIS** | Environmental Impact Statement |
| **ERM** | Environmental Resources Management |
| **ESD** | Ecologically Sustainable Development |
| **FEFLOW** | Finite Element subsurface FLOW system |
| **GCC** | Glennies Creek Colliery |
| **GCCM** | Glennies Creek Coal Management Pty Ltd |
| **GJ** | Gigajoule |
| **GHG** | Greenhouse Gas |
| **ISCM** | Intergovernmental Committee on Surveying and Mapping |
| **kL** | Kilolitres |
| **kWh** | Kilowatt Hours |
| **LALC** | Local Aboriginal Land Council |
| **LGA** | Local Government Area |
| **MCMPR** | Ministerial Council on Mineral and Petroleum Resources |

| | |
|---|---|
| **ML** | Mining Lease |
| **ML/day** | Megalitres per day |
| **ML/yr** | Megalitres per year |
| **mm** | millimetres |
| **mm/m** | millimetres per metre |
| **MMC** | Maitland Main Collieries Pty Ltd |
| **MOP** | Mine Operations Plan |
| **MLPA** | Mining Purpose Lease Application |
| **MSB** | Mine Subsidence Board |
| **Mtpa** | Million tonnes per annum |
| **NSW** | New South Wales |
| **ROM** | Run-of-Mine (raw coal prior to crushing and washing) |
| **s138** | Section 138 of the *Coal Mines Regulation Act 1982* |
| **SCT** | Strata Control Technology |
| **SMP** | Subsidence Management Plan |
| **TSC Act** | *Threatened Species Conservation Act 1995* |
| **XMO** | Xstrata Mt Owen |

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# Annexures