BHP Billiton Mitsubishi Alliance

Appendix J: Groundwater Monitoring Plan

Introduction

This Groundwater Sampling and Analysis Plan is based upon the recommendations made in the groundwater chapter of the Environmental Impact Statement (EIS) for the Caval Ridge Project. The recommendations for groundwater monitoring made in the EIS were as follows:

- A monitoring network should be established prior to the commencement of mining to ensure there is sufficient baseline information on groundwater levels and quality to identify seasonal trends and for comparison when assessing possible impacts of mining on the groundwater resources;
- 15 bores at 10 locations that were installed for the EIS will form part of this network;
- The monitoring network should aim at monitoring on-site and regional groundwater quality of the coal seam aquifer, basalt and alluvium aquifer (where present). Groundwater sampling will be undertaken on a quarterly basis from all groundwater monitoring bores for analysis of the parameters:- pH, electrical conductivity (EC), total dissolved solids (TDS), major cations and anions, nutrients (total N, NOx, ammonia, phosphorous) and selected dissolved metals (boron, chromium, copper, iron, manganese, nickel, selenium and zinc);
- Groundwater level and quality monitoring will initially be undertaken on a regular basis to enable the detection of seasonal fluctuations and any groundwater level or quality impacts; and
- Post mining groundwater monitoring will be undertaken within monitoring bores that are planned for installation during the operational phase of the project.

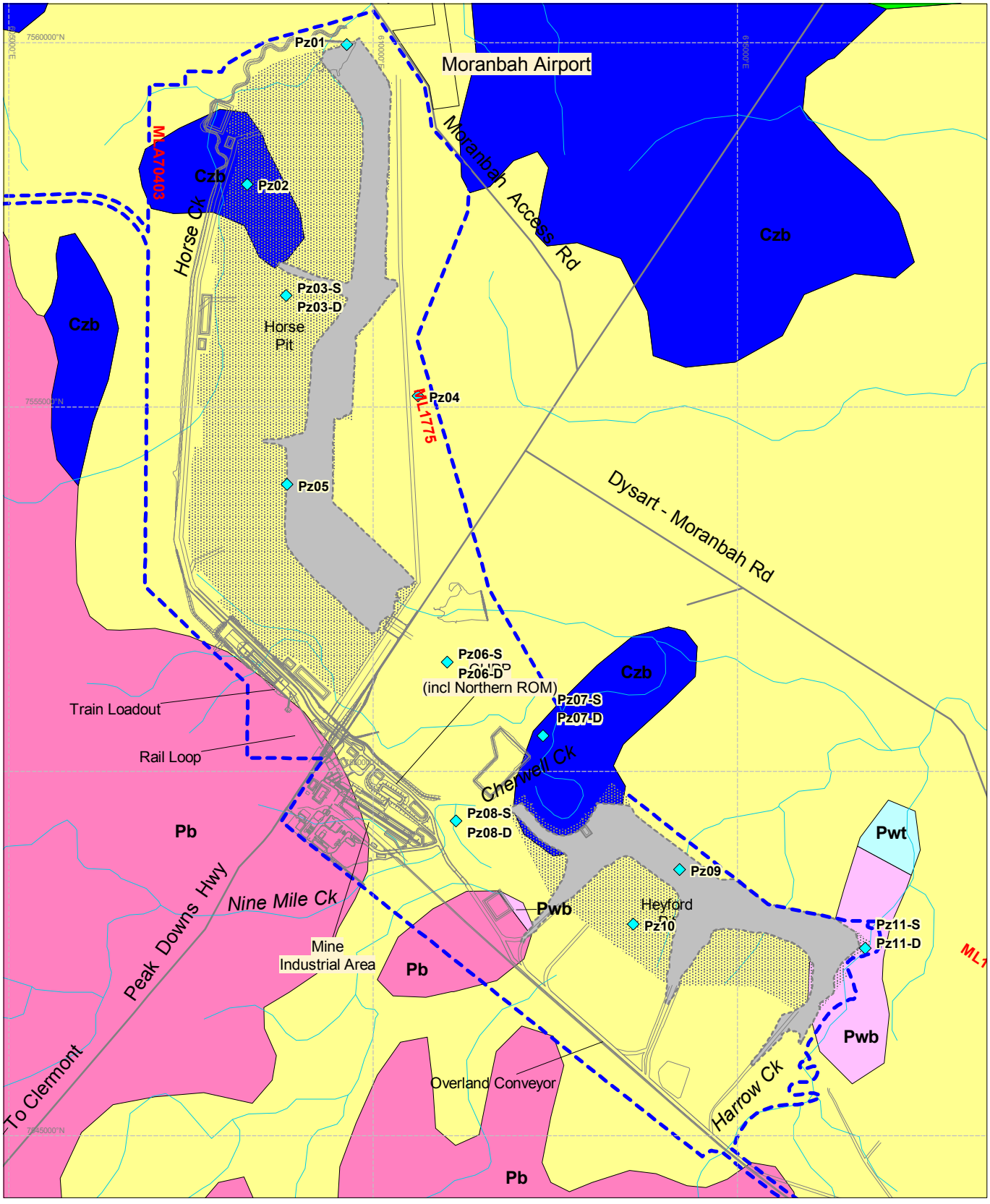
Groundwater Monitoring Bore Network

The groundwater monitoring network will be used to provide baseline hydrogeological conditions and temporal changes in groundwater conditions prior to mine development. The network will also be monitored in the long term (i.e. during and post mining) to provide ongoing measurement of quality and quantity, including temporal and seasonal changes. In addition to providing baseline information, the results from the groundwater monitoring undertaken will provide a measurement of any impacts that are occurring.

The groundwater monitoring network will initially comprise 15 existing groundwater bores which were installed at 10 locations for the EIS. The groundwater monitoring network may be augmented during the life of the mine with additional monitoring bores as bores may be lost during mining or as mine plans change. Additional groundwater monitoring bores will be installed down gradient of potential seepage sources (CHPP, chemical storage, and product/waste stockpile areas), with the locations determined once detailed design has been completed. The locations of the existing bore sites are shown in **Figure 1**. A summary of the existing bores is shown in the **Table 1** below.

Table 1 Summary of existing monitoring bores installed around site

Bore ID	*Easting (m)*	*Northing (m)*	*Strata*	*Screen Depth (mbgl)*	*Purpose*
Pz01	*609752*	*7560149*	*Coal Seam D04*	*82.5-85.5*	*Monitor groundwater level response in coal along northern margin of lease*
Pz02	*608384*	*7558233*	*Basalt*	*24-35*	*Monitor groundwater level response in basalt in centre of lease*
Pz03-S	*608920*	*7556710*	*Basalt*	*17.5-26.5*	*Monitor groundwater level response and connectivity in basalt and coal in centre of lease*
Pz03-D	*608920*	*7556710*	*Coal Seam D04*	*39.8-42.8*	
Pz04	*610730*	*7555327*	*Coal Seam Q*	*87.1-93.1*	*Monitor groundwater level response in coal along eastern margin of lease*
Pz05	*608929*	*7554114*	*Coal Seam D04*	*115-118*	*Monitor groundwater level response in coal in centre of lease*
Pz06-S	*611129*	*7551675*	*Basalt*	*22-31*	*Monitor groundwater level response and connectivity in basalt and coal in centre of lease*
Pz06-D	*611129*	*7551675*	*Coal Seam P02*	*81-84*	
Pz07-S	*612441*	*7550671*	*Alluvium*	*9-15*	*Monitor groundwater level response and connectivity in alluvium and coal downstream along Cherwell Creek*
Pz07-D	*612441*	*7550671*	*Coal Seam Q01*	*41-44*	
Pz08-S	*611249*	*7549500*	*Alluvium*	*9-15*	*Monitor groundwater level response and connectivity in alluvium and coal upstream along Cherwell Creek*
Pz08-D	*611249*	*7549500*	*Sandstone Interburden*	*60-63*	
Pz09	*614317*	*7548834*	*Coal Seam P08*	*71-77*	*Monitor groundwater level response in coal along eastern margin of lease*
Pz11-S	*616863*	*7547756*	*Alluvium*	*6-9*	*Monitor groundwater level response and connectivity in alluvium and coal downstream along Harrow Creek*
Pz11-D	*616863*	*7547756*	*Coal Seam P08*	*55-58*	



Source: Client Supplied Data (December 2007), Qld Gov. DME Geological Mapping, 2007

Client: BMA — BHP Billiton Mitsubishi Alliance

URS

Project: CAVAL RIDGE PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
GROUNDWATER MONITORING PLAN

Title: **LOCATION OF GROUNDWATER MONITORING WELLS**

Drawn: VH	Approved: RS	Date: 09-11-2009
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Figure: **1**

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Groundwater Monitoring Program

The groundwater monitoring program aims to address all groundwater monitoring requirements associated with the coal mining activities in the Caval Ridge Mine. The primary aim of undertaking groundwater monitoring on-site is to ensure sufficient baseline data is gathered for consideration of the following hydrogeological aspects:

- Temporal and spatial variations in groundwater levels;
- Temporal and spatial variation in groundwater quality; and
- Groundwater level or quality impacts (e.g. early detection of drawdown or groundwater quality changes caused by mining activities).

Some aspects of the monitoring may appear to be overly conservative at the beginning of the groundwater monitoring program; however they can be justified by one or more of the following reasons:

- There is a need to establish full baseline (or starting) conditions (typically requires at least 12 months data to obtain dry and wet season data);
- Possible changes to the mining sequence or other activities during the life of the mine resulted in precautionary application of more conservative approach, triggering a higher standard of monitoring; and
- The need for a consistent approach to monitoring for potential impacts of a range of activities.

The groundwater monitoring program will be reviewed annually in view of the monitoring results and development of the mining activities. The review of the groundwater monitoring program will re-assess the potential impacts and will adapt the monitoring to the updated risk rating. It will evaluate the effectiveness of each monitoring location, assess where new locations and modifications to the monitoring programme may be needed, and evaluate what impacts may be occurring. A special monitoring round will be considered in the event of a significant environmental incident.

The following monitoring routine will be undertaken:

- Groundwater levels will be monitored monthly, in the entire monitoring network, for the first two years following commencement of construction to assess seasonal, natural, groundwater fluctuations;
- Thereafter, groundwater levels will be monitored quarterly, preferably at a similar time of year to eliminate variation from seasonal changes;
- Groundwater sampling will be undertaken on a quarterly basis from all groundwater monitoring bores for analysis of the parameters:- pH, EC, TDS, major cations and anions, nutrients (total N, NO_x, ammonia, phosphorous) and selected dissolved metals (boron, chromium, copper, iron, manganese, nickel, selenium and zinc), with analysis for hydrocarbons from bores adjacent to bulk fuel storage vessels; and
- Measurement of daily precipitation, evaporation and mine dewatering volumes.

The monitoring program will be used to identify impacts prior to them being experienced by neighbouring landholders. In addition to this, data collected will be used to further develop and calibrate the existing groundwater model to accurately predict the long term recovery of the aquifers and the final void water balance and water quality. This will assist in the development and implementation of the closure strategy and the refinement of post-mining groundwater monitoring programs.

Groundwater Sampling Procedure

It is important that a rigorous sampling protocol is followed to ensure good sampling practice and due diligence in tracking of the samples and the results. Quality assurance and quality control (QA/QC) samples and procedures should be implemented. Groundwater monitoring will be undertaken based on the requirements in the Queensland EPA's Water Quality Sampling Manual (3rd Edition, EPA 1999), the National Environmental Protection Council's National Environmental Protection (Assessment of Site Contamination) Measure (NEPC Service Corporation, December 1999), and the Australian and New Zealand Standard AS/NZS5667.1:1998: Water quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (Standards Australia, 1998).

The method of groundwater monitoring will be undertaken following the procedure outlined below. Note that these procedures are not exhaustive to good sampling practices:

- Depth to water table will be measured using a calibrated water level meter;
- Bores must be purged of at least three well-volumes of groundwater using a submersible pump or bailer. Purged water will be disposed of to nearby drains or adjacent land. The method of purging will be tailored for each site, dependent on the parameters being analysed to ensure the accuracy of results;
- Analysis of physico-chemical parameters will be undertaken during the purging of each bore using a calibrated water quality (multi-parameter) meter. Calibration records should be made and kept as part of the QA/QC program. Recording of the required parameters will be taken throughout the purging process;
- Collection of groundwater samples will be undertaken following the purging of each bore. Effective purging is demonstrated by the stabilisation of water quality parameters (EC, pH and temperature);
- For groundwater samples, sampling devices will be dedicated and/or disposable for each sample or otherwise decontaminated between sampling locations. If rinsing is used, rinsate samples should be included in the QA/QC program as appropriate;
- Groundwater samples will be collected in laboratory supplied sampling containers that will be appropriately dosed with preservative for the analysis required. The samples are to be submitted for analysis to a NATA accredited laboratory within the holding times with completed chain of custody documentation;
- All sampling events should have a QA/QC program and the QA/QC sample analysis should be checked to validate the integrity of the collected data.

Documenting of Monitoring and Reporting on Monitoring Results

All documentation related to groundwater monitoring should be kept on archive, and be readily accessible to facilitate ease of data analysis against regulatory criteria and monitoring trigger values. Depending on the medium for recording of field monitoring data, relevant monitoring documentation may include (but is not necessarily limited to):

- Hand recorded field observations and data recording;
- Electronic data records and downloaded information;
- Calibration records for field monitoring equipment;

- Photographs of monitoring sites or potential issues of concern;
- Laboratory analytical results reports, including chain-of-custody records;
- Summary and records of quantities of releases of hazardous materials to the environment;
- Internal technical memorandums detailing the results of monitoring programs; and
- Monitoring reports prepared for submission to regulatory authorities.

An organised internal approach to data management and monitoring documentation will significantly enhance the intended benefits of the monitoring program, and facilitate the identification of potential issues of concern in a timely manner, such that appropriate contingency actions can be implemented if warranted.

The groundwater monitoring program will be reviewed annually by an appropriately qualified Hydrogeologist in view of the monitoring results and development of the mining activities. The review of the groundwater monitoring program will re-assess the potential impacts and will adapt the monitoring to the updated risk rating. It will evaluate the effectiveness of each monitoring location, assess where new locations and modifications to the monitoring programme may be needed, and evaluate what impacts may be occurring. A special monitoring round will be considered in the event of a significant environmental incident. The annual review of the groundwater monitoring program, including analysis of results, will be submitted to the authorities for review.