8 MINE MANAGEMENT

8.1 Ground Control Management

8.1.1 Geological Information

Background

The Anglesea Mine is located in an early Tertiary age sedimentary formation; near the coast of Bass Straight.

The major formations at the Anglesea Mine are the Eastern View (Paleocene) and Demons Bluff (Eocene) Formation. General characteristics of the area are marine silts, fine sands clays with fluvial gravel sand, clay and brown coal.

The mining sequence is up to 140 metres thick and hosts two potential seams of brown coal. The Upper Seam is being mined at present and generally exhibits a close to flat dip in the current mining area. The Lower Seam is made up of three separate coal seams, separated by layers of inter-seam clay.

The overburden material consists of fine sands, silty sand, silty clay and clayey silts. The overburden is approximately 70 metres thick and exhibits soil like characteristics.

Material Characteristics

Material characteristics and properties have been derived through limited testing and back analysis of events. Based on Coffey Mining work in 2009, the typical soil profile (used for back analysis of the south-west wall) is representative only of the south-west wall region; however it does give an idealised view of the material layers that may occur in other areas of the mine.

Slope Design

From 1979 there has been an adopted slope design that has been modified based on mining experience and this design is shown in Table 1. The information contained in Table 1 summaries the slope design into batter angle, berm width, batter height and intermediate angle.

Verification

Verification is a process whereby periodic reviews are undertaken to ensure compliance with the design. Verification is undertaken on a regular basis, through tasks such as: prism monitoring, Piezometer and inclinometer monitoring/readings, rain gauge and visual inspections.

Every six months, an external geotechnical engineering consultancy is tasked in ensuring that the geotechnical aspects of the mine are being followed. A GCMP (Ground Control Management Plan) sets out the requirements in regard to ground control and geotechnical issues at the mine. A copy of the current GCMP is included at Appendix F.

8.2 Assessment of Risk

Introduction

Although separated here for clarity, the process for ground control within the Anglesea Mine combines geotechnical and hydrogeological risks. In many cases, the effects of one will not be independent; and should not be treated as such. A change in hydrogeological equilibrium will have consequences on the geotechnical stability.

Geotechnical – Risks

A geotechnical risk can be described as a hazard, relating ground control, being identified and rated in accordance with a recognised system. At Anglesea Mine, there is a process outlined within the GCMP to rate hazards according to their consequence and likelihood.

Hydrogeological – Risks

A hydrogeological risk is similar to a geotechnical risk, in terms of rating and classification. However, a hydrogeological risk pertains to issues such as: ground water changes, dewatering, aquifers and rain fall interaction.

Risk Control

The control of risks is realised through procedures highlighted in the GCMP. The procedures, summarised below, are designed to facilitate the reduction of risk.

Geotechnical Hazard

Before a risk is created, a hazard must first be present. A hazard is identified through a variety of means; this/these range/s from analysis of technical data to visual inspections.

8.3 Risk Assessment Process

After a hazard has been identified, it will be evaluated on a number of parameters. These parameters are based on the likelihood of the hazard becoming an event and the consequences thereof.

The reduction of risks is achieved through lowering the likelihood and/or consequence. The procedure is specific and requires the user to initiate controls through a hierarchy to attain the required reduction of risk.

Risk Mitigation at Anglesea Mine

The current GCMP has outlined a process that formalises the hazard, risk assessment and reduction process. This process is open to all geotechnical risks, for which hydrogeological risks are included, and is to be filled out when any data analysis and/or observation has been made and a hazard is identified.

Risk Register – Site Geotechnical Log

The Site Geotechnical Log is a register that contains a summary of all the geotechnical issues around the mine. As described above, this log is a working document and provides a close out facility for the reconciliation of hazards and related risks.

8.4 Risk Controls

Described above is the process for identifying and documenting hazards and rated risks. The controls put in place at Anglesea Mine are tools that enable constant monitoring of the geotechnical and hydrogeological issues; at frequencies that are determined on past experience at the mine and industry practices.

In the GCMP there is a comprehensive review of the monitoring and reporting undertaken at Anglesea Mine. Listed below is a summation of the process and monitoring systems in place. For further information regarding frequency and data analysis requirements, including reporting; the GCMP must be consulted.

8.4.1 Geotechnical Control

Monitoring

There are numerous geotechnical monitoring and analysis processes in place at Anglesea Mine.

Survey Prisms – Prisms are located throughout the mine and are survey at regular intervals. Prism data is used for long trend analysis and for highlighting any changes in movement with respect to both magnitude and vector.

GPS Monitoring Pins – Outside the normal survey area, GPS Monitoring Pins provide coverage to areas where normal survey is difficult. GPS data is similar to Survey Prism data, although often not as accurate.

Inclinometers – Inclinometers are used to measure lateral displacement within boreholes drilled into a slope.

Inspections

Brief visual inspections on a daily basis and detailed analytical inspections at regular intervals are undertaken at the Anglesea Mine. These inspections are recorded and any issues highlighted and moved to the Site Geotechnical Log.

Hydrogeological Control

Piezometers – Piezometers are installed and monitored throughout the Anglesea Mine. Piezometers are used for determination of the ground water level; showing rises and falls within the ground water over time.

Rain Gauges – Rain gauges are used to show rainfall amount; and should be read in conjunction with Piezometer data.

Design Control

The following are non exclusive to either geotechnical or hydrogeological categories; with these controls utilising both forms of data interacting. (should the following then be noted as subsets of this?)

Design Studies

Design studies, often conducted by external geotechnical consultants, are used to provide verification to the current processes being used.

Stability Analysis

In line with the above, stability studies are often used to model areas of concern where a potential for an event to occur is significant. Stability analysis has been undertaken at Anglesea Mine and is a process undertaken in advance of mining development in new areas.

Reviews

External inspections of geotechnical operations at the Anglesea Mine are undertaken by an external Geotechnical Consultant. These inspections are undertaken at a regimented six monthly basis, and on a as needs basis for any other geotechnical issue.

Ongoing Geotechnical Issues – South Wall

The south wall has been the subject of considerable design analysis, regular monitoring and management of the ground movement in that particular area. The area has also been an area of interest to the Department of Primary Industries (DPI) and is currently being managed as per recommendations from the geotechnical consultant and as agreed to with DPI. Essentially, the management method has called for cessation of coal extraction in the area and the placement of a significant toe buttress arrangement at the base of the batter in the area of concern. Monitoring has been increased in scope across the area and will continue to determine the outcome of this strategy before going back to DPI with results or an alternative strategy for clearance of the area.

GPS monitoring has been extended further back from the face to determine any deep seated movement issues. Other additional points have been established further west along the batter at various distances from the crest to enable base monitoring of an area prior to the progression of mining adjacent to those GPS sites. This work will ensure continuity of monitoring as mine progresses and allow specific risk minimization strategies to be deployed and monitored on an ongoing basis.

Historical Data

The current Anglesea Mine has been operating since 1960's. Through that period, there has been an understanding gained of the local geology, batter and slope performance, leading to a higher level of geotechnical and hydrogeological understanding. Using historical data in a current context is common and this experiential learning over a long time period is a very important part of the design process. Table 8.1 below sets out the development of certain slope design parameters over time and is a blend of experience and technical recommendations.

Table 8.1 Historic Slope Design, Anglesea Coal Mine

Summary of Overburden Slope Design Parameters, Recommendations & Measurements		Anglesea Coal Mine (1979-1997)	BFP Consultants (1997)	Anglesea Coal Mine (1997 - 2005)	Anglesea Coal Mine Present	2009 Survey	
						Re-entrant No 1	Re-entrant No 2
Batter Angle	Above Haul Road	37	25	30	30	24.3	26
	Below Haul Road	45	45	45	33.7	42.3	34.2
Berm Width	Above Haul Road	5m	5m	Varies	Varies	8.5 & 11.8m	8m
	Below Haul Road	5m	5m	5m	Nil*	3m (silted)	6m
Batter Height	Above Haul Road	12m	12m	Varies	Varies	5, 14 & 18m	12 & 14m
	Below Haul Road	12m	12m	Varies	Varies	13 & 20m	34m
Intermediate Angle	Above Haul Road	29.7	21.3	21.3	21.3	19.5	23.2
	Below Haul Road	35.2	35.2	35.2	33.7	42.3	34.2

Notes:

1. 1979 design for upper batters was for 5m berms spaced at 12m vertical intervals, graded to run water at 1 in 125. Batter angle was 1 in 1⅓ or ~37°. The grade was later steepened to 1 in 100.

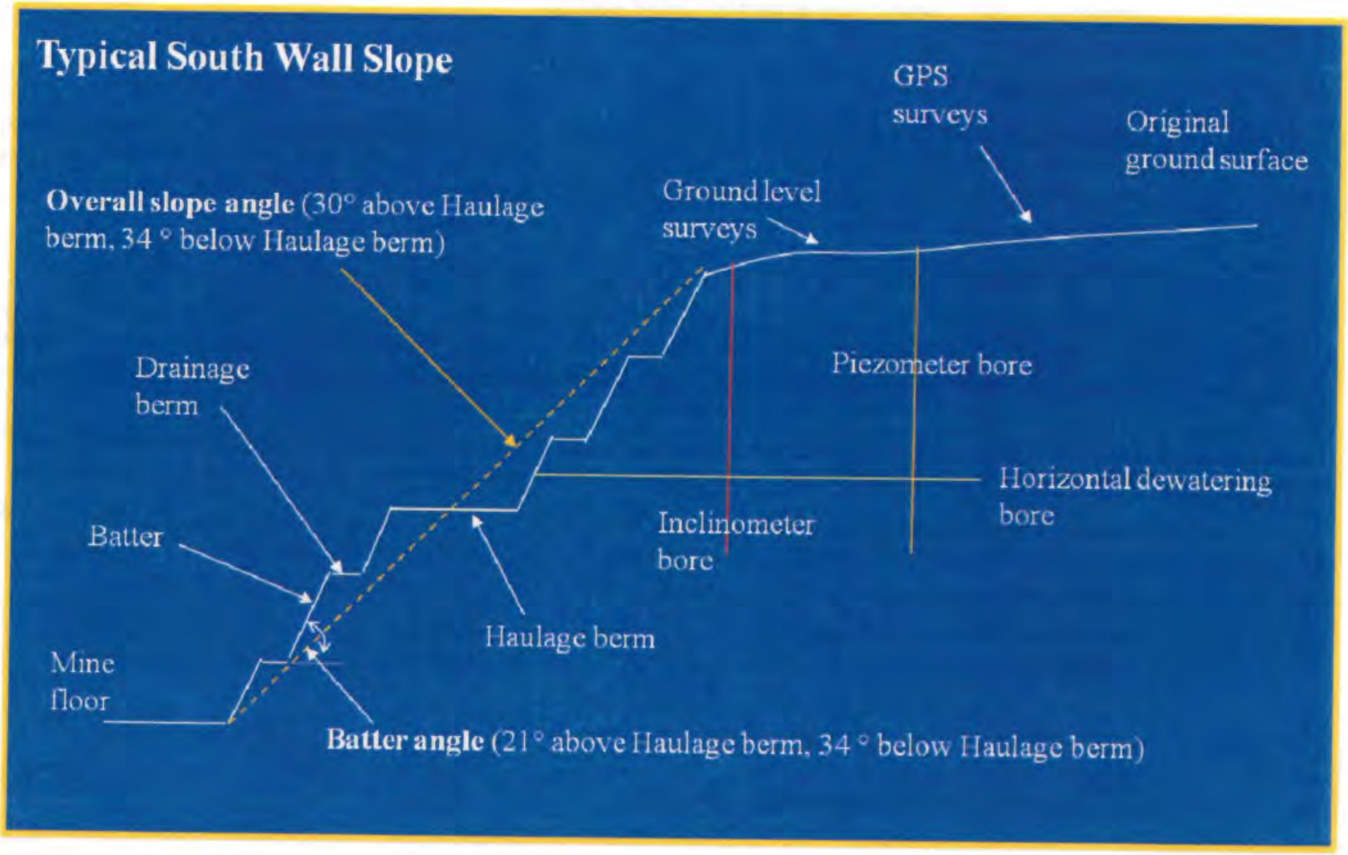
2. At some stage, the grading was reversed to run water to the west. This combined with the varying lengths of the berms resulted in vertical spacing necessarily departing from the original 12m.

3. As a practical result of the BFP Consultants recommendations, a uniform batter angle of 30° was adopted, and the berm was made variable (that is, greater than 5m) to enable an overall batter angle <25° to be achieved as the height varied with the natural surface topography.

4. In 2005 it was decided to reverse the drainage direction of the haulage berm again. This was achieved by placing fill on the western end of the berm. It was felt that this was safe as there would still be no significant amount of clay below the berm.

5. It was found impractical to maintain drainage on the berms below the haulage level. The resulting batter erosion could be effectively repaired as the natural angle of repose of local material is flatter than the 45° batter angle. A slope of 1 in 1.5 or ~33.7° was adopted for planning purposes.

Figure 13.



8.5 Soils Management

Soil management is seen as a critical element of the mine rehabilitation process and is outlined in more detail in the Mine Rehabilitation section of this plan. Essentially, topsoil contains much of the seed required for species return on newly rehabilitated areas and as such, is generally directly transferred from the strip area to the rehabilitation area, as stockpiling will decrease seed viability. Subsoil, both rhizome and rhizome-free layers, can be stockpiled as seed is not present in these layers.

Generally there is currently little need for stockpiling of materials on the mine site and this is anticipated to be the case into the future. Non-rehabilitation stockpiling is usually associated with road making materials, again on a limited basis.

8.6 Water Management

Mine De-watering System

Mine drainage from rainfall and groundwater is currently managed through a series of drainage berms, temporary holding sumps and constructed drains to manage water to the main sump area located at the lowest point in the current operational area in the mine site. This location of the main sump varies over time and this will likely be the basic concept used in the future mining stages. Water is then pumped from the main sump to holding pondages adjacent to the mine, and is used as either mine fire service water or as make up water used in the adjacent power station.

Surface Water

Surface water is generally prevented from entering the mine area in an attempt to minimize subsequent management issues, such as erosion and additional pumping. Where this is not possible, provision must be made for erosion and other management control issues.

Mine Fire Service System

The current mine fire service system is based around an elevated holding dam (Fire Service Dam) located to the north of the current mining area. The fire service dam is filled with water pumped from the mine dewatering system and is at sufficient elevation to provide enough gravity head pressure to act as the emergency fire service ring main for the mine buildings, including the mine workshop, lunch room, amenities and offices. The water is also used for equipment wash down purposes and for use by the water cart for dust suppression and general fire fighting purposes.

An alternative Fire Service System arrangement will only need to be made when Stage 6 of the mining sequence is approached. Further design and planning will be required when this eventuates.

Discharge Points

All discharge points are currently covered by an approved EPA licence and any additional future discharge points will need to be covered by similar EPA licensing.

8.7 Road and Stream Infrastructure

Approvals

Approvals for any modification works to the adjacent stream systems will need to be sought from Southern Rural Water and no works can be undertaken prior to gaining that approval.

Waterway Diversions

Prior to coal mining by Alcoa, starting in 1969, Salt Creek was diverted through a constructed diversion channel to the north. The works were to enable continuity of access to coal reserves that were located under the wide valley section of Salt Creek, just prior to the stream meeting Marshy Creek. The combined flow from the creeks then continues through Anglesea as the estuarine Anglesea River.

As mentioned previously, there is a possibility of either having to re-divert the current diversion channel as part of the mine sequencing Stage 3 or to provide some type of adequate crossing that recognizes both peak creek flows and the size of equipment that would be required to use the crossing. The latter proposition would be required in the event that Stage 3 was abandoned and work continued through Stages 4, 5 &6. A similar crossing currently exists across Marshy Creek as part of the coal haul road system that links the mine to the Primary Crusher.