Technical Review Board

Our Ref: TRB.L26

26 June 2012

Mr J Mitas
General Manager
Minerals and Extractive Operations
Department of Primary Industries
Level 16, 1 Spring St
Melbourne Victoria 3000

Dear John

TRB Recommendations RE: PSM Hazelwood Northern Batter Movement Report

Please find attached the TRB's Recommendations to the Minister arising from of it's review of the PSM Hazelwood Northern Batter Movement Report.

Yours sincerely

JM Galvin
Chair, Technical Review Board

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TRB RECOMMENDATIONS RE:

PSM HAZELWOOD NORTHERN BATTER MOVEMENT REPORT

1. OVERVIEW

In early to mid 2011, a series of ground movement events occurred around the northern batters of Hazelwood Mine, impacting on a range of mine and public infrastructure and resulting in closure of the Princess Freeway for some 7 months. DPI commissioned PSM Consult Pty Limited to undertake a geotechnical assessment of these ground movements, which are referred to, collectively, as the "Northern Batter Movement".

At its May 2012 meeting, the Technical Review Board (TRB) completed its review of the PSM Consult Pty Limited report (the PSM Report) entitled *Hazelwood Northern Batter Movement Report,* PSM reference PSM1632-081R dated 15 February 2012. The review was preceded by an overview presentation by the author of the PSM Report, Mr Tim Sullivan, on 16 February 2012.

The PSM Report concludes that:

> *"…there are some very complex movement patterns some of which are as yet unexplained by the overall stability mechanisms*

and

> *"…. at this stage, the long term solution(s) to achieving a safe and stable northern batter is seen as a major undertaking. Various solutions could be envisaged, but achieving these such that there are also no ongoing risks to the Princes Freeway and risks to Morwell Township and no requirement for ongoing maintenance of dewatering and monitoring systems is difficult to conceive at this time.*

The TRB concurs with both of these conclusions.

The TRB is of the view that the PSM Report has identified the essential elements pertaining to the stability of the Northern Batters at Hazelwood Mine. However, the TRB considers that analysis and conclusions are constrained by gaps in critical data collection and uncertainty in the accuracy of some critical data. Hence, at this point in time, the TRB cannot fully subscribe to some of the conclusions drawn in the PSM Report.

This report reviews the essential elements identified in the PSM Report and provides guidance to the Minister on the level of confidence associated with conclusions drawn in the PSM Report given the currently available data and knowledge base, and guidance on short term and long term mitigation and remediation actions. A number of recommendations are made arising out of this review.

2. TRB ASSESSMENT

2.1 GENERALLY

The TRB accepts that Figure 29 of the PSM Report, reproduced as Figure 1 in this report, generally depicts the current state of movement and cracking in the vicinity of the Northern Batters. The TRB is concerned by the extent of movement and cracking. It is in agreement with the PSM Report that:

> *"The rainfall on the 4th and 5th February 2011 was only a 1 in one year event and of itself could not have caused the Northern Batter Movement."*

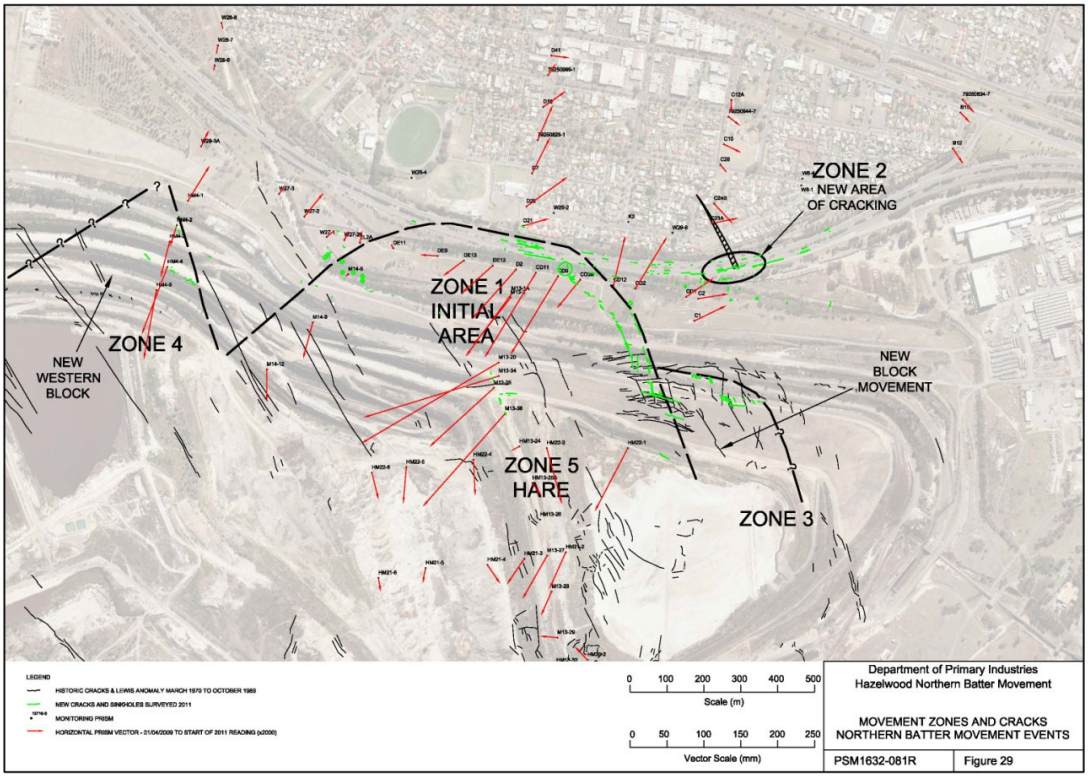

Figure 1: Reproduction of Figure 29 of PSM Report Showing Cracks and Movements in the Northern Batter

The TRB is in general agreement with the PSM Report findings that the event was compounded and contributed to by a range of elements, the principal ones being:

1. Sinkhole formation in and about the Morwell Main Drain.
2. Construction of the Hazelwood Ash Retaining Embankment (HARE) and the Hazelwood Ash Retaining Area (HARA).
3. Horizontal boreholes becoming unserviceable over time.
4. Batter face water management.
5. Batter rehabilitation activities.
6. Differential settlements, primarily associated with aquifer dewatering activities.

2.2 STABILITY ASSESSMENT ELEMENTS

2.2.1 Control of Water Ingress

The Morwell Main Drain (MMD) was constructed in 1977 and currently carries runoff from the Morwell township, the adjacent freeway and the industrial area north-east of the mine as well as from within the mine boundary. It is located immediately to the north of the Northern Batter. The drain comprises a low flow pipe buried beneath an open channel, with overflow reporting to the open channel. The low flow pipe is about 36 inches (~1 m) diameter constructed with from articulated reinforced concrete pipe segments. It is understood that the pipe joints were designed to accommodate about 25mm axial extension and about 1˚ angular deflection. Presumably, for movements greater than these values, there is a strong possibility that leaks will develop. It is understood that the open channel was lined, although the details of the lining are unknown, and that it was intended to have a maximum flow duration of about 20 minutes.

The drain is described in the PSM Report as having received "… *no remediation for the last two decades"* as well as being "*in a poor state with extensive shrub and tree growth*". It is also stated "*one sinkhole started forming in 2007 and some repair works were reported"* and *"other sinkholes were reported in 2009"*. Further to the above, according to plans showing the location of historic cracks and sinkholes, Figure 2 (reproduced from Figure 17 of the PSM Report), there is a likelihood that more cracks and sinkholes had developed in the MMD by this time but were not observed because of the vegetation cover.

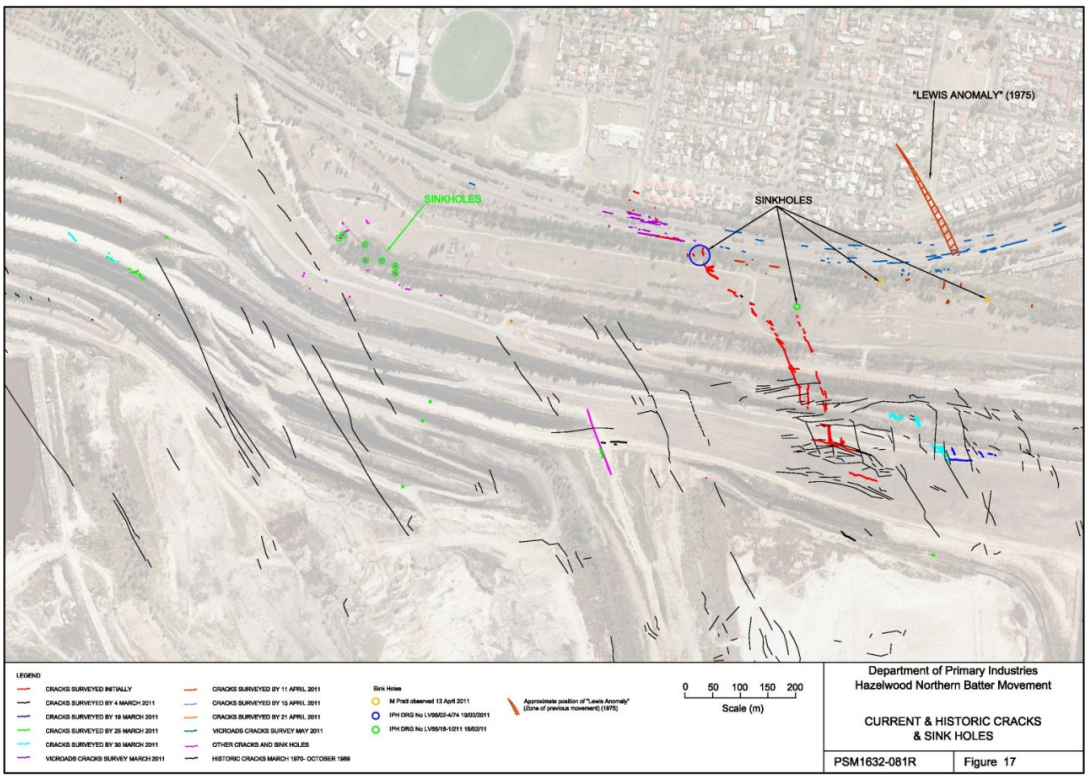

Figure 2: Reproduction of Figure 17 of PSM Report Showing Current and Historic Cracks and Sinkholes

Immediately to the north of the MMD is the Princes Freeway which was constructed in the late 1980s. Following the major rainfall event in early February 2011, the Report notes "*cracking and deformations spread across the whole of Princes Highway …*". There is also reference to "*low strength areas*" under the highway which are understood to have subsequently been grouted. These features will be discussed separately.

In general, one of the principal factors causing slope instability is water. The introduction of water to an otherwise stable slope can often reduce the slope to an unstable condition. This has been clearly demonstrated for the slopes of the LaTrobe Valley mines. There have been many studies, carried out by the LaTrobe Valley mine operators, demonstrating that increases in water pressures in the formations and discontinuities within the formations can have a major negative influence on stability. Even a relatively small volume of water in a narrow near-vertical crack can have a significant adverse influence on stability. Therefore, where there are issues of slope instability at any particular location, it is a basic principle of management to prevent any inflow of water to the area of concern.

The Northern Batter of the Hazelwood Mine is a slope that has marginal stability. Therefore the control of water entering the area above and behind the slope is of critical concern. Dealing with the runoff from areas within the mine adjacent to the crest of the batters is a problem that cannot be avoided. Continuation of the practice of passing large volumes of water over a significant distance along the top of the Northern Batter must be seriously questioned. This is an acute concern when there are clearly stability problems largely driven by water. These are reflected in crack development, sinkholes and major movements (horizontal and vertical, total and differential) in the slopes and surrounding areas. It seems absolutely imperative not only to remove the destabilising water originating within the mining area, but also to not allow water originating from outside the mining area to enter the zone of likely influence on the stability of the mine batters.

As the Northern Batter seems likely to continue experiencing relatively large movements, which must impose a significant risk to the long-term integrity of any drainage channel located close to the crest of this batter, the only effective long term solution to batter failure, other than to significantly redesign the slope, is to divert all external runoff so that it does not enter the mine area and, thus, obviate the need for the drain. Therefore, it is strongly recommended that this total diversion is effected as soon as possible.

As this long term solution may take some time to implement, it is recommended that a temporary short term solution be developed and constructed as quickly as possible. It is understood that consideration is currently being directed towards the reconstruction of the existing MMD as a clay-lined open channel. While the details of the design for the drain's reconstruction have not been provided to the TRB, it is recommended that careful consideration be given to risks to the integrity of any lining. This is especially the case when not only is there continued movement but there may also be areas under the channel footprint that could be potentially unstable, have not been detected, and could threaten the reformed MMD in time to come.

2.2.2 Re-initiation of Primary Consolidation

The PSM Report concludes that one of the major factors influencing the Northern Batter Movement is

> *"The substantial increase in the M2 Aquifer dewatering that appears to have re-instated widespread primary consolidation."*

It is further stated in Section 8.1 that this re-instated primary consolidation

> *" …. probably caused increased batter movements towards the mine void".*

It is not clear to the TRB why increased batter movements towards the mine void should be caused by the re-initiation of primary consolidation.

With regard to the re-initiation of primary consolidation, the evidence presented in the PSM Report in support of this conclusion is sparse. The long term settlements for two pins and their corresponding rates are presented in Figure 3 (reproduced from Figure 25 in the PSM Report).

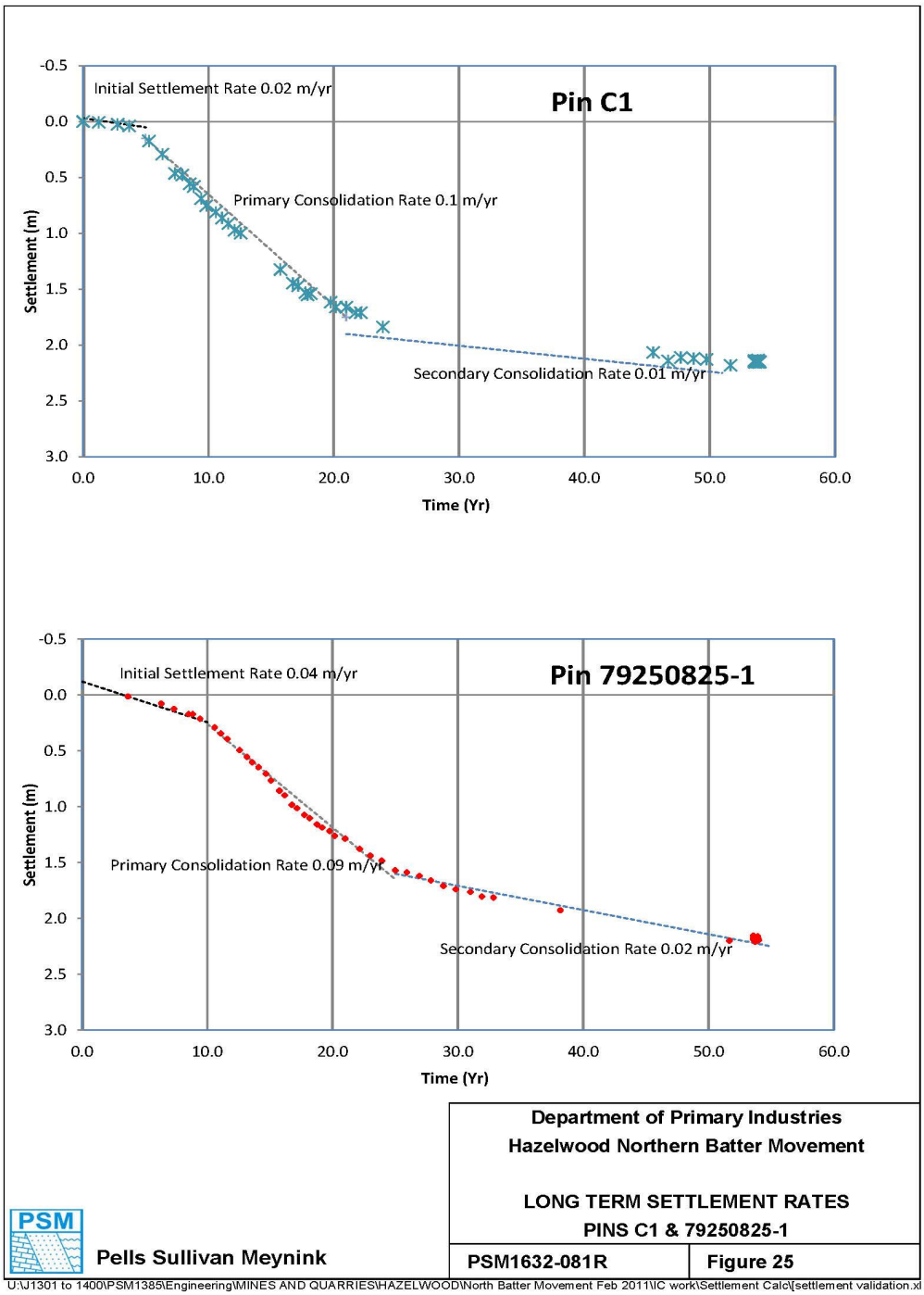

Figure 3: Reproduction of Figure 25 of PSM Report Showing Long Term Settlement Rates

The PSM Report suggests that because the general shape of the two curves shown in Figure 3 is similar to a classical consolidation response curve for a compressible soft clay, consolidation accounts for the long term response of the Northern Batter. However, it is the view of the TRB that this would only apply if the water pressures driving the consolidation process were reduced at the commencement of consolidation and held constant thereafter. In reality, there have been many ongoing significant and complex water pressure changes within the two main aquifers, as shown in Figure 4, suggesting to the TRB that the shape of these two particular long term settlement curves and their similarity with the classical consolidation curve is largely coincidental.

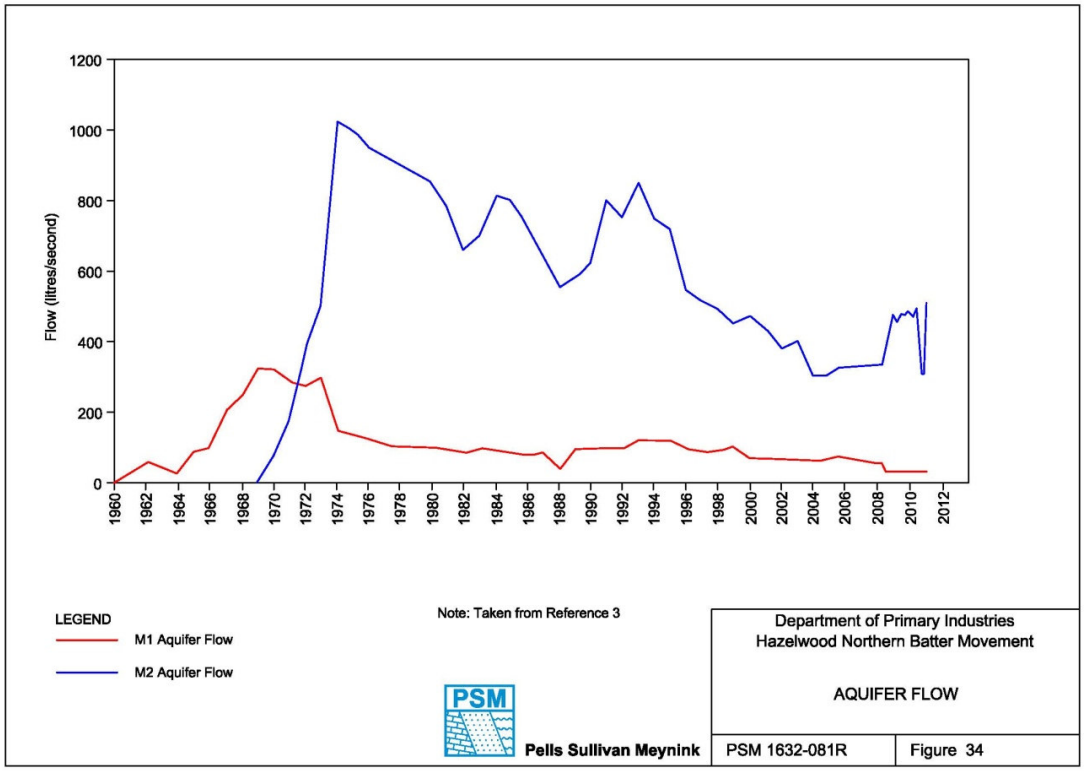

Figure 4: Reproduction of Figure 34 of PSM Report Showing Aquifer Flow

There are several other elements of data offered in the PSM Report as support for the concept of re-initiation of consolidation. One such data set involves pin settlement rates compared with the implied rates of settlement for the two main components of settlement from Figure 3; around 0.1 m/yr typical for primary consolidation and 0.01 to 0.02 m/yr for secondary consolidation. While this is supported by some pins, there seems to be several other pins which should be similarly affected but which show considerably different results.

While the TRB would accept that the re-initiation of primary consolidation may be a factor in the observed movements of the Northern Batter, on the evidence presented, it does not agree that it is necessarily a major factor.

2.2.3 Low Strength Areas Under the Princes Freeway

It is understood that the Princes Freeway experienced significant cracking and deformations on 8th and 9th February 2011 which was followed by a small amount of additional movement within a week or two after the initial movement. Then, following a further rain event on 23rd and 24th March, a new cracking zone developed about 400m to the east of the initial zone.

A VicRoads report entitled "Princes Freeway East Morwell Section" dated 6 April 2011, Report No: GR034-44A provides details of the ground movement experienced by the freeway and describes an investigation undertaken to assess the extent and cause of the movement. On the basis of this investigation, which included 5 boreholes and 69 cone penetrometer tests located "*approximately where pavement cracking and subsidence has developed"*, the VicRoads report states

> *"… there is no evidence of large cavities existing beneath the pavement (i.e. greater than 0.2m in diameter)."*

The report goes on to conclude

> *" … that the freeway pavement has been founded on competent material and there is no local instability issue. It is concluded that the stability of PFE at this location is dictated by the mine stability"*

Further to this report, VicRoads developed a 2nd report entitled "Princes Freeway East Morwell Section Supplementary Assessment Report" dated 19 May 2011, Report No: GR043-44B. This report makes an assessment of whether certain potential sudden deformations due to land movements, including cavities and sinkholes, associated with the mine could occur. It is concluded

> *"… that the likelihood of pavement failure as a result of a large cavity beneath the pavement is 1 in 1000 year event, or very low."*

Based on the above information, it seems odd that the PSM Report contains the short term recommendation:

> *"Grouting of low strength area identified under the carriageways. It is understood this has been completed".*

There does not appear to be any low strength areas identified as existing under the freeway and no grouting undertaken. The TRB notes that even if there were "low strength areas" under the freeway, it is not clear how grouting could be used to strengthen these areas or reduce the risk of sinkholes developing.

It is noted that the PSM Report also contains the recommendation that the earth drain area between the two carriageways of the freeway should be lined. The Report notes that it is understood that VicRoads elected to line only part this area.

It is not clear exactly what has occurred with respect to the earth drain area between the two carriageways of the freeway. However, so that water cannot further aggravate overall stability, the TRB strongly recommends that the water entering this drain is effectively and permanently removed from the area.

2.2.4 Aquifer Depressurisation

The PSM Report identifies three groundwater dependent effects that are important for the management of the stability of the mine and the northern batters. These are: long-term depressurisation of the M1 and M2 aquifers; observed increases in vertical hydraulic connection through the confining layers above and below the main aquifer formations; and, the relationship between the M1 aquifer pressures and the pressures in the coal and interseam materials behind the batters. Whilst the TRB agrees that these effects are potentially significant for stability management of the northern batters, it is concerned that the conclusions drawn in the PSM Report are not sufficiently supported by the presented data and, therefore, that the report recommendations about groundwater are not adequately justified. The TRB recommends a quantitative analysis of the available data to provide a better foundation for future decisions about the rates of pumping from the aquifers. The TRB's concerns are elaborated below.

Long-term aquifer depressurisation

Long term depressurisation of the M1 and M2 aquifers has been carried out since the 1970s to prevent floor heave in the mine. After a period of high initial discharges, the rates of extraction were progressively reduced as the cone of depressurisation expanded to a near stable condition and pumping at other locations, notably Loy Yang Mine, contributed to aquifer pressure reductions at Hazelwood. Prior to 2008, aquifer discharges were set to achieve a minimum acceptable depressurisation beneath the mine floor to prevent heave. This was achieved with discharge rates from the upper M1 aquifer an order of magnitude lower than from the M2 aquifer.

In 2008, an operational change to groundwater pumping took place: discharge from the M1 aquifer was reduced in the area adjacent to the northern batters and discharges from the M2 aquifer were increased to meet a shortfall in power station process water. Both aquifers responded to pumping changes with a rise in the M1 aquifer pressures and a lowering of the M2 aquifer pressures. The PSM Report identifies two effects relevant to batter stability related to these changes, namely:

" …. recent major increases in M2 Aquifer dewatering … would be expected to result in increased movements of the mine floor and northern batters. Increased pumping from the M2 Aquifer led to consolidation of the mine floor. This resulted in associated movement of the batters towards the mine floor, encouraging further opening of the coal joints."

and

"Decreasing pumping in M1 led to some recovery of M1 aquifer levels. If the aquifer is partially or totally connected to the coal unit then this would lead to increasing piezometric pressures within the coal and within coal joints."

Whilst the TRB agrees that these impacts are potentially important for the long term, the scale of these impacts is not as clear as that suggested by the PSM Report. The PSM Report observes that "*The major increase in M2 Aquifer pumping in mid-2008 has caused widespread settlement of the mine floor"*. No data are provided that clearly demonstrate this observation. The changes in aquifer pressures (PSM report Figure 42) are actually rather small (<10m equivalent depth of water) compared to the total pressure decline since the commencement of pumping(>100m). Similarly, no data are provided to indicate the magnitude of the long-term settlement that could be anticipated due to the pumping increase compared to that which would be predicted without the increase in pumping. Nevertheless, the PSM Report recommends in the medium term that "*IPH should investigate the feasibility of reducing the M2 aquifer dewatering and/or spreading the dewatering such that resultant movement effects are preferably stopped or at worst severely reduced.*"

The TRB is concerned that both the significance of the additional aquifer dewatering on settlement and the consequent recommendation are not sufficiently justified. Even if reactivation of consolidation is occurring, this seems likely to be only advancing in time the consolidation that would arise in the longer term from the ongoing regional depressurisation of the aquifers. Given this background, the TRB suggests that a quantified demonstration of the impact of the additional settlement is needed to support the recommendation in the PSM report. Without this demonstration, the adoption of this measure is premature. In spite of the TRB's reservations about the significance of the recommendation, it agrees with the PSM Report's proposition in so far as two of the basic operating principles for the mines should be to minimise over-pumping of the aquifer and, as far as practicable, to reduce consolidation by distributed pumping.

Enhanced vertical hydraulic connection

The report presents arguments to suggest that the vertical hydraulic conductivity of the aquitards (coal and interseams) has increased due to mining. This concept seems likely to be correct. However, the arguments presented are not sufficiently supported by the data presented in the report to be able to confirm or reject this concept.

Two pieces of evidence are employed in the PSM Report. The first piece of evidence concerns the rises in the M1 aquifer pressures at the same time as the increase in M2 aquifer dewatering but in the absence of any changes to the pumping of this aquifer:

"*The major increase in the M2 Aquifer dewatering in mid 2008 obviously led to a sudden decrease in the M2 aquifer levels. However at the same time there was a rise in the M1 Aquifer levels. This effect is due to the fact that all the M2 bores are located around the in-pit storage ponds, Figure 37. These ponds have a storage level of around RL -60m. It is postulated that the ground strains and/or the hydraulic effects of the increased M2 pumping, either caused or increased, the hydraulic connection between the ponds and the M1 aquifer, which is directly under the mine floor."*

It is clear from the data in the PSM Report that there was a rise in the M1 aquifer pressures at almost the same time as the increase in M2 pumping. It is also clear that there appears to have been no change in pumping in the M1 aquifer that can immediately be associated with the pressure rise and that there is a source of water above the aquifer that could provide the necessary water to raise the aquifer pressures if an increase in hydraulic connection is postulated. Unfortunately the postulation of an increase in hydraulic connection in the PSM Report is only one of several alternative hypotheses that could explain the data. It is equally plausible to hypothesise that hydraulic connection between the M1 and the M2 aquifer decreased or that a small proportion of the increased discharge from the M2 aquifer is being 'accidentally' discharged into the M1 aquifer. Furthermore, an undisclosed change in M1 pumping hidden from view by the insensitivity of the discharge meters may also have occurred.

Other postulates can be suggested. What can be shown by basic modelling of the M1 aquifer is that only a small change (approximately 4 litres per second, about 10% of the net M1 aquifer extraction) in discharge to or from the aquifer is required to produce the observed change in pressures. Based on the existence of these alternatives, it is not possible to be as certain as the PSM Report suggests that the one mechanism postulated in the report is the correct one. Without further monitoring and analysis, the precise mechanism cannot be identified and without understanding the mechanism that is operating, it is not reasonable to propose corrective action, should this be needed.

The second piece of evidence produced in the PSM Report relates to the apparent similarity between the aquifer levels and the in-pit storage pond levels.

"*In periods of normal operation, many piezometers show the aquifer levels are static at around RL -60m. Figures 43 to 46 are contour plots of piezometer levels within the different units, showing how these levels are related to that of the in-pit storage ponds. This data indicates hydraulic connections between the ponds and both aquifers.*"

The mine operates its pumping to keep aquifer levels only slightly below the base of the mine floor. As a consequence, these aquifer levels are prescribed by mining operations to be rather similar to the levels of the in-pit storage ponds. It is not necessary to invoke hydraulic connections between the ponds and both aquifers to explain the apparent relationship.

The lack of hydrographs showing a comparison of time dependent head changes in the two aquifers to show that the levels in one are reacting directly to the level changes in the second makes positive identification of a hydraulic connection impractical. The TRB suggests that further work is required to establish the validity of the assumed connections.

Finally, while the dewatering requirements for the mine will be impacted by any alteration of the vertical hydraulic connections between the aquifers, it remains unclear to the TRB what the practical implications of any change in hydraulic connection would be for the management of the stability of the northern batters.

M1 aquifer connection to the M1 coal and interseam materials behind the Northern batter.

The reduction of pumping of the M1 aquifer in the vicinity of the HARA adjacent to the northern batters has caused a rise in heads in the aquifer. When coupled with the reduction in drainage from the base of the batter due to the overburden dumping it is suggested that groundwater heads

behind the batters will have been forced to rise and that this can lead to excess pressures in coal joints in the batters. The connection identified from the aquifer levels is suggested by the PSM report to be supported by water chemistry data for the horizontal drains. The PSM report states:

"*This monitoring shows:*

- *Elevated ground temperatures up to 36^{o},*
- *High salinities (conductivity up to about 2600 µS/cm and*
- *High pH.*

These conditions also tend to occur in the drains with elevated flows and which continue to flow well after rainfall has ceased.

The conclusions from this are that there is now complete of partial hydraulic connections between the following geological units:

1. *The M1 coal and all the underlying geological units, M1 Clay, M1 Aquifer and M2 Aquifer*
2. *M1 Aquifer and M2 Aquifer."*

These conclusions present one mechanism that could explain the data, but again others are feasible. The greater length (compared to the standard drainage bores) of the new horizontal drains mean that these could have intersected warm water in the coal that has been present in the coal for a long time prior to the depressurisation. Alternatively, pressure pulses from the surface recharge could be displacing groundwater in the coal matrix and joints that is then discharged from the drains during and following recharge events. As with the preceding analyses, the lack of clear evidence in the PSM report to support the single hypothesis presented to explain the data reduces confidence in the report's conclusions and recommendations. The TRB cannot reject the PSM report's conclusions based on the data provided. Equally, it cannot confirm these conclusions. Further interpretation of the data is needed.

Importantly, the PSM Report recommends reinstating the M1 depressurisation in the vicinity of the eastern end of the northern batters to maintain stability of the batters. The TRB's review suggests that the data presented in the report do not fully support this recommendation. The vibrating wire piezometers show consistent downward drainage and reducing pressures in the upper formations that do not appear to be impacted by the changes in the M1 aquifer pressures. This apparent lack of impact may be due to the scale used for the graphs presented in the PSM Report. Nevertheless, the M1 aquifer pressures appear to have largely stabilised following the changes in pumping regime in 2008. The identified upward flows from the M2 aquifer beneath the eastern end of the northern batters cannot be confirmed but would, in any case, only lead to a small change in heads in the M1 aquifer.

Whilst the TRB would agree that there may be merit in additional pumping from the M1 aquifer towards the eastern end of the northern batters, this action does not appear to be fully justified as an immediate action for the improvement of the stability of the batters. Currently, the horizontal drains appear to be working well and to be sufficient for the continued drainage of the base of the coal. However, ongoing piezometric monitoring is warranted and a review of the monitoring locations and strategy would appear to be more important at this stage to ensure that any deterioration in the horizontal drains is observed, with trigger points identified for remedial actions that may include additional M1 depressurisation.

2.3 HAZELWOOD ASH RETAINING EMBANKMENT (HARE) / HAZELWOOD ASH RETAINING AREA (HARA)

The PSM Report describes a broad range of concerns about the impact of the HARE/HARA on the stability of the northern batters and a range of concerns about the long-term stability of the HARE/HARA. These concerns lead to the following recommendation:

"*Contact the EPA and advise of the concerns about the stability of the HARE/HARA and the concerns about the seepage and contamination from structure. The groundwater monitoring, sampling and reporting around this structure to assess contaminants should be reviewed.*"

The TRB agrees that the stability of the HARE/HARA is an area for continued review and evaluation. However, it is surprised that the recommendation further implies that there is contamination from the structure, given a complete lack of chemical evidence to substantiate this statement. Further it is unclear that any contamination from the HARA would lead to any significant groundwater pollution concern given the very long travel distances that the contamination would have to cover to reach a point of discharge or groundwater use. It would seem reasonable to assume that the approval of the HARA by the EPA had taken account of the location of the HARA, the potential for its failure and the long term migration of any contamination.

Of greater interest to DPI must be the extent to which any rehabilitation of the northern batters can accommodate the presence of the HARA. The TRB recommends that detailed geotechnical assessment of the properties and performance of the HARE/HARA is undertaken as part of any options evaluations for rehabilitation of the northern batters and for the mine generally.

3. TRB RECOMMENDATIONS TO THE MINISTER

The TRB recommends, in the interests of assuring public safety and protecting public infrastructure, that:

1. The water currently entering the Morwell Main Drain from areas outside the mine boundary be permanently diverted so that it does not cross the mine boundary and

does not influence the stability of the Northern Batter or any other batter. This recommendation should be effected as soon as possible.

2. In the interim, the TRB recommends in the strongest terms that, as a matter of priority:

    a. The low flow pipeline in the Morwell Main Drain be decommissioned.

    b. The entire drain, from crest to crest, be lined with an impermeable membrane that can protect against cracking, sinkholes and ground movements.

    c. Clay, by itself, does not constitute an adequate membrane. If clay is used in this construction, it should be complemented with a suitably engineered geotextile lining extending from crest to crest.

3. The action recommended in point 2 is overdue.

4. In addition, areas within the mine boundary and adjacent to the Northern Batter should be appropriately graded and provided with impervious local drains so that any rain falling in this area can be quickly and efficiently removed from the vicinity of the batter.

5. If not already undertaken, the highway closure response plan to control risk arising from any further batter movement should be 'stress tested' under realistic simulated circumstances.

6. Further studies be undertaken to verify conclusions drawn in PSM Report, with a view to reliably identifying the ground behaviour mechanisms in play. These studies should include additional monitoring and more frequent monitoring to assist with the identification of the main processes and the rejection of alternate hypotheses that may be identified to explain the data.

7. A detailed geotechnical assessment of the properties and performance of the HARE/HARA is undertaken as part of the options evaluation for mine rehabilitation

8. A review be undertaken by a qualified independent third party of the nature of data required to be collected in order to develop a sound understanding of behaviour mechanisms, the processing of these data in a timely and meaningful manner, and the distribution of outcomes to all stakeholders in a form and time frame that enables:

    a. Effective change management in the short term

b. Verification of behaviour mechanisms and identification of remediation measures in the longer term.

9. A Monitoring Management Plan (MMP) be developed that clearly identifies data collection and processing requirements (consistent with Recommendation 6) and assigns accountabilities and responsibilities. Normally, the MMP would be a subset of a Ground Control Management Plan for a mining operation.