Department of Primary Industries
Office of Water

Contact Fergus Hancock
Phone 02 4904 2532
Fax 02 4904 2503
Email fergus.hancock@water.nsw.gov.au

Our ref ER21465
Your ref 10/09073

Major Development Assessments
Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attention: Stephen O'Donoghue

Dear Stephen

Whitehaven Tarrawonga Extension Proposal (MP 11_0047)

I refer to your letter of 16 January, 2012 requesting advice on the Environmental Assessment (EA) for the above proposed project. The NSW Office of Water has reviewed the EA for the above proposed project. The following comments are in addition to the Office of Water's previous submission dated 6 December, 2011.

Under the current provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the potentially relevant works, use and activities approvals are exempt, however access licences and dealings in accordance with the rules of the above water sharing plans are required to authorise interception and/or extraction of groundwaters associated with the proposal. Further, until commencement of the *Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources* later in 2012, any extraction or interception of surface waters, or diversion of rivers, requires licences under s 10 of the *Water Act 1912*.

The site is located within, and/or proposes to access water supply from, water sources within the following water sharing plans:

- *Water Sharing Plan for the Upper and Lower Namoi Regulated River Water Sources 2003*
- *Water Sharing Plan for the Upper and Lower Namoi Ground Water Sources 2004*
- *Water Sharing Plan for the Inland Porous Rock Ground Water Sources 2012*

Goonbri and Bollol Creeks are located within the Maules Creek water source of the draft *Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources*, which is anticipated to commence by mid 2012.

These water sharing plans establish long term average annual extraction limits (LTAAEL), daily extraction limits (in the case of unregulated river plans) and water trading rules.

In simple terms, the creation of a LTAAEL means that any water proposed to be taken by the mining activity needs to be fully licensed and accounted for or in some instances minimised to the greatest extent possible.

The EA therefore needs to fully and robustly predict all water that will be taken from the various water sources and identify how this will be accounted for.

In that regard, the predictive modelling needs to be robustly designed and underpinned by adequate data and sampling regimes. NOW is of the view that more work could be done in this regard.

NOW also notes that the proponent is proposing to minimise the take of water through the use of a low permeability barrier. However, there is not adequate information supporting the long term effectiveness and viability of such a structure to minimise mine inflows from the surrounding water sources, including Zone 4, Upper Namoi Valley (Keepit Dam to Gins's Leap) Groundwater Source (hereafter Zone 4).

The proposal intends to remove a portion of Zone 4 Upper Namoi Alluvium, which is connected to but several kilometres from the Namoi Regulated River. Nevertheless, this river is considered a significant and important river of the Region. Therefore, all water that might flow into the mine directly or indirectly from this River needs to be fully accounted for, with licences of an appropriate security and volume acquired on the water market.

The proposal includes the diversion of a portion of Goonbri Ck. This creek is a 4th order stream and the portion proposed for diversion has been classified as having moderate environmental value under the water sharing planning process. Thus any proposed diversion should ensure that the geomorphic condition of the stream be maintained into the long term, including key characteristics such as the natural bed slope and bank stability. Any potential for interaction with saline water inflows should also be minimised to ensure the overall water quality of the important rivers downstream. The EA requires more work to demonstrate that this will be achieved with the current proposal.

Of particular importance is a full assessment of impacts downstream on Goonbri Ck to the 'Slush Holes', which form a nominated priority protection zone in the Maules Creek report card under the draft *Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources*. The EA does not address the water supply and quality requirements for high priority groundwater dependent ecosystems located on Goonbri Creek and downstream to the Slush Holes, and to the Namoi River.

The NSW Office of Water provides comments on more specific areas of the EA in **Attachment A**.

The Office of Water requests that the matters identified in its review comments are addressed by the Applicant in order to enable the Office of Water to provide an informed assessment of the proposal. If you require further information please contact Fergus Hancock, Senior Planning and Assessment Coordinator on (02) 4904 2532 at the Newcastle office.

Yours sincerely

Rob O'Neill
Director Water Policy and Planning
22 March 2012

Environmental Assessment Test of Adequacy Comments
Whitehaven Tarrawonga Coal Project (MP 11_0047)

Summary

The Office of Water notes that the proposal intends to excavate and intercept some of the alluvial groundwater source which forms part of the Upper Namoi Alluvium, Zone 4 (Keepit Dam to Gin's Leap) Groundwater Source.

The Upper Namoi Alluvium is a fully committed, high value use groundwater source. At the commencement of the water sharing plan in 2006, water entitlements were reduced and structural adjustment money was paid to licence holders under the Achieving Sustainable Groundwater Entitlements program. This program was funded jointly by the NSW and Australian Governments, to align extraction levels to within the sustainable yield of the aquifer.

Therefore any inflow predictions must be robust and fully accounted for in order to minimise the potential for third party impacts. Where it is difficult to fully account for inflows, then prevention or minimisation of these inflows is preferred. Under the rules for granting access licences in the WMA, Regulation and cl 26 of the *Water Sharing Plan for Upper and Lower Namoi Ground Water Sources 2003* (WSPULNGWS), the Applicant will need to purchase entitlement on the water market to account for any inflows.

In that regard, NOW notes that the proposal includes the excision of a portion of the aquifer and its isolation from the mine workings by an engineered low permeability barrier, specifically with the intent of minimising the inflows to the site from the surrounding alluvial aquifer and thus minimising the requirement for licence purchase on the water market. However, the NOW has concerns relating to the uncertainty of the modelling predictions and the long term effectiveness of the low permeability barrier and thus has some concerns that the predicted water flowing into the mine site may be underestimated and not fully accounted for.

Furthermore, these uncertainties mean that the potential for saline water egress from the site may also be underestimated. Given the proposal to maintain the hyper-saline water on-site with the use of an evaporative sink, NOW also believes minimising these uncertainties is important.

The Office of Water's concerns specifically relate to the following:

- The EA does not adequately quantify the potential for inflows from the alluvium overlying the target coal resource and therefore secondary inflows from the (surrounding) alluvium and connected surface waters.
- The EA does not adequately address the use of and associated implementation and maintenance for the low permeability barrier.
- The EA does not adequately address the risks and potential impacts associated with the stability of the high walls on the eastern and northern sides of the final void, should batter slope saturation occur.
- The EA does not provide adequate groundwater data commensurate with the potential impacts to water sources.

Therefore NOW seeks further reassurance as to the estimates of inflows through the low permeability barrier and the effectiveness of such a barrier into the long term, including the potential for maintenance and replacement. Any post-closure costs associated with these activities should also be committed by the proponent.

Water Management Act and water sharing plan provisions

Water Sharing Plan for the Upper and Lower Namoi Ground Water Sources 2003

Access licence dealing rules:

For the water that needs to be fully accounted for, the access licence dealing rules (trading rules)

become relevant. The important ones are as follows:

- Dealings within a groundwater source are prohibited if:
  - the dealing results in the total access licence share components or credited water allocations authorised to be extracted through nominated works at a location exceeding 600 ML/yr per square kilometre (cl 45(2)(b));
  - the dealing would result in the total extraction under access licences through nominated works in the area, plus basic landholder rights extraction, causing an adverse local impact (cl 45(2)(c));
  - the dealing involves a supplementary water access licence, or any water allocation credited to a supplementary water access licence (cl 45(2)(e)).
- Dealings which involve a change of the groundwater source are restricted (cl 46(2)). The Applicant may purchase an access licence from one of the Upper Namoi Groundwater Sources (sub-cl (2)(a)).
- Dealings that result in conversions of an access licence of one category to an access licence of another category are prohibited (cl 47(2)).
- Dealings that result in interstate access licence transfers into or out of these groundwater sources are prohibited (cl 48(2)).

The EA does not include any consideration of these dealing rules as they apply to the project proposal. As the application will require dealing transfer of entitlement for dewatering of the alluvium prior to excavation of the alluvial terrace, and for residual drainage from the Goonbri/Bollol Creek alluvium (Zone 4) that is not prevented by the proposed low permeability barrier, such consideration and associated information is an essential part of the Office of Water's assessment.

Water Sharing Plan for the Inland Porous Rock Ground Water Sources 2012

The Tarrawonga Coal Project is located within the Gunnedah – Oxley Basin MDB (Other) Management Zone of the Gunnedah-Oxley Basin MDB Groundwater Source, which applies to water contained in:

- all rocks of Permian, Triassic, Jurassic, Cretaceous and Tertiary age within the outcropped and buried areas, and
- all alluvial sediments within the outcropped areas, except alluvial sediments included in the Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003.

In the Office of Water comments provided for Test of Adequacy, it was requested that the EA provide a checklist of relevant rules applicable to the proposed mining operation and discussion related to:

Rules for managing access licences:

Up to 0.25ML/unit share of any unused water allocation in the water allocation account of an aquifer access licence may be carried over from one water year to the next (cl 33(2)). The EA should have specified the likely range of groundwater volumes anticipated to ingress to the mining operation, and how an access licence will be tagged to the site to account for long term or permanent take into the final mining void.

Access licence dealing rules:

- Dealings within the groundwater source are restricted (cl 44). These restrictions will not apply to dealings by the Applicant as the Tarrawonga Coal Project is located within the Gunnedah – Oxley Basin MDB (Other) Management Zone.
- Dealings which involve a change of the groundwater source are prohibited (cl 45(2)).
- Dealings involving the interstate transfer of access licences to the Gunnedah – Oxley Basin MDB Groundwater Source may only be permitted where administrative arrangements have been agreed to and implemented by the States (cl 48(4)(a)). This means that interstate transfers are not available to the Applicant.

The EA's should have more detail on how these rules of the plan may affect any proposed licence purchase from these water sources.

Draft Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources - scheduled to commence in mid 2012

The Tarrawonga Coal Project is located within the Maules Creek Tributaries Management Zone of the Maules Creek Water Source, which applies to all water occurring naturally on the ground and in rivers, lakes and wetlands. Whilst this WSP has not yet commenced, NOW is of the view that the provisions of the draft Plan should be considered given the imminence of its commencement and the relative life of the project. In that regard, the EA should have provided a checklist and discussion of relevant rules applicable to the proposal within the draft water sharing plan, including a discussion related to:

Rules for granting access licences:

Under the rules for granting access licences in the WMA, Regulation and cl 41 of this WSP, the Applicant may apply for an unregulated river access licence with zero share component, or an unregulated river access licence in accordance with a dealing. This should be explained in the EA to demonstrate how the take of surface and/or alluvial groundwater not specified in the WSPULNGWS may be accounted for.

Rules for managing access licences:

For the first 3 years of the plan, the volume of water that may be taken under an unregulated river access licence is restricted to 0.5ML/unit share (cl 44(2)). Up to 1ML/ unit share of any unused water allocation in the water allocation account of an unregulated river access licence may be carried over from one water year to the next (cl 44(5)). The Tarrawonga Coal Project is located within a management zone for which flow classes have not been established. The EA should have addressed the potential for long term loss of flow and/or storage within the Goonbri Creek occurring as a result of the diversion and isolation from the western limb of the alluvial terrace. Such flows need to be prevented, minimised or fully accounted for.

Access licence dealing rules:

- Dealings within the groundwater source are restricted: dealings into the management zone are prohibited (cl 63(2)(o)).
- Dealings which involve a change of the groundwater source to the Maules Creek Water Source are prohibited (cl 64(2)(c)(x)).
- Dealings that result in interstate access licence transfers into or out of these groundwater sources are prohibited (cl 67).

Surface water impact assessment

Goonbri Creek is a fourth order watercourse, which was identified during the development of the water sharing plan as being of high environmental value immediately upstream of the proposed diversion, and of moderate value, with high and rapid recovery value at the proposed diversion location. Downstream of the proposed diversion, Goonbri Creek has been moderately to highly impacted by agricultural development. Goonbri and Bollol Creeks maintain flow contributions to the Slush Holes, an anastomising channel of the Namoi River. The Slush Holes have been identified as forming a refuge habitat for baseflow and pool dependent ecosystems within the report card to the Maules Creek tributaries, Maules Creek water source. Within this context, any proposal to modify Goonbri Creek should aim to protect in-stream ecosystem values and geomorphic condition as far as possible.

The EA asserts that Goonbri Creek is an ephemeral creek, with nil connective 'gaining' contributions from groundwaters within the alluvium. This assertion cannot be tested from the information provided in the EA. The EA should have provided an investigation of both seasonal and climatic variations in stream flow against groundwater levels and transmission. The lack of such assessment diminishes the value of the EA for assessment of consequences of potential loss of this connectivity resulting from the excavation and likely permanent depressurisation of the alluvium resulting from the open cut encroachment into the alluvial water source.

The EA extrapolates from an inferred flow duration curve derived from a closed gauging station (GS419044) on Maules Creek. The Office of Water places little confidence in this extrapolated flow duration curve, as the geomorphic and hydrologic settings to the watercourses are dissimilar, and the curve assumes minimal or no groundwater contribution to baseflows within the creek. Although Goonbri Creek may exhibit gaining/losing characteristics on different sections, it cannot be asserted that the river is completely ephemeral. As this has not been examined in the EA, the Office of Water is not in a position to concur with the statements made. The EA should provide a detailed assessment of the relative contribution of shallow groundwater to baseflows within Goonbri Creek, and an assessment of the consequential loss of such flows in the operational and post-mining period.

This should have been extended to the junction of Goonbri and Bollol Creeks to the inflow to the Slush Holes and Barbers Lagoon, to quantify the severity and duration of any such depressurisation-linked loss of baseflows in the river system.

The EA asserts that the diversion of Goonbri Creek will form an effective replication of the current condition of the watercourse. Diversion details are only provided as a conceptual design, which includes two cross sections of the proposed reconstruction of the watercourse. This is not adequate to assess the geomorphic integrity of the proposed reconstruction of Goonbri Creek, nor how necessary variability in channel form, bedload transport and deposition and energy dissipation may be managed.

The information provided in the Surface water assessment does not fully address the DGRs provided by the Office of Water in the letter dated 28 April 2011. The specific surface water DGRs which have not been addressed in the EA include:

- Baseline monitoring or data for a minimum of 2 years fortnightly sampling for surface water quantity and quality for all watercourses within and adjacent to the mining operation area.
- Geomorphic assessment of Goonbri and Bollol Creeks and associated tributaries within the mining area, including details of stream order (using the Strahler System), river style and energy regimes both in channel and on any adjacent floodplains.
- Detailed description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling.
- Detailed description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, channel stability, water quality and hydraulic regime.
- For the proposed construction of a Goonbri Creek diversion, a detailed design description and associated hydrologic and hydraulic modelling, impact assessment, and supporting stabilisation and rehabilitation measures. The impact assessment must include detailed information on the geomorphic character of the river, including hydrologic energy regimes under a range of discharge scenarios, energy management and dissipation, bedload transport, and biophysical maintenance of the river. The impact assessment should also include consideration of the existing riparian and aquatic environments, associated impacts and rehabilitation requirements.
- Description of the design features and measures to be incorporated into the proposed project to guard against long term actual and potential environmental disturbances,, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers.
- Details of the impact on water quality and remedial measures proposed to address any possible adverse effects.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this includes surface water energy and water quality limits and thresholds, and any groundwater level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Assessment of both operational and long term (post project period) impacts to any surface and/or ground water source which may be detrimentally affected.

- Any funding assurances covering the anticipated post development maintenance cost, for example, stream rehabilitation maintenance and performance monitoring and/or on-going groundwater monitoring for the nominated period.

The Assessment has only used the limited data that was already collected for all the water sources within and adjacent to the mining area. There has been no apparent attempt to collect any further information for water quality in this assessment.

The Office of Water recommends that this is addressed and additional information included in the EA to demonstrate the how any potential long term consequences of the diversion of Goonbri Creek have been fully addressed.

Groundwater impact assessment

Groundwater conditions and conceptualisation of groundwater impact model

The information provided in the groundwater assessment does not adequately address the DGRs provided by the Office of Water. The specific groundwater DGRs which have not been addressed in the EA include:

- Baseline monitoring (minimum of fortnightly data) of all surface and groundwater sources and dependent ecosystems within and adjacent to the mining operation area for calibration of models.
- Extent of the alluvium within and adjacent to the mining area.
- Connectivity of all aquifers, assessment of salinity downstream of the Goonbri catchment.
- Predicted impacts of any final landform on the groundwater regime.
- Critical thresholds for minimal impacts to groundwater sources.

a) Groundwater levels

The EA states that there was a collation and review of baseline groundwater data from various data sources including neighbouring mines. No data from this collation was presented in the EA. A summary of the monitoring program from the current Tarrawonga Mine was presented along with the general details of the piezometers installed in May, 2011 however, the frequency at which water levels and quality were measured are inadequate to be able to characterise the groundwater responses temporally, especially with rainfall. This should be accompanied by a full presentation of data used in the calibration of the groundwater model. This is a key requirement to undertake an assessment of adequacy of model predictions, and should be presented in the EA.

The EA does not properly identify the boundaries to the Goonbri Creek (Zone 4 Upper Namoi) alluvium and the adjacent porous rock, which is managed under the *Water Sharing Plan for the Inland Porous Rock Ground Water Sources 2012.* The EA should have clearly identified the boundary to the creek alluvium, and either maintained an offset distance or have full details on the design, installation and maintenance of the proposed low permeability barrier, in order to minimise the interaction between the mining excavation and the residual alluvial groundwater system which will remain after mining operations cease. If this is not done, then any potential for inflows needs to be fully and robustly predicted and fully accounted for. As this has not been presented in the main report, and only appears in Appendix A, the EA creates a confusing and potentially misleading picture of the potential extent, volume and duration of losses from the alluvial groundwater system.

The conceptualisation of the alluvial groundwater system is inadequate upon which to form a robust model which may provide sufficient sensitivity analyses to quantify the likely and potential impacts of excavating into the alluvium connected to Goonbri Creek.

The conceptualisation for the model development should have clearly identified the assumptions, gaps in baseline data for the extent and climatic variability of the alluvium, and the nature and degree of interconnection between Goonbri Creek, the alluvial groundwater system and the underlying porous rock system.

No bore logs were provided to show depth, geologies or construction details for any of the monitoring or production bores indicated on the maps provided. The assessment states *"groundwater levels have been monitored since June 2006 at and near the mine site. In alluvial*

bores, groundwater levels have been fairly stable with only a mild response to rainfall (Figure A-18)." However the data presented in Figure A-18 shows very limited data which is inadequate to demonstrate the above response. This is the same for the deeper bores screened in the coal, interburden and volcanics. There has been no apparent attempt to show all the data from all the bores that are being monitored. Of the bores which were installed in May, 2011 only two of the deeper bores were converted to vibrating wire piezometers. The other piezometers did not have loggers installed to measure water levels.

b) Quality

Baseline groundwater chemistry data only presents median values; there has been no justification as to why these values have been used. Table A-6 shows the median, mean and standard deviation for electrical conductivity. The standard deviation is very large indicating that there is large variation between the groundwater samples collected from each of the bores. The summary of the monitoring program showing that only biannual sampling of EC was undertaken, which is insufficient to determine any variation in water quality especially in the alluvium due to temporal changes. All data collected needs to be presented and any variation in EC needs to be determined. Any uncertainty within the data requires more data to be collected.

c) Alluvial extent

To characterise the alluvium in the project area, the assessment has used Transient electromagnetic (TEM) Survey. Several layers were produced, however there was no cross sectional layer which showed the actual depth of the alluvium. Unconsolidated alluvial materials can generally occur in a wide range of resistivities, which may yield misleading results without field verification. As the TEM methodology is not able to differentiate between high density clay particles, concentrations of salinity and presence of groundwater, the survey should have been compared to bore logs for confirmation with known geology. There was no attempt to map the alluvium adjacent to the mining area.

The extent of the Upper Namoi Alluvium, Upper Namoi Zone 4, Namoi Valley (Keepit Dam to Gin's Leap) Groundwater Source across the mine site is not adequately presented in any of the figures in this appendix. Within the EA the only place where a detailed map exists showing the location of the alluvium is in Appendix R Figure 003.

d) Hydraulic conductivity

Limited data has been presented in the assessment especially for the alluvium with only one borehole pump out result presented. The assessment needs to clarify what the hydraulic conductivity is throughout all aquifers especially the alluvium, as different hydraulic conductivity values were provided in the modelling section.

Figures A-7a to A-7c of Appendix A show the structural geology south of the mine site but not through the mine site. A cross section through the mine site, showing identified geological structures should also have been included. Pp A-9 indicates that the project area is isolated from the Vickery Area by faulting and erosion. This should have been presented on a north south cross section, and clearly delineated in the east-west transect diagram. It is not clear from the information presented whether this was derived from exploration borehole data drilled across the flood plain. If so, the borehole data should have been included in order to demonstrate how model layers were developed for the model. A figure showing the extent of the exploration bores holes is required as this is necessary in determining how the model layer thickness was constructed.

The alluvial geology section of Appendix A refers to shallow boreholes TAWB14- 22. There are no borehole logs of these monitoring bores in the report and the locations of the bores on Figure A-8 are too small to see accurately. TAWB16, TAWB 17, TAWB18, TAWB20, TAWB21 and TAWB22 are shown Fig A-15 but Figure A-15 is not referred to in this section. There are no borehole logs presented for any of the monitoring bores. This severely limits confidence in the development of the model.

e) Surface/groundwater connectivity

There has been no apparent attempt to determine the connectivity of creeks located within and adjacent to the mine area. Since it is proposed to divert Goonbri Creek, which contributes to Bollol Creek and is upstream of the Slush Holes, Barbers Lagoon and Driggle Draggle Creek (Namoi River Lagoons), a surface/groundwater connectivity assessment for all water sources should have been conducted.

f) Groundwater model development

The data which has been used in the model needs to be provided. The main report refers to data in Appendix A (Groundwater Assessment). Appendix A (A2.11) does not clearly describe all the data used in the assessment. There is no comprehensive list of the monitoring bores in Appendix A. These should have been presented in order to allow an assessment of the model applicability to the proposal. In addition, bore logs should have been provided to all bores used in defining steady state and transient conditions for the model runs, and particularly to which geological sub-unit (i.e. sand/gravel lenses, high or low saturated hydraulic conductivity regolithic or porous rock units) they are screened for use in determining groundwater quality.

The geological logs of bores drilled (TAWB16-22) and used to produce the cross section of the alluvium and underlying regolithic blanket in Figure 2-14 are not included in the appendices. This information must be made available to allow an assessment of lateral aquifer extent and groundwater flow directions.

The calibration of the model shows varying trends for the observed and simulated water levels and in some instances underestimation of the simulated results compared to the observed levels. These variances need to be confirmed with an explanation of the differences provided.

Groundwater Dependent Ecosystems (GDEs)

The information provided in the Surface water and ecology assessments does not address the DGRs provided by the Office of Water. The EA does not assess the contributions to surface flows provided by shallow groundwaters within the alluvium. This lack of consideration appears to be based on an assumed permanent depressurised condition in the alluvial groundwater source, which is discussed in the groundwater impact assessment section.

Specific DGRs related to GDEs which have not been addressed in the EA include:

- Baseline monitoring (minimum of fortnightly data) of all surface and groundwater sources and dependent ecosystems within and adjacent to the mining operation area for calibration of models.
- Identification of potential GDEs.
- Details of current GDE Condition, water quantity and quality required by the GDEs (based on minimum 2 year fortnightly baseline data).
- Details of a flora and fauna assessment for all GDEs.
- Details of critical thresholds for negligible impact.

Several GDEs are located within and adjacent to the mining area which consist of baseflow, wetland and terrestrial vegetation GDE types. The EA and supporting assessments did not monitor and/or adequately assess these GDEs. A limited macroinvertebrate assessment was conducted and used to determine the health status of Goonbri Creek. This type of assessment is not suitable for determining impacts to the range of GDEs identified on the proposal site. There has been no assessment of the aquifer's ecological assemblages and potential impacts to those communities.

The EA has not demonstrated the following outcomes prescribed in the DGRs:

- That, where possible, natural patterns of groundwater flow will be maintained.
- That groundwater extraction will be managed within defined limits, so that groundwater levels which are critical for GDEs will not be disrupted and that there is sufficient flow to sustain ecological processes and maintain biodiversity.

- That the proposed project will not pollute or cause adverse changes in groundwater quality, and that sufficient groundwater of suitable quality is available to GDEs when needed.
- That the precautionary principle is applied in the protection of GDEs, particularly with regard to the dynamics of flow and availability, and the species reliant on these attributes.
- Protective measures will minimise any impacts on GDEs and potential offset areas will be monitored and protected.
- Where potential impacts on a groundwater source, GDE or water users are identified, the EA will need to identify threshold limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts.

Low permeability cut off barrier

The installation of a low permeability cut off barrier isolating the adjacent alluvium to the proposed excavation void and evaporative sink on the site is likely to result in the following significant changes to groundwater regimes:

- Reduction in total groundwater storage within the alluvium, with resultant reductions in both pressure head and flow.
- Reductions of baseflow contributions to Goonbri Creek where inflows are not fully accounted for, as the narrower section of the alluvium will have lower recharge and flow rates.
- Permanent changes in groundwater gradients and resultant preferential drainage through; any defects in the low permeability barrier, and any defects or high permeability contact zones between the unconsolidated alluvium and the intact porous rock, and any in situ or mining induced fracture pathways within the porous rock draining to the excavated void

None of the above potential changes to the alluvial groundwater source have been assessed in the EA.

As basal saturation of the cut off barrier has not been assessed, the likelihood of saturation-induced failure of the steep batter face of the void cannot be assessed. This is a commonly recognised and understood risk in cut face slopes in mining engineering, and should have been comprehensively assessed in the EA.

As no construction design details are presented, and minimal details as to the fracture density, orientation and permeability of the underlying porous rock for both in-situ calibration of the groundwater model, and potential fracture development during mining operations, assessment of the integrity of the barrier cannot be conducted.

The acceptability of a permanent final void and evaporative sink in the excavated portion of the Namoi alluvium cannot be determined due to the lack of detailed assessment of the likely risks of batter slope failure due to face seepage and/or basal saturation. This has been examined in a number of mining operations, and consequential risks of such failure can only be assessed when sufficient information is collated and interpreted to adequately describe and assess the likelihood of connection between the remnant alluvial system and the evaporative sink, and implications for the water balance of the sink.

The applicant should present case studies to demonstrate the effectiveness of such low permeability barriers over the extended post-mining period while the evaporative sink is to remain. These case studies should be presented to demonstrate the long term effect of maintaining the remnant alluvial groundwater system adjacent to a permanent evaporative sink, which is anticipated to become hyper-saline as evaporation concentrates inflowing groundwater salinity. In addition, presentations of any case studies should discuss the effectiveness of different materials used for such low permeability barriers, duration and long term integrity of such structures, and maintenance and closure criteria for any preferred option.

End Attachment A
22 March 2012