



DEPARTMENT OF RESOURCES

***Independent Monitor's Audit of
the McArthur River Mine for the
2010 Operational Period***

**DEPARTMENTAL RESPONSE TO
THE AUDIT REPORT**

November 2011

Executive Summary

A review of the *Independent Monitor's Audit of the McArthur River Mine for the 2010 Operational Period* ("the 2011 Audit Report"), prepared by the appointed Independent Monitor ("IM") and submitted to the NT Government in October 2011, was undertaken by the Department of Resources ("DoR") between October and November 2011.

The departmental review focused on the compliance and technical issues raised by the IM relating to the environmental condition, management and monitoring of the McArthur River Mine ("MRM") by McArthur River Mining Pty Ltd ("the operator") and regulatory overview by DoR.

In relation to assessing the regulatory performance of DoR, the IM found that that DoR had demonstrated thorough and appropriate administrative procedures used to check the monitoring and approvals of the MRM operations, indicating the robustness of its mine site evaluation process.

In the 2011 Audit Report, the IM stated that the operator had demonstrated a high level of procedural compliance with commitments made in the 2009/10 Mining Management Plan, as assessed through the provision of evidence of the works undertaken and commitments to undertake further work or continual improvement. Only one non-compliance was identified which related to a lack of shaping of the surface of the tailings storage facility (TSF) cell 1 cover.

During this audit the IM did not identify any issues that were regarded as requiring urgent notification under the *Independent Monitoring Assessment Conditions*. However, the following issues were considered by the IM to be significant and require immediate action towards rectification:

- the volume of water stored in TSF cell 2 - there is considered to be an extreme risk of embankment failure or overtopping of the spillway;
- the visual method of classifying NAF/PAF waste rock because of the potential for miss-classification;
- seepage from the TSF cell 1 into Surprise Creek;
- fugitive dust emissions from the ROM and crushing area, and to a lesser extent the Bing Bong concentrate storage shed;
- the structural integrity of the Bing Bong dredge spoil pond walls;
- slow progress of revegetation on the McArthur River diversion channel; and
- concerns about the inadequacy of reporting of many routine monitoring programs including the lack of:
 - scientific method;
 - background data and site-specific trigger levels;

- quality assurance and quality control reporting;
- adequate discussion of results;
- temporal trend analyses; and
- discussion regarding contaminant sources and mitigation measures.

In its 2011 Audit Report the IM concludes by stating that the environmental performance of MRM is improving and the operator has shown a willingness to improve their environmental monitoring based on recommendations made in previous years. DoR welcomes these finding and is supportive of the majority of recommendations for further improvement put forward by the IM in the 2011 Audit Report. Information provided in the 2011 Audit Report will be used by DoR in the review of the operator's environmental performance and management documents.

Having reviewed the findings of the 2011 Audit Report, DoR is satisfied that issues highlighted will, or are, being addressed by the operator through a process of ongoing continual improvement.

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1 OUTPUT

A review of the *Independent Monitor's Audit of the McArthur River Mine for the 2010 Operational Period* ("the 2011 Audit Report"), prepared by the appointed Independent Monitor ("IM") and submitted to the NT Government in October 2011, was undertaken by the Department of Resources ("DoR") between October and November 2011.

The departmental review focused on the compliance and technical issues raised by the IM relating to the environmental condition, management and monitoring of the McArthur River Mine ("MRM") by McArthur River Mining Pty Ltd ("the operator") and regulatory overview by DoR.

The period examined by the 2011 Audit Report was from October 2009 to September 2010 ("the 2010 operational period"), which represented those activities covered by the operator's 2009/10 Mining Management Plan (MMP) and Water Management Plan (WMP). The 2011 Audit Report also includes information from a site inspection of the MRM operations undertaken by the IM between 30 and 31 May 2011, as well as updated information provided by both the operator and DoR.

2 OBJECTIVES AND OVERVIEW OF THE INDEPENDENT MONITOR'S 2011 AUDIT REPORT

The objectives of the 2011 Audit Report were stated as follows:

1. review the environmental assessments and monitoring activities undertaken by MRM;
2. review environmental assessments and audits undertaken by DoR;
3. report to MRM and DoR any urgent issues requiring investigation and reporting; and
4. provide an annual Audit Report to the Minister for Primary Industry, Fisheries and Resources that:
 - assesses the environmental performance of MRM operations; and
 - recommends improvement measures to increase environmental performance.

The approach taken by the IM to evaluate these aspects included a:

- review of the MRM monitoring data, management systems, and assessments undertaken during the 2010 operational period via:
 - a statutory compliance assessment;
 - a technical review of data and procedures;
 - a site inspection; and
 - interviews with personnel;

- annual update of the IM's risk assessment and gap analysis relating to the MRM operation;
- review of environmental audits, assessment, management systems, and environmental monitoring undertaken by the DoR pertaining to the 2010 operational period;
- community consultation and presentations; and
- provision of an annual report to the Minister for Primary Industry Fisheries and Resources regarding the environmental performance of the MRM operations.

The primary areas of focus for the 2011 Audit Report were:

- the performance of the tailings storage facility (TSF), particularly in terms of:
 - excess water storage in TSF cell 2;
 - current and likely future seepage migration from TSF cell 1 into Surprise Creek;
 - geochemical assessment/hazard classification of tailings; and
 - effectiveness of the progressive rehabilitation of TSF cell 1;
- the performance of the Bing Bong Port dredge spoil ponds since the previous audit;
- dust emissions from the Bing Bong Port concentrate storage shed;
- the level of detail and quality of reporting of monitoring results;
- weed management along the river diversion channels and mine site;
- scientific robustness of routine monitoring results collected by the operator;
- relocation or repair of mine perimeter fence lines to keep out cattle that damage rehabilitation efforts and cause erosion;
- procedures and monitoring results relating to the function and management of the overburden emplacement facility (OEF); and
- rehabilitation and habitat creation along the river diversions.

3 REVIEW OF THE DEPARTMENT'S REGULATORY ROLE

3.1 Background on mining regulation in the Northern Territory

Mining legislation and regulation

Mining activities do impact on the natural environment, and thus the prime role of regulation is to reduce this level of impact to an acceptable standard, while still allowing an activity to occur where the environmental impact can be balanced by the benefits of social and economic outcomes.

Governments' role is to determine what the balance should be with respect to fostering mining activities to further economic development against protecting the environment in its natural state.

The role of DoR is to ensure that the activities of mining operations authorised under the Northern Territory's *Mining Management Act* (MMA) are undertaken in accordance with provisions of the Act.

DoR uses the MMP, which includes the WMP, and the broader MMA to facilitate the incorporation of best practice methods, systems and processes in operational activities. This in turn facilitates continuous improvement and is consistent with the Act's co-regulatory approach.

Under section 82(c) of the MMA, the Minister, in exercising a power or performing a function under the Act, must have regard to the outcomes of any environmental assessment of mining activities undertaken under the *Environmental Assessment Act*. This provides the direct linkage between the authorisation and on-going regulation of mining activities undertaken by DoR and the environmental assessment process undertaken by the Department of Natural Resources, Environment, the Arts and Sport (NRETAS).

Under the MMA any authorised mining activity that is likely to cause a substantial disturbance requires the posting of a 100 % rehabilitation security.

A formal *Memorandum of Understanding* (MoU) exists between DoR and NRETAS for the formal referral of proposed new or amended mining activities that trigger agreed referral criteria. Routine discussions occur between agencies on relevant matters (e.g. water management on mine sites). The off-site discharge of water is regulated by NRETAS under the *Waste Management and Pollution Control Act* (WMPCA) via the issuing of Waste Discharge Licences. Environmental offence provisions in the MMA are aligned to those in the WMPCA, with penalties for breaches set by the *Environmental Offences and Penalties Act*.

In relation to the activities of the MRM, DoR reviews the operator's MMP on an annual basis. Further, as part of this process DoR also reviews the level of rehabilitation security applied to the site and this security is held in the form of bank guarantees.

Inspections, audits and check monitoring activities

DoR periodically undertakes site visits, inspections and audits of mine sites in the Northern Territory including the MRM operations and the port loading facility located at Bing Bong. During the 2010 operational period DoR undertook:

- field visits/inspections between 11 and 13 May 2010;
- water quality check monitoring activities by DoR's Environmental Monitoring Unit (EMU) between 10 and 16 May 2010; and
- one compliance audit between 13 and 16 December 2010.

The annual check monitoring program undertaken by EMU involves the collection of surface and groundwater samples for field measurements and subsequent analysis by a National Association of Testing Authorities (NATA) approved laboratory. The water

quality monitoring points selected and the analyte suites examined are designed to provide a representative sample of the operator's environmental monitoring program to ensure a meaningful comparison of DoR's data to the operators. The analytical suite is selected on a mine-by-mine basis with recognition of the dominant analytes in that water body reflective of mining process and surrounding geochemistry. Water quality results the EMU monitoring are then compared against water quality data supplied by the operator to check that the operator's data are comparable and provide DoR with confidence regarding the overall site data supplied by the operator.

The check monitoring also enables interpretation of trends for validation against the operator's reported performance in comparison with appropriate standards, such as the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines and appropriate waste discharge licensing criteria. DoR reviews the suite of elements annually during the mine site environmental monitoring program review, and periodically when results returned from a sampling event (DoR or operator) indicate significant changes in water quality.

Assessment of both the operator's and DoR's analytical data is undertaken as it is received throughout the year and a formal annual review of all data forms part of DoR's annual mine site review and monitoring program assessment. Additional formal review is undertaken with the review of the operator's annually submitted MMP.

3.2 Independent Monitor's assessment of departmental process and regulation

In the 2011 Audit Report the IM stated that DoR had demonstrated thorough and appropriate administrative procedures used to check the monitoring and approvals of the MRM operations.

The IM did make minor recommendations for:

- a formalised method or structure chart for assigning tasks to staff be developed and maintained;
- increased detail in reporting, including outcomes of discussions, statements of which industry standards the operation is being compared to, the reasons for inspecting certain areas at certain times, be included in DoR's audit and field visit/inspection reports;
- the monitoring areas examined in audits should be rotated in subsequent audits;
- members of staff be rotated for each audit so that different areas of staff expertise can be applied to subsequent audits of the MRM operation;
- discuss with MRM the possibility of attaching separate detailed reports to the MMP to provide greater detail regarding the status of environmental monitoring at the MRM; and
- as part of future check-monitoring reporting, the EMU personnel should include the further information provided in the 2011 Audit Report.

The 2011 annual check monitoring program for the MRM by EMU was undertaken in May 2011, prior to the release of the 2011 Audit Report. Therefore, the recommendations by

the IM for DoR to retain GW47b and GW47C in the groundwater sampling program and to include nutrient sampling in the check monitoring program were not able to be reviewed or implemented. However, DoR will consider these recommendations, and the other recommendations outlined in the 2011 Audit Report, in the review of future check monitoring programs and auditing of the MRM operations.

4 RISK ASSESSMENT

4.1 Outcomes of Risk Assessment

The purpose of the risk assessment in the 2011 Audit Report is to:

1. identify significant environmental risks associated with the MRM operations; and
2. evaluate whether environmental monitoring and assessment practices undertaken by the operator are adequate and appropriate to mitigate the risk of potential environmental impacts.

In the 2011 Audit Report the IM noted that there is an increase in the number of identified environmental risks from previous audits. However, this was not necessarily indicative of environmental performance of the operator deteriorating but rather the IM broadening the scope of the risk assessment. The IM assessed 71 environmental risk items and classified the risk levels as follows:

- 2 extreme;
- 18 high;
- 43 moderate; and
- 8 low.

The extreme risks were identified as the potential:

- overtopping of TSF cells leading to an embankment failure; and
- for acid leachate migration from the TSF into Surprise Creek.

The high risks that were identified included:

- TSF cell 1 embankment failure causing spillage into Surprise Creek;
- failure of the TSF cell 2 embankment due to stability failure;
- failure of TSF cell 2 embankment due to scouring at the toe of the embankment;
- leachate containing salts and metals from TSF entering Surprise Creek and impacting flora and fauna; and
- contamination of surface soils, vegetation and sediments with salts and heavy metals due to dust emissions from the PACRIM crusher at the mine site.

A list of the IM's risk assessment is located in Appendix A of the 2011 Audit Report.

The outcomes of the IM's 2011 risk assessment will be examined by DoR as part of its review of the operator's 2011/12 MMP.

5 GAP ANALYSIS

5.1 Background

The purpose of undertaking a gap analysis is to identify gaps in the environmental monitoring and assessment of an operation that may require improvement. The definition of a gap is defined by the IM as a discrepancy between what is taking place, and what should be taking place, in order for an activity to be maintained at an industry best practice standard. Typically gap analysis includes a comparison of environmental performance against:

- best practice industry standards;
- expert assessment and recommendations; and
- statutory obligations.

5.2 Outcomes of Gap Analysis

In the 2011 Audit Report the IM identified a number of gaps in the operator's ongoing monitoring program that are detailed in the Gap Register. DoR concurs with the recommendation of the IM that the operator use the Gap Register to demonstrate how the identified gaps will be addressed or have been closed.

The gaps identified in the IM's 2011 Gap Register will be examined by DoR as part of its review of the operator's 2011/12 MMP.

6 REVIEW OF MCARTHUR RIVER MINE'S COMMITMENTS

The 2011 Audit Report reviews the key procedures and systems, and selected commitments and conditions, associated with the annual MMP for the MRM operations. In the 2010 Audit Report 4 non-conformances were identified by the IM, which have been resolved for the 2011 Audit Report.

Of the 101 environmental commitments given by the operator in the 2009/10 MMP, the IM found:

- 71 commitments were compliant;
- 22 commitments could not be verified;
- 9 commitments were incomplete; and
- 1 commitment was non-compliant.

The assessed non-compliance was in relation to commitment - "*prior to capping the tailings, the post-mining tailings surface topography will be reformed to minimize erosion*". The IM noted that the cover, which was to be placed at 0.5 m thick, had not undergone reshaping, and was acting as a dust suppression measure only.

The 9 commitments identified by the IM that were incomplete were:

- cattle will be excluded from the mining and processing areas by the construction of a 17 kilometre fence line;
- rehabilitation trials will recommence on the Bing Bong Port dredge spoil and opportunistic planting will occur;
- an improvement to the dust monitoring program in 2010 is to occur with the inclusion of Minivol™ dust samplers, which will allow more accurate measurement of air quality to enable comparison with the relevant air quality standard; National Environment Protection (Ambient Air Quality) Measure (NEPM/AS2800);
- some vegetation scar mapping has been conducted with the use of aerial photographs based on annual photographs taken by AAH Hatch;
- the TSF area has been fenced to exclude stock, and permanent fire breaks will be constructed around the perimeter;
- the top of the clay layer encapsulating the PAF cells will be covered by a minimum of 3 m of NAF material;
- the PAF dams will consist of two parts: first, a sediment trap dam into which any runoff and/or leachate will flow and second, a main dam with runoff from the OEF spilling into the sediment dam first; activities completed in the last operational year that were approved in the last MMP included: completion and commissioning of the tailings line upgrade (No. 96); and
- operation of water recovery bores from the Surprise Creek corridor back to TSF cell 2.

Overall, the IM noted that the operator displayed a high level of compliance with the environmental commitments in the MMP 2009/10, which was also observed by DoR during the 2010 compliance audit.

7 OUTCOMES OF THE TECHNICAL AUDIT OF MCARTHUR RIVER MINE'S ENVIRONMENTAL MONITORING PROGRAMS AND TECHNICAL REVIEW

The key areas focussed on by the IM during the technical audit of the 2011 Audit Report undertaken in 2011 included:

- surface water and artificial water monitoring;
- groundwater monitoring and management;
- dust monitoring;
- soil monitoring;
- fluvial sediment monitoring;
- marine monitoring - seawater and sediment;

- flora and fauna monitoring;
- geotechnical monitoring;
- geochemical monitoring; and
- surface water hydraulics.

The following section is DoR's commentary on the outcomes of the technical audit of the 2011 Audit Report.

7.1 Surface water and artificial water monitoring

The IM notes that the presentation and interpretation of surface water monitoring and management by MRM in the reporting period has demonstrated improvement in the 2010 operational period. DoR agrees with the IM's statements in the 2011 Audit Report acknowledging these improvements.

The IM recommends that:

- additional potential surface water source risks to water quality be included in the annual WMP;
- data associated with cease to flow should be provided on the trend charts;
- additional surface water sampling point be included in the monitoring program at:
 - the bridge over Surprise Creek downstream from cell 1 of the TSF; and
 - the drainage line where the seepage from the Northern OEF.
- quality assurance and control reporting should be presented and discussed.

DoR agrees with the IM's recommendations outlined in the 2011 Audit Report with the exception of the recommendation regarding the inclusion of an additional surface water quality monitoring location at the Surprise Creek Bridge. The operator currently undertakes water quality sampling at SW2, which is located downstream of the TSF where the Carpentaria Highway crosses Surprise Creek. DoR considers this sample location to be a representative site for the water quality conditions at the Surprise Creek Bridge. In addition, DoR directed the operator in January 2011 to monitor this site and if substantial salt deposits are observed the operator is to collect samples of these salts for analysis to determine the constituents and possible source of the salts. Therefore, the addition of another surface water quality monitoring site at this location is not deemed necessary by DoR.

7.2 Groundwater monitoring and management

The IM's recommendations regarding the review of the groundwater monitoring and management undertaken by the operator include:

- improved quality control and quality assurance analyses and reporting;
- a separate and more robust hydrogeological and hydrogeochemical model and report should be developed and updated annually, and that this report be provided as an appendix to MRM's annual WMP with the findings incorporated into the body of the report, including actions to address the recommendations made; and
- groundwater contours in each separate formation need to be presented at least bi-annually, at the end of wet and end of dry seasons.

The latter has been recommended to the operator previously by the IM.

DoR acknowledges the IM's recommendations and supports the inclusions of more detailed reporting by the operator with regards to the groundwater monitoring and management at the MRM operations.

7.3 Dust monitoring

In the 2011 Audit Report the IM commended the operator for responding to the recommendations made during the previous audit. The IM also noted that the operator has shown some improvement in their reporting of dust monitoring results. However, the IM states that further efforts to control fugitive dust emissions are needed.

The IM recommends that the operator:

- increases concentrate moisture, reduces concentrate stockpiles, increases the use of water sprays and water tucks, implements a split concentrate recovery program and more effectively train staff to eliminate dust issues;
- improve quality control and quality assurance analyses and reporting;
- place a vegetation barrier between the ROM pad and main road, implement an extraction system in the concentrate shed and increase the use of street sweepers; and
- investigate the option of applying a commercially available dust stabilisation product to aid in dust mitigation.

DoR supports the IM's recommendation for the ongoing development and improvement of dust management strategies. However, DoR strongly supports the implementation of preventive measures as opposed to corrective activities to mitigate against environmental risks. Therefore, the implementation of additional dust mitigation measures will be supported by DoR once it is demonstrated that there is a sound maintenance and monitoring program, supplemented with proper procedures to interpret and report the data. DoR will consider the recommendation provided by the IM during the evaluation of the operator's dust monitoring as part of the review of the operator's 2011/12 MMP.

7.4 Soil monitoring

In the 2011 Audit Report the IM acknowledged that the operator's soil monitoring program was generally appropriate and that the associated laboratory analytical program was comprehensive. However, the IM noted that there is significant room for improvement.

The IM recommends that the operator:

- immediately cease applying Health-based Investigation Level (HIL) concentrations as trigger levels up to which contamination is not considered to be an issue;
- temporal monitoring assessments should be undertaken and discussed in detail to evaluate whether contamination is occurring, and where contamination is coming from;
- implement field quality assurance and quality control measures;
- assess soil results in line with depositional dust metal concentrations and fluvial sediment concentrations to establish causes and potential transport mechanisms;
- undertake more discussion of parameters analysed; and
- increase the sampling program to include stream sediments and areas outside of the mineral lease.

DoR acknowledges the IM's recommendations. DoR has previously addressed the appropriateness of the use of NEPM HIL levels with the operator during the review of the 2010/11 MMP and will continue to review the use of trigger values for the soil monitoring program at MRM during the annual assessment of the operator's MMP. DoR also supports the expansion of the soil monitoring program to include areas typical of background conditions. However, DoR does not support the recommendation that the operator undertakes a comprehensive human health and ecological risk assessment, which was also recommended by the IM during the 2010 Audit Report. DoR believes that the results of the background survey and expanded monitoring program should inform the need for a project of this type.

7.5 Fluvial sediment monitoring

In the 2011 Audit Report the IM considered that the fluvial sediment monitoring program was generally appropriate and acknowledges the comprehensiveness of the laboratory analytical program undertaken by the operator. DoR concurs with the IM's commendation of the operator.

The IM recommends that:

- urgent attention is required to prevent the ongoing ingress of dust/runoff sediments entering creeks and rivers close to the mine;
- conduct a study to determine background heavy metal concentrations;
- evaluate trends in sediment concentrations;
- compare fluvial sediment data with ANZECC/ARMCANZ (2000) ISQGs;
- undertake toxicity testing for sediments exceeding the ISQGs thresholds; and
- implement field quality assurance and quality control.

DoR supports the IM's recommendations for the ongoing improvement of the analytical program and reporting of the fluvial sediment monitoring program. The recommendations by the IM will be considered during the review of the fluvial sediment monitoring program by DoR.

7.6 Seawater and marine monitoring

The IM considered the frequency, locations and analytes in the seawater and sediment monitoring program to be appropriate. DoR agrees with these comments regarding the seawater and sediment monitoring program.

The IM recommends that:

- the operator ensure that seawater samples collected as part of the monthly seawater monitoring are filtered so as to assess the dissolved metal phase concentrations;
- include the results of analyses undertaken using the DGT methodology in future WMP;
- ensure that the chosen ANZECC/ARMCANZ (2000) 95% of protection level values for seawater are protective of key ecosystem species, and provide an explanation into why this level was chosen;
- provide a long-term trend analysis;
- samples at either side of the transects, outside the swing basin, should be collected and analysed to assess the lateral extent of heavy metal impacts.
- transect samples already being collected as part of the marine monitoring program should be analysed individually and not composited;

- nickel be included in the analyte suite;
- determination of lead isotope ratios of suspended sediments in the McArthur River delta and at Bing Bong Port should be continued; and
- monitoring of the McArthur River delta sediments east of Bing Bong Port should be undertaken as the potential for impact exists at this location.

DoR supports most of the recommendations presented in the IM review of the seawater and marine monitoring. DoR will review, in consultation with NRETAS, the appropriateness of trigger values at the Bing Bong marine area during the annual review of the operator's seawater and marine monitoring program undertaken by DoR.

In DoR's response to the 2010 Audit Report it was noted that DoR does not support the IM's recommendation to filter samples using a nominal filter size and believes that the operator's seawater monitoring program is currently undertaken in accordance with Australian regulatory guidelines. However, all of the IM's recommendations will be considered as part of the review of the operator's 2011/12 MMP.

7.7 Flora and fauna monitoring

In the 2011 Audit Report the IM noted that the flora and fauna monitoring and management at MRM is generally moving in a positive direction and that most of the concerns raised by the IM during the previous audit have been addressed. DoR welcomes these findings and supports the continual improvement with regards to flora and fauna monitoring.

In response to the review of the flora and fauna monitoring program the IM recommends that:

- species diversity along the diversions that more closely resembles the original river channels;
- continuation of successful planting of cane grass and freshwater mangroves on the McArthur River diversion;
- expansion of the current vegetation monitoring program undertaken by CDU on the McArthur River diversion;
- comparison of actual data versus baseline and analogue sites data for Barney Creek should be expanded in the annual revegetation monitoring reports;
- status on the major areas to be rehabilitated to be included in the MMP;
- information and a map for the topsoil section of the MMP describing current stockpile locations, future areas requiring topsoil and from where the soil will be sourced;
- exotic species not be used for rehabilitation;
- exclude cattle from areas of sensitive rehabilitation;
- continue macroinvertebrate monitoring for effects of mine operations and diversions on biota;
- continue to monitor and add large woody debris into the diversions;
- maintain the functionality/integrity of the perimeter spoon drain to reduce the risk of saline concentrated seepage causing dieback in vegetation surrounding the dredge spoil;
- commission a suitable contractor to commence revegetation studies and interpret orthophoto vegetation mapping such as making renewed efforts to attract a PhD student;
- create a dredge management plan well in advance of scheduled dredging operations;
- old tyres at the waste dump at the mine should have drainage holes inserted;

- not to spray the dredge ponds with insecticide;
- nine days after each of a selected number of heavy rainfall events, the operator should carry out larval counts of mosquitoes from the dredge ponds in the wet season;
- fill in artificial dips where water ponds around the mine in the dry season.
- seagrass monitoring should continue to be undertaken at the end of the dry season
- include seagrass control sites beyond any potential influences of the port operations;
- should a large disturbance to seagrass communities be identified, a post disturbance survey should be conducted in order to assess whether these changes relate to natural disturbances or Bing Bong operations; and
- the organisms examined for heavy metal contamination should be referred to as gastropods or bivalves rather than molluscs.

DoR concurs with the IM's recommendations and encourages the operator to consider these recommendations during its review of the flora and fauna monitoring programs.

7.8 Geotechnical monitoring

The IM reported a number of inadequacies regarding the geotechnical monitoring at the TSF, OEF and at Bing Bong dredge spoil ponds undertaken by the operator and offered the following recommendations:

- install piezometers in embankments and carry out a comprehensive dam safety review including stability analysis of the embankments, especially the southern embankment of TSF cell 2 where water is ponding against the embankment;
- prior to the imminent wet season, carry out a review of the available capacity to store tailings and process water and rainfall runoff while maintaining sufficient freeboard;
- inspect seepage outfall drains and clean any that are blocked to ensure free flow of seepage;
- remove the temporary bund in the spillway;
- remove excess water from the facility;
- install bund or secondary containment pipe on the pipeline ramp to the TSF;
- construct a top cover over the OEF prior to the wet season;
- review classification method for identifying NAF waste;
- review the mineralogy of the NAF and PAF and AC waste to determine what minerals are present including carbonates, dolomites, sulfides and sulfates;
- produce a technical specification for clay placement and maintain a higher level of supervision for clay placement;
- improve compaction and moisture control for basal clay liner and lateral clay covers.
- place a paddock dumped cover over basal clay liner and lateral clay covers on completion of compaction of clay;
- rather than the end dumping procedure, MRM may consider horizontal layer paddock dumping across the face of the PAF cell. Monitor the QA/QC of the clay placement to ensure that the design material thickness is maintained over the slope. Armour the clay cover prior to the wet season;
- reconsider the implementation of larger kinetic cells or test columns on site;
- review and analyse selected waste rock samples for sulfide sulfur as well as total sulphur;
- correct errors in the MRM conceptual model of seepage from TSF cell 1;
- accelerate leaching trials on current tailings to establish the number of pore volumes required to consume buffering capacity;

- evaluate the possibility of recovering the tailings from cell 1 for inclusion in the design the tailings seepage and closure management system;
- investigate and discuss when seepage will occur from TSF cell 2 and where it will go to determine what the likely impacts will be;
- geotechnical review of embankment stability is required prior to the imminent wet season;
- clean out existing drain to allow free flow of drainage;
- install piezometers and survey monuments for the geotechnical monitoring program to be implemented; and
- install an engineered spillway before the imminent wet season.

DoR concurs with the IM's conclusions and further emphasises that it is imperative for relevant information and contingency measures to be explored by the operator prior to undertaking works and monitoring at the MRM operations. In addition, DoR agrees with the IM's recommendations regarding the need to improve the management and monitoring of seepage and quantity issues, in line with industry best practise, such as recommended in the ANCOLD. DoR also supports the IM's recommendation for the operator to undertake further waste rock characterisation and hydrogeological modelling to better understand the risk and closure/remediation options for the MRM operation. DoR has and will continue to evaluate these issues as part of the review of the operator's MMP submissions.

In light of the IM's concerns relating to the TSF DoR will require the operator to undertake a third-party independent review of the stability, structural integrity, fitness for purpose and management of the TSF.

7.9 Geochemical monitoring

In response to the review of the geochemical monitoring by the operator the IM recommends that:

- the operator correct errors in the conceptual model of seepage from TSF cell 1;
- accelerate leaching trials on current tailings to establish the number of pore volumes required to consume buffering capacity;
- evaluate and design a tailings seepage and closure management system, including in the evaluation the possibility of recovering the tailings from TSF cell 1; and
- investigate and discuss when and where seepage will occur from TSF cell 2, and what the likely impacts will be.

DoR supports the IM's recommendations for the operator to better understand the geochemical characteristics of wastes and materials at the MRM operations.

7.10 Surface water hydraulics

The IM considered that the 2010/11 WMP was far more complete than the previous WMP report.

The IM recommends that the operator:

- use the same RL datum throughout the mine project to relate the zero reading values of all the various gauging stations;

- use the May 2010 aerial photography to draw comparisons of erosion along both diversion channels. In addition, use of the accompanying ALS ground truth data to map changes in the diversion channel batters;
- improve the presentation of the Barney Creek gauging station and early warning flood station data by the adoption of the same twelve month time axis plot presentation for all stations;
- a series of permanent posts or a similar system be installed and recorded on a map to define the exact locations and orientations from which photographs are taken to ensure consistency for comparison. In addition, when taking new photographs, staff should carry copies of past photographs to ensure this consistency.
- discuss the variable trends in gauging station readings in the WMP report;
- include in future WMP reports a map which plots labels the complete network of sediment traps;
- following future protective works, in the immediately following WMP report, include details about rock types, their source and sizes are used for the repair work;
- incorporate the overland flow path between the old McArthur River and the diversion into the work as-built diversion channel model;
- include discussion of the relative magnitudes of flows in each wet season in future reporting of erosion trends; and
- in future, compare historic flows with the range of design flows by linking the data sets for the 2008/09, 2009/10 and 2010/11 wet season flows and the design flood flows for three locations along the McArthur River.

DoR supports the IM's recommendations and suggests that the operator consider these recommendations during the review of the surface water hydraulics monitoring program. Please note that DoR requires all the geospatial information that is provided to DoR to be based on the Geocentric Datum of Australia 1994 (GDA 94) and the Australian Height Datum (AHD). Also, DoR is aware that the Barney Creek gauging station is to be relocated prior to the beginning of the 2011/12 wet season.

8 CONCLUSION

In its 2011 Audit Report the IM concludes by stating that the environmental performance of MRM is improving and the operator has shown a willingness to improve their environmental monitoring based on recommendations made in previous years. DoR welcomes these finding and is supportive of the majority of recommendations for further improvement put forward in the 2011 Audit Report. Information provided in the 2011 Audit Report will be used by DoR in the review of the operator's environmental performance and management documents.

In relation to assessing the regulatory performance of DoR, the IM found that that DoR had demonstrated thorough and appropriate administrative procedures used to check the monitoring and approvals of the MRM operations, indicating the robustness of its mine site evaluation process.

Having reviewed the findings of the 2011 Audit Report, DoR is satisfied that issues highlighted will, or are, being addressed by the operator through a process of ongoing continual improvement.

