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GLENCORE

# RAVENSWORTH EAST RESOURCE RECOVERY PROJECT

Response to Submissions

**July 2013**

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Response to Submissions

**July 2013**

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Mount Owen Pty Limited

| | |
|---|---|
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| Report No. | **3081/R03/FINAL** |
| Date: | **July 2013** |

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# TABLE OF CONTENTS

# FIGURES



# APPENDICES

# 1.0 Introduction

This document has been prepared in response to a request from the Director-General of the Department of Planning and Infrastructure (DP&I) on 19 February 2013 to address the issues raised during the public exhibition period of the Environmental Assessment (EA) for the proposed Ravensworth East Resource Recovery (RERR) Project. The EA supported a Section 75W application to modify DA 52-03-99 to allow for the continuation of mining operations at the Ravensworth East Mine within the RERR mining area which forms part of the Mount Owen Complex and was exhibited from 01 February to 18 February 2013.

Following the recent merger of Glencore plc and Xstrata plc in May 2013, the names of certain Xstrata companies have been changed. As a result, the company formerly known as Xstrata Mount Owen Pty Limited is now named Mount Owen Pty Limited. This change was effective on 7 June 2013.

## 1.1 Ravensworth East Resource Recovery Project

Mining operations at Ravensworth East Mine are undertaken in accordance with DA 52-03-99 which allows for the extraction of 4 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 2021. The extraction of all approved accessible coal resources within the current West Pit at Ravensworth East Mine, is expected to be complete by quarter three 2013. The proposed modification seeks to modify DA 52-03-99 under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to allow Mount Owen Pty Limited (Mount Owen) to continue mining within the RERR mining area. The RERR mining area is an area previously disturbed by mining operations that was formerly known as Tailings Pit 2 (TP2).

The proposed modification does not include any changes to the current approved mining method or extraction rate, employment numbers, product transportation or operating hours. No alterations or additions to the existing surface infrastructure facilities are proposed and no construction activities are required.

More specifically the proposed modification includes:

- overburden removal and coal extraction within the RERR mining area down to a depth of approximately 200 metres, utilising the personnel and mining methods currently operating in the West Pit (subject to equipment replacement and upgrades); and

- emplacement of overburden within the West Pit overburden emplacement area to a maximum height of approximately RL 180 metres, an increase of 20 metres in height from the currently approved RL160 metres.

Further details of the existing and approved mining operations at Ravensworth East Mine and a detailed description of the proposed modification is provided in the RERR EA.

## 1.2 Summary of Submissions Received

Eight submissions (six agency and two public submissions) (see **Appendix 1**) were received during the public exhibition period as follows:

- NSW Trade & Investment, Regional Infrastructure & Services, Division of Resources & Energy (DRE), letter dated 19 February 2013;

- NSW Environmental Protection Authority (EPA), letter dated 27 February 2013;
- Office of the Environment and Heritage (OEH), letter dated 22 February 2013;
- Office of Agricultural Sustainability & Food Security (OAS&FS), letter dated 19 February 2013;
- NSW Transport Roads and Maritime Services (RMS), letter dated 26 February 2013; and
- Department of Primary Industries (DPI), letter dated 10 May 2013.

Two public submissions:

- Vale Integra Underground Mine, letter dated 22 February 2013; and
- Community submission, email dated 17 February 2012.

All submissions which raised issues or concerns were comprehensively reviewed and considered.

The issues raised in the submissions received from the Government Agencies are addressed in **Section 2.0**. The issues raised in the two public submissions are addressed in **Section 3.0**.

## 1.3 Report Structure

This Response to Submissions report has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Mount Owen to address the key issues raised by the submissions received in regards to the RERR EA through the public exhibition period. For each issue, the issue raised is noted in bold, followed by a response in normal type.

# 2.0 Response to Agency Submissions

## 2.1 NSW Trade and Investment, Regional Infrastructure and Services, Division of Resources and Energy

### 2.1.1 Rehabilitation

#### 2.1.1.1 Final Voids

**The EA does not consider alternatives to a final void should the void not be required for tailings emplacement other than to defer a decision until two years prior to mine closure. Rehabilitation of the void may be constrained by activities such as remote emplacement of spoil prior to the closure plan being developed. A contingency plan should be developed for if a void is remaining at the completion of mining at the Mt Owen Complex. This may include:**

- **Coarse rejects be disposed of into RERR void at completion of RERR mining operations.**

- **Spoil be located to west of RERR (burying pasture rehab if necessary) to enable capping of tailings or pushing into final RERR void if tailings do not fill void by close of mine.**

- **A tailings management strategy and land management strategy be prepared that includes the RERR void.**

The conceptual mine plans for the RERR project (Year four and five) have been revised to address concerns raised by the DRE in relation to final voids, overburden emplacement height and the location of overburden emplacement.

As described in Section 3.0 of the RERR EA the mining operations associated with the Project would initially involve the excavation of overburden emplaced within the RERR mining area previously as part of approved mining operations. This overburden would be transported and emplaced within the West Pit Overburden Emplacement Area requiring the disturbance of approximately 54.2 hectares of an area previously rehabilitated. As mining progressed within the RERR mining area, overburden emplacement would continue within the West Pit Overburden emplacement area to an approximate height of RL 180 metres, an increase of 20 metres in height from the currently approved RL 160 metres.

To address the concerns raised by the DRE in relation to the final void the conceptual mine plans (years 4 and 5) (refer to **Figures 1.1** and **1.2**) have been amended to include the co-disposal of coarse reject and overburden within the West Pit and RERR Mining Area as mining progresses. The co-disposal of coarse reject within the West Pit and the RERR mining area will reduce the size of the RERR void at the end of mining operations at the Ravensworth East mine and will confine emplacement to the southern end of the West Pit Overburden Emplacement Area. The reduction in overburden emplacement on the West Pit Overburden Emplacement Area results in a maximum required height of RL 170 metres (previously proposed to RL 180 metres, currently approved to RL 160 metres). The additional 10 metres in height above that currently approved will allow a more natural landform to be achieved.

As outlined in Section 6.10 of the RERR EA, the intention is to utilise the RERR void for the emplacement of tailings from future mining operations at the Mount Owen Complex. However should this intended use not be realised the following management measures would be applied:

- The highwall of the void will be stabilised in accordance with DRE requirements (this will include the construction of a trench, safety berm and fence around the highwall and the development and implementation of stabilisation works dependent on the outcome of geotechnical investigations).

- The lowwall will be reshaped to be generally less than 10 degrees (with steeper slopes being the exception (a maximum of 14 degrees subject to approval) and revegetated consistent with the Rehabilitation Environmental Management Plan.

- A surface drainage network will be established to divert the bulk of surface water away from the void so as to maximise replenishment of the local catchment areas.

In accordance with the relevant development consent requirements and Glencore Xstrata standards, the Final Closure Plan for the Mount Owen Complex will be developed within two years of projected mine closure. The development of the Final Closure Plan will include the identification of possible beneficial uses for the final void, modelling predictions of final void water quality and levels and long term management, monitoring and mitigation measures.


Source: Glencore (2012)
Note: Contour Interval 5m

0 0.5 1.0 1.25km
1:25 000

Legend
- Active Dump
- Active Mining
- Tailings Emplacement

FIGURE 1.1

RERR Revised Conceptual Mine Plan (Year 4)


**Source:** Glencore (2012)
**Note:** Contour Interval 5m

0 0.5 1.0 1.25km
1:25 000

**Legend**
- Rehabilitation
- Tailings Emplacement
- RERR Void

FIGURE 1.2

**RERR Revised Conceptual Mine Plan (Year 5)**

Should the RERR void be used for the emplacement of tailings for future mining operations at the Mount Owen Complex, tailings emplacement will be undertaken in accordance with the Tailings Management Plan (Mount Owen, undated) and capping and rehabilitation requirements will be undertaken in accordance with the Rehabilitation Environmental Management Plan.

The current Tailings Management Plan for the Mount Owen Complex (refer to Section 2.5 of the RERR EA) is under review, including an assessment of the requirement for the use of the RERR Mining Area for tailings emplacement.

#### 2.1.1.2 Proposed Increase Spoil Emplacement Height

**DRE does not support the proposed increase in spoil emplacement height at 180 metres. DRE recommends that the Proponent investigates the opportunities for placing the spoil closer to the RERR and West Pit areas thereby providing opportunities for the voids to be backfilled at the completion of mining and/or tailings emplacement and thereby providing maximum rehabilitation outcomes for the project.**

As discussed in **Section 2.1.1.1** the conceptual mine plans for the RERR project (Year four and five) have been revised (refer to **Figures 1.1** and **1.2**). The conceptual mine plans have been amended to maximise the co-disposal of coarse reject and overburden within the West Pit and RERR Mining Area as mining progresses. The co-disposal of coarse reject within the West Pit and the RERR mining area will reduce the size of the RERR void at the end of mining operations at the Ravensworth East Mine and will minimise the emplacement of overburden, confining overburden emplacement to the southern end of the West Pit Overburden Emplacement Area. The revised conceptual mine plans result in a reduced need for emplacement of overburden at height and has enabled Mount Owen to reduce the proposed height from RL 180 metres to RL 170 metres, an increase of only 10 metres from the currently approved height (RL 160 metres). Increasing the height of the West Pit Overburden Emplacement Area by 10 metres will allow for the creation of a more natural landform than would otherwise be achieved by restricting the height to RL 160 metres.

#### 2.1.1.3 Spoil Emplacement Rehabilitation

**Figure 3.4 of the conceptual rehabilitation mine plan (year five) shows the contours being stepped and angular. This is inconsistent with providing a final landform typical of the surrounding natural landscape.**

**DRE recommend that the Proponent provide conceptual rehabilitation mine plans which blend with the surrounding natural landscape.**

As discussed in **Section 2.1.1.1**, the conceptual mine plans (years four and five) (refer to **Figures 1.1** and **1.2**) have been amended to include the co-disposal of coarse reject and overburden within the West Pit and RERR Mining Area as mining progresses. The co-disposal of coarse reject within the West Pit and the RERR mining area will reduce the size of the RERR void at the end of mining operations at the Ravensworth East mine and will minimise the emplacement of overburden confining emplacement to the southern end of the West Pit Overburden Emplacement Area. The reduced emplacement of overburden in the West Pit Overburden Emplacement Area also results in a revised conceptual landform for this area to provide a more natural landscape.

The revised conceptual mine plan (year five) (refer to **Figure 1.2**) now proposes a more natural landform within the West Pit Overburden Emplacement Area. This will be achieved through the revised location and shaping of overburden emplacement and restricting the height of overburden emplacement to RL 170 metres, previously proposed to RL 180 metres

(increase of 10 metres). The West Pit void is proposed to continue to be utilised for the emplacement of tailings from mining operations at the Mount Owen Complex, capping and rehabilitation works will be undertaken once the tailings have sufficiently consolidated. Rehabilitation will be undertaken in accordance with the Rehabilitation strategy for the Ravensworth East Mine as detailed in the Mount Owen Complex Landscape Management Plan 2011.

As discussed in Section 3.0 of the RERR EA, the RERR void will be retained to provide for long term tailings storage associated with future mining operations within the Mount Owen Complex. Should the void be utilised for tailings emplacement, capping and rehabilitation works will be undertaken once the tailings have sufficiently consolidated. As discussed in **Section 2.1.1.1**, should the use of the void for tailings emplacement not be realised, the possible final use for the void and required management measures will be developed as part of the Final Closure Plan for the Mount Owen Complex.

#### 2.1.1.4 Rehabilitated Slopes

**Section 6.10.8 states that it is proposed that the slopes of the emplacement would be 'an average of 10 degrees', while Table 6.18 states 'rehabilitated slopes are generally less than 10 degrees'. DRE considers that a natural landscape would have slopes that are less than 10 degrees and that slopes greater than 10 degrees would be the exception.**

**DRE recommends that as stated in Table 6.18 rehabilitated slopes be generally less than 10 degrees, with steeper slopes the exception.**

Slopes will be generally less than 10 degrees with steeper slopes being the exception (a maximum of 14 degrees, subject to approval) in accordance with the preliminary rehabilitation criteria detailed in the existing Mount Owen Complex Landscape Management Plan 2011.

#### 2.1.1.5 Mine Closure Plan

**A productive post mine land use for the Ravensworth East Mine may not be realised if activities that allow for future uses are not designed for as materials become available. For example disposal of spoil remote from voids increases transport cost of overburden and reduces the viability of backfilling voids. Current pasture land use is being compromised by aging of exotic pasture species and weed infestation.**

**DRE recommends that:**

- **The spoil emplacements should be located close to the final voids so as not to make refilling of voids unviable in the future.**
- **The Land Management Plan be updated to include improved Pasture Management, for example return to grazing sooner rather than later to ensure nutritional value of pasture is maximised.**
- **The plan should address the Precautionary Principle (Section 8.3.1) for what could result from the various options for the void and demonstrate how a void meets the objectives of Intergenerational Equity (Section 8.3.2) to 'maintain the health, diversity and productivity of the environment for future generations'.**

As discussed in **Section 2.1.1.1,** the conceptual mine plans (years four and five) (refer to **Figures 1.1** and **1.2**) have been amended to include the co-disposal of coarse reject and overburden within the West Pit and RERR Mining Area as mining progresses. The co-disposal of coarse reject within the West Pit and the RERR mining area will reduce the size of the RERR void at the end of mining operations at the Ravensworth East mine and will minimise the emplacement of overburden, confining emplacement to the southern end of the West Pit Overburden Emplacement Area.

As detailed in the existing Mount Owen Complex Landscape Management Plan 2011, the rehabilitation strategy for the Ravensworth East and Glendell Mines 'aims to emulate the pre-mining grazing areas, enhance local and regional ecological linkages and provide for a sustainable final land use option. The pre-mining land use was primarily agricultural with areas of remnant vegetation. The rehabilitation strategy includes the establishment of primarily pasture with habitat corridors which have been designed to provide a functional link between remnant vegetation areas. Habitat corridors consisting of trees, shrubs and groundcover will be established in visually prominent areas in order to reduce the visual impact of the mining operations'. It is considered that returning the land to pasture with established habitat corridors will create a diverse and productive environment.

The current closure criteria for the Ravensworth East Mine are based on the site being returned to 70 per cent pasture and 30 per cent native trees or shrubs. Pasture species consist of grasses and legumes which are appropriate to the district and recognised as suitable for grazing as well as the implementation of weed control. Recent rehabilitation monitoring indicates all pasture plots within the existing rehabilitation areas meet the ground cover completion criteria (minimum vegetative ground cover of 70 per cent over a minimum of 95 per cent of areas one year after sowing), noting an ongoing need for weed control.

Weed control measures currently implemented at the Mount Owen Complex are detailed in the Mount Owen Complex Landscape Management Plan 2011 and include:

- stockpiles to be kept longer than three months will be sown with a suitable cover crop to minimise soil erosion and invasion of weed species;
- weed growth will be monitored and subsequently controlled if necessary;
- prior to re-spreading, weed growth will be scalped from the top of the stockpiles to minimise the transport of weeds into rehabilitated areas; and
- monitoring of rehabilitated areas and implementation of physical and chemical controls as required.

Rehabilitation monitoring and weed control measures will continue to be implemented in accordance with the existing Mount Owen Complex Land Management Plan 2011 to ensure weed infestation is controlled.

The existing Mount Owen Complex Landscape Management Plan 2011 includes a Final Void Management Plan which addresses the various use options for voids at the Mount Owen Complex, potential issues and any further assessment required. The rehabilitation strategy outlined in the Mount Owen Complex Landscape Management Plan 2011 for the Ravensworth East Mine proposes returning the area to pre-mining land use which was primarily agricultural with areas of remnant vegetation, to maintain future productivity and diversity providing grazing for agricultural use and habitat corridors for native fauna. The existing Mount Owen Complex Landscape Management Plan 2011 will be amended to include the RERR void should the RERR project be approved.

### 2.1.1.6 Rehabilitation Vegetation

**The project includes a proposal to disturb approximately 54.2 ha of rehabilitated land. The 'Rehabilitation (Grassland Complex)' (Section 6.7.3.1) describes vegetation of low ecological value. DRE considers that there may be limited soil able to be recovered from the previously rehabilitated areas for reuse. This may reduce the success of establishing a grassland complex community.**

**DRE recommends that the Proponent provide additional detail on how soils would be engineered and managed to facilitate the development of the proposed vegetation covers/types.**

As detailed in Section 3.0 of the RERR EA, the original conceptual mine plans required the disturbance of approximately 54.2 hectares of mine rehabilitation within the West Pit Overburden Emplacement Area, comprising of immature rehabilitation forest complex rehabilitation grassland complex. The revised conceptual mine plans year four and five (refer to **Figures 1.1** and **1.2**) have been amended to provide for co-disposal of coarse reject and overburden within the West Pit and RERR mining area as mining continues to minimise emplacement of overburden on the existing West Pit Overburden Emplacement Area. The emplacement of overburden on the West Pit Overburden Emplacement Area will be confined to the southern end of the emplacement area which negates the requirement to disturb approximately 41.6 hectares of rehabilitated grassland and forest complex from what was originally proposed. Also the remaining 12.6 hectares previously identified to be disturbed falls within the current approved Ravensworth East mining operations area. The currently nominated end land use for the Ravensworth East Mining area is grazing, as detailed within the Mount Owen Complex Landscape Management Plan 2011. Rehabilitation techniques include planting of native trees and shrubs directly into overburden material with the remaining area spread with stockpiled topsoil and planted with a mixture of pasture grasses. Any topsoil removed from the mining areas at Ravensworth East Mine is managed in accordance with existing topsoil management practices detailed in the existing Mount Owen Complex Landscape Management Plan 2011. Where topsoil stockpiles are not sufficient to provide for rehabilitation practices, topsoil is sourced from a suitable supplier.

As discussed in **Section 2.1.1.5,** rehabilitation monitoring is undertaken at the Mount Owen Complex to ensure rehabilitation success and improvement. The results of recent rehabilitation monitoring undertaken within the West Pit rehabilitation area indicate the area is a good example of rehabilitation practices with successful pasture, woodland and forest re-vegetation. The resulting management recommendations include continued monitoring and maintenance (such as weed control) as required, fertilising practices and some areas requiring supplementary tube stock planting to enforce specific vegetation community construction.

**The EA considers the Rehabilitated Grassland Complex in terms of biodiversity value only. No criteria given for rehabilitation success, especially for pasture which could be as much as 70% of the final rehabilitated land use. The EA provides no indication of the proposed biodiversity value of rehabilitated woodland communities (compared to nearby woodland remnants).**

**The EA does not identify a benchmark for agricultural production for the rehabilitated landscape other than 'Pasture areas can be demonstrated to have a suitable carrying capacity of a specified head of stock' (Table 6.18). There is concern the pasture could be poor unless managed to maintain sufficient nutritional value from the start of the rehabilitation program. DRE recommend that any project approval include a condition regarding the productivity (agricultural class) of the pasture. The condition should include:**

**The post mining rehabilitation should be returned to agricultural production (for example livestock carrying capacity) similar to adjacent pastures, at a minimum. Methods to achieve the agricultural production standard, including monitoring, should be detailed in the rehabilitation/land management plan.**

As discussed in **Section 2.1.1.5,** the rehabilitation strategy for the Ravensworth East Mine aims to emulate the pre-mining grazing areas as well as enhancing local and regional ecological linkages with a proposed 70 per cent pasture and 30 per cent native trees or shrubs rehabilitation cover. Detailed rehabilitation monitoring and maintenance is undertaken at the Mount Owen Complex in accordance with the existing Mount Owen Complex Landscape Management Plan, 2011 to ensure rehabilitation targets are met.

The current mine closure, rehabilitation and final void management measures implemented at the Mount Owen Complex are detailed within the existing Mount Owen Complex Landscape Management Plan 2011. Should the proposed modification be approved, the Landscape Management Plan will be updated to include the proposed changes to the West Pit Overburden Emplacement Area and the RERR Mining Area.

#### 2.1.1.7 Cover Crops

**The project proposes to use a cover crop during adverse conditions for rehabilitation (Section 6.10.8). DRE consider this strategy acceptable for woodland rehabilitation, however questions the benefit of establishing a temporary cover crop instead of final pasture over an area that has been land-formed and had topsoil or substitute spread.**

**DRE recommend that the circumstances leading to the use of cover crops should be clearly articulated in a Land Management Plan.**

Cover crops are used at the Mount Owen Complex as a temporary measure for dust suppression and erosion and sediment control. Section 3.12 of the existing Mount Owen Air Quality and Greenhouse Gas Management Plan 2011 details the key air quality controls implemented at the Mount Owen Complex in relation to rehabilitation activities including 'cover crops are used where possible to establish quick groundcover until desirable species have established'. The use of cover crops is also detailed within the existing Mount Owen Complex Landscape Management Plan 2011 in relation to topsoil management, Section 5.3.2 of the Landscape Management Plan states 'stockpiles to be kept longer than three months will be sown with a suitable cover crop to minimise soil erosion and invasion of weed species'.

Should the RERR Project be approved, the existing Mount Owen Landscape Management Plan, 2011 will be amended to ensure consistency between the management measures detailed within the Air Quality and Greenhouse Gas Management Plan and the Landscape Management Plan.

## 2.2 NSW Environmental Protection Authority

### 2.2.1 Air Quality

**In relation to mitigation of air quality impacts, the EPA notes that the proponent assumes 85% control of emissions from haulage roads through watering. That is, the assessment of potential impacts from the proposed project utilises percentage reductions in emission calculations based on proposed best practice control methods and as such, the predicted potential for impact relies heavily on whether emissions are as effectively controlled as assumed in the assessment.**

**The air quality impact assessment also assumes a silt surface moisture content of 2% for emission calculations based on the average value of three test samples, which were 3.3%, 1.3%, 1.1%. The EPA recommends that further testing is conducted by the proponent to verify % surface moisture however notes that it is unlikely that adjusting emission calculations to reflect real values will be significant enough to change the outcomes of the assessment. What is clear however is that the proponent needs to be able to quantitatively demonstrate that the proposed watering practices actually achieve the degree of emission control assumed in the assessment. This will be required once best practice management conditions are implemented on coal mining licences via the EPA's Dust Stop Program.**

The level of dust control on haul roads assumed for the air quality modelling for the RERR project is based on the current dust suppression activities employed at the Mount Owen Complex in accordance with the Mount Owen Complex Air Quality and Greenhouse Management Plan 2011. The surface silt content of haul roads taken to be 2 per cent is based on silt testing undertaken at the site in 2011 measured by Carbon Based Environmental on behalf of Mount Owen (see Appendix B of the RERR Air Quality Assessment).

Mount Owen intend to continue to implement dust suppression management measures at Ravensworth East Mine in accordance with the existing Mount Owen Complex Air Quality and Greenhouse Management Plan 2011 to ensure the assumed emissions controls are achieved. Mount Owen will also continue to undertake continued monitoring to identify the most practical means to reduce particle emissions in accordance with condition U1.1 of the Ravensworth East Mine Environmental Protection Licence (EPL #10860).

**The EPA also notes that the proponent has based their assessment on private receptors not currently subject to acquisition rights. The proponent should note the recent Planning Assessment Commission determination for Tarrawonga Mine in which consent conditions require that reasonable and feasible avoidance and mitigation measures are implemented to avoid exceedances of the criteria at all private residences, while acknowledging that it may not be reasonable and feasible to avoid impacts at certain times at residences identified for acquisition.**

Mount Owen will continue to implement the existing mitigation measures and monitoring requirements in relation to air quality currently undertaken at the Mount Owen Complex to ensure that all reasonable and feasible measures are taken to avoid an exceedance of the criteria.

### 2.2.2 Noise Assessment

**The impacts of temperature inversions were predicted in the EA referring to inversion strength as a temperature lapse rate. However, the EPA proposes requiring the proponent to monitor for the presence of inversion conditions using the sigma-theta method and that limits would accordingly apply up to and including F class inversions rather than the modelled 3°C/100m lapse rate. If this is not acceptable to the proponent, the EPA is willing to consider alternative approaches including direct measurement of temperature lapse rate.**

This method of monitoring is currently undertaken at the Mount Owen Complex.

### 2.2.3 Recommended Conditions

#### 2.2.3.1 Air Conditions

**2. General Dust Conditions**

**2.1 Activities occurring in or on the premises must be carried out in a manner that will minimise the generation, or emission from the premises, of wind-blown or traffic generated dust.**

**3. Requirement to Monitor Weather**

**3.1 The licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns.**

**Point # (actual point number to be confirmed in the Environmental Protection Licence)**

| Parameter | Unit of Measure | Frequency | Averaging Period | Sampling Method (see Note 1) |
|---|---|---|---|---|
| Rainfall | mm/hour | continuous | 1 hour | AM-4 |
| Sigma theta | Degrees | continuous | 10 minute | AM-2 and AM-4 |
| Siting | | | | AM-1 |
| Temperature at 2 metres | Kelvin | continuous | 10 minute | AM-4 |
| Temperature at 10 Metres | Kelvin | continuous | 10 minute | AM-4 |
| Total solar radiation | Watts per square metre | continuous | 10 minute | AM-4 |
| Wind direction at 10 metres | Degrees | continuous | 10 minute | AM-2 and AM-4 |
| Wind Speed at 10 metres | Metres per second | continuous | 10 minute | AM-2 and AM-4 |
| Relative Humidity | % | continuous | 1 hour | AM-4 |

***Note 1: For details of sampling method refer to the EPA's Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales.***

The requested air quality conditions are consistent with current air quality management at the Mount Owen Complex. However in relation to weather monitoring, temperature is currently recorded in degrees Celsius, not Kelvin as detailed in the above table. Mount Owen intend to continue to use degrees Celsius to measure temperature.

#### 2.2.3.2 Noise Conditions

**4 Limit Conditions**

**4.1 Noise generated at the premises must not exceed the noise limits in the table below.**

| | | Noise Limits dB(A) | | | |
|---|---|---|---|---|---|
| **Locality** | **Location** | **Day** | **Evening** | **Night** | |
| | | $L_{Aeq\ (15\ Minute)}$ | $L_{Aeq\ (15\ Minute)}$ | $L_{Aeq\ (15\ Minute)}$ | $L_{A1\ (1\ Minute)}$ |
| **Any residential receiver** | **All privately-owned residential receivers** | **35** | **35** | **35** | **45** |

**4.2 For the purpose of condition 4.1:**

- **Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays.**
- **Evening is defined as the period 6pm to 10pm.**
- **Night is defined as the period from l0pm to 7am Monday to Saturday and 10pm to 8am Sunday and Public Holidays.**

**4.3 The noise limits set out in condition 4.1 apply under all meteorological conditions except for the following:**

**a) Wind speeds greater than 3 metres/second at 10 metres above ground level; or**
**b) Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or**
**c) Stability category G temperature inversion conditions**

**4.4 For the purposes of condition 4.3:**

**a) Data recorded by the meteorological station identified as EPA Identification Point # (Point number to be specified in the Environment Protection Licence) must be used to determine meteorological conditions; and**
**b) Temperature inversion conditions (stability category) are to be determined by the sigmatheta method referred to in Part E4 of Appendix E to the NSW Industrial Noise Policy.**

**4.5 To determine compliance:**

**a) with the $L_{Aeq}$(15minute, noise limits in condition 4.1, the noise measurement equipment must be located:**

- **approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or**
- **within 30 metres of a dwelling facade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable;**
- **within approximately 50 metres of the boundary of a National Park or a Nature Reserve.**

**b) with the $L_{A1(1\ minute)}$ noise limits in condition 4.1, the noise measurement equipment must be located within 1 metre of a dwelling facade.**

**c) with the noise limits in condition 4.1, the noise measurement equipment must be located:**

- **at the most affected point at a location where there is no dwelling at the location; or**
- **at the most affected point within an area at a location prescribed by conditions 4.5(a) or 4.5(b).**

**4.6 A non-compliance of condition 4.1 will still occur where noise generated from the premises in excess of the specified noise limit is measured:**

- **at a location other than an area prescribed by conditions 4.5(a) and 4.5(b); and/or**
- **at a point other than the most affected point at a location.**

**4.7 For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.**

The requested noise conditions are consistent with current noise management implemented at the site. It is requested that the wording in relation to condition 4.1 is amended to read 'noise generated by the project does not exceed the criteria in Table xx at any residence on privately owned land' to be consistent with the existing consent condition.

#### 2.2.3.3 Blasting Conditions

**5.1 Blasting in or on the premises must only be carried out between 0900 hours and 1700 hours, Monday to Saturday. Blasting in or on the premises must not take place on Sundays or Public Holidays without the prior approval of the EPA.**

**5.2 The airblast overpressure level from blasting operations at the premises must not exceed 120 dB(Lin Peak) at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit.**

**5.3 The airblast overpressure level from blasting operations at the premises must not exceed 115 dB(Lin Peak) at any time at any noise sensitive locations for more than five percent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.**

**5.4 Ground vibration peak particle velocity from blasting operations at the premises must not exceed 10mmlsec at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.**

**5.5 Ground vibration peak particle velocity from blasting operations at the premises must not exceed 5mmlsec at any time at any noise sensitive locations for more than five percent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.**

**5.6 The airblast overpressure and ground vibration levels in conditions 5.2, 5.3, 5.4 or 5.5 do not apply at noise sensitive locations that are owned by the licensee or subject to a private agreement relating to airblast overpressure and ground vibration level between the licensee and the land owner.**

The requested blast management conditions are consistent with current blast management undertaken at the Mount Owen Complex. It is requested that the reference to 'noise sensitive location' is defined (such as school or hospital) consistent with the existing consent conditions.

### 2.2.3.4 Monitoring Conditions

**6.1 The meteorological weather station must be maintained so as to be capable of continuously monitoring the parameters specified in condition 3.1.**

**7 Requirement to Monitor Noise and Blasting**

**7.1 To assess compliance with Condition 4.1, attended noise monitoring must be undertaken in accordance with Conditions 4.5 and:**

**a) at each one of Residence 20, Residence 23., Residence 114, residence 143 and residence 155 as shown in Figure 1.3 of the document Ravensworth East Resource Recovery Project Environmental Assessment (Umwelt (Australia) Pty Limited December 2012);**
**b) occur quarterly in a reporting period;**
**c) occur during each day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum of:**
- **1.5 hours during the day;**
- **30 minutes during the evening; and**
- **1 hour during the night; and**

**d) occur for three consecutive operating days.**

**7.2 To determine compliance with conditions 5.2, 5.3, 5.4 and 5.5:**

**a) Airblast overpressure and ground vibration must be measured at any residence or noise sensitive site that is likely to be most affected and is not owned by the licensee or subject of a private agreement between the owner of the residence or noise sensitive site and the licensee as to an alternative blasting level for all blasts carried out in or on the premises; and**
**b) Instrumentation used to measure the airblast overpressure and ground vibration must meet the requirements of Australian Standard AS 2187.2-2006.**

The Mount Owen Complex currently monitors noise generated by mining operations in accordance with the existing Mount Owen Complex Noise Monitoring Program. The existing Mount Owen Complex noise monitoring program includes a network of continuous noise monitoring units as well as undertaking attended noise monitoring in the surrounding area and mobile continuous noise monitors that are utilised for additional noise monitoring and complaint investigation. Noise monitoring locations are continuously reviewed and where necessary, modified according to monitoring results, physical changes in mining operations, or following the acquisition of private property.

The results of the Noise Impact Assessment (see Section 6.1 of the RERR EA) indicates that the noise impacts associated with the proposed modification will be contained within the existing Mount Owen affectation zone with no additional properties being affected. It is therefore requested that monitoring requirements continue to be undertaken in accordance with the existing Mount Owen Complex Noise Monitoring Program. The changes to the noise monitoring program proposed by the EPA are considered to be overly prescriptive and would require extensive monitoring effort that is not commensurate with the environmental assessment results, which predict very little change in the noise environment as a result of the RERR Project. We also note that a more comprehensive review of the Mount Owen noise monitoring program will be undertaken as a result of the Mount Owen Continued Operations Project which is currently the subject of an environmental assessment. It is planned that this project (if approved) will encompass ongoing operations at Ravensworth East Mine.

In addition to the above, we note that Mount Owen are currently undertaking a review of noise monitoring and compliance management in consultation with the EPA. This review will determine the most appropriate mechanisms for monitoring noise at Mount Owen and determining compliance. We suggest that this is a more appropriate approach to determining the noise monitoring regime, than including specific and extensive monitoring conditions in the consent or EPL as a result of the RERR Project.

In relation to monitoring of blasting impacts it is requested that the consent condition is consistent with the existing consent condition in referring to airblast overpressure and ground vibration being measured 'at or near the nearest residence or noise sensitive location (such as a school or hospital).'

#### 2.2.3.5 Reporting Conditions

**8.1 Noise Monitoring Report**

**A noise compliance assessment report must be submitted to the EPA with each Annual Return. The assessment must be prepared by a suitably qualified and experienced acoustical consultant and include:**

**a) an assessment of compliance with noise limits presented in Condition 4.1;**
**b) measurement and reporting of C-weighted noise levels: and**
**c) an outline of any management actions taken within the monitoring period to address any exceedences of the limits contained in Condition 4.1.**

Mount Owen currently undertakes reporting in relation to noise monitoring in accordance with this requested condition.

## 2.3 Office of the Environment and Heritage

The OEH raised the issue of the availability of biodiversity monitoring data and the results of its analysis. OEH noted the Mount Owen Complex website provides summary data of rehabilitation and environmental monitoring programs, this information has also been presented in forums such as the workshop on mine-site rehabilitation in the Hunter Valley held in 2012. From this it is clear that the monitoring program at Mount Owen is extensive and that the analysis of data is occurring. OEH therefore recommends that Mount Owen provide more environmental monitoring data and the analysis of that data on the Mount Owen Complex Website. OEH consider this will result in the Mount Owen Complex leading further by example and allowing for lessons learnt by the proponent to be more readily communicated to other mines allowing for more effective use of resources to achieve

biodiversity outcomes, particularly in the area of mine site rehabilitation across the Hunter Valley.

**OEH recommends that DP&I include the following condition in the consent if granted for the proposed modification:**

**That the proponent shall make publically available, on their website, a copy of the ecological monitoring data collected for this project, and any subsequent analysis within six months of completion of each monitoring period, to the satisfaction of the Director General Department of Planning and Infrastructure.**

Agreed.

## 2.4 Office of Agricultural Sustainability and Food Security

The OAS&FS noted that an Agricultural Impact Statement had not be completed for the proposed modification as it is very likely to have nil impact on agricultural resources, therefore no issues associated with agriculture were raised.

## 2.5 NSW Transport Roads and Maritime Services

The RMS advised they had no objections to or requirements for the proposed modification as the modification will not result in any significant impact on the classified road network.

## 2.6 Department of Primary Industries

The submission from the DPI included consolidated comments from Crowns Lands, Fisheries NSW, the NSW Forestry Corporation, the OAS&FS and NOW. A response to the submission is provided below.

### 2.6.1 Crown Lands

Crown Lands advised that as there is no crown land within the Project area that would be impacted, they did not have any issues to raise.

### 2.6.2 Fisheries NSW

Fisheries NSW advised that as the Project area did not contain any significant Key Fish Habitat and that the changes to both surface water and groundwater are expected to be minor, they did not have any objections to the proposed modification being approved.

### 2.6.3 Forestry Corporation NSW

Forestry Corporation NSW identified that the main forest area of the Ravensworth State Forest is adjacent to the North and that a segmented part is immediately adjacent to the development application boundary area. The Forestry Corporation provided the following comments.

**(i) Forestry Corporation NSW has not been consulted as a stakeholder and neighbour in respect to the application.**

Since receipt of the submission, Mount Owen has actively sought to consult with Forestry NSW regarding the proposed modification. This consultation included both a tele-conference held on 31 May 2013 and a face to face meeting at the Maitland Office on 12 June 2013. During both these meetings, Forestry Corporation NSW was provided a briefing of the proposed modification. These Project briefings were well received by the Forestry Corporation NSW representative.

**(ii) Although Forestry Corporation NSW is invited as an observer to the Flora and Fauna Management Group, it has not been approached for any input into the environmental assessment for this Project.**

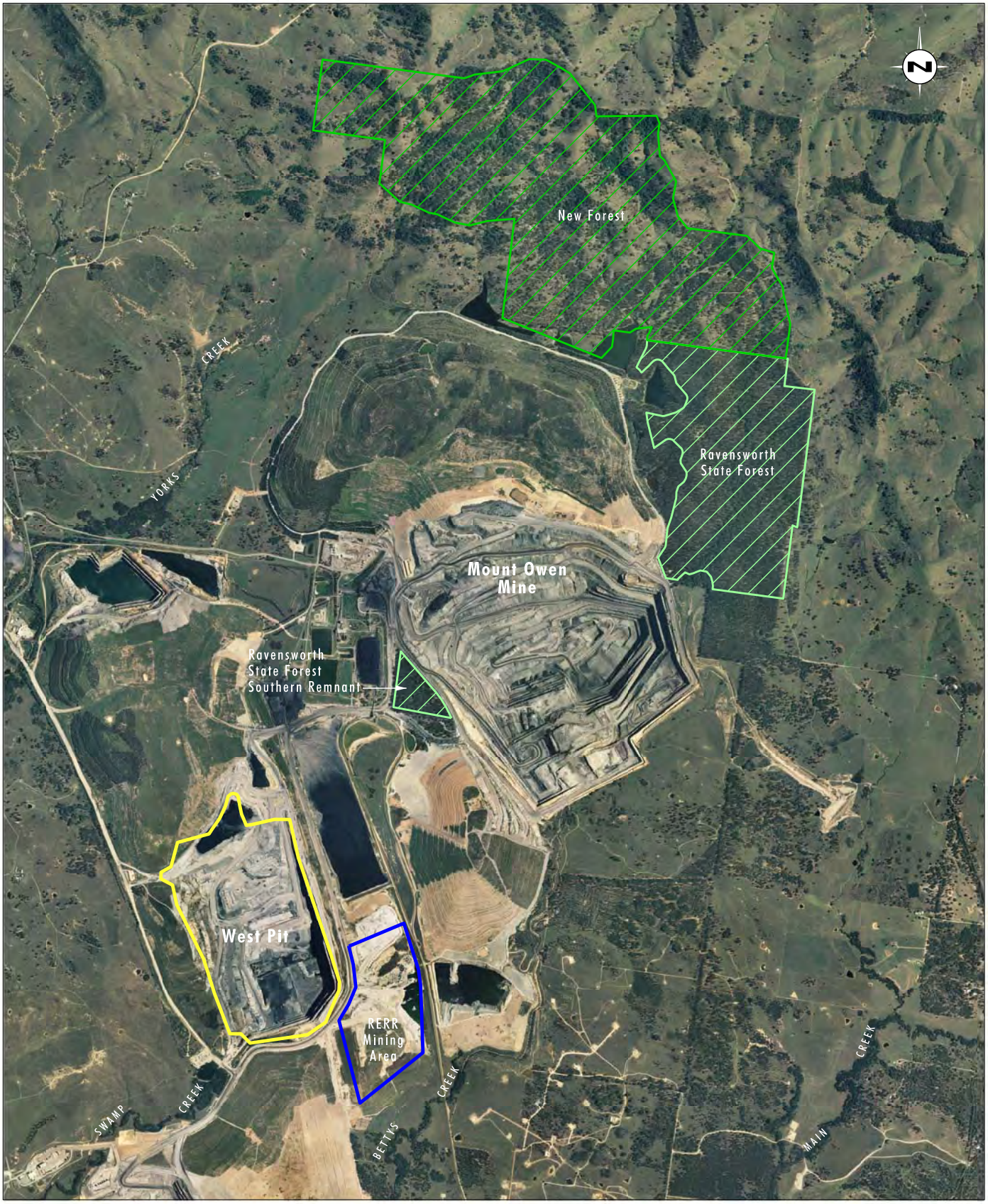
As outlined above, since receipt of the submission, Mount Owen has actively sought to consult with Forestry NSW regarding the proposed modification, subsequently holding two meetings. The proposed modification is located wholly on land that has been previously disturbed by approved mining operations. Moreover, the proposed modification would not impact the Ravensworth State Forest, which is located 3.25 kilometres from the RERR mining area or the southern remnant, which is located 1.5 kilometres from the RERR mining area, refer to **Figure 2.1**. Notwithstanding, during the recent consultation with the Forestry Corporation, no further issues were raised in relation to the EA for the proposed modification.

It is also important to note that the Flora and Fauna Management Group (full title being the Mount Owen Flora and Fauna Interagency Advisory Group (FFIAG)) is a requirement under a previous approval at the Mount Owen Mine (North Pit), not the Ravensworth East development consent, which is the subject of this proposed modification. The most recent FFIAG meeting was held on 4 July 2013. Unfortunately, the Forestry NSW representative was an apology for that meeting.

**(iii) Forestry Corporation NSW has concerns in relation to the degradation of the southern remnant of the Ravensworth State Forest which is partially within and otherwise adjacent to the project area. The Corporation can find no evidence in the environmental assessment of any assessment of the impact of this project, and the cumulative impact from the larger Mt Owen Project on this forest area.**

The proposed modification is located wholly on land that has been previously disturbed by approved mining operations. The southern remnant of the Ravensworth State Forest is not located within the RERR mining area or the west pit overburden emplacement area, rather it is located 1.5 kilometres to the north-east, refer to **Figure 2.1**. Accordingly as the proposed modification will avoid all impacts to the Ravensworth State Forest, including the southern remnant, no further assessment of impact was included in the environmental assessment. The ecological assessment completed for the proposed modification concluded that there would be no significant impact on ecological matters.

During consultation with Forests NSW, it was identified that there has been inconsistency in the depiction of the boundary of the southern remnant of the Ravensworth State Forest across both Mount Owen and Forests NSW documentation. As a result, Mount Owen undertook to survey and supplied an updated drawing of the boundary for the southern remnant of the Ravensworth State Forest, having regard to the minimum area requirements (that is, 10 hectares). This survey has been completed and the updated drawing files provided to Forests NSW. **Figure 2.1** includes the amended boundary to reflect this change and relevant Mount Owen Environmental Management System documentation will be updated as required.




Source: Glencore (2012)

0 0.5 1.0 2.0km
1:40 000

## Legend

- West Pit Overburden Emplacement Area
- RERR Mining Area
- State Forest
- New Forest

FIGURE 2.1

Ravensworth State Forest

### 2.6.4 Office of Agricultural Sustainability and Food Security

As outlined in **Section 2.5**, the OAS&FS noted that an Agricultural Impact Statement had not be completed for the proposed modification as it is very likely to have nil impact on agricultural resources, therefore no issues associated with agriculture were raised.

### 2.6.5 NSW Office of Water

#### 2.6.5.1 Undertake a peer review of the groundwater flow model to assess its suitability and its classification under the Australian groundwater modelling guidelines

The proposed modification is considered to be a relatively small coal project in the context of the surrounding operations. The RERR Project proposes to recover approximately 6 million tonnes of ROM coal from an area surrounded by existing open cut and underground mining activities and previously disturbed by mining activities. In developing the groundwater model for the proposed modification, Sinclair Knight Merz (SKM) took into account the models suitability to assess potential impacts associated with the proposed modification and considered it fit for purpose. An independent peer review of the groundwater model was not undertaken and is not considered warranted for the proposed modification.

To address the issues raised by the Office of Water regarding the suitability and classification of the model, SKM undertook an internal evaluation against the *Australian Groundwater Modelling Guidelines* (Barnett *et al*. 2012). This is summarised below with the full detail provided in **Appendix 2**. The evaluation was undertaken in consultation with Mr Brian Barnett, SKM's Practice Leader for Groundwater Modelling who is also the lead author of the *Australian Groundwater Modelling Guidelines* (Barnett *et al*. 2012).

The Australian Groundwater Modelling Guidelines recommend that a Class 2 model is developed for mine dewatering evaluations. The model developed for the proposed modification has an overall class 2 (medium confidence) level however some aspects of the model are considered to comply with the Class 3 status. A summary of the results of the model evaluation is provided in **Table 2.1**.

**Table 2.1 – Evaluation of Model Confidence Level Classification**

| Indicator | Confidence Level Classification (Class) |
|---|---|
| Amount and Quality of Data | 2<br>(Limited information prior to 1980) |
| Calibration methodology and accuracy | Alluvium = 3<br>Hard Rock = 2 |
| Prediction formulation | 3<br>(Stochastic methodology) |
| Overall Classification | 2 |

A Class 2 model is considered to be suitable to provide estimates of the dewatering requirements for the proposed modification and for the prediction of associated impacts on medium value aquifers. The stochastic calibration methodology adopted for the regional scale model, which was calibrated against the alluvial groundwater levels, is appropriate for a Class 3 classification for the assessment of impacts to the relevant alluvial aquifers.

Further detail regarding the evaluation of the model is provided in **Appendix 2**.

### 2.6.5.2 Supply additional information to allow an understanding of the operational scenarios modelled and their cumulative impacts on groundwater, in particular:

**Explain how the Hunter River and the unregulated streams were treated in the groundwater flow model**

The model was created using the Groundwater Vistas pre-processor with the MODFLOW-SURFACT (Version 4.0) finite difference code (Hydrogeologic 2011). The Hunter River (and Bowmans and Glennies Creeks) are represented using the River Cell package of MODFLOW. River Cells are assigned to replicate the surface water/groundwater interaction of these water bodies and the associated alluvium. Other (non-perennial) streams including Yorks, Bettys and Swamp Creek are represented using Drain cells. Drain cells are considered appropriate representations of these non-perennial streams as these streams are not considered baseflow systems due to their ephemeral nature.

Further detail regarding the design of the groundwater model is provided in **Appendix 2**.

**Clarify the volumes and timing of modelled peak contributions from the Hunter Unegulated Alluvium, Bowmans Creek Water Source and Glennies Creek Water Source**

The predictive model results illustrating the estimated drawdown in the alluvial aquifers are shown in Figures 2 to 4 in **Appendix 2**. Figures 2 to 4 in **Appendix 2** replace Figure 5-2 in the RERR Groundwater Impact Assessment Report (SKM 2012). These figures have been provided to clearly illustrate the results in increased resolution using a larger format. Also Figure 5-2 included in the Groundwater Impact Assessment Report (SKM 2012) incorrectly illustrated modelling results in relation to the predicted alluvial drawdown at the end of the modelling period. The modelling results are now correctly illustrated in Figure 4 (**Appendix 2**).

The impact of the proposed modification on the unregulated alluvial water sources was determined through subtracting the base case model (existing approved operations) results from the predictive model results simulating the proposed modification. This gave an indication of the incremental impacts of the proposed modification on the alluvial and fractured rock groundwater sources. The predicted incremental impacts as a result of the proposed modification is negligible (i.e. less than 0.25 metre) drawdown in the alluvial water sources during periods of estimated peak pit inflows (2014 to 2016).

**Clarify the predicted maximum water take from the surface water sources**

The modelling results indicated there will negligible drawdown (<0.25 metre) in the alluvial water sources (Figures 2 to 4 **Appendix 2**) at the time of peak inflows into the RERR pit in 2016, at the end of the current mining consent 2021 and at the end of the modelling period 2120.

Based on the modelling results and the negligible incremental impacts it is considered that the water take from the alluvial sources would be minimal. This is consistent with previous groundwater assessments undertaken for the Ravensworth East, Mount Owen and Glendell Mining operations. The groundwater assessment (MER 1998) for the current development consent for the Ravensworth East Mine described 'minimal' opportunity for downward leakage as a result of mining activities.

**Clearly define and illustrate the peak mining and residual post mining take scenarios and their effect on groundwater levels, including levels in the alluvium.**

The predictive model results in relation to drawdown in the alluvial aquifers and the predicted drawdown in the hard rock aquifer are illustrated in Figures 2 to 10 in **Appendix 2**. As discussed previously, Figures 2 to 4 (**Appendix 2**) replace Figure 5-2 in the RERR Groundwater Impact Assessment Report (SKM 2012). The revised figures have been provided to illustrate the results in increased resolution and using a larger format. Figure 5-2 included in the Groundwater Impact Assessment Report (SKM 2012) also incorrectly illustrated modelling results in relation to the predicted alluvial drawdown at the end of modelling. The modelling results are now correctly illustrated in Figure 4 (**Appendix 2**). The results illustrated in Figures 5 to 10 (**Appendix 2**) are consistent with that presented in Figure 5-1 in the RERR Groundwater Impact Assessment Report (SKM 2012) and are included to provide additional detail only.

As previously discussed, based on the modelling results it is considered that the peak and residual post mining water take would be negligible (refer to Figures 2 to 4, **Appendix 2**). The modelling results (refer to Figures 5 to 10, **Appendix 2**) indicate that there would be some drawdown around the proposed RERR mining area within the overburden and the Bayswater coal seam that will increase as mining operations progress. This is due to the increased hydraulic conductivity of the infill material compared to existing rock composition. However the low permeability of the surrounding rock prevents significant impact outside of the mining area.

The estimated drawdown for the overburden and the Bayswater seam (2120) illustrated in Figures 7 and 10 (**Appendix 2**) indicate that there will be drawdown within the hard rock aquifer at the end of the modelling period. It should however be noted that the estimated drawdowns are calculated as the difference between the base case and the proposed case scenarios and it is considered that the lack of a deep void (under the base case) would allow the recovery of groundwater levels after the cessation of mining activities from neighbouring operations.

#### 2.6.5.3 Illustrate that the Mount Owen Complex Part 5 entitlement under the Water Act 1912 is sufficient to account for the peak groundwater take from the RERR open pit modification

The modelling results indicate that the magnitudes of inflow for the combined RERR mining area and the West Pit are similar to that predicted originally for the Ravensworth East operations (West Pit only), however the mine progression has been modified so the timing of peak inflow is different. The estimated pit inflows to the currently active West Pit peak at 770ML/year (2.1 ML/day) in 2014, given the proposed timing of mining operations the modelling predictions indicate the contribution to the inflows from the RERR mining area will be negligible in 2014 and the combined total inflow for the West Pit and the RERR mining area will also peaks at approximately 770 ML/year in 2014 and 700 ML/year in 2016. The modelling results indicate that the predicted inflows to the RERR mining area will peak in year 2016 at approximately 330 ML/year (0.9 ML/day), estimated from the median ($50^{th}$ percentile) value of the calibrated datasets.

Mount Owen currently holds groundwater extraction licenses of 1020 ML/year under the *Water Act 1912* which is sufficient to account for the groundwater take from the proposed RERR mining area.

#### 2.6.5.4 Provide additional information in Appendix A of the SKM report to allow complete assessment of the groundwater model construction and performance, including:

**A water balance**

Further detail regarding the calibration of the RERR groundwater model including water balance data for a representative dataset used for modelling is provided in **Appendix 2**.

**Peak groundwater take during mining and post mining**

As discussed in **Section 2.7.5.3**, the peak groundwater take (estimated as the combined peak pit inflow for the RERR mining area and West Pit) is predicted to be 770 ML/year in 2014. The estimated post mining groundwater levels are illustrated in Figure 11 (**Appendix 2**).

**The peak groundwater levels drawdown in the Permian strata and the alluvium, during and post mining**

As discussed in **Section 2.7.5.2**, the model results for predicted drawdown in the alluvial aquifers and the predicted drawdown for the hard rock aquifers are shown in Figures 2 to 10 in **Appendix 2**. As discussed previously, Figures 2 to 4 in **Appendix 2** replace Figure 5-2 and Figures 5 to 10 replace figure 5-1 in the RERR Groundwater Impact Assessment Report (SKM 2012). The figures have been provided to illustrate the results in increased resolution using a larger format. Figure 5-2 included in the Groundwater Impact Assessment Report (SKM 2012) also incorrectly illustrated modelling results in relation to the predicted alluvial drawdown at the end of modelling. The modelling results are now correctly illustrated in Figure 4 (**Appendix 2**). The results illustrated in Figures 5 to 10 (**Appendix 2**) are consistent with that presented in Figure 5-1 in the RERR Groundwater Impact Assessment Report (2012) and are provided for additional detail only. Figure 11 (**Appendix 2**) is provided to illustrate predicted post mining groundwater levels.

**Quantification of the modification and the cumulative take from the surface water bodies**

The RERR groundwater model incorporates the existing mining operations within the vicinity of the Ravensworth East Mine based on publically available information of mining operations with influence in the modelling domain. The RERR groundwater impact assessment focuses on the incremental impact of the RERR modification within the context of the approved mining operations within the region.

The modelling results predict that there will be negligible water take (less than 0.25 metre drawdown) from the alluvial aquifers in the local area as a result of the proposed modification.

# 3.0 Response to Public Submissions

## 3.1 Vale Integra Underground Coal Mine

A submission was received from the General Manager of Integra Coal on 22 February 2013 in relation to the proposed modification. The letter states that 'in principle, Integra agrees with Mount Owen's approach of managing impacts from blasting through the implementation of a Personnel Withdrawal Protocol'. However Integra are concerned that the proposed modification will have economic impacts on the Integra Mining operations and requests that DP&I consider and resolve the following matters before Mount Owen's carries out any blasting which could impact on the Integra Mining Operations:

a. **Safety – Integra is to be given an opportunity to confirm that the modelling of vibration impacts contained in the RERR Project EA, including assumptions, are validated through testing and monitoring;**

b. **Damage – Integra and Xstrata agree how any damage caused to Integra as a result of blasting associated with the RERR Project is to be compensated by Xstrata;**

c. **Production delays and other losses – Integra and Xstrata agree how Integra is to be compensated for any production delays and other losses incurred due to the RERR Project;**

d. **Development of a personnel evacuation protocol – Integra and Xstrata agree a process for Xstrata to consult with Integra on the development of this protocol, and for it to be approved by the Division of Resources & Energy, within NSW Trade & Investment;**

e. **Testing and Monitoring – Integra and Xstrata agree on a program of testing and monitoring of the impacts on Integra's underground mine, to be carried out by Xstrata and for Integra to be consulted on the results;**

f. **Management Plan – Xstrata to prepare and obtain the relevant government authorities approval of a management plan covering the impacts of the RERR project on Integra's Underground Mine, prior to carrying out any blasting which impacts upon Integra's Operations. The management plan is to be prepared in consultation with Integra.**

**Specifically Integra requests that a condition be imposed in the Ministers approval of the RERR Project, if granted, to the effect that Xstrata will not carry out any blasting which impacts upon Integra's operations unless Xstrata has first:**

a. **Entered into an agreement with Integra addressing the matters set out in paragraphs (a) to (e) above; and**

b. **Prepared a management plan referred to in paragraph (f) above in consultation with Integra, and has obtained approval of that plan from the relevant government authorities; and**

c. **The conditions of approval require compliance with that management plan.**

Mount Owen have begun consultation with Integra Coal regarding the development of the required blast management practices and the associated commercial negotiations. As discussed in Section 6.3 of the RERR EA, the blast impact assessment undertaken for the RERR project recommended the implementation of a personnel withdrawal protocol in consultation with Integra. The personnel withdrawl protocol will include blast notification, vibration limits and underground personnel management similar to that previously implemented when blasting was conducted within the Eastern Rail Pit at the Mount Owen Mine. Xstrata have also agreed to an ongoing process of review and refinement of blasting practices and blast design parameters as mining develops to confirm the predicted vibration limits, as underground mining conditions are better understood.

The existing Mount Owen Mine development consent DA 1-14-2004 includes the following condition in relation to blasting activities in close proximity to underground mine workings (which excludes commercial negotiations):

**16. Prior to carrying out any blasting within 500 metres of active mining areas at Glennies Creek Colliery or any privately owned land, the Applicant shall revise the Blast Management Plan for the development, in consultation with Glennies Creek Coal Management Pty Ltd (or its assigns or successors in title) or the relevant landowner, to the satisfaction of the Director-General.**

It is suggested that a similar condition could be added to the Ravensworth East development consent.

## 3.2 Community submission – Deidre Olofsson

The issues raised in the submission letter dated 17 February 2012 are detailed below in bold, a response to each issue raised is also provided.

**Cumulative impact study on health diseases related to air quality in the hunter valley.**

**Cumulative health risk assessment for the hunter valley related to air quality.**

**Cumulative impact study on the health risks for neighbours within 20km radius.**

**Cost analysis of the impacts of poor air quality on the hunter valley, related to health services and associated services.**

The proposed modification involves the continuation of the existing mining operations at the Ravensworth East Mine, within the current approval timeframe and within an area previously disturbed by mining operations. A detailed assessment of the potential air quality impacts associated with the proposed modification was undertaken (see Section 6.4 and Appendix 4 of the RERR EA).

The Air Quality Impact assessment determined that there are no privately owned residences (not currently subject to acquisition rights) that are predicted to experience annual average Total suspended particulate (TSP) or dust deposition levels above the assessment criteria as a result of the cumulative emissions. It was also determined that as a result of the proposed modification the probability of cumulative 24-hour $PM_{10}$ concentrations exceeding the criteria of 50 $\mu g/m^3$ is increased on average by approximately 2 per cent at the nearest residence. Therefore the proposed modification is not considered a significant contributor to $PM_{10}$ levels at receptors within the vicinity.

Given the results of the Air Quality Assessment, and given that Hunter Valley air quality and health risks are a cumulative issue, we do not believe it would be appropriate for the RERR project to be responsible for the conduct of health risk studies associated with air quality.

**Department of Planning and infrastructure must release a full map of all areas under exploration or set aside for exploration, for mining or extractive industries. This must be released to the public for consultation to ensure an open and transparent system, it also must identify all the companies etc, which have licences and the amounts paid to the state.**

This issue is directed to the Department of Planning and Infrastructure for comment.

**Cumulative impact study on the water network system related to extractive industries plus any potential exploration which has the potential to cause harm. The water network system is related to aquifers, underground system and surface water, regulated and unregulated rivers and streams.**

**Cumulative impact of 30 voids on the hunter valley region, in which maintenance, testing of water quality, leaching of contaminants in the water network system.**

The RERR EA included detailed surface water, groundwater and water balance assessments (see Sections 6.5 and 6.6 and Appendices 5 and 6 of the RERR EA). Based on the conclusions of these assessments it was determined that the groundwater and surface water impacts associated with the proposed modification would be negligible and would continue to be managed in accordance with the existing Mount Owen Water Management Plan (Mount Owen 2011).

The Mount Owen Complex has an existing extensive monitoring system (refer to Figure 2.3 of the EA) this includes ground and surface water monitoring points, which monitor water quality. The monitoring network is implemented to minimise the environmental impact of the mining operations and to evaluate the effectiveness of the environmental management system.

**Cumulative impact of the rehabilitation of the land, and the economic sustainability of the land-use to the community and the state.**

**Rehabilitated land must have no voids and must be back to original classification before any mining took place in the hunter. The company must be able demonstrate that they can rehabilitate to previous land form and land-use and must be sustainable.**

As detailed in Section 6.10 of the RERR EA as part of the ongoing operations at the Mount Owen Complex, the existing Mount Owen Conceptual Closure Plan will continue to be reviewed and updated to reflect changes to the Mount Owen Complex mining operations. This plan will include details regarding the final land use objectives and closure criteria, rehabilitation and final void management strategies associated with the proposed modification as well as the process for engaging relevant stakeholders in the closure planning process to be adopted throughout the mine life. It is the intention that the Conceptual Closure Plan will form the basis of the Final Closure Plan, which is to be developed following the completion of the detailed mine closure planning process and submitted to the relevant government authorities at least two years prior to the planned closure date.

**Cumulative effect of decreasing rural land holders, and agriculture in the area, the amount of landholders which have been acquired and made refugees of the mining industry. We forget that by closing communities down for self-interest of foreign investors, in which most of the money actual leaves the shores what emotional and mental stress we place on communities of sense of loss.**

As detailed in the RERR EA the proposed modification will be undertaken within an area previously disturbed by mining operations and there will be no exceedance of any air quality or noise criteria to those residences not currently subject to acquisition rights as a result of the proposed modification.

**The company must demonstrate that no dust or PM leaves the transport by rail to the port, if they cannot demonstrate and the community can prove PM which is coal dust is leaving the transport, all trains must be covered or use a product which prevents the dust or Pm from leaving the train.**

No change is proposed to the current extraction rate, coal processing or product transportation as a result of the proposed modification. Rail movements along the Main Northern Railway Line are operated by the Australian Rail Track Corporation (ARTC) who is required to comply with specific requirements in relation to air emissions detailed within their EPL issued by the EPA. Compliance with the required criteria is subject to continuous monitoring and analysis.

**The company must demonstrate a social licence from their closest neighbours, which must be communities that they deserve the right to precede in the modification.**

The surrounding community were consulted regarding the proposed modification as part of the Social Impact and Opportunities Assessment (SIOA) as detailed in Section 4.3 and Appendix 2 of the RERR EA. Through the consultation process it was evident that community concerns specifically relating to the proposed modification were minimal with the main concern of the community being associated with the Mount Owen Complex as a whole and cumulative issues associated with mining in the region in general.

Mount Owen propose to continue to manage the mining operations at the Mount Owen Complex in accordance with the existing Environmental Management System (EMS). Mount Owen also propose to manage the social impacts (Ravensworth East specifically and Mount Owen Complex as a whole) identified by the SIOA process through the continued implementation of the management and enhancement strategies which form part of the EMS. These management and enhancement strategies are detailed in Section 4.3.2 of the RERR EA.

**There also must be a cumulative statement from the industry of how much diesel is used per day, and per month and what affect does this have on the environment, and public health, and other industries. What is the cumulative impact on the nation resources of fuel?**

Section 6.8 and Appendix 8 of the RERR EA includes the results of the Greenhouse Gas and Energy Assessment (GHGEA). This assessment details the diesel usage associated with the Ravensworth East operations. Mount Owen propose to continue to manage energy efficiency through the continued implementation of the existing Air Quality and Greenhouse Gas Management Plan (Mount Owen 2011) which includes the following initiatives:

- optimising the design of haul roads to minimise the distance travelled between the pit and the ROM stockpiles and overburden dumping locations;
- managing truck payloads to utilise the tray space without overloading; and
- maintaining the mine fleet in good operating order.

# 4.0 Abbreviations

| | |
|---|---|
| AHD | Australian Height Datum |
| BMP | Blast Management Plan |
| CHPP | Coal Handling and Preparation Plant |
| dB | Decibel |
| DP&I | Department of Planning and Infrastructure (NSW) |
| EA | Environmental Assessment |
| EEO | Energy Efficiency Opportunities |
| e.g. | 'exempli gratia' meaning 'for the sake of example' |
| EMS | Environmental Management System |
| EPA | Environmental Protection Authority |
| EP&A Act | *Environmental Planning and Assessment Act 1979* (NSW) |
| EPL | Environmental Protection Licence |
| ERP | Eastern Rail Pit |
| ESAP | Energy Savings Action Plan |
| GHG | Greenhouse Gas |
| ha | Hectares |
| HVAS | High Volume Air Samplers |
| i.e. | 'id est' meaning 'that is' |
| INP | Industrial Noise Policy |
| IUM | Integra Underground Mine |
| km | Kilometres |
| $LA_{eq}$ | Equivalent continuous A-weighted sound pressure level |
| LGA | Local Government Area |
| m | metres |
| MIA | Mining Infrastructure Area |
| Mtpa | Million tonnes per annum |
| NOW | NSW Office of Water (NSW) |
| NSW | New South Wales |
| OEH | Office of Environment and Heritage |
| $PM_1$ | Particle Matter less than 1 micron |
| $PM_{2.5}$ | Particle Matter less than 2.5 microns |
| $PM_{10}$ | Particle Matter less than 10 microns |
| PSNL | Project Specific Noise Level |
| RBL | Rating Background Level |
| Rd | Road |
| RERR | Ravensworth East Resource Recovery Project |
| ROM | Run of Mine |
| RMS | Roads and Maritime Services (NSW) |
| SIOA | Social Impact and Opportunities Assessment |
| SWL | Sound Power Level |
| TP2 | Tailings Pit 2 |
| TSP | Total Suspended Particulate Matter |
| Umwelt | Umwelt (Australia) Pty Limited |

# 5.0 References

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# APPENDIX 1

Copy of Submissions

NSW GOVERNMENT Resources & Energy

OUT13/3849

Mr David Mooney
Mining and Industry Projects
Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Dear Mr Mooney

**Ravensworth East Resource Recovery Project**
**Environmental Assessment Review**

I refer to your email of 29 January 2013 regarding Xstrata Mount Owen Pty Limited application for the Bulga Optimisation Project to modify its consent for the Ravensworth East mine to recover an additional 6 million tonnes of coal and increase the overburden dump height from RL160m TO RL 180m.

NSW Trade & Investment, Regional Infrastructure & Services, Division of Resources & Energy (DRE) has reviewed the *Ravensworth East Resource Recovery Project Environmental Assessment* (EA) dated December 2012 and provides the following comments which are directed at specific areas of DRE responsibility for this proposal.

**MINING TITLE**

As coal is a prescribed mineral under the *Mining Act 1992*, the proponent is required to hold appropriate mining titles from DRE in order to mine this mineral. DRE understand that this project is within existing mining leases (ML) held by Xstrata Mt Owen Pty Limited and ML 1476 held by Glendell Tenements Pty Limited.

Under the *Mining Act 1992*, rehabilitation is regulated by conditions included in mining leases, including requirements for the submission of a Mining Operations Plan (MOP) prior to the commencement of operations, and subsequent Annual Environmental Management Reports (AEMR).

**REHABILITATION**

Final Voids

The EA states that the West Pit void will be used for tailings emplacement for the life of the project and together with the Ravensworth East Resource Recovery Project (RERR) void will be retained for future ongoing tailings disposal if required (Section 6.10.5). If the voids are not required for future tailings disposal

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the voids would be stabilised in accordance with DRE guidelines (Section 6.10.5.1).

The EA does not consider alternates to a final void should the void not be required for tailings emplacement other than to defer a decision until two years prior to mine closure. Rehabilitation of the void may be constrained by activities such as remote emplacement of spoil prior to the closure plan being developed. A contingency plan should be developed for if a void is remaining at the completion of mining at the Mt Owen Complex. This may include:

- Coarse rejects be disposed of into RERR void at completion of RERR mining operations.
- Spoil be located to west of RERR (burying pasture rehab if necessary) to enable capping of tailings or pushing into final RERR void if tailings do not fill void by close of mine.
- A tailings management strategy and land management strategy be prepared that includes the RERR void.

A tailings management strategy and land management strategy should be prepared that includes the RERR void.

Proposed Increase Spoil Emplacement Height.
The EA does not consider and assess alternate options for the location of spoil emplacement.

**DRE does not support the proposed increase in spoil emplacement height to 180 metres.** DRE recommends that the Proponent investigates the opportunities for placing the spoil closer to the RERR and the West Pit areas thereby providing opportunities for the voids to be backfill at the completion of mining and/or tailings emplacement and thereby providing maximum rehabilitation outcomes for the Project.

Spoil Emplacement Rehabilitation
Figure 3.4 the conceptual rehabilitation mine plan (Year 5) shows the contours being stepped and angular. This is inconsistence with providing a final landform typical of the surrounding natural landscape.

DRE recommend that the Proponent provide conceptual rehabilitation mine plans which blend with the surrounding natural landscape.

Rehabilitated Slopes
Section 6.10.8 states that it is proposed that the slopes of the emplacement would be "an average of 10 degrees", while Table 6.18 states "rehabilitated slopes are generally less than 10 degrees". DRE considers that a natural landscape would have slopes that are less than 10 degrees and that slopes greater than 10 degrees would be the exception.

DRE recommend that as stated in Table 6.18 rehabilitated slopes be generally less than 10 degrees, with steeper slopes the exception.

Mine Closure Plan

The Conceptual Closure Plan forms the basis of the detailed Final Closure Plan, submitted to relevant Government Authorities at least two years prior to the planned closure date.

A productive post mine land use for the Ravensworth East Mine may not be realised if activities that allow for future uses are not designed for as materials become available. For example disposal of spoil remote from voids increases transport cost of overburden and reduces the viability of backfilling voids.

Current pasture land use is being compromised by aging of exotic pasture species and weed infestation.

DRE recommends that:

- The spoil emplacements should be located close to the final voids so as not to make refilling of voids unviable in the future.
- The Land Management Plan be updated to include improved pasture management, for example return to grazing sooner rather than later to ensure nutritional value of pasture is maximised.
- The plan should address the Precautionary Principle (Section 8.3.1) for what could result from the various options for the void and demonstrate how a void meets the objectives of Intergenerational Equity (Section 8.3.2) to "maintain the health, diversity and productivity of the environment for future generations".

Rehabilitation Vegetation

The Project includes a proposal to disturb approximately 54.2 ha of rehabilitation land. The "Rehabilitation (Grassland Complex)" (Section.6.7.3.1) describes vegetation of low ecological value. DRE considers that there may be limited soil able to be recovered from the previously rehabilitated areas for reuse. This may reduce the success of establishing a Grassland Complex community.

DRE recommends that the Proponent provide additional detail on how soils would be engineered and managed to facilitate the development of the proposed vegetation covers/types.

The EA considers the Rehabilitated Grassland Complex in terms of biodiversity value only. No criteria given for rehabilitation success, especially for pasture which could be as much as 70 % of the final rehabilitated land use. The EA provides no indication of the proposed biodiversity value of rehabilitated woodland communities (compared to nearby woodland remnants).

The EA does not identify a benchmark for agricultural production for the rehabilitated landscape other than "Pasture areas can be demonstrated to have a suitable carrying capacity of a specified head of stock" (Table 6.18). There is concern the pasture could be poor unless managed to maintain sufficient nutritional value from the start of the rehabilitation program. DRE recommend that any project approval include a condition regarding the productivity (agricultural class) of the pasture. The condition should include:

> The post mining rehabilitation should be returned to agricultural production (for example livestock carrying capacity) similar to adjacent pastures, at a minimum. Methods to achieve the agricultural production standard, including monitoring, should be detailed in the rehabilitation / land management plan.

Cover Crops

The Project proposes to use a cover crop during adverse conditions for rehabilitation (Section 6.10.8). DRE consider this strategy acceptable for woodland rehabilitation; however questions the benefit of establishing a temporary cover crop instead of final pasture over an area that has been land-formed and had topsoil (or substitute) spread.

DRE recommend that the circumstances leading to the use of cover crops should be clearly articulated in a Landscape Management Plan.

Should you have any enquires regarding this matter please contact Julie Moloney, Principal Adviser, Industry Coordination on (02) 4931 6549.

Yours sincerely

**William Hughes**
**Acting Director**
**Minerals Operations**

19/2/13

NSW EPA

Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001
Attention: David Mooney

Your reference:
Our reference: PART 3A DOC13/4123; DOC13/2758; DOC13/4628; LIC09/1944-02
Contact: Karen Marler (02) 4908 6803

27 FEB 2013

Dear Mr Mooney

**DA 52 03 99 MOD 5 - Mount Owen Mining Complex Modifications to the Ravensworth East Mine**

I refer to your email of 29 January 2013 and the document titled *"Ravensworth East Resource Recovery Project Environmental Assessment"* (the EA) prepared by Umwelt (Australia) Pty Limited and dated December 2012 and requesting comments and recommended conditions of approval from the Environment Protection Authority (EPA) for the project.

The EPA has reviewed the EA, and understands that the proponent is seeking approval for the following:

- Allow continuation of mining within the Ravensworth East Resource Recovery (RERR) mining area which is an area previously disturbed by mining and formerly known as Tailings Pit 2 (TP2) to a depth of approximately 200 metres; and
- Emplacement of overburden within the West Pit overburden emplacement area to a maximum height of RL 180 metres (and increase in height of 20 metres from the currently approved height)

The EPA provides the following comments and advice in relation to the project. Recommended conditions of approval are provided at **Attachment A**. Environment Protection Licence (EPL 10860) currently authorises operations at the Ravensworth East Mine. While it appears that the current EPL premises boundary includes the majority of the proposed RERR mining area, the proponent should confirm that all scheduled activities will take place within the existing licensed premises, or otherwise make application to the EPA, if consent is granted, to vary the EPL to amend the licensed premises boundary to authorise mining in the RERR area.

Air Quality

The EA includes an Air Quality Impact Assessment which has been satisfactorily conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. The assessment indicates the proposed works are unlikely to result in a significant increase in risk of adverse impacts at sensitive receptors above those experienced from existing operations, provided operations are well managed and consistent with those proposed in the EA.

The EPA notes that:

- No exceedances are predicted for project only 24 hour average $PM_{10}$, project only and cumulative annual average $PM_{10}$ and TSP at any private receptor not currently subject to acquisition rights;
- The maximum project only 24 hour average $PM_{10}$ predicted increment for a private receptor is approximately 5 $\mu g/m^3$ during 2016 (worst case modelled year);

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- A cumulative 24 hour average $PM_{10}$ assessment was conducted using the Monte Carlo simulation technique. This assessment indicates that the 24 hour impact assessment criterion is likely to be exceeded at the nearest sensitive receptors for approximately 7 days per year (2%) due to existing background concentrations. When the proposed modification works are included this probability increases to 2.2%, or an additional day;
- Monitoring data from the existing Mt Owen Complex HVAS and TEOM network demonstrates general compliance with the EPA's 24 hour and annual average $PM_{10}$ criteria with a limited number of readings above 50 $\mu g/m^3$ recorded between January 2008 and January 2012;
- An assessment of $PM_{2.5}$ impacts was not conducted however given the predicted $PM_{10}$ impacts it is unlikely that the advisory standard for $PM_{2.5}$ would be exceeded;

In relation to mitigation of air quality impacts, the EPA notes that the proponent assumes 85% control of emissions from haulage roads through watering. That is, the assessment of potential impacts from the proposed project utilises percentage reductions in emission calculations based on proposed best practice control methods and as such, the predicted potential for impact relies heavily on whether emissions are as effectively controlled as assumed in the assessment.

The air quality impact assessment also assumes a silt surface moisture content of 2% for emission calculations based on the average value of three test samples, which were 3.3%, 1.3%, 1.1%. The EPA recommends that further testing is conducted by the proponent to verify % surface moisture however notes that it is unlikely that adjusting emission calculations to reflect real values will be significant enough to change the outcomes of the assessment. What is clear however is that the proponent needs to be able to quantitatively demonstrate that the proposed watering practices actually achieve the degree of emission control assumed in the assessment. This will be required once best practice management conditions are implemented on coal mining licences via the EPA's Dust Stop Program.

The EPA also notes that the proponent has based their assessment on private receptors not currently subject to acquisition rights. The proponent should note the recent Planning Assessment Commission determination for Tarrawonga Mine in which consent conditions require that reasonable and feasible avoidance and mitigation measures are implemented to avoid exceedances of the criteria at all private residences, while acknowledging that it may not be reasonable and feasible to avoid impacts at certain times at residences identified for acquisition.

The proponent has committed to the management of air quality impacts from the proposed works in accordance with the existing Mt Owen Complex Air Quality and Greenhouse Gas Management Plan. Included in this plan is the use of predictive and real time meteorological monitoring and real time dust monitoring to manage site activities to minimise dust impacts at receptors.

Noise Assessment

The impacts of temperature inversions were predicted in the EA referring to inversion strength as a temperature lapse rate. However, the EPA proposes requiring the proponent to monitor for the presence of inversion conditions using the sigma-theta method as and that limits would accordingly apply up to and including F class inversions rather than the modelled 3°C/100m lapse rate. If this is not acceptable to the proponent, the EPA is willing to consider alternative approaches including direct measurement of temperature lapse rate.

Recommended conditions are provided at **Attachment A.** These conditions do not repeat conditions which already exist in EPL 10860. The recommended conditions to provide updated and revised conditions which should be reflected in any consent granted for the project.

Please contact me on (02) 4908 6803 if you require any further information regarding this matter.

Yours sincerely

**KAREN MARLER**
**Head Regional Operations Unit – Hunter**
**Environment Protection Authority**

Enclosure: Recommended conditions of approval – Ravensworth Resource Recovery Project

**ATTACHMENT A**

## RECOMMENDED CONDITIONS OF APPROVAL – RAVENSWORTH EAST RESOURCE RECOVERY PROJECT

## ADMINISTRATIVE CONDITIONS

**Works to be undertaken in accordance with information supplied**

1. Except as provided by these recommended conditions of approval, the works and activities shall be undertaken in accordance with the proposal contained in:

   (a) The development application DA 52 03 99 MOD 5 submitted to the NSW Department of Planning and Infrastructure;
   (b) The document *"Ravensworth East Resource Recovery Project Environmental Assessment"* prepared by Umwelt (Australia) Pty Ltd and dated December 2012

   unless otherwise specified in these conditions of approval.

## AIR CONDITIONS

**2. General Dust Conditions**

**2.1** Activities occurring in or on the premises must be carried out in a manner that will minimise the generation, or emission from the premises, of wind-blown or traffic generated dust.

**3. Requirement to monitor weather**

**3.1** The licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns.

**Point #** (actual point number to be confirmed in the Environment Protection Licence)

| **Parameter** | **Units of measure** | **Frequency** | **Averaging Period** | **Sampling Method** (See Note1) |
|---|---|---|---|---|
| Rainfall | mm/hour | continuous | 1 hour | AM-4 |
| Sigma theta | degrees | continuous | 10 minute | AM-2 and AM-4 |
| Siting | | | | AM-1 |
| Temperature at 2 metres | kelvin | continuous | 10 minute | AM-4 |
| Temperature at 10 metres | kelvin | continuous | 10 minute | AM-4 |
| Total solar radiation | watts per square metre | continuous | 10 minute | AM-4 |
| Wind Direction at 10 metres | degrees | continuous | 10 minute | AM-2 and AM-4 |
| Wind Speed at 10 metres | metres per second | continuous | 10 minute | AM-2 and AM-4 |
| Relative humidity | % | continuous | 1 Hour | AM-4 |

Note 1: For details of sampling method refer to the EPA's *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*

## NOISE CONDITIONS

### 4. Limit Conditions

**4.1** Noise generated at the premises must not exceed the noise limits in the table below.

| | | NOISE LIMITS dB(A) | | | |
|---|---|---|---|---|---|
| **Locality** | **Location** | **Day** | **Evening** | **Night** | |
| | | $L_{Aeq\ (15\ minute)}$ | $L_{Aeq\ (15\ minute)}$ | $L_{Aeq\ (15\ minute)}$ | $L_{A1\ (1\ minute)}$ |
| Any residential receiver | All privately-owned residential receivers | 35 | 35 | 35 | 45 |

**4.2** For the purpose of condition 4.1;

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays.
- Evening is defined as the period 6pm to 10pm.
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and Public Holidays.

**4.3** The noise limits set out in condition 4.1 apply under all meteorological conditions except for the following:

a) Wind speeds greater than 3 metres/second at 10 metres above ground level; or
b) Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or
c) Stability category G temperature inversion conditions.

**4.4** For the purposes of condition 4.3:

a) Data recorded by the meteorological station identified as EPA Identification Point # (Point number to be specified in the Environment Protection Licence) must be used to determine meteorological conditions; and
b) Temperature inversion conditions (stability category) are to be determined by the sigma-theta method referred to in Part E4 of Appendix E to the NSW Industrial Noise Policy.

**4.5** To determine compliance:

a) with the $L_{Aeq(15\ minute)}$ noise limits in condition 4.1, the noise measurement equipment must be located:

- approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or

- within 30 metres of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable
- within approximately 50 metres of the boundary of a National Park or a Nature Reserve.

b) with the $L_{A1(1\ minute)}$ noise limits in condition 4.1, the noise measurement equipment must be located within 1 metre of a dwelling façade.

c) with the noise limits in condition 4.1, the noise measurement equipment must be located:

- at the most affected point at a location where there is no dwelling at the location; or
- at the most affected point within an area at a location prescribed by conditions 4.5(a) or 4.5(b).

**4.6** A non-compliance of condition 4.1 will still occur where noise generated from the premises in excess of the specified noise limit is measured:

- at a location other than an area prescribed by conditions 4.5(a) and 4.5(b); and/or
- at a point other than the most affected point at a location.

**4.7** For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

## 5. Blasting

**5.1** Blasting in or on the premises must only be carried out between 0900 hours and 1700 hours, Monday to Saturday. Blasting in or on the premises must not take place on Sundays or Public Holidays without the prior approval of the EPA.

**5.2** The airblast overpressure level from blasting operations at the premises must not exceed 120 dB(Lin Peak) at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

**5.3** The airblast overpressure level from blasting operations at the premises must not exceed 115 dB(Lin Peak) at any time at any noise sensitive locations for more than five percent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

**5.4** Ground vibration peak particle velocity from blasting operations at the premises must not exceed 10mm/sec at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

**5.5** Ground vibration peak particle velocity from blasting operations at the premises must not exceed 5mm/sec at any time at any noise sensitive locations for more than five percent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

**5.6** The airblast overpressure and ground vibration levels in conditions 5.2, 5.3, 5.4 or 5.5 do not apply at noise sensitive locations that are owned by the licensee or subject to a private agreement relating to airblast overpressure and ground vibration level between the licensee and the land owner.

## 6. Monitoring Conditions

**6.1** The meteorological weather station must be maintained so as to be capable of continuously monitoring the parameters specified in condition 3.1.

## 7. Requirement to Monitor Noise and Blasting

**7.1** To assess compliance with Condition 4.1, attended noise monitoring must be undertaken in accordance with Conditions 4.5 and:

a) at each one of Residence 20, Residence 23., Residence 114, residence 143 and residence 155 as shown in Figure 1.3 of the document *Ravensworth East Resource Recovery Project Environmental Assessment* (Umwelt (Australia) Pty Limited December 2012);
b) occur quarterly in a reporting period;
c) occur during each day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum of:
   - 1.5 hours during the day;
   - 30 minutes during the evening; and
   - 1 hour during the night; and
d) occur for three consecutive operating days.

**7.2** To determine compliance with conditions 5.2, 5.3, 5.4 and 5.5:

a) Airblast overpressure and ground vibration must be measured at any residence or noise sensitive site that is likely to be most affected and is not owned by the licensee or subject of a private agreement between the owner of the residence or noise sensitive site and the licensee as to an alternative blasting level for all blasts carried out in or on the premises; and

b) Instrumentation used to measure the airblast overpressure and ground vibration must meet the requirements of Australian Standard AS 2187.2-2006.

## 8. Reporting Conditions

### 8.1 Noise Monitoring Report

A noise compliance assessment report must be submitted to the EPA with each Annual Return. The assessment must be prepared by a suitably qualified and experienced acoustical consultant and include:

a) an assessment of compliance with noise limits presented in Condition 4.1;
b) measurement and reporting of C-weighted noise levels; and
c) an outline of any management actions taken within the monitoring period to address any exceedences of the limits contained in Condition 4.1.

**Additions to Definition of Terms of the licence**

- NSW Industrial Noise Policy - the document entitled "New South Wales Industrial Noise Policy published by the Environment Protection Authority in January 2000."

- Noise - sound pressure levels' for the purposes of conditions 4.1 to 4.6.

- 'Noise sensitive locations' includes buildings used as a residence, hospital, school, childcare centre, place of worship and nursing homes. A noise sensitive location includes the land within 30 metres of the building.

NSW GOVERNMENT | Office of Environment & Heritage

Your reference: DA 52-03-99 MOD 5
Our reference: DOC13/2700; FIL13/2161
Contact: Robert Gibson, 4908 6851

Mr David Mooney
Senior Planner, Mining Projects
Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Dear Mr Mooney

**RE: MOUNT OWEN MINING COMPLEX – MODIFICATION TO RAVENSWORTH EAST MINE (DA 52-03-99 MOD 5) ASSESSMENT OF EA AND RECOMMENDED CONDITION OF APPROVAL**

I refer to your email dated 29 January 2013 seeking comment on the Environmental Assessment (EA) for the proposed modification (MOD 5) to the Ravensworth East Mine. The Office of Environment and Heritage (OEH) received a printed copy of the EA for this project, titled 'Ravensworth East Resource Recovery Project: Environmental Assessment', dated December 2012 on 8 February 2012.

OEH notes that the project involves the resumption in mining of Tailings Pit 2, to access an additional six million tonnes of coal, and to provide a further six years of mine life for the local workforce. The additional overburden generated would be taken to the currently operating West Pit Overburden Emplacement Area, which would require the maximum height of overburden to be increased from Relative Level 160 metres to 180 metres. The changes sought require a variation to the existing consent through a modification under section 75W of the *Environmental Planning and Assessment Act 1979*.

OEH has reviewed the EA for potential impacts on flooding and threatened biodiversity issues. In this case an assessment of Aboriginal cultural heritage issues was not considered necessary due to the project area occurring in previously mined areas. OEH has not identified any significant flooding or threatened biodiversity issues in the EA. More details, along with a recommended condition of approval are provided in **Attachment 1**.

If you have any questions concerning this advice, please contact Robert Gibson, Regional Biodiversity Conservation Officer, on 4908 6851.

Yours sincerely

22 FEB 2013

**RICHARD BATH**
**Head – Hunter Planning Unit**
**Regional Operations**

Enclosure: Attachment 1

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## ATTACHMENT 1: REVIEW OF PROPOSED MODIFICATION TO RAVENSWORTH EAST MINE (DA 52-03-99 MOD 5) WITH RECOMMENDED CONDITIONS FOR APPROVAL

The Office of Environment and Heritage (OEH) has reviewed the Environmental Assessment (EA) for the proposed modification of the Ravensworth East Mine, including Section 6.7, for potential impacts on flooding and threatened biodiversity. OEH provides the following comments and a recommended condition of approval.

### FLOODING ASSESSMENT

OEH has not identified any potential flooding issues for this modification over which it has a regulatory role.

### THREATENED BIODIVERSITY ASSESSMENT

The proposed modification occurs in a box cut open pit about 30 metres deep that is currently partially filled with overburden. The existing overburden would be removed and all newly generated overburden would be taken to the West Pit Overburden Emplacement Area. This project, if approved would lead to the loss of about 7.3 hectares of immature woody 'Forest Complex' rehabilitation, about 53.1 hectares of grassland complex rehabilitation, and potential Green and Golden Bell Frog habitat (EA, section 6.74; Figure 6.13).

The ecological study area for this project covers about 299 hectares, and occurs in a post-mined landscape. The flora survey, and presumably the fauna survey of the study area also were conducted on 23 May 2012 (EA, section 6.7.2.1). The survey effort and timing of survey for the suite of local threatened species is therefore not in accordance with OEH's threatened species survey guidelines (DEC, 2004; DECC 2009). In addition, the list of flora species recorded during the site inspection was not presented in the EA as indicated in section 6.7.3. The EA does not indicate if any targeted surveys for Green and Golden Bell Frogs have been conducted in dams in the study area for this project, during the site visit in May 2012 or during any previous surveys. OEH notes that Green and Golden Bell Frogs have been recorded on the Mount Owen Mining Complex by previous studies near Betty's Creek, to the east of the project area (EA, Appendix 7).

In section 6.7.3.4 of the EA the proponent identifies three threatened microbat species that have been found to utilise woody revegetation on the Mount Owen Mine Complex. The Grey-crowned Babbler *Pomatostomus temporalis temporalis* has similarly been recorded using isolated woody rehabilitation on the adjacent Integra Coal Operations (EA for MP 08_0102). OEH notes that all four species have been considered in the 'test of significance' in Appendix 7 of the EA.

Despite the apparent limitations of the threatened biodiversity assessment for this project, due to the highly modified nature of the landscape the project does not appear to have any requirements for the provision of biodiversity offsets for state-listed threatened species.

The only other matter OEH wishes to raise is the availability of biodiversity monitoring data and the results of its analysis. The Mount Owen Complex Annual Environmental Management Reports, available on the Mount Owen Mine Complex website, provide summary data of rehabilitation and environmental monitoring programmes. Some details of the biodiversity monitoring on the Mount Owen Mining Complex have also been presented at forums, such as the workshop on mine-site rehabilitation in the Hunter Valley held in Singleton in September 2012, and from these it is clear that the monitoring programme at Mount Owen is extensive and that analysis of the data is occurring. OEH recommends that Mount Owen provides more of its environmental monitoring data, and the analysis of that data on its own website. That way Mount Owen Mining Complex can lead further by example and allow for lessons learnt by the proponent to be more readily communicated to other mines. This would allow for more effective use of resources to achieve biodiversity outcomes, particularly in the area of mine site rehabilitation across the Hunter Valley.

## RECOMMENDED CONDITION OF APPROVAL FOR THREATENED BIODIVERSITY

OEH recommends that DP&I include the following condition in any consent granted for this proposed modification:

1. That the proponent shall make publically available, on their website, a copy of the ecological monitoring data collected for this project, and any subsequent analysis within six months of completion of each monitoring period, to the satisfaction of the Director General Department of Planning and Infrastructure.

References

DECC (2009) Threatened species survey and assessment guidelines: field survey methods for fauna: Amphibians. NSW Department of Environment and Climate Change, Sydney.
www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf

DEC (2004) Threatened Biodiversity Survey and Assessment: guidelines for Developments and Activities. Working Draft. November 2004. NSW Department of Environment and Conservation, Hurstville.
www.environment.nsw.gov.au/resources/nature/TBSAGuidelinesDraft.pdf

NSW GOVERNMENT | Department of Primary Industries

19 FEB 2013

OUT13/1989

David Mooney
Senior Planner, Mining Projects
NSW Department of Planning & Infrastructure
GPO Box 39
Sydney NSW 2001

E david.mooney@planning.nsw.gov.au

Dear Mr Mooney

Thank you for your email of 29 January 2013 concerning the review of the Environmental Assessment for the proposed Mt Owen Mining Complex – Modification to Ravensworth East Mine for Xstrata Mt Owen Pty Ltd.

The Office of Agricultural Sustainability & Food Security (OAS&FS) notes that an Agricultural Impact Statement has not been undertaken for this proposal because it is very likely to have a nil impact on agricultural resources. I therefore advise that there are no issues associated with agriculture.

If you wish to discuss this aspect further please call Liz Rogers on telephone 02 63913642 or by email liz.rogers@dpi.nsw.gov.au.

Yours sincerely

**Dr Regina Fogarty**
**Director Office of Agricultural Sustainability & Food Security**

Transport
Roads & Maritime
Services

26 February 2013

SF2012/012709
CR2013/001279
MJ

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

Attention: Mr David Mooney

**NEW ENGLAND HIGHWAY (HW9): MOUNT OWEN MINING COMPLEX – MODIFICATION TO RAVENSWORTH EAST MINE, NEW ENGLAND HIGHWAY, RAVENSWORTH (DA 52-03-99 MOD5)**

Dear Mr Mooney

I refer to your email dated 29 January 2013 regarding the subject modification forwarded to Roads and Maritime Services (RMS) for comment.

**RMS Responsibilities**

Transport for NSW and RMS primary interests are in the road network, traffic and broader transport issues. In particular, the efficiency and safety of the classified road network, the security of property assets and the integration of land use and transport.

In accordance with the *Roads Act 1993*, RMS has powers in relation to road works, traffic control facilities, connections to roads and other works on the classified road network. The New England Highway (HW9) is a classified (State) road and part of the National Land Transport Network. RMS concurrence is required for connections to the road with Council consent, under Section 138 of the Act. Council is the roads authority for this road and all other public roads in the area.

**RMS Response and Requirements**

RMS has reviewed the information provided and has no objections to or requirements for the proposed modification as it is considered that the modification will not result in any significant impact on the classified road network.

On the Minister's determination of this matter, it would be appreciated if a copy of the Project Approval is forwarded to RMS for record and / or action purposes.

**Roads & Maritime Services**

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**T** 02 4324 0688 | **F** 02 4324 0342 | **E** David.N.Young@rms.nsw.gov.au **www.rmservices.nsw.gov.au | 13 22 13**

Should you require further advice please contact me on (02) 4924 0688

Yours sincerely

Dave Young
Manager Land Use
Hunter Region

Cc Mr Frank Sullivan
Singleton Council

NSW GOVERNMENT | Department of Primary Industries

OUT13/10953

10 MAY 2013

Mr David Mooney
Mining Projects
NSW Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

David.Mooney@planning.nsw.gov.au

Dear Mr Mooney,

**Ravensworth East Mine (Mount Owen Mining Complex) (DA 52-03-99 MOD 5)**
**Proposed Modification**

I refer to your email dated 29 January 2013 requesting advice from the Department of Primary Industries (DPI) in respect to the above matter, and to the referral of documentation by the proponent by undated letter received on 13 February 2013.

Comment by Crown Lands
Crown Lands advises there does not appear to be any Crown land impacted and as such raise no issues.

For further information please contact Martin Dawson, Senior Natural Resource Management Officer (Maitland) on 4937 9346, or at: martin.dawson@lands.nsw.gov.au.

Comment by Fisheries NSW
Fisheries NSW is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend. To achieve this, Fisheries NSW ensures that developments comply with the requirements of the *Fisheries Management Act 1994* (namely the aquatic habitat protection and threatened species provisions in Parts 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Aquatic habitat Management and Fish Conservation (1999).* In addition, Fisheries NSW is responsible for ensuring the sustainable management of commercial and recreational fishing in NSW.

The proposed mining occurs in an area that has been previously heavily modified by mining and mine-related development. There is no significant Key Fish Habitat in the development footprint and the changes to both groundwater and surface water impacts are expected to be relatively minor. Fisheries NSW advise it would have no objections to the proposal being approved.

For further information in this regard please contact Scott Carter, Senior Conservation Manager (Port Stephens office) on 02 4916 3931, or at: Scott.Carter@dpi.nsw.gov.au.

Comment by NSW Office of Water

The NSW Office of Water advises there are several issues which require clarification by the proponent, being the need to:

- undertake a peer review of the groundwater flow model to assess its suitability and its classification under the Australian Groundwater Modelling Guidelines.
- supply additional information to allow an understanding of the operational scenarios modelled and their cumulative impacts on groundwater.
- clarify the volume of potential take of water from the alluvium.
- demonstrate that sufficient entitlement is held to account for the predicted maximum take of water from all affected water sources, and ensure that all water taken during and post mining operations will be accounted for.
- provide additional information in Appendix A of the SKM report to allow complete assessment of the groundwater model.

Detailed comment in these regards is provided in Attachment A.

For further information please contact Hemantha DeSilva, Senior Water Regulation Officer (Newcastle office) on 4904 2525, or at: Hemantha.DeSilva@water.nsw.gov.au.

Comment by Forestry Corporation NSW

The main forest area of the Ravensworth State Forest is adjacent to the north. A segmented part is immediately adjacent to the development application boundary area. Forestry Corporation NSW (formerly Forests NSW) advises:

(i) Forestry Corporation NSW has not been consulted as a stakeholder and neighbour in respect to the application.

(ii) Although Forestry Corporation NSW is invited as an observer to the Flora and Fauna Management Group, it has not been approached for any input to the environmental assessment for this project.

(iii) Forestry Corporation NSW has concerns in relation to the degradation of the southern remnant of Ravensworth State Forest which is partially within and otherwise adjacent to the project area. The Corporation can find no evidence in the environmental assessment of any assessment of the impact of this project, and the cumulative impact from the larger Mt Owen project on this forest area.

For further information please contact Judith Parr, Land Administration Officer (Wauchope office) on 6586 9718, or at: judep@sf.nsw.gov.au.

Comment by Office of Agricultural Sustainability & Food Security

In accordance with procedures for mining applications that affect agricultural land the Office of Agricultural Sustainability & Food Security has responded separately to your Department by letter dated 19 February 2013.

For further information please contact Liz Rogers, Program Manager (Orange office) on 6391 3642, or at: liz.rogers@dpi.nsw.gov.au.

Yours sincerely

Phil Anquetil
**Executive Director Business Services**

## Attachment A

## Ravensworth East Mine (Mount Owen Mining Complex) (DA 52-03-99 MOD 5)
## Proposed Modification
## Additional comment by NSW Office of Water

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### 1. Background

#### 1.1 Project Proposal

The Ravensworth East Resource Recovery (RERR) modification is for a new open pit operation at Xstrata's Ravensworth East mine. The Ravensworth East mine is part of the Xstrata Mount Owen Complex, which also includes the Mount Owen and Glendell open cut mining operations. There are a number of other open cut an underground mining operations in the area. The Mount Owen Complex is located in the Upper Hunter Valley approximately 20 kilometres north-west of Singleton, 24 kilometres south-east of Muswellbrook and approximately 4.5 kilometres to the north of Camberwell village.

The new open pit to be the subject of this modification is east of the existing west pit. Operations are scheduled to commence at the end of 2013 once extraction of all economically accessible coal is completed in the west pit. Mining is scheduled to be completed by the end of the Ravensworth East mine lease in 2021. The mine will be approximately 200 metres deep, targeting the Ravensworth and Bayswater coal seams. Overburden will initially be placed in the west pit overburden emplacement area and then in the existing west pit.

#### 1.2 Geology/Hydrogeology

The proponent describes the hydrogeology of the Mount Owen complex and surrounds as comprising two main systems:

- quaternary alluvium of the Hunter River and its tributaries, including Bowmans Creek, Swamp Creek, Glennies Creek, and Baywater Creek, and
- the underlying Permian strata consist of low permeability sandstones, siltstone (interburden) and low to moderately permeable coal seams. The coal seams in the area are part of the Wittingham Coal measures.

The coal measures in the vicinity of the Ravensworth East mine are partially depressurised due to existing mining activities across the region.

#### 1.3 Surface water bodies and groundwater dependent ecosystems

The Ravensworth East mine is within the Bowmans's Creek catchment. The sub-catchments in proximity to the site include third order York's Creek, fourth order Swamp Creek and Bettys Creek and the six order Bowman's Creek.

Swamp Creek and Bettys Creek are ephemeral watercourses to the south-west and south of the site respectively. Bettys Creek has been largely modified by and incorporated into the Mount Owen Complex water management system, with the upper third of Bettys Creek has been diverted east to Main Creek. York Creek is an ephemeral watercourse that flows in a south-west direction from north of the Ravensworth East mine. Bowmans Creek is a perennial stream that flows in a southerly direction to the Hunter River and is to the west of the site.

Outside of the Bowmans Creek catchment but in close proximity to the Ravensworth East mine site are the Hunter River, Bayswater Creek and Glennies Creek. No details on the flow in these watercourses were included in the environmental assessment.

The groundwater assessment by SKM states that the ephemeral nature of the creeks suggests that there is no groundwater interaction (baseflow). It is considered that although these are not

baseflow systems that downward leakage from the alluvium may occur due to depressurisation of the Permian coal measures, influencing the surface water / groundwater interaction in these streams.

The proponent has identified that there are no groundwater dependent ecosystems in the vicinity of the Ravensworth East mine site.

### 1.4 Existing groundwater users

The proponent has identified that the nearest groundwater users are four or more kilometres west or south of the existing Ravensworth East operations and are located within shallow alluvium of Bowmans Creek and York Creek. They have identified that they may be affected by the mining operations if sustained dry periods occur and downward leakage from the alluvium is initiated as a result of depressurisation of the coal measures.

The proponent does not anticipate this occurring. It is stated that the Xstrata Mount Owen Surface Water and Groundwater Response Plan would be initiated at any location where loss of economic yield due to mine development can be demonstrated. A copy of the response plan was not in the environmental assessment to be able to comment on its adequacy.

## 2. Groundwater Modelling

### 2.1 Model construction and performance

To assess the cumulative impacts of the existing mining in the area and of the proposed modification, a new MODFLOW numerical model which uses the SURFACT module to account for the inflows into the mined voids was developed by SKM. The model was based on the Ravensworth Underground Mine (RUM) model.

The RUM model consists of 50x50m and 100X100m grid cells and is composed of 16 layers representing the hydrostratigraphy from the surface down to the Saltwater Creek Formation at the base of the Wittingham Coal measures. The model includes the Ravensworth underground and open cut mine and the Coal & Allied and Ashton underground operations.

The RERR model extended the RUM model by 5.5 kilometres to the north to include the Liddel open cut and underground operations and 11.4 kilometres to the east to include Mount Owen and Glendell mines to form the model extent. The grid size of the RERR model is 100m X 100m and has 19 layers.

Alluvial deposits included in the uppermost layer of the model vary in thickness from 10m in the upper reaches of the Bowmans, Bayswater and Glennies Creeks to 30m along the Hunter River. Outside of the areas where the alluvium is present, layer 1 is uniformly 1m thick. Layer 2 of the model represents alluvial sediments within the river valleys, and regolith elsewhere. The remaining layers represent the Permian strata.

There is no indication that surface water / groundwater interaction in the alluvium adjacent to streams were represented by river cells in the model. The use of river cells enables modelling of the flux between the surface water and groundwater sources.

The modelling initially consisted of preparing calibrated steady state and transient models. SKM were unable to prepare calibrated steady state and transient models. It was stated that the calibration of the steady state model was hindered by the lack of pre-mining groundwater level data, while the development of the calibrated transient model was hindered by the inadequate records of historic mining activities. The historic mining data missing which prevented the calibration of the transient model is not identified.

It is uncertain why calibrated steady state and transient models could not be developed for the area when there is the existing RUM model which covers are large portion of the model area.

An alternative approach to calibration was adopted where the transient model was run multiple times using randomly generated data sets from within pre-defined parameters. The difficulties in obtaining suitable data for a transient model resulted in it being non-unique and not highly constrained.

An uncertainty analysis was conducted using a stochastic modelling approach to investigate the variability in parameter values that might lead to adequate transient model calibration. The approach was completed in two stages:

- running a set of 1000 realisations to determine the parameter sets that provide a reasonable level of calibration, and
- running a set of 20 realisations to determine the range of outputs that these models generate when in the predictive mode.

The model parameter ranges and median values established from the set of 20 realisations were used for the predictive modelling. In reviewing the model construction and performance, insufficient information is provided in the SKM report to complete the assessment. It is considered that additional information is required in Appendix A of the report including:

- a water balance,
- peak groundwater take during mining and post mining,
- the peak groundwater levels drawdown in the Permian strata and the alluvium, during and post mining, and
- quantification of the modification and cumulative take from the surface water bodies.

### 2.2 Predictive modelling approach

The predictive model was designed to commence from the end of the "calibration" model and includes the proposed modification and a recovery period after mining ceases. The predictive model used rainfall recharge reflecting an average, dry and wet weather. The model runs were run with two different future mining assumptions:

- a base case model assumes future mining operations that would be expected under current approvals, and
- the expanded mine case assumes future mining that would occur under the proposed modification.

The results from the two different scenario cases are subtracted to generate the incremental impacts associated with the proposed modification.

SKM have classified the model as Class 2 (medium confidence) under the Australian Groundwater Modelling Guidelines (Barnett et al, 2012) classification scheme. It is considered that there is insufficient evidence to demonstrate that the model meet the requirements of a class 2 classification, due to:

- there being no calibrated steady state or transient model,
- there is no statistical analysis of the SRMS or RMS,
- it is uncertain how sensitive the stochastic modelling is to key parameters,
- there is no indication of the mass balance error, and
- there is no indication of a review by an independent hydrogeologist to deem it as fit for purpose.

### 2.3 Modelled prediction of impacts of mine modification

The numerical modelling has been used to predict the impact of the mine modification compared to the current approved mining operations.

The predicted maximum peak daily groundwater inflows into the RERR open pit are modelled to be about 1.4ML/day (511 ML/yr) which would occur in 2016. The peak combined groundwater inflows into the RERR and the existing west open pit at about 775 ML/yr occurring in 2014. The additional depressurisation of the Permian strata in the vicinity of the RERR mine area is anticipated to impact an area of about 2 to 3 kilometres by 2120. The assessment does not

describe the direction of the groundwater level but provides contour diagrams of the incremental impact. These diagrams indicate that the groundwater level drawdown is to the south of the RERR mine area. The incremental drawdown on licensed bores in the vicinity of the site was determined by the proponent to be negligible.

It is uncertain when the maximum drawdown of the RERR modification occurs. The assessment only provides information of the modelled incremental drawdown at the end of the modelling period (2120).

The alluvial aquifers of the Hunter River, Bowmans Creek, Glennies Creek and Bayswater Creek are predicted to continue to experience residual drawdown at the end of the modelled period in 2120. The modelled incremental groundwater level drawdown in the alluvium of the Hunter River is up to 0.5 metres and between 1 to 2 metres in Bowmans Creek and Glennies Creek. The cumulative drawdown from the approved mining and the modification is not identified.

The proponent states that the take from the alluvial aquifer systems would be negligible due to the groundwater level decline being generally less than 2 metres and the ephemeral nature of the majority of the streams. However, the drawdown in Bayswater Creek is greater than 2 metres. The impact being stated as negligible in Bayswater Creek by the proponent is assumed to be due to it being an ephemeral watercourse.

The proponent has shown the results of the numerical predictions in very minor detail. The numerical model report provided as an appendix to the main report contains the expected level of detail in relation model conceptualisation, development and calibration. However there is no detailed information on the predictive scenarios modelled and the results found as one would normally expect. Therefore it is not possible to accept with confidence the statements made by the proponent in relation to the predicted impacts on groundwater levels in the alluvium and connected surface water.

The groundwater in the Permian strata is identified as naturally saline, with the beneficial use limited to stock water supply. Any change in the groundwater quality in the alluvial aquifers is anticipated to be an improvement due to the depressurisation of the Permian strata where upward leakage of saline groundwater may occur.

## 3. Groundwater Monitoring

Groundwater monitoring for the RERR modification will be included in the existing water monitoring plan for the Mount Owen Complex. Additional vibrating wire piezometers and a series of standpipes in the alluvium were installed in 2012.

There is insufficient information in the assessment to comment if the existing monitoring is adequate. It is stated that it includes:

- water levels, salinity, pH and periodic chemistry for the regional monitoring bore network,
- measurement of water levels and water quality in the mine surface water bodies (dams and voids), and
- annual reporting as part of the licensing conditions.

It is stated that the monitoring would allow periodic update of the groundwater model to validate the predictive scenarios and modify future mine water balances. It is considered that the periodic update of the groundwater model should consider the benefit of developing calibrated steady state and transient models, especially if the modelling is not validated by the monitoring.

## 4. Licensing and Water Sharing Plans

The mining activities occur in a porous rock where a Water Sharing Plan is yet to commence; hence the *Water Act 1912* applies. Xstrata holds a Part 5 licence and an entitlement of 1160

ML/yr for the Mount Owen Complex. The proponent has not fully demonstrated that the current entitlement is sufficient to meet all water take for current and future operations.

The modelling indicates that the modification will cause incremental drawdown in the alluvial groundwater levels in the Hunter River, Bowman Creek and Glennies Creek alluvium. The proponents view is that the drawdown is negligible and there is no anticipated impact on alluvial aquifers from the modification.

Clarification is required on the potential take from the alluvium.

Shares may need to be purchased to account for the residual groundwater take from the Hunter Regulated Water Source within the *Water Sharing Plan for the Hunter Regulated River Water Source 2003* and/or the Hunter Unregulated and Alluvial Water Sources within the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*.

## 5. Aquifer Interference assessment

The RERR modification has the potential to impact on Bowmans and Glennies Creek which the proponent has identified as being part of the Biophysical Strategic Agricultural Land in the Strategic Regional Land Use Plan for the Upper Hunter. The proponent presents a view that these alluvial areas have undergone significant (approved) disruption in the course of previous and current mining activities, therefore no Biophysical Strategic Agricultural Land will be impacted and the gateway process of assessment for approval is not applicable.

The proponent presents the position that the impact of the RERR modification meets the minimal harm requirements of the Aquifer Interference policy of less than a 2 metre cumulative decline at any adjacent water supply work and 10% water table decline within 40 metres of a high priority Groundwater Dependent Ecosystem (GDE). The assessment tabulated below accepts the position as stated, with a caveat in relation to the inconclusive reporting of model predictions previously described.

A summary of assessment of the proposed modification according to the Aquifer Interference Policy minimal impact considerations is shown in Table 1.

Table 1: **Aquifer Interference Policy minimal impact considerations**

| Aquifer | Category | Level 1 Minimal Impact Consideration | Assessment |
|---|---|---|---|
| Porous/ Fractured Rock | Less Productive | Water Table<br><br>1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any:<br>(a) high priority groundwater dependent ecosystem; or<br>(b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan.<br><br>A maximum of a 2m decline cumulatively at any water supply work. | **Level 1 - acceptable**<br>There is no identified high priority GDE or culturally significant site in the vicinity of the proposed modification that will be impacted. There are no bores that would be impacted by a 2m decline cumulatively at any water supply work on adjacent land. |
| | | Water Pressure<br><br>1. A cumulative pressure head decline of not more than a 2m decline, at any water supply work. | **Level 1 - acceptable**<br>There are no bores that would be impacted by a 2m decline cumulatively at any water supply work on adjacent land. |
| | | Water Quality<br><br>1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity. | **Level 1 - acceptable**<br>There is no anticipated change in beneficial use category |

| | | | |
|---|---|---|---|
| Alluvium – Hunter River alluvium | Highly productive | Water Table<br><br>1. Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any:<br>(a) high priority groundwater dependent ecosystem; or<br>(b) high priority culturally significant site;<br><br>listed in the schedule of the relevant water sharing plan; or<br>A maximum of a 2m decline cumulatively at any water supply work. | **Level 1 - acceptable**<br>There are no identified high priority GDE or culturally significant sites in the vicinity of the proposed modification that will be impacted.<br>There are no bores that would be impacted by a 2m decline cumulatively at any water supply work on adjacent land. |
| | | Water Quality<br><br>1. (a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity; and<br>(b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity.<br><br>Redesign of a highly connected surface water source that is defined as a "reliable water supply" is not an appropriate mitigation measure to meet considerations 1.(a) and 1.(b) above. | **Level 1 - acceptable**<br>There is no anticipated change in beneficial use category |
| Alluvium – Bowmans Creek & Glennies Creek | Less Productive | Water Table<br><br>1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any:<br>(a) high priority groundwater dependent ecosystem; or<br>(b) high priority culturally significant site;<br><br>listed in the schedule of the relevant water sharing plan; or<br>A maximum of a 2m decline cumulatively at any water supply work unless make good provisions should apply. | **Level 1 – acceptable**<br>There are no identified high priority GDE or culturally significant sites in the vicinity of the proposed modification that will be impacted<br>There are no bores that would be impacted by a 2m decline cumulatively at any water supply work on adjacent land. |
| | | Water Quality<br><br>1. (a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity; and<br>(b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity.<br>Redesign of a highly connected surface water source that is defined as a "reliable water supply" is not an appropriate mitigation measure to meet considerations 1.(a) and 1.(b) above.<br>(c) No mining activity to be below the natural ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial material - whichever is the lesser distance) of a highly connected surface water source that is defined as a "reliable water supply". | **Level 1 - acceptable**<br>There is no anticipated change in beneficial use category |

## 6. Recommendations

It is recommended the proponent:

(i) Undertake a peer review of the groundwater flow model to assess its suitability and its classification under the Australian groundwater modelling guidelines.

(ii) Supply additional information to allow an understanding of the operational scenarios modelled and their cumulative impacts on groundwater, in particular:
   a. explain how the Hunter River and the unregulated streams were treated in the groundwater flow model.
   b. clarify the volumes and timing of modelled peak contributions from the Hunter Regulated Alluvium, Bowmans Creek Water Source and Glennies Creek Water Source.
   c. clarify the predicted maximum water take from the surface water sources.
   d. clearly define and illustrate the peak mining and residual post mining take scenarios and their effect on groundwater levels, including levels in the alluvium.

(iii) Illustrate that the Xstrata Mount Owen Complex Part 5 entitlement under the *Water Act 1912* is sufficient to account for the peak groundwater take from the RERR open pit modification.

(iv) Provide additional information in Appendix A of the SKM report to allow complete assessment of the groundwater model construction and performance, including:
   a. a water balance,
   b. peak groundwater take during mining and post mining,
   c. the peak groundwater levels drawdown in the Permian strata and the alluvium, during and post mining, and
   d. quantification of the modification and cumulative take from the surface water bodies.

**End Attachment A**

22 February 2013

Matthew Sprott
Planning Officer, Mining Projects
Department of Planning & Infrastructure
GPO Box 39 SYDNEY 2001

By email: matthew.sprott@planning.nsw.gov.au

Dear Matthew

**RE: RAVENSWORTH EAST RESOURCE RECOVERY PROJECT (DA 52-03-99 MOD 5)**

We refer to the application by Xstrata Mt Owen Pty Limited (Xstrata) requesting to modify DA 52-03-99 dated 19 December 2012 (RERR Project). We also refer to your e-mail dated 19 February 2013 confirming that Integra Coal Operations Pty Limited (Integra) has until Friday 22 February 2013 to lodge its submission on the RERR Project with the Department of Planning and Infrastructure (DP&I).

Integra seeks to ensure that the assessment being carried out by DP&I adequately and appropriately addresses the potential impacts of the RERR Project on the Integra Mine Complex and, in particular, any impacts from blasting in the RERR Pit on Integra's underground mining operations.

Integra has reviewed the environmental assessment dated December 2012 prepared by Umwelt (Australia) Pty Limited (RERR Project EA), which outlines the potential interactions between Integra's underground mining operations and the RERR Project. As you are aware, Integra and Xstrata have held, and are continuing, discussions on how to address the interactions between the two operations.

In principle, Integra agrees with Xstrata's proposed approach of managing impacts from blasting through the implementation of a Personnel Withdrawal Protocol. This is set out in the blast impact assessment included in the RERR Project EA, which takes into account the possibility that blasting of the RERR project mining area could coincide with Integra's operations underground.

However, Integra is concerned that the RERR Project will cause additional impacts that have not been adequately addressed, in the RERR Project EA or otherwise. In particular, the removal of personnel will require Integra to cease production, at least temporarily. Ceasing operations will result in lost production time and delays in coal extraction. Even temporary cessation of Integra's underground operations will have an economic impact on the mine, particularly in the current economic climate, and on the profitability of the Integra Mine Complex overall. Integra wishes to ensure that it does not suffer any loss or damage as a result of the RERR Project, and also wishes to ensure that Integra's ability to maximise resource recovery is not jeopardised.

As you are aware, Integra and Xstrata are seeking to reach to an agreement to address the interactions between the two mines. Concurrently, in this submission, Integra requests that DP&I's assessment of the RERR Project EA consider and resolve the following matters before Xstrata carries out any blasting which impacts upon Integra's operations:

a. **Safety** – Integra is to be given an opportunity to confirm that the modelling of vibration impacts contained in the RERR Project EA, including assumptions, are validated through testing and monitoring;

Integra Coal Operations Pty Ltd ABN 96 118 030 998
Underground
640 Middle Falbrook Rd Singleton 2330Tel +61 2 6577 4200 Fax +61 2 6577 4235

b. **Damage** – Integra and Xstrata agree how any damage caused to Integra as a result of blasting associated with the RERR Project is to be compensated by Xstrata;

c. **Production delays and other losses**– Integra and Xstrata agree how Integra is to be compensated for any production delays and other losses incurred due to the RERR Project;

d. **Development of a personnel evacuation protocol** – Integra and Xstrata agree a process for Xstrata to consult with Integra on the development of this protocol, and for it to be approved by the Division of Resources & Energy, within NSW Trade & Investment;

e. **Testing and monitoring** – Integra and Xstrata agree on a program of testing and monitoring of the impacts on Integra's underground mine, to be carried out by Xstrata, and for Integra to be consulted on the results;

f. **Management Plan** – Xstrata to prepare and obtain the relevant government authorities' approval of a management plan covering the impacts of the RERR Project on Integra's underground mine, prior to carrying out any blasting which impacts upon Integra's operations. The management plan is to be prepared in consultation with Integra.

Specifically, Integra requests that a condition be imposed in the Minister's approval of the RERR Project, if granted, to the effect that Xstrata will not carry out any blasting which impacts upon Integra's operations unless Xstrata has first:

a. Entered into an agreement with Integra addressing the matters set out in paragraphs (a) to (e) above; and

b. Prepared of the management plan referred to in paragraph (f) above in consultation with Integra, and has obtained approval of that plan from the relevant government authorities; and

c. The conditions of approval require compliance with that management plan.

If you have any questions or require further information, I can be contacted by phone on (02) 6570 2104.

Yours Sincerely,

Andrew Betts
General Manager – Integra

17th February 2012

Ravensworth east mine-Mod 5- mine extension

DA 52-03-99 mod 5

To Department of Planning

This is my submission against the application due to a number of grounds. The issues which are raised in the submission will be in point form.

- Cumulative impact study on health diseases related to air quality in the hunter valley.
- Cumulative health risk assessment for the hunter valley related to air quality
- Cumulative impact study on the health risks for neighbours within 20km radius
- Cost analysis of the impacts of poor air quality on the hunter valley, related to health services and associated services
- Department of Planning and infrastructure must release a full map of all areas under exploration or set aside for exploration, for mining or extractive industries. This must be released to the public for consultation to ensure an open and transparent system, it also must identify all the companies ect, which have licences and the amounts paid to the state.
- Cumulative impact study on the water network system related to extractive industries plus any potential exploration which has the potential to cause harm. The water network system is related to aquifers, underground system and surface water, regulated and unregulated rivers and streams.
- Cumulative impact of 30 voids on the hunter valley region, in which maintenance, testing of water quality, leaching of contaminants in the water network system

- Cumulative impact of the rehabilitation of the land, and the economic sustainability of the land-use to the community and the state
- Rehabilitated land must have no voids and must be back to original classification before any mining took place in the hunter. The company must be able demonstrate that they can rehabilitate to previous land form and land-use and must be sustainable.
- Cumulative effect of decreasing rural land holders, and agriculture in the area, the amount of landholders which have been acquired and made refugees of the mining industry. We forget that by closing communities down for self-interest of foreign investors, in which most of the money actual leaves the shores what emotional and mental stress we place on communities of sense of loss.
- The company must demonstrate that no dust or PM leaves the transport by rail to the port, if they cannot demonstrate and the community can prove PM which is coal dust is leaving the transport, all trains must be covered or use a product which prevents the dust or Pm from leaving the train.
- The company must demonstrate a social licence from their closest neighbours, which must be communities that they deserve the right to precede in the modification.
- There also must be a cumulative statement from the industry of how much diesel is used per day, and per month and what affect does this have on the environment, and public health, and other industries. What is the cumulative impact on the nation resources of fuel,

The request of all this information should be sent to my address, until we understand the whole picture of extractive industries in the hunter valley and cumulative impact on large number of areas.

As I have no confidence in the Department of Planning, this project will be approved, anyway as apparent in recommending approve destroy alluvial soils for open cut mining.

Regards

Deidre Olofsson

# APPENDIX 2

Groundwater Modelling Briefing Note
(SKM)

# Attachment 2
# Ravensworth East Mod 5 Groundwater Impact Assessment Response to NSW Office of Water Comments

## 1. Introduction

Mount Owen Pty Limited (Mount Owen), formerly known as Xstrata Mt Owen Pty Limited, is seeking a modification to Development Consent DA 52-03-99 to continue coal mining operations within the Ravensworth East Mine, which is part of the Mt Owen Mining Complex. The proposed modification comprises the extension of a former shallow open cut pit previously known as TP2, which has since been backfilled, to a depth of approximately 200 metres (m) to extract coal from deeper seams not previously targeted. The modification will be completed wholly within previously disturbed land and will allow efficient use of existing facilities and infrastructure and allow enhanced resource recovery. The modification is known as the Ravensworth East Resource Recovery Project (RERR).

SKM was engaged by Umwelt (Australia) Pty Limited, on behalf of Mount Owen, to undertake a Groundwater Impact Assessment for the proposed modification as part of the Environmental Assessment (EA). In May 2013 the NSW Department of Primary Industries and the NSW Office of Water provided comments on the RERR Groundwater Impact Assessment Report (SKM, December 2012). The comments are presented in **Table 1** along with SKM's response. Additional information and justification for the responses provided is presented in this letter and in **Attachment A**, which provides additional detail on the construction and performance of the groundwater model used for the assessment. **Section 2** of this letter provides further clarification of the numerical groundwater model results and estimated impacts to groundwater systems based on predictive simulations of the proposed modification.

## Table 1 – NSW Office of Water Recommendations and SKM Response

| Recommendation | SKM Response |
|---|---|
| Undertake a peer review of the groundwater flow model to assess its suitability and its classification under the Australian groundwater modelling guidelines. | SKM has not undertaken an independent peer review of the groundwater model used for the RERR impact assessment. However SKM provides an assessment of the model used against the *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012). The assessment takes into account the model's suitability and fit for purpose for the proposed modification, with the evaluation reviewed by Mr Brian Barnett, SKM's Practice Leader for Groundwater Modelling and lead author of the *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012).<br><br>The regional scale groundwater model used for the RERR assessment is considered to have attained a Class 2 (medium confidence) status in accordance with the key indicators designated by the guidelines, and there are aspects of the model that comply with Class 3 confidence level requirements. A Class 2 model is considered suitable for providing estimates of dewatering requirements for mines and for the prediction of associated impacts on medium value aquifers. The stochastic calibration methodology adopted for the regional scale model, which was calibrated against alluvial groundwater levels, is appropriate for a Class 3 classification for the assessment of impacts to these alluvial aquifers.<br><br>***See Attachment A, Section A1 – Model Confidence Level Classification*** |

| Recommendation | SKM Response |
|---|---|
| Supply additional information to allow an understanding of the operational scenarios modelled and their cumulative impacts on groundwater, in particular:<br>a. Explain how the Hunter River and the unregulated streams were treated in the groundwater flow model.<br>b. Clarify the volumes and timing of modelled peak contributions from the Hunter Unregulated Alluvium, Bowmans Creek Water Source and Glennies Creek Water Source.<br>c. Clarify the predicted maximum water take from the surface water sources.<br>d. Clearly define and illustrate the peak mining and residual post mining take scenarios and their effect on groundwater levels, including levels in the alluvium. | Additional information is summarized below and discussed in the referenced section.<br>a. The Hunter River was represented using the River Cell package of MODFLOW. Other (non-perennial) streams were represented using Drain cells as these streams were not considered baseflow systems. ***See Attachment A, Section A2.4 – Boundary Conditions***<br>b. Impacts on the unregulated alluvial water sources were determined through subtraction of the base case model (existing approved operations) results from predictive model results simulating the proposed modification. This revealed the incremental impacts of the proposed modification on the alluvial and fractured rock groundwater sources. The predicted incremental impacts resulting from the proposed modification revealed negligible (i.e. less than 0.25 m) drawdown in the alluvial water sources during periods of estimated peak pit inflows (2014-16). ***See Section 2.2 and Figures 2 through 4***<br>c. As the predicted incremental drawdown in the alluvial systems is negligible, the predicted maximum water take from the surface water sources is similar to that deduced for previous assessments for Ravensworth East, namely 'minimal' (MER, 1998). ***See Section 2.2***<br>d. ***Figures 2 through 11*** illustrate the peak and residual mining impacts on groundwater levels in the area. |
| Illustrate that the Xstrata Mount Owen Complex Part 5 entitlement under the Water Act 1912 is sufficient to account for the peak groundwater take from the RERR open pit modification. | Modelling predicts that peak inflow for Ravensworth East will reach 770 ML in 2014 and 700 ML in 2016. Current entitlements for the Mount Owen Complex are 1160 ML/ye**ar. *See Section 2.3*** |

| Recommendation | SKM Response |
|---|---|
| Provide additional information in Appendix A of the SKM report to allow complete assessment of the groundwater model construction and performance, including:<br>a. A water balance,<br>b. Peak groundwater take during mining and post mining,<br>c. The peak groundwater levels drawdown in the Permian strata and the alluvium, during and post mining, and<br>d. Quantification of the modification and cumulative take from the surface water bodies. | Additional information describing the groundwater model construction and performance is provided below and in **Attachment A**. Specifically:<br>a. A representative water balance of inflows and outflows for the groundwater model is provided in **Table A4**. Note that there are a range of inflow and outflow values available due to the stochastic approach adopted for the calibration and predictive modelling, which resulted in a series of calibrated realisations (i.e. datasets). The water balance figures presented in **Table A4** provided representative water balance data for the model.<br>b. Peak groundwater take (as estimated as peak pit inflow for the RERR mining area and West Pit) is predicted to be 770 ML/year in 2014. ***See Section 2.3***<br>Post mining groundwater levels are presented in ***Figure 11***.<br>c. Peak drawdown levels are illustrated in ***Figures 2 through 11***. These replace the figures presented in the RERR Groundwater Impact Assessment Report (SKM, 2012) and provide additional detail only (i.e. they are the same results as those provided in the Report).<br>d. The groundwater model incorporates existing mines based on publically available information for mining operations with influence in the modelling domain. For some mining operations such information is limited to publicly available information and data, which may not include detailed mine plans or extraction data. The RERR Groundwater Impact Assessment focuses on the incremental impact of the RERR modification within the context of approved mining operations in the region. The model predicts negligible water take (less than 0.25 m drawdown) from the alluvial aquifers in the local area as a result of the proposed RERR modification. ***See Section 2.2*** |

## 2. Predictive Groundwater Modelling

The regional scale groundwater model developed by SKM includes several historical and currently operating coal mines within the Bowmans and Glennies Creek catchments of the Upper Hunter Valley. Development of the regional scale model was predicated on the desire to account for the cumulative impacts of mining operations in the region on local groundwater and surface water resources and to allow assessment of groundwater impacts from different mines. The predictive model results presented in the following section relate specifically to the RERR modification, with simulations designed to determine the incremental impacts of the RERR modification on local groundwater systems. **Attachment A** provides additional information on the design, construction, calibration, and performance of the regional scale model.

### 2.1 Predictive Simulations

Following model calibration (refer **Attachment A, Section A3**), 20 calibrated datasets were used to run predictive simulations to investigate the potential impacts of mining activities on local aquifer systems. The predictive simulations began from the end of the calibration model scenarios (end of 2011) and included yearly time steps to the end of the current operations approval for Ravensworth East (DA 52-03-99, expiry 2021) followed by a recovery period after mining activities cease. The recovery period simulated was 100 years to 2120.

Predictive simulations were undertaken using two different scenarios in order to better quantify the potential impacts of the proposed modification on groundwater resources:

- Base case: simulates all currently approved mining operations; and
- Proposed case: includes all currently approved mining operations and the proposed modification.

Model results for the Base case simulations provide an estimation of the cumulative impacts to local groundwater resources that can be attributed to historical and currently approved mining operations at Ravensworth East. Results for the Proposed and Base case simulations provide estimates of the incremental impact (if any) that can be attributed to the proposed modification. SKM notes that Xstrata Coal Pty Limited mining operations are represented in the model from detailed mine and extraction plans, however other mining operations are included based on the availability and extent of information that is readily available (i.e. via released Environmental Assessments and published Management Plans).

The annual progression of the RERR project simulated for the Proposed case scenario is shown in **Figure 1**. The mining progression is shown as the incremental change in surface elevation for each year, or the elevation at the end of the year less the elevation at the start of that year. **Figure 1** shows the yearly progression of the RERR mining area, with the pit deepening between 10 m to more than 30 m per year in subsequent mining years. Drain cells within the vertical layers of the model were progressively switched on according to the years shown in **Figure 1** to simulate the deepening of the TP2 pit under the proposed modification.

Areas of positive change in elevation (blue shaded areas) reflect emplacement areas under the Proposed case scenario.

## 2.2 Estimated Groundwater Flows and Drawdowns

Predictive model results for drawdown in the alluvial aquifers are presented in **Figures 2** through **4**, and predicted drawdown for the hard rock aquifer are shown in **Figures 5** through **10** at the end of this letter. The estimated drawdown shown has been determined by subtracting the predicted water level under the Base case scenario from the predicted water level for the Proposed case scenario for the prescribed time step. This approach allows the incremental contribution of impacts from the proposed RERR project to be assessed and quantified. The drawdowns were determined from the median ($50^{th}$ percentile) of results from the series of 20 calibrated stochastic datasets for the Base case and Proposed case scenarios.

**Figures 2** through **10** replace Figures 5-1 and 5-2 presented in the Ravensworth East Resource Recovery Groundwater Impact Assessment Report (SKM, December 2012), providing increased resolution by using larger formats. SKM notes that **Figure 4** presented in this letter (alluvial drawdown at the end of modelling) differs to the figure previously included in the Impact Assessment Report (Figure 5-2; SKM, December 2012). Model results predict negligible drawdown in the alluvial aquifers as a result of the proposed RERR project at the time of peak inflows into the pit (year 2016, refer to Impact Assessment Report), at the end of current mining consent (2021), and at the end of the modelling period (2120). Figure 5-2 of the Impact Assessment Report (SKM, December 2012) was issued in error, specifically the presentation of the alluvial drawdown at the end of modelling (2120) was an editing error that was overlooked in the Report's publication. Drawdown at the end of modelling is predicted to be negligible, and **Figure 4** provided in this letter represents the corrected drawdown figure. The drawdown predictions described in the text of the Report (SKM, December 2012) were correct, and this updated figure only represents a correction of an editing error in the original report.

The groundwater model estimates negligible water take or water loss from the alluvial aquifers in the local area as a result of the proposed RERR modification, which is demonstrated by the lack of predicted drawdown shown in **Figures 2** through **4**, at the time of peak inflows into the pit (2016), at the end of current mining consent (2021), and at the end of the modelling period (2120). Based upon these results and the negligible incremental impacts, the cumulative water take from the alluvial sources due to the proposed modification would be no more than that estimated in previous groundwater assessments for the Ravensworth East, Mt Owen and Glendell mines. The groundwater assessment previously undertaken by Mackie Environmental Research (MER) for the original development consent for Ravensworth East in 1998 (MER, 1998) described 'minimal' opportunity for downward leakage as a result of mining activities.

The drawdowns shown in **Figures 7** and **10** for the overburden and Bayswater Seam at the end of modelling (year 2120) indicate significant drawdown within the hard rock aquifer at the end of the designated recovery period. It is important to recognize that the drawdowns shown

are calculated as the difference between the Proposed case and Base case scenarios. Under the Base case, the lack of a deep void allows recovery of water levels after the cessation of mining activities from neighbouring operations. In the Proposed case, the final void will result in equilibrium potentiometric heads of approximately -40 m AHD in this area of the void as shown in **Figure 11**.

### 2.3 Estimated Pit Inflows

In addition to flow and drawdown estimates, the predictive simulations also provide estimates of pit inflows to the RERR mining area. Predicted inflows to the RERR mining area peak in the year 2016 at approximately 0.9 ML/day (330 ML/year), estimated from the median ($50^{th}$ percentile) value of the calibrated datasets. Estimated pit inflows to the currently active West Pit at Ravensworth East peak at 2.1 ML/day (770 ML/year) in 2014. The combined inflow total for Ravensworth East (total for the RERR mining area and West Pit) peaks at approximately 770 ML/year in 2014 and 700 ML/year in 2016. Mount Owen currently holds sufficient groundwater extraction licenses (1160 ML/year) under the *Water Act 1912* for the regional hard rock aquifer water source, the source of the pit inflows, to account for these predicted inflows.

## 3. Conclusion

Additional information and data has been provided in this letter to address the comments provided by the NSW Department of Primary Industries and the NSW Office of Water on the Ravensworth East Resource Recovery Groundwater Impact Assessment report (SKM, December 2012) and support the findings of that assessment. This letter should be read in conjunction with that report.

## Attachments

- **Figures 1** through **11**
- **Attachment A**: Numerical Groundwater Modelling for the Ravensworth East Resource Recovery Project

# Figures

# Figure 1: RERR Mining Progression





**LEGEND**

**Change in Elevation (m)**

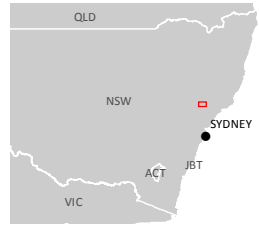
- Greater than 40
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10
- -10 to 0
- -20 to -10
- -30 to -20
- Less than -30
- RERR Mining Area



GDA 1994 MGA Zone 56

0 2

Kilometres




SKM

File Name: RERR GIA_Mine Sequence
Prepared by: CD
Checked by: RC

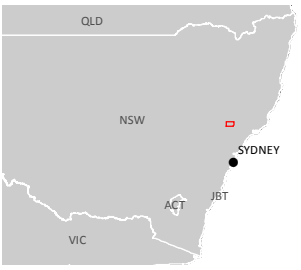
# Figure 2: Alluvial Drawdown at 2016


**LEGEND**

**Drawdown (m)**
- < 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 2

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres






GDA 1994 MGA Zone 56

File Name: RERR GIA_Alluvium DDs
Prepared by: CD
Checked by: RC

SKM

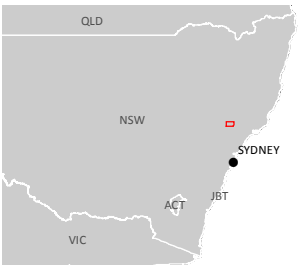
# Figure 3: Alluvial Drawdown at 2021


**LEGEND**

**Drawdown (m)**
- < 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 2

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres






GDA 1994 MGA Zone 56

File Name: RERR GIA_Alluvium DDs
Prepared by: CD
Checked by: RC

SKM

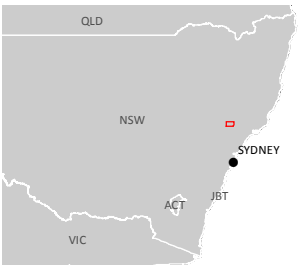
# Figure 4: Alluvial Drawdown at 2120


**LEGEND**

**Drawdown (m)**
- < 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 2

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



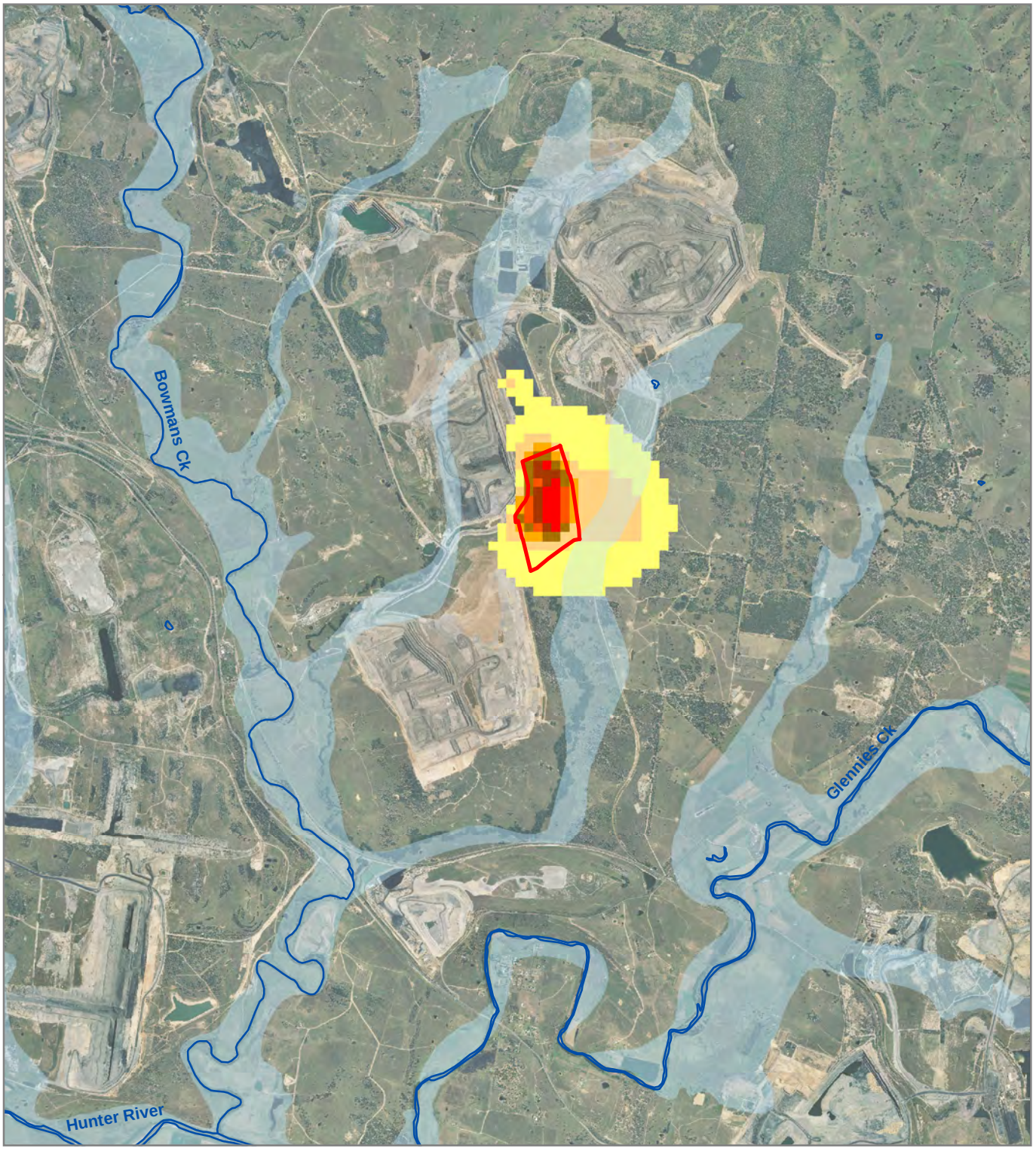



GDA 1994 MGA Zone 56

File Name: RERR GIA_Alluvium DDs
Prepared by: CD
Checked by: RC

SKM

# Figure 5: Overburden Drawdown at 2016

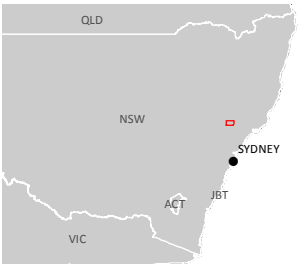



**LEGEND**

**Drawdown (m)**
- <2
- 3 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



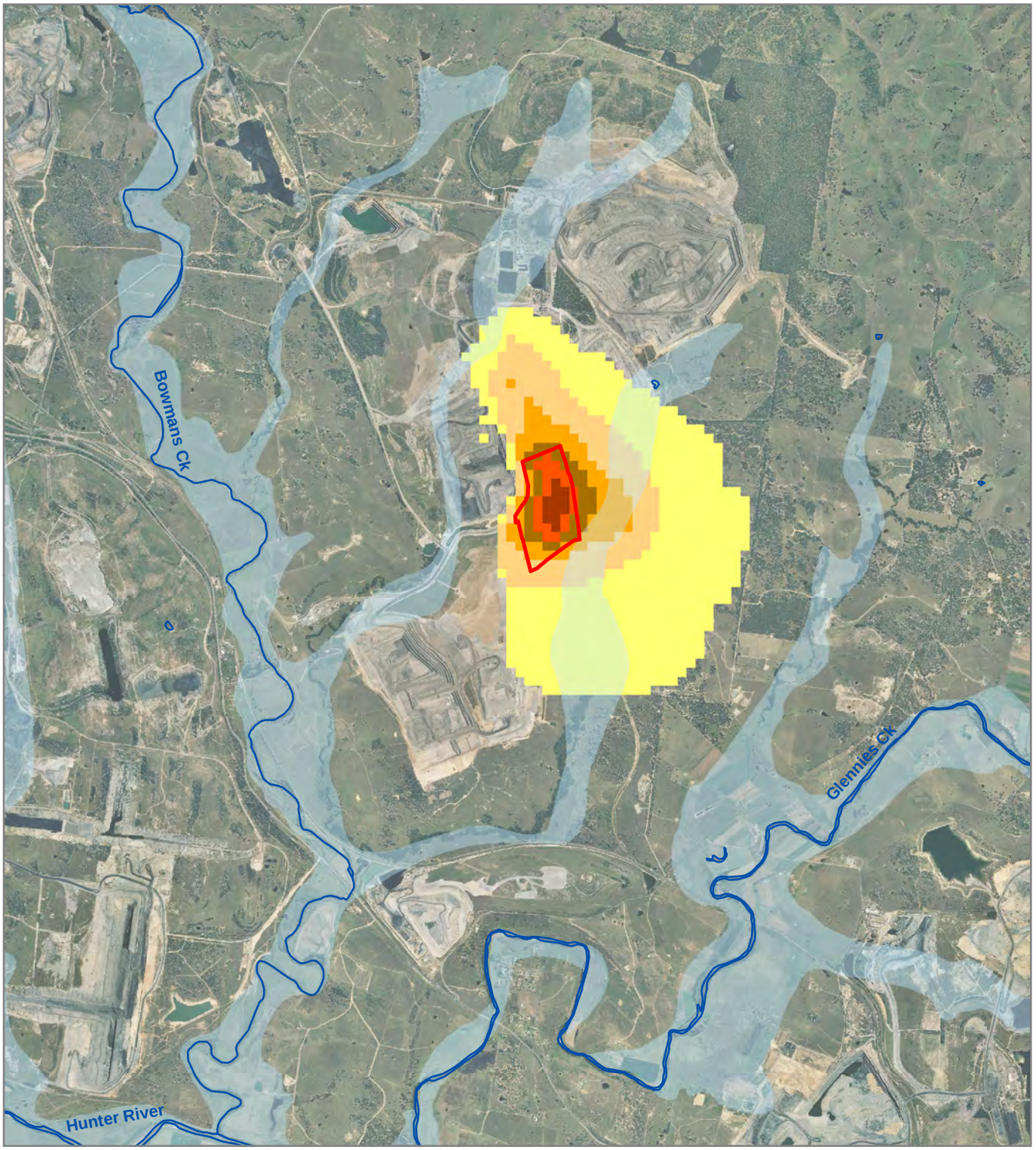



GDA 1994 MGA Zone 56

File Name: RERR GIA_Seam DDs
Prepared by: CD
Checked by: RC

SKM

# Figure 6: Overburden Drawdown at 2021

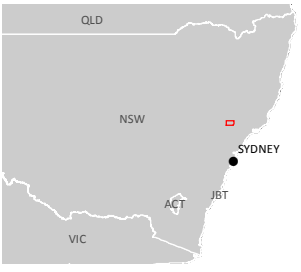



**LEGEND**

**Drawdown (m)**
- <2
- 3 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



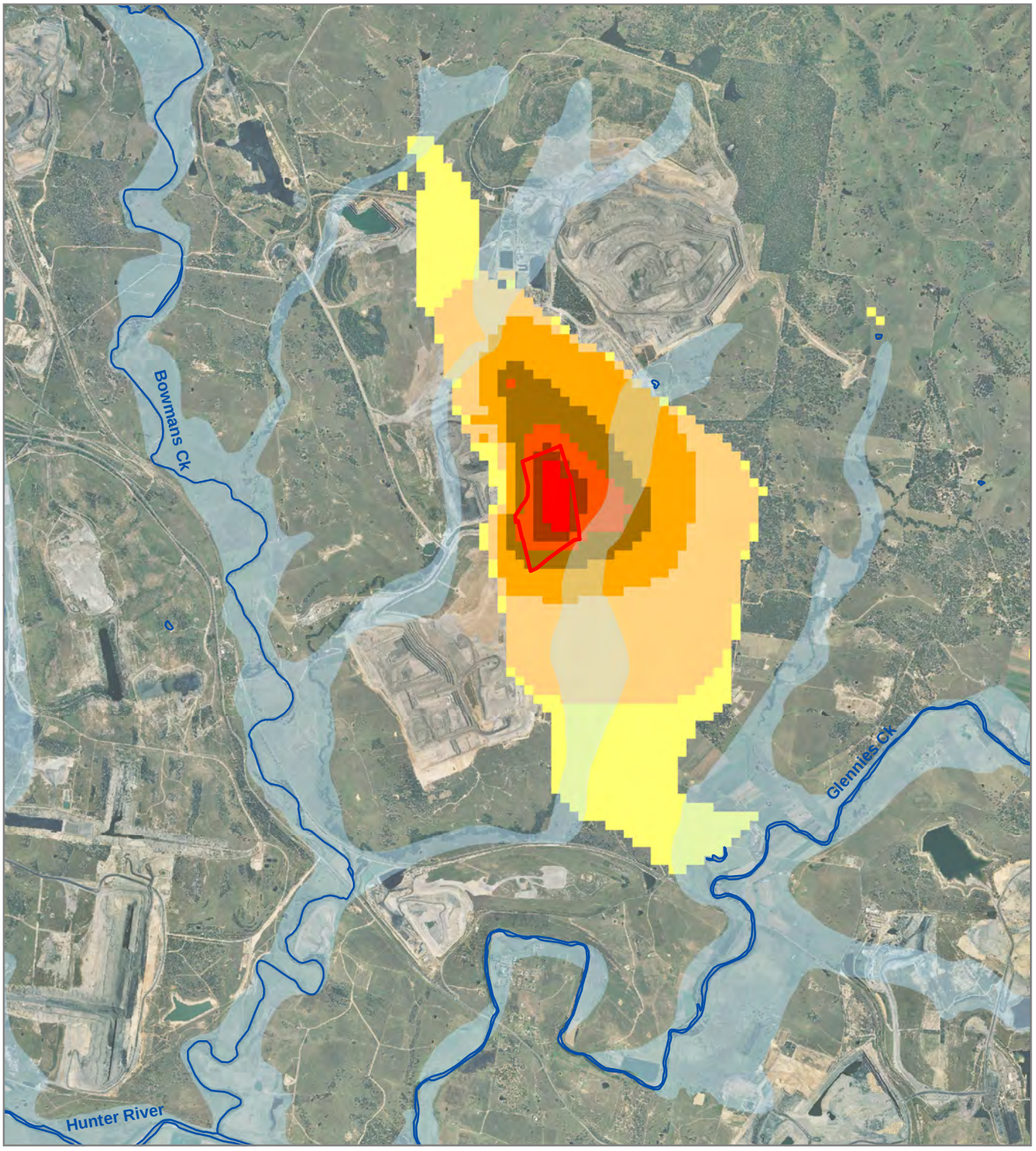



GDA 1994 MGA Zone 56

File Name: RERR GIA_Seam DDs
Prepared by: CD
Checked by: RC

SKM

# Figure 7: Overburden Drawdown at 2120

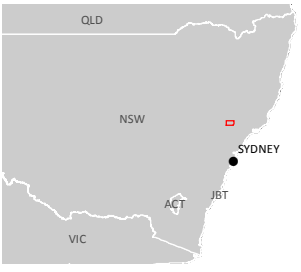



**LEGEND**

**Drawdown (m)**
- <2
- 3 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



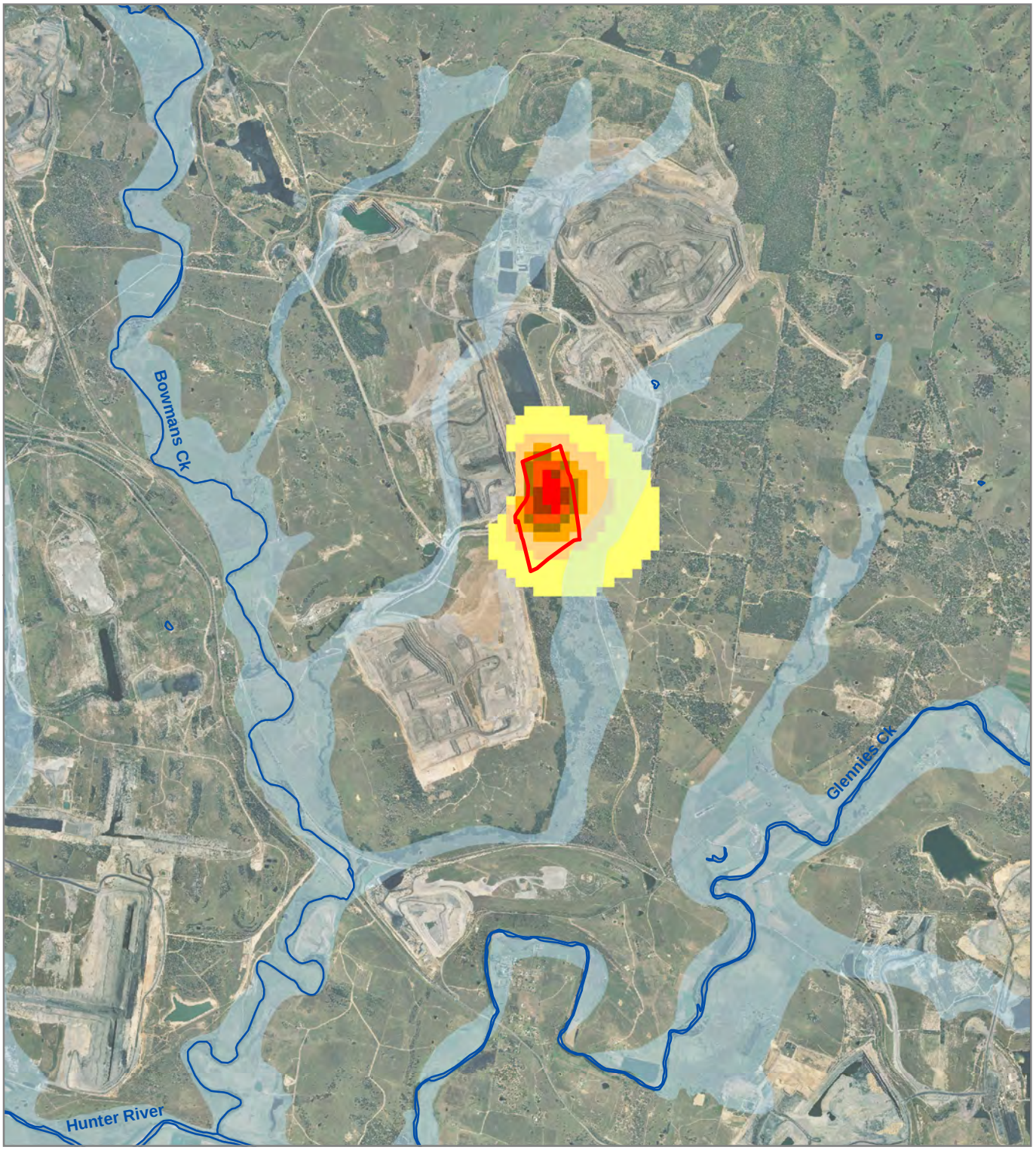



GDA 1994 MGA Zone 56

File Name: RERR GIA_Seam DDs
Prepared by: CD
Checked by: RC

SKM

# Figure 8: Bayswater Seam Drawdown at 2016

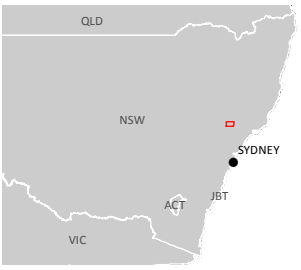



**LEGEND**

**Drawdown (m)**
- <2
- 3 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



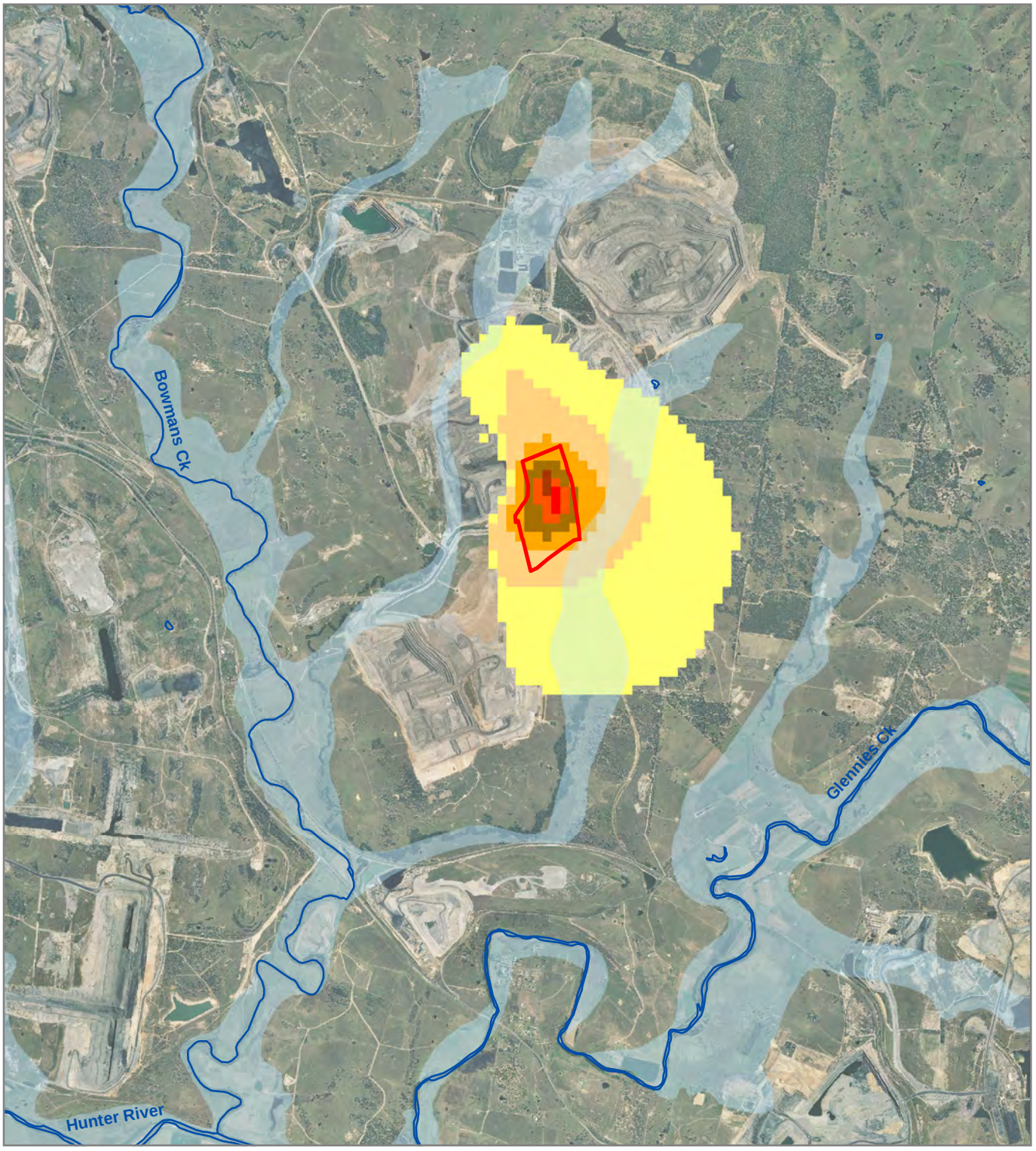



GDA 1994 MGA Zone 56

File Name: RERR GIA_Seam DDs
Prepared by: CD
Checked by: RC

SKM

# Figure 9: Bayswater Seam Drawdown at 2021

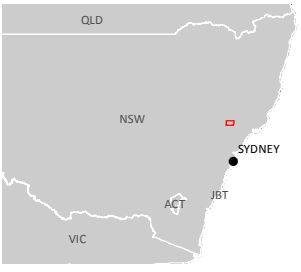



**LEGEND**

**Drawdown (m)**
- <2
- 3 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



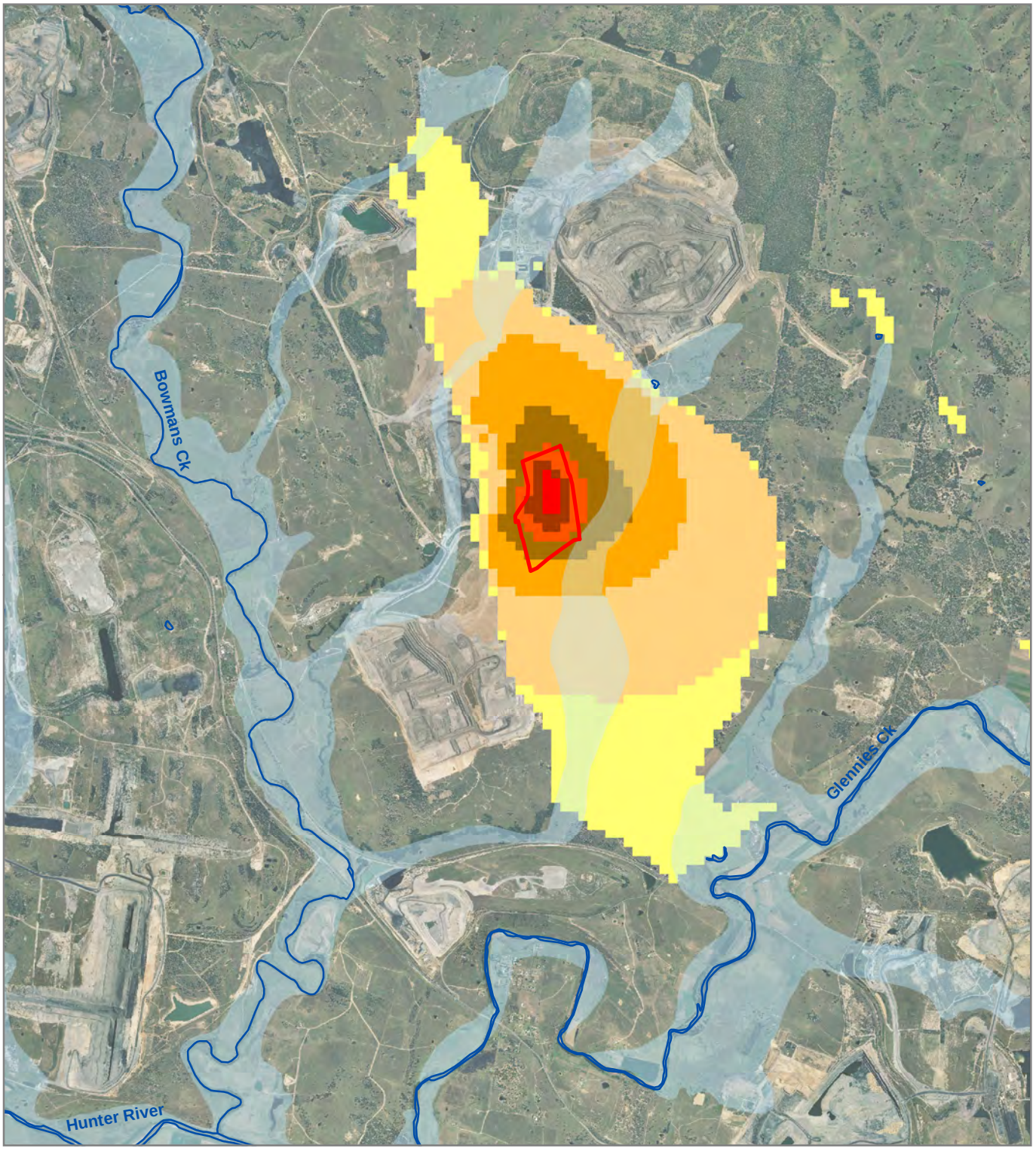



GDA 1994 MGA Zone 56

File Name: RERR GIA_Seam DDs
Prepared by: CD
Checked by: RC

SKM

# Figure 10: Bayswater Seam Drawdown at 2120




**LEGEND**

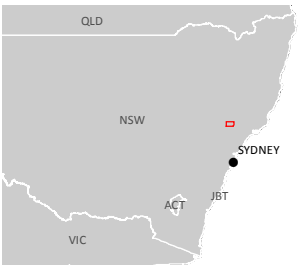
**Drawdown (m)**
- <2
- 3 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.6
Kilometres



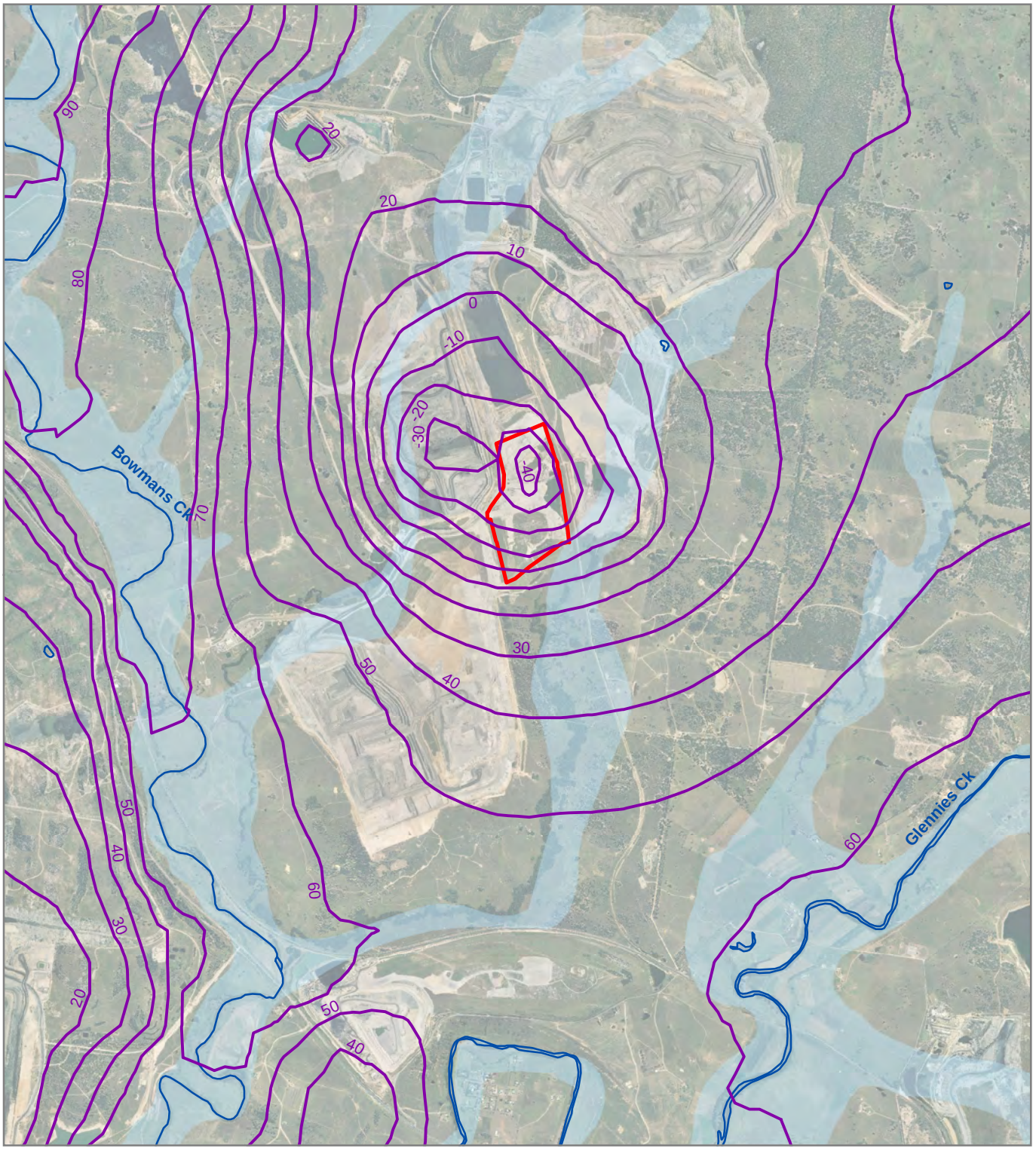
GDA 1994 MGA Zone 56




File Name: RERR GIA_Seam DDs
Prepared by: CD
Checked by: RC

SKM

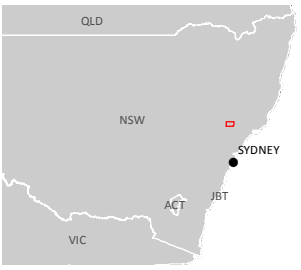
# Figure 11: Water Table at 2120 (m AHD)




**LEGEND**

- Potentiometric Surface
- Quaternary Alluvium
- Surface Water Features
- RERR Mining Area

0 1.2
Kilometres






GDA 1994 MGA Zone 56

File Name: RERR GIA_Seam Contours_2120
Prepared by: CD
Checked by: RC

SKM

# Attachment A

## Numerical Groundwater Modelling for the Ravensworth East Resource Recovery Project

The information provided here is intended to augment and update information in the Ravensworth East Resource Recovery (RERR) Groundwater Impact Assessment report (SKM, December 2012) and should be read in conjunction with that report.

## A1. Model Confidence Level Classification

The *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012) defines model confidence level classification as a means of rating models according to the confidence with which they can be used as a predictive tool. The classification depends on a number of factors including:

- The amount and quality of data on which the conceptualisation and model calibration are based,
- The manner in which the model is calibrated and the accuracy of the calibration,
- The objectives and requirements of the investigation, and
- The manner in which the predictions are formulated.

At the model planning stage it is important to decide and document an appropriate target confidence level classification that reflects the modelling objectives and expected modelling procedures and takes account of the project scope and environmental setting. In this case the salient aspects of the project that are likely to control the confidence level classification are:

- The level of expense associated with mine dewatering and water management infrastructure and the potential environmental consequences of adverse impacts suggests that a high level of confidence in model predictions is desirable.
- The amount and quality of regional hydrogeological data (including local scale geological information at the mine site) available for the study provides a basis for conceptualisation of the local hydrogeological regime appropriate for the model objectives.
- Calibration of the regional scale groundwater model is hindered by poorly defined historical mine operation records prior to 1980, particularly for mines to the west of Bowmans Creek, and by poor surface water records that restrict estimates of potential baseflow to surface water and connected groundwater (i.e. alluvial) sources. In the vicinity of the RERR mining area however, mining history and groundwater level records are well-documented.
- There are no available records of groundwater inflow rates to existing and historical mining operations suitable for calibration purposes. Accordingly calibration has been limited to matching groundwater heads.
- The *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012) provide guidance on the appropriate confidence level classification for various modelling objectives, and it recommends a Class 2 model for mine dewatering evaluations.

Given these issues and in consideration of the key indicators of model confidence level classification as described by the *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012), the regional scale groundwater model used for the RERR assessment is considered to have attained a Class 2 (medium confidence) status, as summarized in **Table A1**. **Table A1** also indicates there are aspects of the model that comply with Class 3 requirements. Critically, the level of information available prior to 1980 limits the ability to quantify cumulative impacts on the hard rock aquifer and forestalls the accurate inclusion of pre-1980 mining activities in the area, which included significant underground operations.

- **Table A1 – Assessment of Model Confidence Level Classification**

| Indicator | Confidence Level Classification (Class) |
|---|---|
| Amount and quality of data | 2<br>(limited information prior to 1980) |
| Calibration methodology and accuracy | Alluvium = 3<br>Hard rock = 2 |
| Prediction formulation | 3<br>(stochastic methodology) |
| **Overall classification** | **2** |

A Class 2 model is considered suitable for providing estimates of dewatering requirements for mines and excavations and the associated impacts and prediction of impacts of proposed developments in medium value aquifers (Barnett et al., 2012). Additional confidence in model predictions (and an increase in confidence level classification) can be expected should additional calibration or validation data be obtained in the future.

The scope of the RERR project, comprising the deepening of an existing open cut pit within a region already significantly impacted by existing open cut and underground mining activities, places specific requirements for an assessment of the incremental impacts of the proposed mining operations within the context of the cumulative impacts of mining in the region. In this regard the confidence with which the predictions of incremental impacts can be viewed are greater than the overall model rating as the potential uncertainties related to impacts prior to 1980 (due to data limitations) are implicitly accounted for in the evaluation approach.

The stochastic methodology (described in **Section A3**) adopted for model calibration and predictive scenarios, provides an indication of the sensitivity and uncertainties associated with key hydrogeological parameters (e.g. hydraulic conductivity, recharge, etc.). This approach has resulted in an explicit representation of predictive uncertainty for estimates of both mine inflows and the associated impacts on nearby alluvial aquifers and surface waters.

For impacts to shallow, alluvial systems with high inherent importance, a Class 3 model should be developed, if possible. For the alluvial systems of the *Hunter Unregulated and Alluvial Water Sources* in this area there is sufficient information, at a time-scale commensurate with source response, for a Class 3 classification of the model to be appropriate. In particular, the

stochastic calibration methodology applied to observed groundwater levels in the alluvial systems is appropriate for a Class 3 classification.

# A2. Groundwater Model Design

## A2.1 Model Description

The regional scale model is based on the existing model for the Ravensworth Underground Mine (RUM; MER, 2011b) extended to the north and east to include the Liddell, Mt Owen Complex and Glendell mines. The model was created using the Groundwater Vistas pre-processor with the MODFLOW-SURFACT (Version 4.0) finite difference code (Hydrogeologic, 2011) to allow for saturated and unsaturated conditions. A MODFLOW-based model was chosen because it is well documented and widely used program, and is often used for open-cut and underground mining projects.

MODFLOW-SURFACT was chosen for the following reasons:

- The dewatering and re-saturation of rock and fill material is a major consideration for model simulations. Although not intending to accurately depict the unsaturated flow processes, the variable saturated flow options within MODFLOW-SURFACT add numerical stability to the de-saturation and re-saturation cycle that is likely to occur in and around the mining operations represented in the model.
- MODFLOW-SURFACT package has an automatic time stepping routine that allows for the calculation time increments to increase or decrease depending upon how many iterations are required to find a solution. This package has been shown to improve numerical stability when applied to mine dewatering applications.
- MODFLOW–SURFACT allows for time-varying material properties (TMP1 package), which is important for replicating the changes to hydrogeological parameters as a result of mining and placement of backfill.

As part of the conceptualisation and construction of the model, the following processes were not included:

- Private bores and any associated pumping;
- Flooding events or high river stage recharge; or
- Calibration to baseflow.

These processes were not explicitly included due to lack of available data or because they were assumed to represent relatively minor influences on the groundwater regime with respect to the modelling scope and objectives.

## A2.2 Model Domain

The model extent measures 20.5 km in the north-south direction and 27.4 km in the east-west direction, with the model origin (southwest corner) located at 305000 Easting and 6400000 Northing (GDA94 MGA Zone 56). Grid cells are 100 m by 100 m, resulting in a model grid of

205 rows and 274 columns. Model cells were designated inactive in areas were coal seams belonging to the Vane Subgroup were not present, such as in the northwest and southeast corners of the model domain and north of the Hunter Thrust. In total the model contains 676,533 active cells.

## A2.3 Model Layers

The model includes 20 layers representing stratigraphy from the ground surface down to the Saltwater Creek Formation, with a description of each model layer provided in **Table A2**.

- **Table A2 – Model Layers**

| Layer | Name | Description |
|---|---|---|
| 1 | Alluvium | Alluvial deposits surrounding the major rivers. |
| 2 | Alluvium/Regolith | Basal Alluvial sediments surrounding the rivers and Regolith (weathered rock) elsewhere. |
| 3 | Overburden | Everything between the base of weathering and the top of the Bayswater Seam, can include seams, but mostly sandstone, claystone and/or siltstone. |
| 4 | Bayswater Seam | All the Bayswater Seams. Includes the upper Bayswater 1, upper Bayswater 2 and Lower Bayswater at Liddell. Also includes interburden between these seams. |
| 5-6 | Interburden | Everything between the base of the Bayswater Seam and the top of the Upper Pikes Gully Seam, includes Lemington Seam. |
| 7 | Upper Pikes Gully Seam | Upper Pikes Gully Seam. |
| 8 | Interburden | Everything between the base of the upper Pikes Gully Seam and the top of the middle Pikes Gully Seam. |
| 9 | Middle and Lower Pikes Gully Seam | Everything between the top of the middle Pikes Gully Seam and the base of the lower Pikes Gully Seam, includes interburden between the two seams. |
| 10 | Interburden | Everything between the base of the lower Pikes Gully Seam and the top of the Arties Seam. |
| 11 | Arties Seam | All the Arties Seams. Includes the Arties A, Arties B, Arties L1 and Arties L2 at Liddell. |
| 12 | Interburden | Everything between the base of the lower Pikes Gully Seam and the top of the Arties Seam. |
| 13 | Liddell Seam Sections A & B | All the Liddell Seams in Sections A and B. Includes the Liddell A1, Liddell Parting, Liddell B1, upper Liddell B2 and lower Liddell B2 at Liddell. Also includes interburden between these seams. |
| 14 | Liddell Seam Section C | All the Liddell Seams in Section C. Includes the upper Liddell C1, lower Liddell C1 at Liddell. Also includes interburden between the two seams. |
| 15 | Liddell Seam Section D | All the Liddell Seams in Section D. Includes the upper Liddell D1, lower Liddell D1 at Liddell. Also includes interburden between the two seams. |
| 16 | Interburden | Everything between the base of the Liddell Seam Section D and the top of the Barrett Seam. |
| 17 | Barrett Seam | All the Barrett Seams, including the Barrett A, upper Barrett B, middle Barrett B, lower Barrett B, Barrett C1, Barrett C2 and Barrett D seams. Also includes interburden between these seams. |
| 18 | Interburden | Everything between the base of the Barrett Seam and the top of the Hebden Seam. |
| 19 | Hebden Seam | All the Hebden Seams. Includes upper Hebden and lower Hebden at Liddell. |

| Layer | Name | Description |
|---|---|---|
| | | Also includes interburden between the two seams. |
| 20 | Saltwater Creek Formation | This layer represents the basement below the Hebden Seam, its upper part is composed of the Saltwater Creek Formation. |

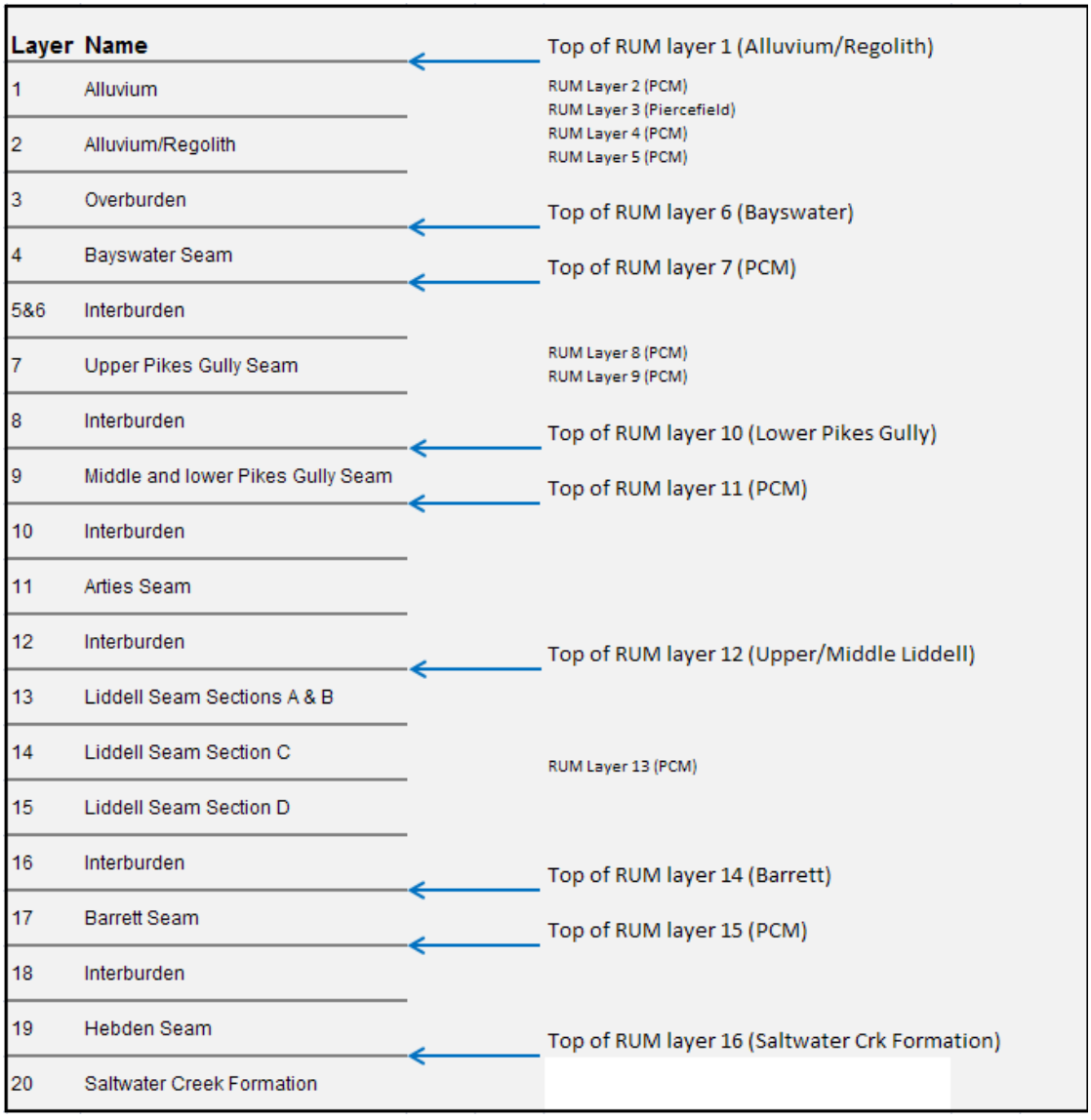
A number of assumptions were made to create the surfaces that define the tops and bottoms of the model layers.

- For all areas outside the extents of Light Detection and Ranging (LIDAR) remote sensing data provided by XCN, the top of layer 1 (which represents the ground surface) is based on a 25 m digital elevation model (DEM) obtained from NSW Land and Property Information.
- Alluvial deposits are included in the uppermost layer of the model. In areas where alluvial deposits are present the thickness of the top model layer varies from 10 m in the upper reaches of Bowmans, Bayswater and Glennies Creeks, to 30 m along the Hunter River. These alluvial thicknesses are based on Probert and Stevenson (1970) and Beckett (1987) and represent the maximum thicknesses of alluvial sediments beneath the alignment of the rivers and creeks. The alluvium thickness was set to 1 m along the boundaries of the alluvium extent. This extent is based on the analysis of the latest available LIDAR data (personal communication with Col Mackie). Outside the areas where alluvium is present the top model layer is uniformly 1 m thick.
- Layer 2 of the model represents some areas of alluvial sediments within the river valleys and regolith elsewhere.
- The tops and bottoms of the model layers that represent the coal measures and interburden strata were based on surfaces from the Liddell Minescape Geological Model, the Ravensworth \ Glendell geological model, and the Mt Owen geological model. Beyond the XCN mine extents (Liddell, Ravensworth, Glendell and Mt Owen), layer elevations from the original RUM model (MER, 2011b) were used where correspondence exists between the RUM and regional scale model layering. The correspondence between the RUM model layers and the regional scale model layers is summarized in **Figure A1**.
- The subcrop locations for the individual seams are not known with accuracy outside the Liddell and Mt Owen geological models. The Bayswater Seam was assumed to subcrop where the Jerrys Plain Subgroup does, while the Pikes Gully, Arties, Liddell, Barrett and Hebden Seams were assumed to subcrop where the Vane Subgroup subcrops. The subcrop of the Jerrys Plain Subgroup and the Vane Subgroup were located according to the Hunter Coalfield Regional Geology map (NSW Dept of Mineral Resources, 1993).
- The top of RUM model layer 10 (Lower Pikes Gully Seam) was assumed to be the top of the Middle Pikes Gully Seam in the regional model. This assumption is reasonable to the south of Liddell Coal Operations (LCO) where the difference is less than 4 m, though it is recognized that greater discrepancies may occur further to the south.
- The division of the Liddell Seam between Sections A & B, C and D was based on their elevations at LCO. These seams separate further to the south of LCO, meaning that in the

southern part of the model the three layers representing the Liddell Seam may incorporate significant thicknesses of interburden. In order to account for this stratigraphy lower hydraulic conductivity values are assigned to the model layers that represent the Liddell Seam in the south of the model.

- The bottom layer (basement) was assigned a constant thickness of 20 m.

**Figure A1 – Relationship between the RUM and Regional Scale Model Layers**




## A2.4 Boundary Conditions

### A2.4.1 General Head Boundaries

General head boundaries are assigned at active cells adjacent to model boundaries where the aquifer is known to extend beyond the limit of the model domain. Heads were adjusted for all

boundaries during initial calibration and sensitivity assessments to produce a reasonable piezometric surface.

### A2.4.2 River Cells

River cells are assigned to replicate the surface water - groundwater interaction of the Hunter River, Bowmans Creek, Glennies Creek and associated alluvium. The river bottom elevations are set to be 1 m below surface elevation and a uniform 0.1 m stage is assumed for all rivers.

### A2.4.3 Non-Perennial Streams

Drain cells are assigned to non-perennial streams (e.g. Yorks, Bettys and Swamp Creeks) within the model domain, with the drain elevation assumed to be 0.1 m below the ground surface elevation. The drain cell conductance is set sufficiently high not to constrain flow to these cells. Drain cells were considered appropriate representations of these non-perennial streams as their ephemeral nature indicates groundwater contributions to the streams' flow (i.e. baseflow) is likely negligible.

### A2.4.4 Wall Boundary Conditions

Structural features within the regional model domain that are known to act as horizontal flow barriers are represented in the model using the MODFLOW Wall boundary condition. Features such as the subsurface dyke and coal barrier in the southeast and east of the Liddell Coal Operations Development Application (DA) boundary are replicated in the model using the wall boundary condition. The wall cells are defined along the mapped structures and conductance values assigned according to the feature properties. There are no wall boundary conditions considered to impact directly on the RERR model predictions.

### A2.4.5 Recharge and Evapotranspiration

Recharge was applied to the upper most active hydrogeological unit at a rate consistent with the surface geology characterisation. Areas of alluvium were assigned a recharge rate between 1% and 15% average annual rainfall, and other areas were assigned recharge rates between 0.001% and 2% average annual rainfall for calibration and sensitivity assessments. Evapotranspiration rates were set to the corrected pan evaporation rate for the region (approximately 1,460 mm/yr) with an extinction depth of 2 m.

## A2.5 Regional Mining Operations

The regional scale model incorporates historic and future mining operations that have already been approved. The operational mining sequences that fall within the calibration period (post-1980) are incorporated and have a significant influence on the calibration process. Underground mining prior to 1980 is represented in the model by increased hydraulic conductivity (both horizontal and vertical) as well as increased storage properties (specific yield). The post-1980 modelling stress periods incorporate both dewatering associated with underground and open cut operations through the use of drain boundary conditions. Post-dewatering re-saturation and groundwater recovery influenced by the final voids is modelled

through the use of changing hydrogeological parameters, time varying evapotranspiration surfaces, and recharge rates.

### A2.5.1 Drain Cells

The mining operations and associated progressions included in the model come from a variety of sources and have been updated throughout the development of the model as additional information becomes available. Model representation of open cut mining operations comprises drain cells being assigned to the target seam layer and all model layers above it. For underground operations, drains are assigned to only the target seam layers. Where mining depth contour plans have been provided, drain elevations have been set to the pit floor elevation or layer bottom, whichever is higher. For areas where only the target seam(s) is known, the drain elevation is set to the bottom elevation of the target seam layer and layer bottom for layers above the target seam, where appropriate. Drain cells representing mining operations are assigned a uniform conductance of 100 $m^2$/day, a value sufficiently high to ensure water levels drop to the base of the pits when required, but low enough to prevent numerical instability.

### A2.5.2 Hydrogeological Parameters

An important feature of the regional scale model is the inclusion of changing hydrogeological parameters as a result of mining and backfill sequencing. The TMP1 package implemented in MODFLOW-SURFACT allows time-varying hydrogeological parameters to be incorporated into transient simulations. When changing the hydrogeological parameters using the TMP1 package there are two key inputs:

- The timing of the changes; and
- The multiplier to be applied to the parameter starting value.

The timing and magnitude of the changes are then tied spatially to the progression of the simulated mine operation. The areas used for the drain cells depicting mine operations were used to delineate Hydrostratigraphic Units (HSUs) within the model. HSUs are used in Groundwater Vistas to group cells so that their parameters can be changed together. The TMP1 package allows for hydrogeological parameters to be varied according to HSU zones.

Since HSUs are defined by both the timing of the change and the multiplier to be applied, many different zones are required to fully represent the aerial and vertical migration of pit growth and subsequent backfilling sequences. The changes to parameters used to replicate groundwater recovery post-mining take effect for the stress period following that which each drain cell becomes inactive. The multiplier for each HSU was calculated by dividing the new parameter(s) by the starting (i.e. calibrated) parameter(s). Backfill was assumed to have a hydraulic conductivity five times greater than the in-situ materials within the underground mining footprint.

# A3. Model Calibration

## A3.1 Monte Carlo Analysis

Calibration of the regional scale model was undertaken using Monte Carlo analysis to meet the following objectives:

- Establish datasets of model parameters that match measured groundwater levels within acceptable error limits. These parameter sets are reported collectively as the 'stochastic datasets'.
- Run the predictive simulations with the stochastic datasets to obtain an envelope of possible outcomes that also collectively represent the uncertainties associated with predictive modelling.

Model calibration using the stochastic approach employed here accounts for the inherent uncertainty associated with complex models based on many inter-related parameters. Each of the 'calibrated' datasets, or realisations that generate model results within the adopted calibration acceptance criteria, is considered equally plausible. The range of model results generated using these stochastic datasets provides a good indication of the uncertainties associated with predictive modelling. Such uncertainty analysis is important in any predictive modelling exercise and is recommended under the National Water Commission's recent *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012).

The methodology followed for the Monte Carlo analysis comprised:

- Generation of the initial datasets,
- Model simulations using each dataset,
- Comparison of model results with historical groundwater levels,
- Establish the set of stochastic datasets, and
- Run predictive simulations for both the calibrated and stochastic datasets.

The model parameters used as inputs for the Monte Carlo analysis included hydraulic properties (horizontal and vertical conductivity, specific yield) and recharge rates for the uppermost active layer in the model. The initial input datasets for the Monte Carlo analysis comprised 1,000 unique combinations of these model parameters generated automatically using a program developed by SKM. The program allows for the range of values for each parameter to be:

- Distributed as normal, log normal, random, or log random, and
- Constrained or tied to other parameters. For example, one parameter can be constrained so that it cannot exceed another parameter, or one parameter may be defined as a multiplier of another parameter (as commonly used to define a consistent level of anisotropy in hydraulic conductivity).

The generation of datasets in this method allows for flexibility in how parameters are defined and constrained, and also allows for multiple linking of parameters and constraints. For

example, the horizontal conductivity of the regolith was not allowed to exceed that of the alluvium, while at the same time the vertical conductivity of the regolith was not allowed to exceed the horizontal hydraulic conductivity of the regolith, thus indirectly tying it to the horizontal conductivity of the alluvium. These checks and constraints are important in generating datasets to ensure that datasets are not created that violate our conceptual understanding of the system (e.g. vertical conductivities exceeding horizontal conductivities, or the hydraulic conductivity of the interburden exceeding that of the coal seams).

The level of constraint for the parameter bounds was directly related to field-based and reference information available for the parameters. For instance, a comprehensive dataset is available for the range in expected hydraulic conductivity values of the coal seams and interburden material. Therefore the range in hydraulic conductivity values permitted for these layers is relatively small compared to the range permitted for the regolith and alluvium, units for which there was less site specific data available.

The ranges in parameters allowed does not necessarily reflect the expected or final values that will be selected for analysing potential inflows but are simply intended to:

- allow for a wide range of potential values and thus possibilities to be assessed through the calibration process, and
- evaluate the sensitivity and uncertainty in the parameterisation and calibration of the model.

## A3.2 Calibration Target

Amongst all the observation bores within the model domain, 104 bores were selected for use as calibration targets. Bores were chosen based on the following criteria:

- Groundwater head data were available as elevations in m AHD,
- At least three years of data were available, and
- Bores had at least ten distinct observation records.

## A3.3 Calibration Results

The 1,000 simulations performed for the Monte Carlo analysis were undertaken in parallel across a dedicated modelling server at SKM. Amongst the 1,000 simulations, the 20 realisations that best matched the target calibration data were identified and selected as the calibrated datasets. **Table A3** summarizes the stochastic range and median value of the calibrated datasets for the model parameters.

## Table A3 – Range of Model Parameter Values for Calibrated Datasets

| Parameter | Geologic unit | Stochastic Minimum | Stochastic Maximum | Median of Calibrated Datasets |
|---|---|---|---|---|
| Sy | Alluvium | 5.00E-02 | 2.00E-01 | 6.44E-02 |
| Sy | Regolith | 1.00E-02 | 1.00E-01 | 5.62E-02 |
| Sy | Interburden | 5.00E-03 | 5.00E-02 | 6.11E-03 |
| Sy | Pikes Gully Seam | 5.00E-03 | 5.00E-02 | 5.52E-03 |
| Sy | Liddell Seam | 5.00E-03 | 5.00E-02 | 5.59E-03 |
| Sy | Barrett Seam | 5.00E-03 | 5.00E-02 | 5.68E-03 |
| Sy | All other seams | 5.00E-03 | 5.00E-02 | 3.71E-03 |
| Sy | Underground workings (Pikes Gully) | -- | -- | 7.35E-08 |
| Sy | Underground workings (Hazeldene and Liddell) | -- | -- | 7.90E-07 |
| | | | | |
| Kx (m/d) | Alluvium | 1.00E-01 | 1.00E+02 | 6.25E+01 |
| Kx (m/d) | Regolith | 1.00E-01 | 5.00E+01 | 2.39E+00 |
| Kx (m/d) | Interburden | 1.00E-05 | 3.00E-02 | 4.87E-03 |
| Kx (m/d) | Pikes Gully Seam | 1.00E-03 | 2.00E-01 | 6.30E-03 |
| Kx (m/d) | Liddell Seam | 1.00E-03 | 4.00E-01 | 6.02E-03 |
| Kx (m/d) | Barrett Seam | 1.00E-03 | 5.00E-02 | 5.45E-03 |
| Kx (m/d) | All other seams | 9.00E-04 | 4.00E-01 | 8.74E-03 |
| Kx (m/d) | Underground workings (Pikes Gully) | 5.00E-03 | 1.00E+00 | 3.15E-02 |
| Kx (m/d) | Underground workings (Hazeldene and Liddell) | 5.00E-03 | 2.00E+00 | 3.01E-02 |
| Kz (m/d) | Alluvium | 1.00E-02 | 1.00E+01 | 6.25E+00 |
| Kz (m/d) | Regolith | 1.00E-02 | 5.00E+00 | 2.39E-01 |
| Kz (m/d) | Interburden | 1.00E-06 | 3.00E-03 | 4.87E-04 |
| Kz (m/d) | Pikes Gully Seam | 1.00E-04 | 2.00E-02 | 6.30E-04 |
| Kz (m/d) | Liddell Seam | 1.00E-04 | 4.00E-02 | 6.02E-04 |
| Kz (m/d) | Barrett Seam | 1.00E-04 | 5.00E-03 | 5.45E-04 |
| Kz (m/d) | All other seams | 9.00E-05 | 4.00E-02 | 8.74E-04 |
| Kz (m/d) | Underground workings (Pikes Gully) | 5.00E-04 | 1.00E-01 | 3.15E-03 |
| Kz (m/d) | Underground workings (Hazeldene and Liddell) | 5.00E-04 | 2.00E-01 | 3.01E-03 |
| | | | | |
| Recharge[1] | Alluvium | 1.00E+00% | 1.50E+01% | 9.90E+00% |
| Recharge[1] | Jerrys Plain Subgroup subcrop | 1.00E-03% | 2.00E+00% | 4.93E-02% |
| Recharge[1] | Vane Subgroup subcrop | 1.00E-03% | 2.00E+00% | 5.19E-02% |
| Recharge[1] | Saltwater Creek Formation subcrop | 1.00E-03% | 2.00E+00% | 4,47E-02% |
| Recharge[1] | Western subcrop | 1.00E-05% | 1.00E-01% | 4.16E-03% |
| [1] Percent of annual rainfall (Station # 61086) equal to 645 mm/yr (www.bom.gov.au) | | | | |

Water balance data for a representative dataset (amongst the calibrated realisations) used for the RERR modelling is summarized in **Table A4**.

- **Table A4 – Water Balance Data for a Calibrated Model Realisation**

| Model Parameter | Inflow (ML/day) | Outflow (ML/day) |
|---|---|---|
| Storage | 18.6 | 3.1 |
| General Head Boundary | 2.3 | 0 |
| River | 26.0 | 13.8 |
| Drains | 0 | 32.0 |
| Recharge | 14.1 | 0 |
| Evapotranspiration | 0 | 12.1 |
| **Total** | **61.0** | **61.0** |

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