



# Ulan Coal

## SURFACE AND GROUNDWATER MONITORING PROGRAM

### *Document Information and Revision History*

|                          |  |                        |
|--------------------------|--|------------------------|
| <b>Document Purpose</b>  | <p>To establish a detailed groundwater environmental management plan for the ongoing assessment of the groundwater resource in which Ulan Coal Mines Limited (UCML) operates its underground operations. This management plan will also define a criterion for a groundwater response plan in the event of adverse and/ or unexpected groundwater impacts resulting from the operations of Ulan Mine.</p> <p>This management plan has been developed to ensure compliance with the SMP Approval for 2<sup>nd</sup> workings for Longwall Panels West 2 and West 3 (W2W3) as issued by the Department Investment &amp; Industry – Mineral Resources on the 21 January 2009 in addition to various statutory instruments that relate to the Ulan Mine.</p> <p>This monitoring program supplements HSEC MGP 017 Environmental Monitoring Program (EMProg)</p> |                        |
| <b>Key Words</b>         | Water, Groundwater, Dewatering, Monitoring, Reviewing, Inspections   |                        |
| <b>Document Owner</b>    | Environment & Community Manager  |                        |
| <b>Approved By</b>       | Jamie Lees (Signed original on file)   |                        |
|                          | Environment & Community Manager  | Date: 12 February 2010 |
| <b>Distribution List</b> | Operations Manager (Underground)<br>Environment & Community Officer<br>Engineering Project Manager<br>Technical Services Manager   |                        |
| <b>Review Frequency</b>  | 2 Yearly   |                        |
| <b>Document Location</b> | Intranet: HSEC/Work Environment/Water Management   |                        |

| Version No | Review Date   | Review Team                 | Nature of Amendment   |
|------------|---------------|-----------------------------|---|
| 0          | August 2008   | Phil English                | Management Plan developed in accordance with the 1 <sup>st</sup> workings approval issued by the DPI for W2W3 on the 16 June 2008 |
| 1          | February 2010 | Jamie Lees<br>Cheryl Holden | Management plan reviewed and submitted in accordance with Condition 13 of SMP approval of W2 and W3 on the 21 Jan 2009            |

|   |            |   |                 |
|---|------------|---|-----------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>1 of 24 |
|---|------------|---|-----------------|



**TABLE OF CONTENTS**

**1.0 Scope..... 3**

**2.0 Objectives..... 6**

**3.0 Background..... 7**

**4.0 Water Quality ..... 10**

**5.0 Surface Water and Groundwater Monitoring, Measurement, & Goals ..... 11**

**6.0 Groundwater Management Planning ..... 12**

**7.0 Complaints Management..... 14**

**8.0 Trigger Action Response Plan..... 15**

**9.0 Training and Awareness..... 17**

**10.0 Consultation ..... 17**

**11.0 Reporting and Reviewing..... 19**

**12.0 Accountability / Responsibilities..... 20**

**13.0 Relevant documents and legislation ..... 20**

**Appendix 1: UCML PIEZOMETER REGISTER ..... 22**



## **1.0 Scope**

Ulan Coal Mines Limited (UCML) operates both underground and open cut mining operations near the village of Ulan, approximately 45 kilometres north east of the township of Mudgee.

UCML operates an extensive network of water management infrastructure assets, consisting of but not limited to water storages, the Bobadeen Irrigation System and Reverse Osmosis Plant, sedimentation and detention basins, settling and tailings ponds, drains and pumps. The purpose of this plan is to provide a defined document to monitor and review the groundwater environment relative to the Ulan Mine(s). Furthermore the purpose of this document is to establish an Action Response Plan to adverse and/or unexpected groundwater impacts as a result of UCML's mining operations.

The structure of this Groundwater Environmental Management Plan ("the Plan") is to ensure consistency with Development Consent 113-12-98, issued by the Department of Infrastructure, Planning & Natural Resources (DIPNR), Development Approval 103-5-2005 issued by the Department of Planning, Subsidence Management Plan Approval issued to UCML on the 16 June 2008 by the Department of Primary Industries – Mineral Resources and Risks identified by UCML in accordance with *HSEC STD 012 – Risk Management*. **Tables 1 and 2** summarise the relevant conditions of the consent and highlight where the various statutory elements have been addressed.

The review of this Plan has been undertaken in consultation with the Department of Water and Energy (DWE) in accordance with the requirements of the 1<sup>st</sup> workings approval as issued by the DPI for Longwall Panels West 2 West 3 (W2W3).

|   |            |   |                 |
|---|------------|---|-----------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>3 of 24 |
|---|------------|---|-----------------|



**Table 1: Checklist taken from Consent Condition 13 (DA No. 103-5-2005) (December 2005) which relates to the specific requirements for the preparation of a Water Management Plan.**

| Condition | Consent - Management Plan Conditions  | Relevant section(s) in this Mgt Plan                 |
|-----------|---|--|
| <b>13</b> | Within 6 months of this consent, the Applicant shall prepare (and subsequently implement) a Water Management Plan for the Ulan Mine, in consultation with DEC and DNR, and to the satisfaction of the Director-General. This plan must Include: | This plan and attachments                            |
|           | a) a site water balance;  | Detailed within HSEC MGP 018 – Water Management Plan |
|           | b) a Surface Water Monitoring Program;  | Detailed within HSEC MGP 018 – Water Management Plan |
|           | c) a Groundwater Monitoring Program; and  | <b>See Section 5.0 of this document</b>              |
|           | d) a Surface and Groundwater Response Plan, to address any potential adverse impacts associated with the mine.  | <b>See Section 8.0 of this document</b>              |



**Table 2: Checklist taken from Ulan Coal Mines Subsidence Management Plan Approval for Longwall W2W3 (January 2009), which relates to the specific requirements for the preparation of a Groundwater Environmental Management Plan.**

| Condition        | Consent - Management Plan Conditions  | Relevant section(s) in this Mgt Plan |
|------------------|---|--------------------------------------|
| <p><b>13</b></p> | <p>The leaseholder must submit to the Director Environmental Sustainability for approval an environmental monitoring programme (EMP) for the longwall panels which are the subject of this Approval. This programme must address subsidence impacts on:</p> <ul style="list-style-type: none"> <li>a) Surface and groundwater (quality and quantity)</li> <li>b) Aboriginal sites;</li> <li>c) Flora &amp; fauna</li> </ul> <p>The EMP must develop a response strategy for each of the above to include:</p> <ul style="list-style-type: none"> <li>a) trigger levels for subsidence impacts that require actions and responses;</li> <li>b) the procedure that would be followed in the event that the monitoring indicates an exceedence of the trigger levels</li> <li>c) measures to mitigate, remediate and/or compensate any identified impacts</li> <li>d) a protocol for the notification of identified exceedences of the trigger levels.</li> </ul> <p>This response strategy must be prepared within 60 days of this approval in consultation with relevant landholders, Department of Water and Energy and government agencies. The Groundwater EMP must be consistent with the Department of Water and Energy's <i>"Draft Guidelines for Groundwater Monitoring"</i>.</p> <p><b>Note:</b> The programme should be submitted to the Principal Subsidence Engineer at least 30 days prior to the expected commencement of extraction to enable sufficient time for the assessment of the programme. The Principal Subsidence Engineer may require the provision of further information to assist in the assessment of the programme or a resubmission of the programme if it is considered inadequate. Complex issues or the need for additional information to a resubmission of the programme may require a longer assessment period.</p> | <p>This plan and attachments</p>     |



## 2.0 Objectives

Mining activities in most operational aspects has the potential to impact on water quality both on and off site. This includes chemical, biological and aesthetic pollution to both surface water and groundwaters.

The Ulan Mine is a net surplus water management operation, with the water make of the underground operation exceeding the operational water demand. The water surplus is a direct result of the water make from UCML's underground operations.

*HSEC MGP 043 - Groundwater Environmental Management Plan* has been developed in order to supplement *HSEC MGP 019 - Water Management Plan* and *HSEC MGP 017 Environmental Monitoring Program (EMProg)* as maintained by UCML.

The objectives of this Plan are to define the required management protocols to prevent any adverse and /or unexpected impact on groundwater as a result of the operation of the mine or establish a define agreed management protocol for the management of any adverse impacts that may result from UCML's operations. The specific objectives of this plan include:

- Meet the requirements of the relevant Development Consent and Subsidence Management Plan (SMP) approval conditions regulating the operation of UCML;
- ensure the ongoing compliance with DA103-5-2005 as issued by the Department of Planning (December, 2005);
- detailing appropriate control measures to minimise groundwater impacts by UCML's mining activities;
- establishing a mechanism in the form of a Trigger Action Response Plan for addressing groundwater quality/quantity issues to adjoining or 3<sup>rd</sup> party bore owners;
- describing Groundwater Monitoring & Measurement activities;
- detailing the Review and Reporting protocols;
- establishing Responsibilities for the management of groundwater management at UCML; and
- provide a framework to review long term groundwater behaviour based on information obtained from ongoing groundwater monitoring and modelling.

|   |            |   |                 |
|---|------------|---|-----------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>6 of 24 |
|---|------------|---|-----------------|

These aims have been developed in accordance with the principles of the following key documents:

- *Protection of the Environment Operations Act 1997*;
- Draft Guidelines for Groundwater Monitoring (Department of Water and Energy);
- ANZECC 2000 Water Quality Guidelines;
- Interim Environmental Catchment Objectives; and
- CMA Catchment Action Plans and associated targets for flow and salinity; and
- Standards Australia (1998) AS 5667.11-1998: Guidance on Sampling of Groundwaters.
- *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales* (Department of Environment and Conservation, 2004)

### **3.0 Background**

Groundwater modelling as undertaken for the Ulan Mine has indicated that the operation will continue to make additional water as the mining operation continues. There are two (2) main sources of groundwater associated with the existing underground mining operations:

- Localised depressurisation of the Permian coal measure following the establishment of development panels by UCML; and
- The broader interception of groundwater within the Permian and overlying strata following the longwall mining process undertaken by UCML.

In order to address this risk, since March 2005 UCML embarked on an extensive expansion to its regional groundwater monitoring program. The monitoring from this network will provide UCML specific data on the groundwater behaviour within the Ulan Region and assist in the prediction on future excess mine water volumes and thus in turn identify the need for any additional mine water management infrastructure required in order to support the Ulan Mine.

Groundwater monitoring within and surrounding the UCML mine lease is conducted via the use of several UCML groundwater monitoring piezometer networks. The two main groundwater monitoring piezometer networks at Ulan Coal Mine comprise the Bobadeen Monitoring Network (BMN) and the North Monitoring Network (NMN).

Installation of the NMN began in 1997 with conversion of resource exploration boreholes to groundwater monitoring piezometers, but underwent expansion



between 2000 and 2001, and significant expansion in the last few years. The NMN serves the purpose of monitoring groundwater levels at relatively discrete horizons in Permian Coal Measures and Mesozoic sandstone aquifers that may be subject to potential impacts from underground mining activities within the consolidated mine lease. The monitoring data collected from the network serves to allow an assessment of the three-dimensional total hydraulic head distribution in the fractured rock groundwater system. The network underwent significant expansion in 2006 and currently comprises 51 points where groundwater total hydraulic head can be measured directly or reliably calculated (38 conventional screened piezometers and 13 VWP units), at 22 locations. Conventional screened piezometers are monitored manually on a six-monthly basis for groundwater levels and on an annual basis for groundwater quality. Pore pressure data collected at VWP installations are downloaded periodically by SCT.

The Bobadeen Monitoring Network (BMN) was installed in 2003 to monitor the impacts of irrigation of mine water on groundwater levels and groundwater quality of unconsolidated sediments within the upper catchments of the Mona Creek, Ulan Creek, and Spring Gully Creek drainage courses. Irrigation water is applied using five irrigation pivots in the northwest and central parts of the mine lease. The BMN consists of 9 piezometers installed to depths of up to 12m in residual soils and colluvium.

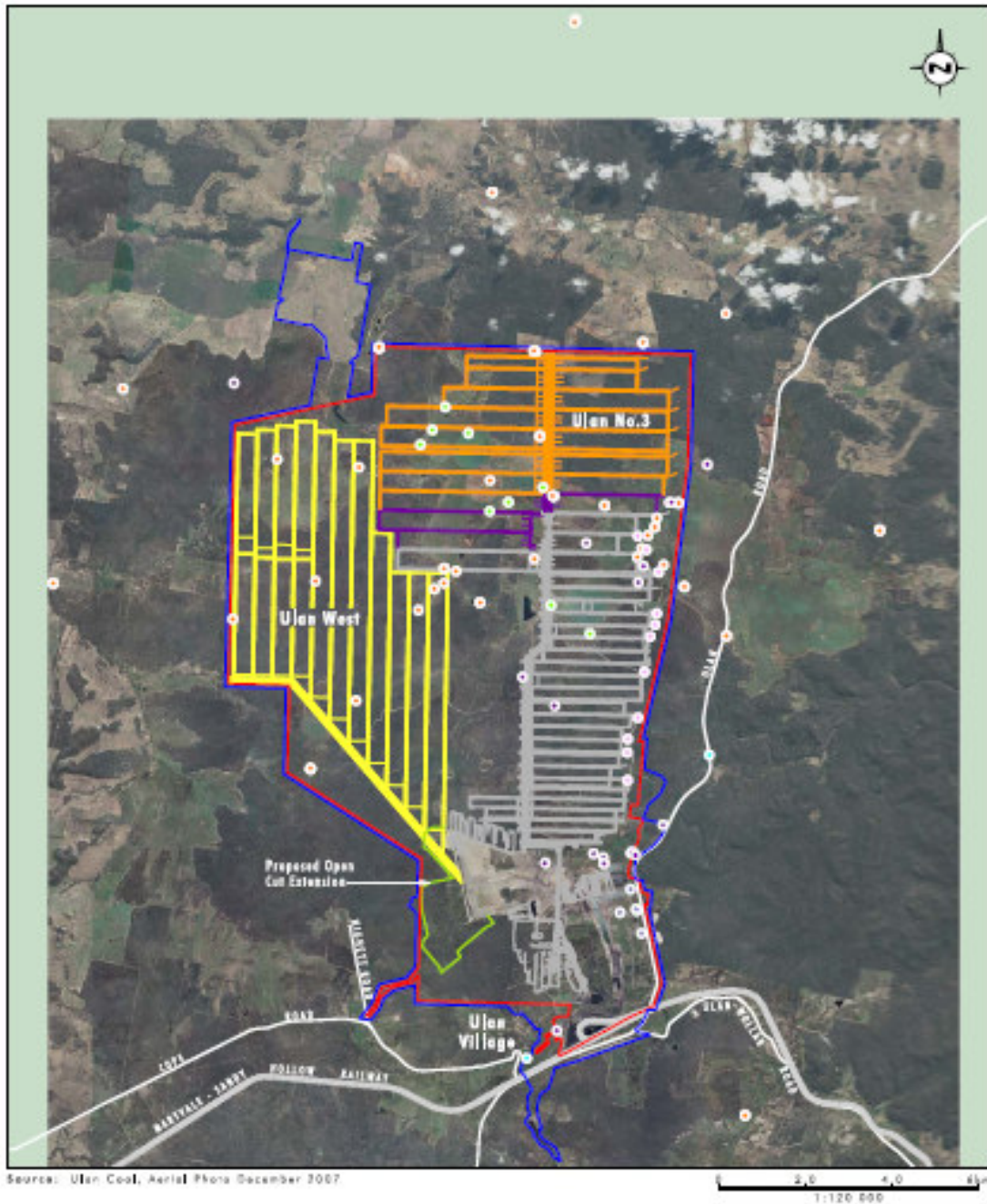
In addition to the NMN and BMN, there are three other groundwater monitoring networks at Ulan Mine as follows:

- Intermittent Monitoring Network (IMN): This network consists of 42 points where groundwater total hydraulic head can be measured directly or reliably calculated (18 conventional screened piezometers and 24 VWP units), at 20 locations (see Appendix A), screened in fractured rock or mine spoil. The IMN comprises bores or piezometers that either have been installed for specific purposes, and/or have extensive screens (and so measure a depth-averaged hydraulic head), which may be monitored intermittently for groundwater levels and quality to provide additional data to complement the NMN monitoring data to allow better understanding of more complex groundwater processes as the need arises. The IMN forms a substantial complement to the NMN and can be used to expand the NMN for specific issues as the need arise. PZ20 was installed during 2006 and, together with the Spoil Bore allows water levels in the Northwest Pit spoil to be monitored for water balance assessment purposes.
- Goulburn River and Ulan Creek Alluvium Monitoring Network (AMN): This network consists of 10 piezometers at 9 locations (see Appendix A) which are generally screened throughout the thickness of alluvium associated with the Goulburn River or Ulan Creek. They may be monitored intermittently for groundwater levels and quality to provide additional data for ongoing projects.
- Goulburn River Diversion Baseline Assessment Monitoring Network (GRDBAMN): This network was installed in 2006 as part of an assessment of the Goulburn River Diversion. It consists of 5 piezometers at 4 locations in the East Pit, and together with piezometers in the AMN, is monitored to provide groundwater level data for the alluvium, Permian Coal Measures, and East Pit spoil.

**Figure 1** details the nature of the groundwater monitoring network relative to UCML's operations.

|   |            |   |                 |
|---|------------|---|-----------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>8 of 24 |
|---|------------|---|-----------------|

*Figure 1 – UCML Groundwater Monitoring Network overview*



- Intermittent Monitoring Network
- North Monitoring Network
- Ulan Creek Flow Gauge Monitoring Network
- Bobadeen Monitoring Network
- Goulburn River and Ulan Creek Alluvial Monitoring Network
- Goulburn River Diversion Baseline Assessment Monitoring Network
- Other Network Monitoring
- Pleugers Monitoring Network

UCML maintains a comprehensive surface water monitoring program within its operation. This program is detailed within the *HSEC MGP 017 Environmental Monitoring Program (EMProg)*.

Monitoring of surface water within the SMP approved area of W2 and W3 is limited to several small stock water dams (all within UCML ownership) and ephemeral watercourses.

#### **4.0 Water Quality**

UCML maintains an extensive groundwater monitoring program supporting *HSEC MGP 043 – Groundwater Environmental Monitoring Program*. The results obtained from this monitoring indicate that overall, the salinity of the Wollar Sandstone groundwater is around half the salinity of PCM groundwater. pH results indicate a slightly basic character to PCM groundwater and a neutral character for Wollar Sandstone groundwater.

Comparison of the Wollar Sandstone groundwater quality with guidelines for the 95% protection level for aquatic ecosystems suggests the groundwater may be unsuitable for this use; however the suitability of the groundwater for ecosystem protection needs to take into account the quality of receiving surface water ways in the Ulan Mine area. The perennial water courses which drain the catchments of the mine lease are the Goulburn River to the southeast and Talbragar River to the northwest.

Water quality results also indicate that the Wollar Sandstone groundwater may be unsuitable for aesthetic uses. Discharge water from pump tests conducted in 2001 in several wells screened in the quartzose facies in the Ulan Mine area was observed to change colour from clear to orange after several hours of contact with the atmosphere.

Based on the tested analytes only (pathogens and organic chemicals have not been analysed for any samples), the data suggest that with minor treatment the Wollar Sandstone groundwater could be suitable as drinking water. The groundwater will be more likely to be suitable for agricultural and industrial uses as it exhibits relatively low dissolved solids, is relatively shallow, and of reasonable yield.

**Table 3. Overall EC and pH of Unmined Strata**

|  | <b>Wollar Sandstone</b> | <b>Permian Coal Measures</b> |
|--|-------------------------|------------------------------|
| <b>Electrical Conductivity (uS/cm)</b> |                         |                              |
| Average                                | 410                     | 845                          |
| Standard Deviation                     | 192                     | 387                          |
| <b>pH</b>                              |                         |                              |
| Average                                | 7.0                     | 8.2                          |
| Standard Deviation                     | 1.4                     | 1.4                          |

## **5.0 Surface Water and Groundwater Monitoring, Measurement, & Goals**

Water monitoring at UCML is undertaken to assess compliance against licence conditions and Consent Conditions, provide data for the management of water within the mine and to assess the impacts of the mines operations when compared against UCML imposed criteria or predictions. Further details of water monitoring undertaken at Ulan Mine are contained within *HSEC MGP 017 – Environmental Monitoring Program*.

UCML also undertakes monitoring for operational purposes which is in addition to that outlined in the various licences. This monitoring is undertaken on an “as needed” basis to assist the mine in its day to day management of its mine water operations. The frequency of monitoring and the parameters monitored for operational purposes is undertaken at the discretion of UCML.

UCML maintains a significant number of monitoring peizometers across its operation. Peizometers are maintained in consultation with NSW Office of Water, and the monitoring regime adopted for any new installation will be consistent parameters detailed in the *HSEC MGP 17 Environmental Monitoring Program (EMProg)*.

### **5.1 Regional Groundwater Monitoring**

In March 2005 UCML embarked on an extensive expansion to its regional groundwater monitoring program. Groundwater modelling undertaken from this network has been critical to UCML in developing this Management Plan.

The results of groundwater monitoring will be modelled annually in accordance with *HSEC MGP 019 – Water Management Plan* to ensure the ongoing relevance of the management plan and the controls identified and utilised for water management at Ulan Mine. It is anticipated that modelling will assist UCML in identifying additional mine water management infrastructure or deficiencies in the current system.

### **5.2 Regional Private Water Bore Monitoring**

Since 2001 UCML has been monitoring private water bores. A database of registered private water bores within 10km of the UCML mine lease has been compiled based on:

- Several searches of government records conducted since 2001;
- Three private bore surveys conducted since 2001 (comprising two inspection surveys (most recently conducted in August 2007) and one pump testing survey); and
- Consultation with bore users.



UCML will continue to monitor adjoining private bores within the 5km radius of Ulan current longwall panel on an annual basis. Monitoring will update UCML private bore database and assess potential impacts resulting from UCML's operations. The two most critical criteria that influence the risk to a private bore from mining operations are:

- The distance of the bore from mining operations; and
- The depth of the bore (and the aquifers it intersects) compared to the mined horizon.

Information on bore depths is not complete but is being acquired. In many cases access to the bore casing requires significant effort (dismantling positive displacement pump cavities, suspension of downhole pump strings after dismantling). For these reasons monitoring of private bores is conducted as a dynamic process according to the approach of mining operations and continued consultation with bore users and monitoring.

Bores potentially at risk of mining operations will be identified on a regular basis as part of the UCML ongoing continuous improvement process. Baseline monitoring comprises annual water level and quality monitoring as required. Where impacts due to mine operations are identified or suspected, UCML will consult directly with the affected bore user in accordance with the Trigger Action Response Plan as detailed within *HSEC MGP 043 – Groundwater Environmental Monitoring Plan*.

### **5.3 Surface Water Monitoring**

Surface water resources within Longwall W1 & W2 are limited to ephemeral water courses and water storage dams. No Groundwater Dependant Ecosystems have been identified in the SMP area.

Monitoring of the existing resources will occur:

- pre mining;
- during mining; and
- post mining

This monitoring aims to identify any impact from subsidence and develop any required remediation action.

UCML owns all water storage dams in the SMP area and therefore remediation (if required) of these water sources will be undertaken on an as needs basis.

## **6.0 Groundwater Management Planning**

It is anticipated that also through this process, the objectives of this Plan which are to "prevent any adverse and /or unexpected impact on surface water and groundwater as a result of the operation of the mine" will be fully addressed. The review of these long term strategies will be formulated via the following steps:

|   |            |   |                  |
|---|------------|---|------------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>12 of 24 |
|---|------------|---|------------------|

### **6.1 Ground Water Monitoring**

For the purposes of detailed monitoring, UCML will undertake a staged groundwater monitoring program of its North Monitoring Network as follows:

- On a 3 monthly basis UCML will monitor water levels within the piezometers. The monitoring frequency will be reviewed from time to time in consultation with regulatory agencies to optimise acquired data.
- On an annual basis UCML will monitor a suite of water quality parameters in addition to the water level. This suite of parameters is outlined in this management plan.

Monitoring at UCML will be undertaken in accordance with *Draft Guidelines for Groundwater Monitoring* (Department of Water and Energy), the *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales* (Department of Environment and Conservation, 2004) and Standards Australia (1998) AS 5667.11-1998: *Guidance on Sampling of Groundwaters*.

It is anticipated that this process will assist UCML determine any fluctuation or deviations in water quality or quantity within groundwater reserves for the duration of operations at site and as such determine any potential impacts that may arise of third party groundwater users. Furthermore, it is expected that this extensive groundwater monitoring program will assist UCML manage water ingress into the mine by pre-empting infrastructure needs for the management of water ingress.

### **6.2 Groundwater Model**

On an Annual basis UCML will engage a suitably qualified independent hydrologist to review and refine the UCML groundwater model predictions for short, medium and long term durations. Results of the annual groundwater modelling will be reported in the Annual Environmental Management Report for the Ulan Mine.

### **6.3 Meteorological Monitoring**

Climatic conditions (such as rainfall and evaporation) directly affect the quality and quantity of water discharges from the site. Meteorological data is collected by on-site weather stations located at Rowans Dam, Ulan Open Cut and Bobadeen) for use in impact assessment and interpretation of monitoring data. Further details on the monitoring parameters and location of these monitoring sites are detailed within *HSEC MGP 017 – Environmental Monitoring Program*. Weather monitoring generally undertaken under this management plan includes:

- Rainfall;
- Temperature; and
- Wind Speed & Direction



The station is downloaded by accredited personnel and collected data is sent to the Environment and Community Officer (ECO) on a fortnightly basis. Annual meteorological data is reported in the Annual Environmental Management Report.

In addition, weather data (including wind data) can be sourced from the Bureau of Meteorology station at the Ulan Post Office (south-west of the mine) either to verify data collected by the site weather station or to provide data coverage should data on the site station be lost (e.g. due to equipment failure).

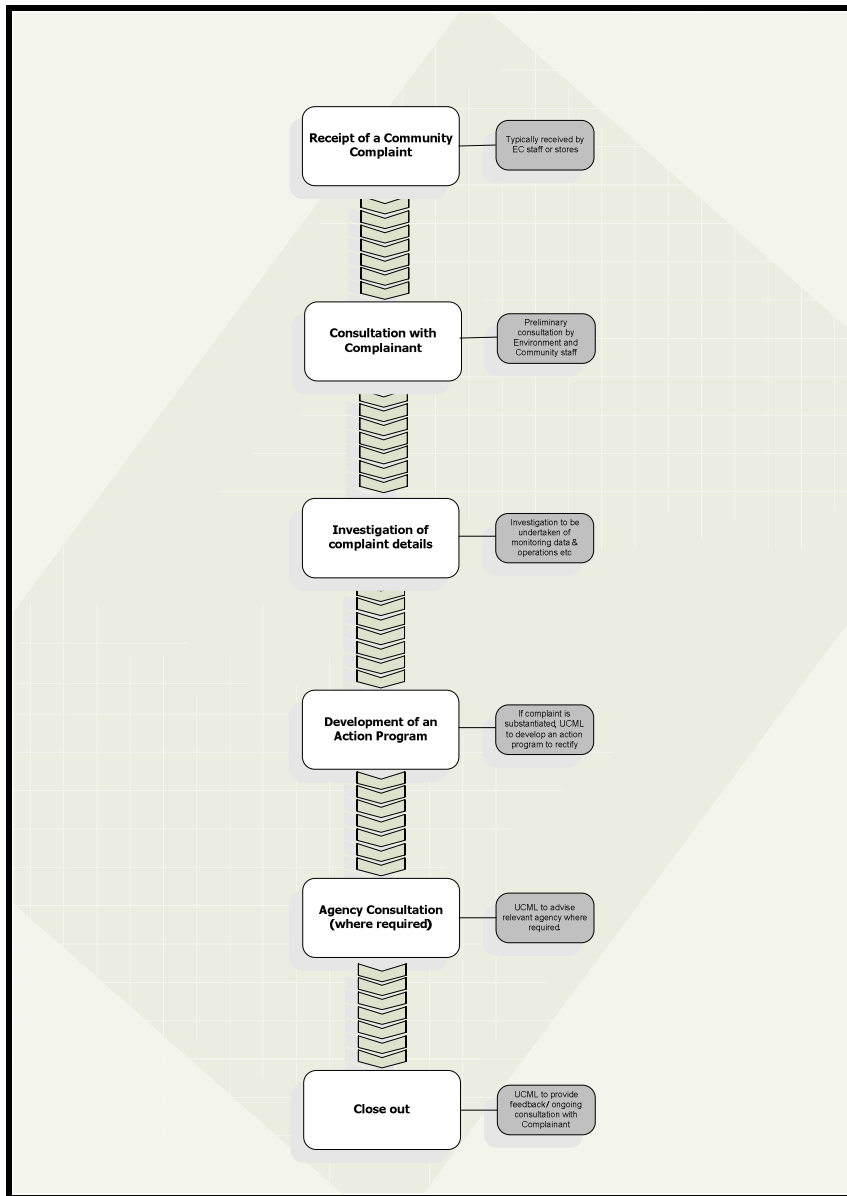
## **7.0 Complaints Management**

Community complaints management includes receipt of complaints, investigation, implementation of appropriate remedial action, feedback to the complainant as well as communication to site management or personnel and notification to external bodies, such as the DECC, where necessary. An overview of the Complaint Management process is provided in **Figure 2**.

Community complaints at UCML are managed in accordance with *HSEC-PRO-001-Complaints Procedure* which has been established to assist in the recording of complaints, complaint investigation and follow up actions. The procedure includes standard requirements for complaint management and reporting.

Details of all community complaints are reported in the Annual Environmental Management Report (AEMR) and the Annual Return for EPL 394 in accordance with UCML's external reporting requirements.

**Figure 2 – Complaint Management Overview**



## 8.0 Trigger Action Response Plan

Impacts to private water bores will be monitored on a bore-by-bore dynamic basis as follows:

Bores coming to within the zone of risk of approaching longwalls will be identified as being potentially at imminent risk. The level of risk will depend on bore depth and the distance from the workings. The monitoring frequency may be increased as risk increases. Consultation with users of bores at risk will be intensified as risk increases.

In the event UCML activities adversely impact on a surrounding landholder's water supply source(s), UCML will supplement water supplies to the impacted landholder(s).

The following Trigger Action Response Plan will be implemented at the appropriate stage for an individual bore:

**Trigger:**

Trigger levels will be assessed on a bore by bore basis. In general the following guidelines will be used

- loss of 10% or 4m of the water column, whichever occurs first, above the pump intake
- water quality deterioration (pH and EC)

**Action:**

- assess bore performance
- assess water requirements with the bore owner

**Response:**

- increased monitoring (bi-monthly)
- tanking in water supplies
- drilling a new bore
- lowering pump/ replacing

**Plan:**

- prioritise based on the needs of the owner regarding the use of the bore
- minimal timeframe of implementation of responses

The implementation of the surface water or groundwater response plan will be typically activated through the review of the routine monitoring data and the comparison of this data against regulatory or UCML imposed criteria. This process is consistent with the UCML's internal TARP process (T – trigger; A – Action; R – response; P – Plan). In the event of an abnormal or unexpected monitoring result, the following actions will be initiated:

- The Environment & Community Manager will be immediately notified;
- An investigation into the cause of the potential exceedence will commence. While it is not possible to pre-empt the scope of the investigation and / or control measures required, there are a number of general actions which may be implemented as outlined below:
- Undertake expanded sampling regime. The minimum / suggested suite of analytes for surface water/groundwater investigations are:

- Major anions and cations (Na, K, Mg, Ca, SO<sub>4</sub>, CO<sub>3</sub>, HCO<sub>3</sub>, Cl);
  - Selected trace metals/elements in particular bromide and iodine;
  - Nitrate, nitrite and ammonia; and
  - Isotopes - oxygen and deuterium - to enable the determination of source areas and mixing patterns.
- Review historical data which may indicate similar trends;
  - Investigate any potential external influence which may be affecting the results (such as seasonal climatic changes);
  - Review operations and investigate for links to operational activities eg oil spills, mechanical breakdown etc;
  - If criteria is based on a model prediction, confirm model assumptions are correct / reflect what is occurring in the mine;
  - Consultation with relevant agencies on investigation and outcomes.

## **9.0 Training and Awareness**

UCML recognises that training and awareness is an integral part of *HSEC MGP 007 - Environmental Management Strategy*. This is the means by which personnel are informed about the components of the Water Management Plan and how it is implemented on the sites. The training also includes detail on people's specific responsibilities with respect to the management of water on the mining lease.

UCML's environmental training and awareness program is defined within *HSEC MGP 007 - Environmental Management Strategy* (and more specifically in Appendix 12 – Environment and Community Training Needs Analysis). Generally training at UCML consists of induction training for new starters and contractors along with annual refresher and ongoing "toolbox" training for all permanent employees as required.

## **10.0 Consultation**

### **10.1 Agency Consultation**

For the purpose of the development of *HSEC MGP 043 – Groundwater Environmental Management Plan* and in accordance with the requirement of Subsidence Management Plan Approval as issued by the Department of Primary Industries for W2W3 (June 2008), UCML must liaise and consult

|   |            |   |                  |
|---|------------|---|------------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>17 of 24 |
|---|------------|---|------------------|

with various stakeholders, including relevant landholders, Department of Water and Energy and other various government agencies.

*HSEC MGP 043 – Groundwater Environmental Management Plan* has been developed in consultation with agencies with an interest in the management of groundwater at the Ulan Mine.

## **10.2 Community Consultation**

UCML actively encourages engagement with its various stakeholders in accordance with *HSEC MGP 035 – Social Involvement Plan*. For comprehensive details of UCML's Community engagement system, reference should be made to *HSEC MGP 035 – Social Involvement Plan*. In general, the manner in which UCML engage stakeholders is detailed below:

- Face to Face meetings upon request;
- Newsletters (internal for employees and external for adjacent residents or local community);
- Community Consultative Committee Meetings;
- Community information sheets on key environmental issues (e.g. NSW Minerals Council:
  - Fact Sheets;
  - Community education strategies including open days, participation in school excursion programs or teacher training programs, information sessions around key issues etc;
  - Seminars and presentations;
  - Web site (located at [www.ulancoal.com.au](http://www.ulancoal.com.au))
  - Annual Xstrata plc HSEC report;
  - Employee tool box talks;
  - Media statements; and;
  - Community Support Programs; and
  - Community Surveys

In accordance with the specific requirements of *HSEC MGP 043 – Groundwater Environmental Management Plan* under Subsidence Management Approval issued by the Department of Primary Industries (June, 2008) for Longwall Panels W2W3, UCML has developed a third party groundwater monitoring program as detailed within this management plan.

Monitoring will be undertaken in accordance with the detailed monitoring program established under this Management Plan with results will be presented to the landholders on receipt and externally reported via the Annual Environmental Management Report for the Ulan Mine.

## **11.0 Reporting and Reviewing**

The following section of the Plan includes the Reporting and Reviewing requirements relating to the management of water related issues at UCML.

### **11.1 Quality Assurance and Quality Control**

As a standard operating procedure and in accordance with the requirements of EPL 394, UCML will only utilise laboratories with NATA (or equivalent) accreditation for Water Quality analysis. The ongoing development of the groundwater monitoring network at UCML will be undertaken in accordance with *Draft Guidelines for Groundwater Monitoring* (Department of Water and Energy) and Standards Australia (1998) *AS 5667.11-1998: Guidance on Sampling of Groundwaters*.

Records of routine equipment calibration (eg data loggers used at certain piezometers) and testing are to be maintained with the original laboratory reports and recorded in accordance with the requirements of *HSEC MGP 007 – Environmental Management Strategy*.

### **11.2 Reporting**

All external and internal reporting is undertaken in accordance with the reporting requirements of *HSEC MGP 007 – Environmental Management Strategy* and UCML's statutory requirements.

Groundwater monitoring results are also to be reported to DWE as part of the Annual Environmental Management Report process, as required in the Development Consent and the licences.

A summary of the water monitoring, any water management issues and actions arising throughout the year will generally be presented in the AEMR. This also includes a summary of performance against the criteria, goals and predictions detailed in the Water Management Plan. A copy of the report will be distributed to the relevant regulatory agencies including DoP, DNR, DEC, DPI).

### **11.3 Review**

*HSEC MGP 043 – Groundwater Environmental Management Plan* will be reviewed and updated regularly in accordance with the Document Control provisions of *HSEC MGP 007 – Environmental Management Strategy*. This will be generally as follows:

- at least every two (2) years ;
- following the issue of new or modified approval conditions for all relevant SMP Approvals, Development Consents, Mining Leases or Licences (EPL);
- when there is a change to the mining operation such that it is likely to change the impacts related to Erosion and Sediment Control;
- the addition of new monitoring points within the groundwater monitoring network; and/or
- as otherwise directed by the Director General in consultation with relevant government agencies.

|   |            |   |                  |
|---|------------|---|------------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>19 of 24 |
|---|------------|---|------------------|

The plan will be reviewed and updated to ensure compliance with all new and existing statutory approvals and conditions relevant to the mining areas.

## **12.0 Accountability / Responsibilities**

The Environment & Community Manager (ECM) is responsible for implementation of *HSEC MGP 043– Groundwater Environmental Management Plan*, while the Operations Manager of the Underground is responsible for ensuring that adequate resources are available for the implementation of the Plan. The Manager(s) may allocate responsibility for specific tasks where necessary.

The ECM and the Environment & Community Officer (ECO) are to provide technical support to the Manager(s) for all water related issues where required.

## **13.0 Relevant documents and legislation**

The following section lists the relevant documentation as applicable to the Water Management Plan for UCML. Key relevant legislation has been noted, however a more comprehensive list is included in the register of *Legal Register* (Appendix 16) and *Legal Instruments and Other Requirements* (Appendix 6) of *HSEC MGP 007 – Environmental Management Strategy*.

### **Relevant documents**

- Umwelt (June 2007), Supporting Documentation for Variation of Environment Protection Licence 394.
- Ulan Coal Mine Limited, *HSEC MGP 007 - Environmental Management Strategy*
- Umwelt (January 2007), Water Report.
- Umwelt (2006), Water Balance Assessment Report.
- Kinhill Pty Ltd (1998) Mining Lease Application No. 80 – Development Application and Environmental Impact Statement, Ulan Coal Mines Limited;
- Environmental Protection Licence No. 394 – NSW DEC.
- GSS Environmental (2007) Environmental Risk Assessment (ERA) & Establishment of a Risk Register for the Ulan Open Cut and Underground Coal Mines.
- GSS Environmental (2005) Subsidence Management Plan Longwalls LW23-26, W1.
- Ulan Coal Mine Limited, Bobadeen Irrigation Scheme Operating Procedure

### **Relevant Legislation & Guidelines:**

- Protection of the Environment Operations Act (1997);

|   |            |   |                  |
|---|------------|---|------------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>20 of 24 |
|---|------------|---|------------------|



- Coal Mines Regulations Act (2000);
- Environmental Planning and Assessment Act (1979);
- Australia and New Zealand Environment Conservation Council (ANZECC) (2000) – Australian and New Zealand Guidelines for Fresh & Marine Water Quality;
- NSW EPA Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (2004);
- Water Management Act (2000);
- Interim Environmental Catchment Objectives (EPA);
- Catchment Management Authority - Catchment Action Plans (Hunter & Central West Catchments);
- Department of Natural Resources (April 1999), A Guide for Establishing a Groundwater Monitoring Program for Mine Sites within the Hunter Region.



**Appendix 1: UCML PIEZOMETER REGISTER**

|   |            |   |                  |
|---|------------|---|------------------|
| HSEC MGP 043<br>Surface & Ground Water Monitoring Program | Version: 1 | Effective: 12 February 2010<br>Review: 12 February 2012 | Page<br>22 of 24 |
|---|------------|---|------------------|

**THIS DOCUMENT IS UNCONTROLLED UNLESS VIEWED ON THE INTRANET**

**TABLE A1. NORTH MONITORING NETWORK**

| Piezometer Name | Screened Stratum             | Easting (mMGA) | Northing (mMGA) | Meas. Pt. Elevation (mAHD) | Ground Elevation (mAHD) | Total Depth (mbgl) | Screen Depth |           |
|-----------------|------------------------------|----------------|-----------------|----------------------------|-------------------------|--------------------|--------------|-----------|
|                 |                              |                |                 |                            |                         |                    | From (mbgl)  | To (mbgl) |
| PZ01A           | Triassic                     | 761186         | 6441552         | 534.25                     | *                       | 165                | 144          | 159       |
| PZ04A           | Triassic                     | 762140         | 6435921         | 440.74                     | *                       | 55                 | 42           | 54        |
| PZ06A           | Lower PCM                    | 755106         | 6441412         | 450.71                     | 449.69                  | 169                | 161          | 169       |
| PZ06B           | Ulan Seam                    | 755109         | 6441425         | 450.80                     | 449.78                  | 159                | 147          | 159       |
| PZ06C           | Triassic                     | 755105         | 6441437         | 450.72                     | 449.70                  | 71                 | 58           | 71        |
| PZ07A           | Lower PCM                    | 759136         | 6438002         | 502.71                     | 502.39                  | 274                | 262          | 274       |
| PZ07B           | Ulan Seam                    | 759122         | 6438005         | 502.59                     | 502.12                  | 255                | 240          | 255       |
| PZ07C           | Triassic                     | 759105         | 6438009         | 502.19                     | 501.88                  | 121                | 102          | 121       |
| PZ08B           | Permian                      | 761995         | 6437847         | *                          | 481.09                  | 265                | 170          | 265       |
| PZ08C           | Triassic                     | 762011         | 6437848         | *                          | 482.00                  | 130                | 90           | 130       |
| PZ09A           | Lower PCM                    | 758720         | 6441337         | *                          | 541.84                  | 330                | 314          | 330       |
| PZ09B           | Ulan Seam                    | 758702         | 6441339         | *                          | 541.56                  | 310                | 290          | 310       |
| PZ09C           | Triassic                     | 758683         | 6441343         | *                          | 541.04                  | 165                | 150          | 165       |
| PZ09D           | Jurassic                     | 758668         | 6441348         | *                          | 540.59                  | 80                 | 50           | 80        |
| PZ10A           | Triassic                     | 758812         | 6439393         | *                          | 513.80                  | 165                | 150          | 165       |
| PZ10B           | Jurassic                     | 758808         | 6439383         | *                          | 514.10                  | 46                 | 26           | 46        |
| PZ11A           | Ulan Seam                    | 757426         | 6435557         | *                          | 476.73                  | 175                | 160          | 175       |
| PZ11B           | Triassic                     | 757434         | 6435550         | *                          | 476.46                  | 82                 | 68           | 82        |
| PZ12A           | Lower PCM                    | 753529         | 6431711         | *                          | 571.79                  | 187                | 176          | 187       |
| PZ12B           | Ulan Seam                    | 753528         | 6431725         | *                          | 571.30                  | 172                | 158          | 172       |
| PZ12C           | Triassic                     | 753526         | 6431739         | *                          | 570.60                  | 75                 | 55           | 75        |
| PZ13A           | Ulan Seam                    | 749207         | 6440479         | *                          | 445.75                  | 73                 | 65           | 73        |
| PZ14A           | Ulan Seam                    | 766630         | 6437232         | 453.80                     | 453.37                  | 328                | 294          | 328       |
| PZ14B           | Triassic                     | 766633         | 6437221         | 454.10                     | 453.67                  | 182                | 140          | 182       |
| PZ14C           | Jurassic                     | 766637         | 6437208         | 454.56                     | 454.20                  | 56                 | 32           | 56        |
| PZ24A           | Ulan Seam                    | 763109         | 6434793         | 421.12                     | 420.78                  | 236                | 208          | 236       |
| PZ24B           | Triassic                     | 763107         | 6434783         | 420.95                     | 420.59                  | 74                 | 44           | 74        |
| PZ25A           | Lower PCM                    | 763535         | 6423746         | 431.15                     | 430.75                  | 86                 | 78           | 86        |
| PZ25B           | Ulan Seam                    | 763533         | 6423732         | 430.98                     | 430.65                  | 78                 | 60           | 78        |
| PZ26A           | Lower PCM                    | 759629         | 6448988         | 448.72                     | 448.25                  | 265                | 248^         | 265^      |
| PZ26B           | Ulan Seam                    | 759621         | 6448966         | 448.67                     | 448.21                  | 243                | 225^         | 240^      |
| PZ26C           | Triassic                     | 759613         | 6448943         | 448.33                     | 447.92                  | 130                | 60^          | 90^       |
| PZ26D           | Jurassic                     | 759605         | 6448921         | 447.97                     | 447.55                  | 22                 | 16^          | 22^       |
| PZ28A           | Triassic                     | 757722         | 6445002         | *                          | 475.43                  | 130                | 108          | 130       |
| PZ28B           | Jurassic                     | 757712         | 6445005         | *                          | 475.19                  | 44                 | 38           | 44        |
| R752            | Basalt                       | 756607         | 6436339         | 549.10                     | *                       | 46                 | 31           | 43        |
| R753A           | Triassic                     | 760299         | 6437786         | 482.12                     | *                       | 91                 | 78           | 90        |
| R755A           | Triassic                     | 761457         | 6437292         | 462.42                     | *                       | 91                 | 78           | 90        |
| DDH266          | 3 VWP Units (Various Strata) | 752760         | 6438854         | *                          | 493.50                  | 192                | 80^          | 190^      |
| DDH270          | 3 VWP Units (Various Strata) | 753643         | 6436046         | *                          | 490.80                  | 173                | 76^          | 171^      |
| DDH271          | 3 VWP Units (Various Strata) | 754574         | 6433293         | *                          | 507.63                  | 156                | 45^          | 155^      |
| R894            | 4 VWP Units (Various Strata) | 763091         | 6442209         | 489.28                     | 487.32                  | 261                | 90^          | 255^      |

\* To be surveyed.

^ To be confirmed.

Meas. Pt. denotes the water level measurement point on the piezometer casing.

AHD: Australian Height Datum.

mbgl: metres below ground level.

MGA: Map Grid of Australia (Zone 55 for Ulan Mine).

PCM: Permian Coal Measures.

VWP: Vibrating Wire Piezometer (measures water pressure).

Denotes the depth interval between the top and bottom VWP units.

**TABLE A2. BOBADEEN MONITORING NETWORK**

| Piezometer Name | Screened Stratum          | Easting (mMGA) | Northing (mMGA) | Meas. Pt. Elevation (mAHD) | Ground Elevation^ (mAHD) | Total Depth (mbgl) | Screen Depth |           |
|-----------------|---------------------------|----------------|-----------------|----------------------------|--------------------------|--------------------|--------------|-----------|
|                 |                           |                |                 |                            |                          |                    | From (mbgl)  | To (mbgl) |
| IMW01           | Residual Soil & Colluvium | 756334         | 6439529         | *                          | 468                      | 2.2                | 0.5          | 2.2       |
| IMW02           | Residual Soil & Colluvium | 756059         | 6439190         | *                          | 483                      | 3.5                | 1.0          | 4.0       |
| IMW03           | Residual Soil & Colluvium | 756630         | 6440058         | *                          | 450                      | 7.4                | 0.3          | 7.3       |
| IMW04           | Residual Soil & Colluvium | 757165         | 6439453         | *                          | 470                      | 2.7                | 0.3          | 2.6       |
| IMW05           | Residual Soil & Colluvium | 758879         | 6438205         | *                          | 483                      | 11.4               | 0.5          | 11.4      |
| IMW06           | Residual Soil & Colluvium | 757653         | 6437657         | *                          | 472                      | 7.5                | 1.5          | 7.5       |
| IMW07           | Residual Soil & Colluvium | 758087         | 6437869         | *                          | 479                      | 3.4                | 0.5          | 3.4       |
| IMW08           | Residual Soil & Colluvium | 759964         | 6434831         | *                          | 464                      | 1.1                | 0.2          | 1.0       |
| IMW09           | Residual Soil & Colluvium | 759068         | 6435489         | *                          | 470                      | 2.8                | 0.3          | 2.7       |

\* To be surveyed.

^ Ground elevations are approximate only and are to be resurveyed.

**TABLE A3. INTERMITTENT MONITORING NETWORK**

| Piezometer Name | Screened Stratum                | Easting (mMGA) | Northing (mMGA) | Meas. Pt. Elevation (mAHD) | Ground Elevation (mAHD) | Total Depth (mbgl) | Screen Depth |           |
|-----------------|---------------------------------|----------------|-----------------|----------------------------|-------------------------|--------------------|--------------|-----------|
|                 |                                 |                |                 |                            |                         |                    | From (mbgl)  | To (mbgl) |
| AB1             | Granite                         | 759202         | 6425691         | *                          | *                       | 81                 | Open Hole    |           |
| DDH57           | Triassic (previously PCM)       | 762667         | 6438731         | 522.83                     | 522.24                  | 319                | Unknown      |           |
| DDH70           | Upper PCM                       | 751762         | 6440611         | *                          | 506.79                  | 185                |              | 125       |
| DDH116          | Lower PCM                       | 758410         | 6433835         | 493.00                     | *                       | 189                |              | 178       |
| DDH242          | 8 VWP Units (Various Strata)    | 759879         | 6436920         | *                          | 522.55                  | 280                | 30           | 271       |
| DDH247          | 8 VWP Units (Various Strata)    | 761078         | 6436019         | *                          | 465.76                  | 196                | 35           | 175       |
| MW16OC          | Ulan Seam                       | 760907         | 6429779         | 397.82                     | *                       | 80                 | 65           | 80        |
| MW17OC          | Lower PCM                       | 760940         | 6429805         | 397.51                     | *                       | 103                | 88           | 103       |
| PB01            | PCM                             | 761793         | 6437858         | *                          | 478.59                  | 263                | 162          | 263       |
| PB2             | Ulan Seam and PCM               | 761011         | 6429738         | 402.73                     | *                       | 89                 | 38           | 70        |
| PB3             | Upper PCM                       | 761645         | 6430433         | 391.51                     | *                       | 109                | 43           | 90        |
| PB5             | Ulan Seam and PCM               | 760270         | 6429673         | 402.30                     | *                       | 70                 | 35           | 55        |
| PP9             | Ulan Seam                       | 760047         | 6429773         | 402.99                     | *                       | 62                 | 40           | 58        |
| PZ08A           | PCM                             | 761839         | 6437854         | *                          | 478.40                  | 263                | 166          | 263       |
| PZ20            | Spoil (Northwest Pit)           | 758748         | 6429234         | *                          | 407.42                  | 33                 | 26           | 31        |
| PZ27            | Triassic (LW12 Longwall Caving) | 759149         | 6433174         | *                          | 533.32                  | 56                 | Open Hole    |           |
| R280            | Lower PCM                       | 761721         | 6429076         | *                          | 414.80                  | 126                | Unknown      |           |
| R3007A          | Upper PCM                       | 760284         | 6429545         | *                          | *                       | 60                 | Unknown      |           |
| R3007B          | Lower PCM                       | 760284         | 6429545         | *                          | *                       | 86                 | Unknown      |           |
| R855            | 8 VWP Units (Various Strata)    | 761195         | 6436392         | *                          | 492.13                  | 264                | 44           | 265       |
| Spoil Bore      | Spoil (Northwest Pit)           | 758932         | 6429553         | 410.29                     | *                       | 42                 |              | 42        |

\* To be surveyed.

Denotes the depth interval between the top and bottom VWP units

**TABLE A4. GOULBURN RIVER AND ULAN CREEK ALLUVIUM MONITORING NETWORK**

| Piezometer Name | Screened Stratum                | Easting (mMGA) | Northing (mMGA) | Meas. Pt. Elevation (mAHD) | Ground Elevation (mAHD) | Total Depth (mbgl) | Screen Depth |           |
|-----------------|---------------------------------|----------------|-----------------|----------------------------|-------------------------|--------------------|--------------|-----------|
|                 |                                 |                |                 |                            |                         |                    | From (mbgl)  | To (mbgl) |
| GW1             | Alluvium (Goulburn River)       | 762626         | 6431948         | 390.19                     | *                       | 6.5                | 2.0          | 6.5       |
| GW2             | Alluvium (Goulburn R & Ulan Ck) | 760910         | 6429778         | 397.85                     | *                       | 5.1                | 2.1          | 5.1       |
| GW3             | Alluvium (Goulburn R & Ulan Ck) | 760872         | 6429871         | 397.16                     | *                       | 8.8                | 2.8          | 8.8       |
| GW4             | Alluvium (Goulburn R & Ulan Ck) | 760844         | 6429968         | 398.08                     | *                       | 5.5                | 2.5          | 5.5       |
| MW11OC          | Alluvium (Goulburn River)       | 759188         | 6425959         | 411.33                     | *                       | 5.0                | 2.0          | 5.0       |
| MW12OC          | Alluvium (Goulburn River)       | 759241         | 6425965         | 411.19                     | *                       | 4.0                | 1.0          | 4.0       |
| MW13OC          | Alluvium (Goulburn River)       | 759342         | 6425985         | 410.71                     | *                       | 4.0                | 0.0          | 3.0       |
| MW14OC          | Alluvium (Goulburn River)       | 758527         | 6425021         | 415.31                     | *                       | 7.7                | 0.7          | 6.7       |
| MW15OC          | Alluvium (Goulburn R & Ulan Ck) | 760906         | 6429776         | 397.84                     | *                       | 9.0                | 0.6          | 6.6       |
| MW16UG          | Alluvium (Ulan Creek)           | 758859         | 6429814         | 413.29                     | *                       | 12.5               | 1.0          | 9.5       |

\* To be surveyed.

**TABLE A5. ULAN CREEK FLOW GAUGE MONITORING NETWORK**

| Piezometer Name | Screened Stratum   | Easting (mMGA) | Northing (mMGA) | Meas. Pt. Elevation (mAHD) | Ground Elevation (mAHD) | Total Depth (mbgl) | Screen Depth |           |
|-----------------|--------------------|----------------|-----------------|----------------------------|-------------------------|--------------------|--------------|-----------|
|                 |                    |                |                 |                            |                         |                    | From (mbgl)  | To (mbgl) |
| PZ21 (MW03)     | Alluvium (Ulan Ck) | 758283         | 6430370         | 413.18                     | 412.38                  | 6.0                | 4.5          | 6.0       |
| PZ22 (MW02)     | Alluvium (Ulan Ck) | 758253         | 6430354         | 413.37                     | 412.37                  | 6.0                | 4.7          | 6.0       |
| PZ23 (MW01)     | Alluvium (Ulan Ck) | 758240         | 6430347         | 413.49                     | 412.57                  | 5.8                | 4.3          | 5.8       |

**TABLE A6. GOULBURN RIVER DIVERSION BASELINE ASSESSMENT MONITORING NETWORK**

| Piezometer Name | Screened Stratum          | Easting (mMGA) | Northing (mMGA) | Meas. Pt. Elevation (mAHD) | Ground Elevation (mAHD) | Total Depth (mbgl) | Screen Depth |           |
|-----------------|---------------------------|----------------|-----------------|----------------------------|-------------------------|--------------------|--------------|-----------|
|                 |                           |                |                 |                            |                         |                    | From (mbgl)  | To (mbgl) |
| PZ15            | Ulan Seam                 | 760897         | 6428948         | 401.95                     | 400.93                  | 67                 | 57           | 66        |
| PZ16            | Alluvium (Goulburn River) | 761028         | 6428445         | 403.55                     | 402.38                  | 30                 | 8            | 15        |
| PZ17            | Ulan Seam and Below       | 761152         | 6427929         | 410.16                     | 409.19                  | 52                 | 30           | 51        |
| PZ18            | Ulan Seam                 | 761029         | 6428498         | 403.39                     | 402.27                  | 42                 | 32           | 40        |
| PZ19            | Spoil (East Pit)          | 760653         | 6428409         | 406.74                     | 405.65                  | 42                 | 32           | 40        |