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NORTHPARKES

NORTHPARKES MINES STEP CHANGE PROJECT

RESPONSE TO SUBMISSIONS

Part 3A Environmental Assessment

September 2013

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Part 3A Environmental Assessment

September 2013

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Northparkes Mines

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Report No.	**2949/R16/FINAL**
Date:	**September 2013**

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1.0 Introduction

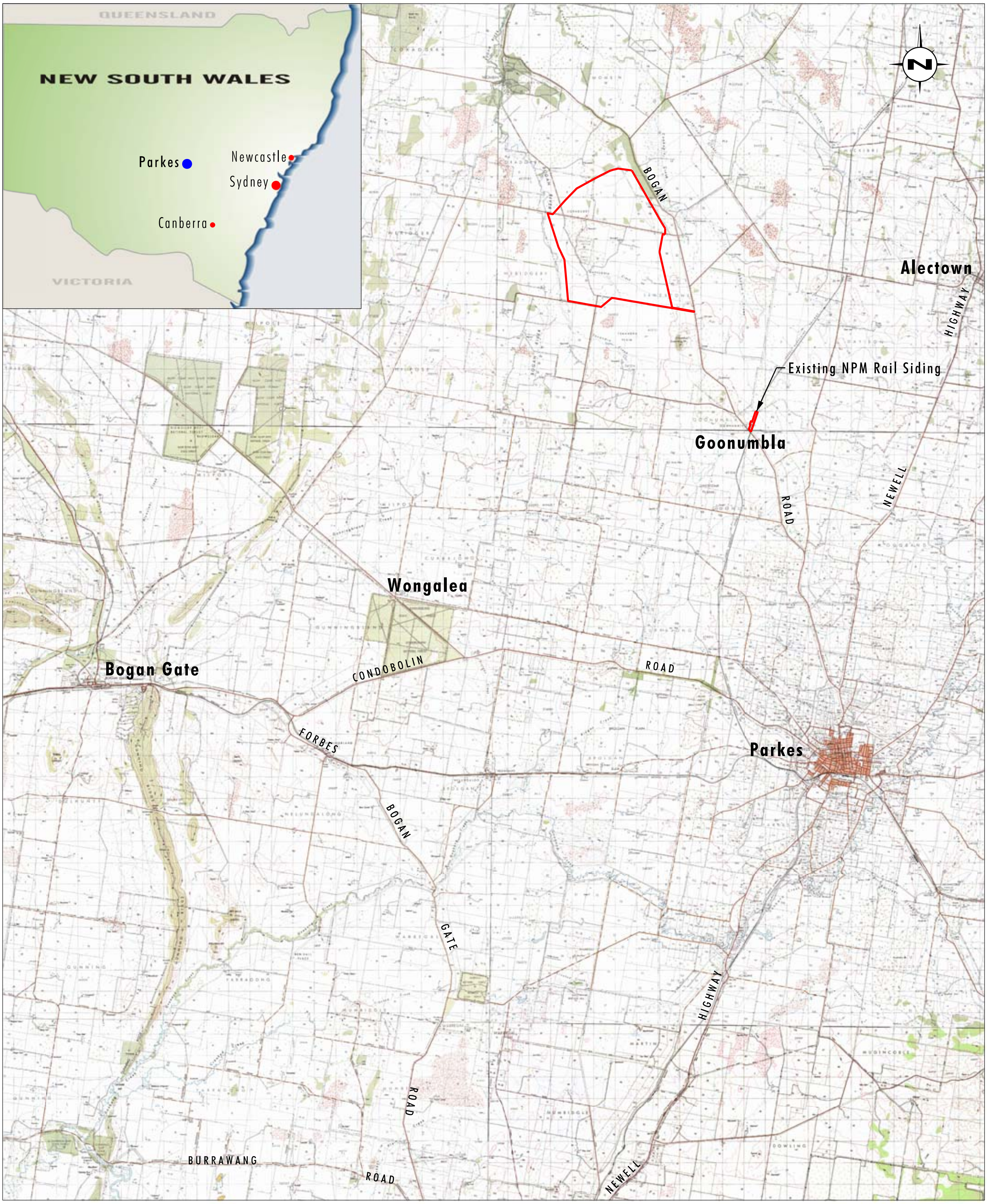
The Environmental Assessment (EA) for the Northparkes Mines Step Change Project (Project) (Umwelt 2013) was placed on public exhibition from 11 July 2013 to 15 August 2013. The Project is the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases, augmentation to approved Tailings Storage Facilities (TSFs) and an extended mine life of seven years until 2032 at the existing Northparkes Mine (NPM) site, located north-west of Parkes (refer to **Section 1.1** for detail). The NPM site (refer to **Figure 1.1**) is operated by North Mining Limited (NML) which is seeking project approval for the Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

In response to the public exhibition of the EA, nine submissions were made on the Project. This included eight agency submissions and one community submission. This report has been prepared in response to a written request from the Director-General of the Department of Planning and Infrastructure (DP&I) that NPM prepare a response to these submissions. This report has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of NPM and addresses the issues raised in submissions during the public exhibition period of the EA.

A total of nine submissions were received during the public exhibition period for the EA, with submissions received from:

- Department of Primary Industries (DPI):
  - Crown Lands;
  - NSW Office of Water (NOW); and
  - Fisheries NSW;
- DPI – The Office of Agricultural Sustainability and Food Security (OASFS);
- Environment Protection Authority (EPA);
- Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) – Division of Resources and Energy (DRE);
- Forbes Shire Council (FSC);
- The Office of Environment and Heritage (OEH);
- Parkes Shire Council (PSC);
- Roads and Maritime Services (RMS); and
- One community submission from a nearby landowner.

The PSC and FSC submissions raised no objection, concerns or conditions and were in support of the proposed Project. Additionally, Fisheries NSW advised no issues in regard to the Project.



Source: NPM (2013), Department of Lands (2006)

0 3.0 6.0 12km
1:250 000

Legend

Project Area

FIGURE 1.1

Locality Map

1.1 The Project

The Project encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases, augmentation to approved Tailings Storage Facilities (TSFs) and an extended mine life of seven years until 2032. Associated with the extension to mining operations is the development of supporting surface infrastructure related to amended access and tailings/waste material storage facilities (refer to **Figure 1.2**).

There has been no change to the Project since the EA was exhibited. A summary of the key components of the project in comparison to approved operations is provided in **Table 1.1** below.

Table 1.1 – Key Features of the Project

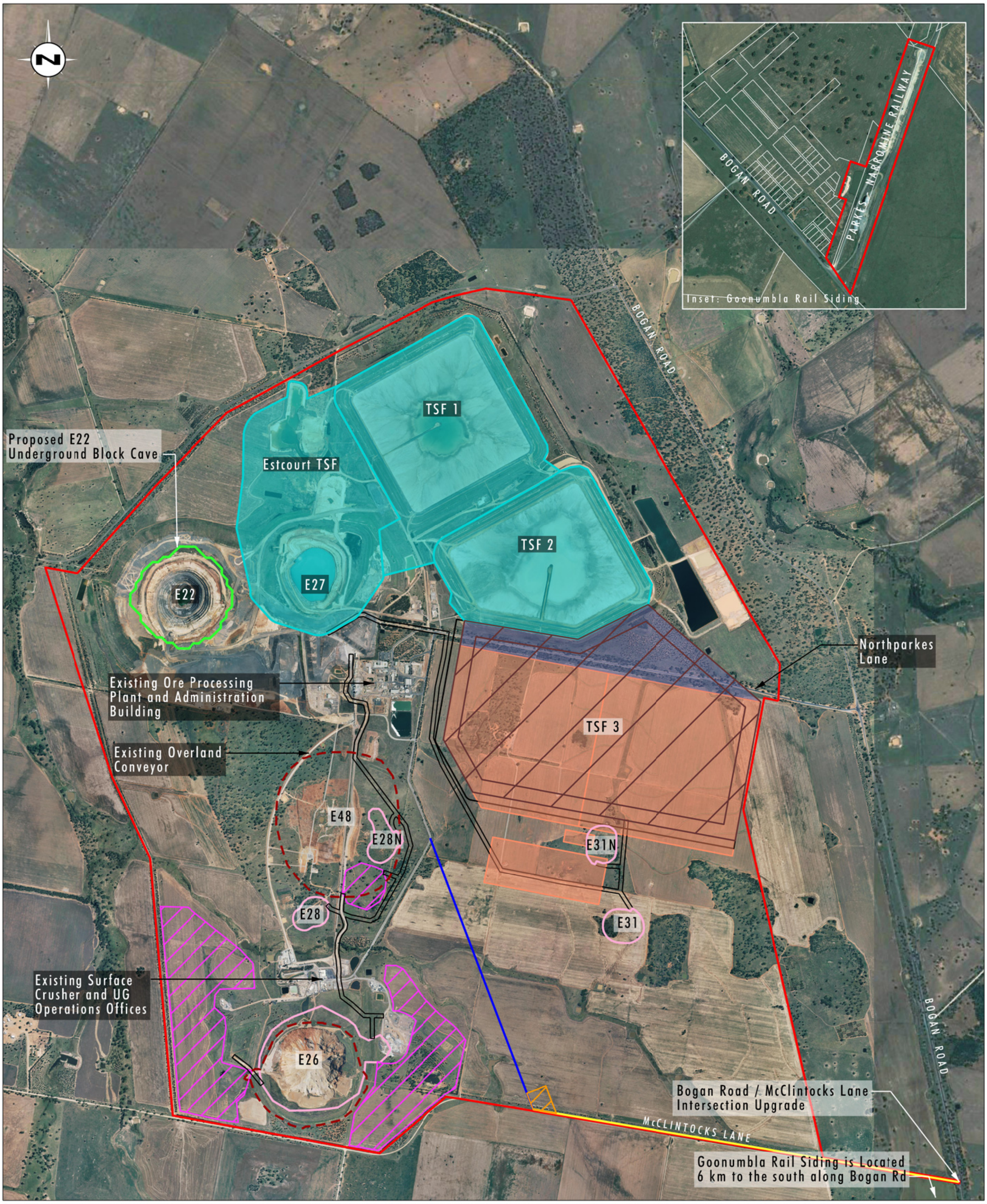
Major Project Components/ Aspects	Existing and Approved Operations	Proposed Operations
Mining Areas	• Underground block cave mining of E26 and E48 ore bodies. • Open cut mining of E22 and E27 (ceased in 2010).	• Continued block caving of the E26 and E48 ore bodies (as per current approval). • Development of block cave mining in the E22 resource (previously subject to open cut mining). • Development of open cut mining area in existing mine subsidence zone for E26. • Development of four small open cuts to extract ore from E28, E28N, E31 and E31N. • All proposed open cut mining areas are located within the existing PA 06_0026 Project Area and existing Mining leases.
Ore Processing	• Up to 8.5 Mtpa of ore, sourced from underground and open cut mining areas.	• Continuation of processing up to 8.5 Mtpa of ore through the existing processing plant sourced from underground and open cut mining areas.
Mine Life	• Until 2025.	• Extension of mining by seven years until end of 2032.
Operating Hours	• 24 hours a day, seven days per week.	• No Change.
Number of Employees	• Approximately 700 full time equivalents.	• No Change.
Mining Methods	• Multiple Underground Block Cave. • Campaign open cut mining yielding up to 2 Mtpa for stockpiling and processing as required.	• Multiple Underground Block Cave. • Campaign Open cut mining of up to 7 Mtpa for stockpiling and processing as required.

Table 1.1 – Key Features of the Project (cont.)

Major Project Components/ Aspects	Existing and Approved Operations	Proposed Operations
Infrastructure	**Operation of:** • TSF 1 - 4. • Ore processing plant including surface crusher, crushed ore stockpiles, active grinding mills, froth flotation area and concentrate storage. • Site offices, training rooms and workshop facilities. • Road haulage of concentrate to the Goonumbla rail siding for transport to Port Kembla. • An overland conveyor to transport ore from the hoisting shaft to the ore processing plant stockpiles. • Operation of four wastewater treatment plants.	**Construction and operation of:** • TSF to be augmented to connect existing and approved tailings facilities, through the development of TSF3 southward from the existing southern embankment of TSF2. The proposed TSF3 will substantially include the approved TSF3 (known as Rosedale). • Establishment of new waste stockpiles to store waste material generated during open cut mining campaigns including a vehicle wash down area. • Continued operation of existing processing plant, site offices, underground access, water supply infrastructure and logistics connections. • Continued road haulage of concentrate to Goonumbla rail siding for transport to Port Kembla. • Closure of the existing site access road through the development of TSF3. • Provision of an upgraded site access road along a new alignment from McClintocks Lane. • Development of an access control and visitors car parking at the intersection of the proposed site access and McClintocks Lane. • Upgrade/sealing of McClintocks Lane between the NPM access road and Bogan Road. • Upgrades as required to the intersection of McClintocks Lane and Bogan Road.
Block Cave Knowledge Centre	• Onsite Rio Tinto Block Cave Knowledge Centre operates for the domestic and international training of underground block cave mining methodology.	• Continued operation of the Rio Tinto Block Cave Knowledge Centre.

1.2 Summary of Issues Raised in Submissions

DP&I advised that a total of nine submissions were received during the EA exhibition period. The submissions raised issues requiring clarification in relation to the Project associated with water resources (surface water and groundwater), noise and vibration, visual impacts, waste, traffic and transport, stock movement, flora and fauna, and biodiversity offsetting.



Source: NPM (2013), Google Earth (2010)

0 200 400 800m 0 0.5 1 2km

Legend

- Project Area
- Approved Tailings Storage Facility (Rosedale)
- Approved Subsidence Management Areas
- Existing Tailings Storage Facility
- Proposed Tailings Storage Facility Extension
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Upgrade to McClintocks Lane
- Proposed Access Control and Visitor Car Park
- Proposed Waste Dumps
- Proposed Site Access Road
- Proposed Haul Road

FIGURE 1.2

Northparkes Mines Step Change Project

File Name (A4): R16/2949_360.dgn
20130828 11.27

A number of agencies outlined proposed conditions of approval for consideration by the DP&I in the determination of the Project.

1.2.1 Report Structure

In the preparation of this report, the issues raised in each of the nine submissions have been comprehensively reviewed and considered. Matters raised by each submission are addressed by category of issue, with additional information and/or clarification (if required) provided. **Section 2.0** of this report addresses the issues or concerns raised in submissions made by government agencies and the community submission.

2.0 Response to Submissions

This section provides additional detail in response to the issues raised in the submissions for the EA for the Project.

2.1 Parkes Shire Council

PSC has provided a letter dated 15 August 2013 indicating support for the Project as it is satisfied that the environmental, social and economic impacts of the proposal will be positive for the Parkes Local Government Area (LGA).

NPM has irrevocably offered to enter into a VPA with PSC regarding the following matters:

- provision of an annual monetary contribution of $100,000 per annum for economic diversification and planning for mine closure;
- provision of an annual road maintenance contribution of $65,000 per annum, for the ongoing maintenance of roads affected by Northparkes Mine Traffic;
- construction of a new seagull intersection at the intersection of Bogan Road and McClintocks Lane designed to Austroads standards; and
- provision of a monetary contribution equivalent to 80 per cent of the costs for resealing Bogan and McClintocks Lane for a maximum of 2 kilometres in any year and reconstructing the Mine Access Road to Austroads standards on an as needs basis for a maximum of 2 kilometres in any year.

2.2 Forbes Shire Council

FSC met on 15 April 2013 to consider the Project and resolved to support the Project based on the positive economic activity to the shire and that it will not exceed the permissible water extraction of 4.5 Giga litres per annum.

The FSC submission notes the 10 per cent of workforce employment relates to residents of Forbes Shire along with the direct injection of $3.2 million per annum into the local economy and $30 million spent per annum on regional goods and services (with regional including the towns of Orange, Dubbo, Parkes and Forbes).

The FSC praises the NPM land holder consultation process, noting the opportunity that the community has received to be involved in the Project.

2.3 Environment Protection Authority

2.3.1 Water Resources

2.3.1.1 Groundwater

<u>Groundwater Management</u>

The EPA request the EA include an assessment of the potential for contaminated water and groundwater impacts on local surface water resources for all downstream uses.

As discussed in Section 5.7.4.1 of the EA, the impact of the proposed Project on groundwater levels is expected to be localised, and limited mainly to the vicinity of the mine operations. The predictive modelling results do not indicate a significant change in groundwater regional flow direction as a result of the Project activities.

Golders have further considered this matter and confirmed that the Project will not result in any measurable groundwater impact on surface water resources within, or in the vicinity of, the Project Area (refer to **Appendix 1** for detail).

The groundwater monitoring plan should assess the need for specific monitoring bores and depths established for the purpose of leak detection. There may be preferential pathways in upper strata layers which should be targeted if deemed necessary with consideration to the site specific hydrogeology.

Additional monitoring was recommended in Section 7.3.2 of Appendix 10 of the EA and captured in the Statement of Commitments (refer to Section 6.0 of the main text of the EA). As discussed in Section 6.0 of **Appendix 1**, additional monitoring bores will be installed around the proposed waste facilities (TSF3, new waste rock stockpiles) for the purpose of leak detection and for monitoring the potential impact to groundwater. Additionally, groundwater level and quality monitoring will be conducted adjacent to the water storage facilities to ensure the effectiveness of design, maintenance and management.

Refer to Section 6.0 of **Appendix 1** for more detail.

Further assessment is required to identify whether the existing groundwater monitoring network is sufficient in detecting leakage from TSF's and other contaminated water structures and to identify the need for additional monitoring at different monitoring locations and depths. The findings of the assessment should form part of the revised groundwater monitoring program for the site.

NPM has an extensive monitoring network as summarised in Table 17 of **Appendix 1**, with spatial distribution of available groundwater quality data of the regional and mine monitoring sites provided in Figures 16b and 16c in **Appendix 1**. It has been assessed that the existing groundwater monitoring data suites are adequate.

Additional monitoring was recommended in Section 7.3.2 of Appendix 10 of the EA and captured in the Statement of Commitments (refer to Section 6.0 of the main text of the EA).

2.3.1.2 Surface Water

Dirty Water System

The EPA request the EA be revised to include:

- ***an assessment of why there are elevated levels of pollutants in the dirty water system;***

  The Surface Water Assessment (refer to Appendix 11 of the EA) includes the default ANZECC triggers for pH, electrical conductivity (EC), total suspended solids (TSS) and copper (Cu) values within Charts 3.7, 3.8 and 3.9 of Section 3.4.2 of Appendix 11 of the EA. The default ANZECC triggers are intended for watercourses and are therefore not directly applicable to water quality within a closed dirty water management system.

  Elevated EC, TSS and Cu, and varying pH values are to be expected within a dirty water management system that manages runoff generated from a variety of disturbed areas within NPM.

  The dirty water system at NPM is designed to minimise the risks of discharges from the site by utilising water transfers and reuse, thereby mitigating the potential impacts of the elevated pH, EC, TSS and Cu values on the downstream environment.

  NPM has developed site specific triggers values for the clean, dirty and contaminated water management systems to assist in site operations and management of water quality. To reduce the potential confusion associated with comparing the default ANZECC trigger values against the water quality observations within the dirty water management system (refer to Section 3.4.2 of Appendix 11 of the EA), the water quality analysis has been amended to include a comparison against the site specific water quality triggers developed for NPM's dirty water management system. The amended water quality charts are included in **Appendix 2**.

  The site specific water quality triggers were developed by NPM from observed water quality data for the period from 2009 to 2011. A two stage trigger system has been developed for each analyte. The two stage water quality trigger system provides an initial warning of potential water quality issues (Stage 1), prior to the analyte concentrations exceeding the observed historical data set (Stage 2). Stage 1 triggers are equivalent to the 95th percentile of the observed water quality values, whilst Stage 2 triggers are equivalent to the 99th percentile of the observed water quality values. In addition NPM also include the 99.9th percentile as secondary Stage 2 trigger level for use in analysis of monitoring results. The water quality triggers form part of the operational water monitoring procedures for the site with atypical results identified, investigated and managed.

  As the dirty water management system manages runoff generated from the disturbed areas of the NPM site elevated levels of pollutants (e.g. EC, TSS and Cu) and varying pH values are to be expected. In addition, given that the site specific Stage 1 and Stage 2 triggers are based on the 95th and 99th percentiles of the observed water quality values and occasional exceedences are expected.

  An analysis of the water quality monitoring results against the site specific water quality triggers indicates the following:

1. The historical ranges pH, EC, TSS and Cu are typically within the site specific Stage 1 and Stage 2 water quality trigger ranges for the clean water system, dirty water system and contaminated water system (refer to **Appendix 2**).
2. Sediment pond SP14 includes a single data point that is below the Stage 2 water quality trigger for pH (refer to Chart 3.7 in **Appendix 2**).
3. Sediment pond SP1 includes a single data point that exceeds the EC Stage 1 trigger threshold, whilst Sediment pond SP8 includes a single data point that exceeds the EC Stage 2 trigger threshold (refer to Chart 3.8 in **Appendix 2**).
4. TSS values within the dirty water system (refer to Chart 3.9 in **Appendix 2**) include exceedences of the Stage 2 trigger threshold for all of the sediments dams.

NPM has also developed site specific Stage 1 and Stage 2 water quality triggers for a wide range of other analytes, including turbidity, alkalinity, trace elements (such as calcium and magnesium) and heavy metals (such as arsenic and cyanide). These analytes are monitored quarterly. The historical ranges of these analytes and the site specific Stage 1 and Stage 2 water quality triggers are included in **Appendix 3**.

- ***historical water quality monitoring data of runoff associated with waste rock stockpiles and tailings dam walls;***

The Surface Water Assessment (refer to Appendix 11 of the EA) includes a summary (in the form of box and whisper charts) of the historical pH, EC and Cu concentrations within the sediment dams, based on historical records of water quality from February 2003 to January 2013 (refer to Sections 3.4.2 of Appendix 11 of the EA). The sediment dams included within the dirty water system intercept dirty water runoff from waste rock stockpiles and tailings dam walls.

The water quality charts included in the Surface Water Assessment (refer to Section 3.4.2 of Appendix 11 of the EA) include the default ANZECC trigger values for comparative purposes. As outlined above, the default ANZECC trigger values are intended for natural watercourses, not dirty water systems. Therefore, the water quality charts included in the Surface Water Assessment have been amended to include the site specific water quality triggers developed by NPM (as outlined above). The inclusion of site specific water quality triggers for the dirty water management system provides a clearer indication of the typical range of water quality parameters that is to be expected at NPM. The amended water quality charts indicate that historical water quality within the dirty water management system (i.e. sediment dams that receive water from the waste rock stockpiles and tailing dam walls) are typically within the Stage 1 trigger range for pH, EC and Cu concentrations. Historical observations of TSS are typically above the site specific trigger ranges, however this is to be expected given that the dirty water management system is primarily intended to manage TSS and turbidity.

NPM has also undertaken quarterly water quality monitoring data for a wide range of analytes for the period from August 2011 to May 2013. The range of recorded values for these analytes is included within Table 1.3 in **Appendix 3** for the monitoring locations within the dirty water system for the locations shown on Figure 3.3 of Appendix 11 of the EA.

- ***a full characterisation of water quality in sediment basins associated with the dirty water system (depending on the appropriateness and relevance of the historical water quality monitoring data);***

  The Surface Water Assessment (refer to Appendix 11 of the EA) includes an assessment of the pH, EC, TSS and Cu concentrations within the dirty water system (refer to Section 3.4.2 of Appendix 11 of the EA), based on quarterly water quality samples.

  NPM also undertakes quarterly water quality monitoring of the dirty water system for a full characterisation of water quality analytes at the locations shown on Figure 3.3 of Appendix 11 of the EA. A summary of the observed range of historical water quality analytes within the dirty water system is included in Table 1.3 in **Appendix 3**.

- ***an assessment of the impact on in-stream water quality in the event of controlled discharges or overtopping of the dirty water system sediment basins against ANZECC (2000) water guidelines for protection of aquatic ecosystems, downstream users and any drinking water supply; and***

  Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines (2000) (ANZECC guidelines) provide default trigger values to characterise water quality in natural watercourses. The trigger values can be used to estimate the ecological integrity of the water resource. However, the ANZECC guidelines also indicate the preferred use of site specific trigger values. NPM has developed site specific water quality triggers for the clean water system, based on water quality samples from the watercourses and farm dams surrounding NPM, for the period from 2009 to 2011. These site specific water quality triggers for the clean water system are to be used in preference to the ANZECC default water quality trigger values and should be used to determine the potential impact on in-stream water quality in the event discharges from the dirty water system sediment dams.

  In assessing the potential impacts of discharges from the dirty water system sediment dams, the Surface Water Assessment (refer to Appendix 11 of the EA) states that the dirty water system is designed in accordance with the *Blue Book* Volume 1 (Landcom 2004) and Volume 2E (Mines and Quarries; DECC 2008). The minimum design standard for sediment dams at NPM are to be sufficient to capture the runoff generated by the 90th percentile five day duration rainfall event, and assuming Fine (Type F) soils (refer to Section 4.2.2 of Appendix 11 of the EA).

  In addition, the water management system includes sufficient pumping capacity to maintain sediment dam volumes at 30 per cent capacity in order to maximise the capacity of the sediment dams to capture sediment laden runoff, maximise water reuse on site and minimise the potential for uncontrolled discharges (refer to Section 4.2.2 of Appendix 11 of the EA).

  The water contained within the dirty water management system typically has an EC of approximately 2100 μs/cm, which is higher than the site specific water quality trigger for the clean water system (watercourses) of 350 μs/cm (Stage 1 trigger).

  The water contained within the dirty water management system typically has a TSS of approximately 140 mg/L, which is less than the site specific water quality trigger for the clean water management system (watercourses) of 470 mg/L (stage 1 trigger).

  The water contained within the dirty water management system typically has a pH of approximately 7.7, which is within the site specific water quality trigger range for the clean water management system (watercourses) of 6.0 to 7.8 (stage 1 trigger).

As a result, the potential impacts of discharges from the dirty water management system into the downstream environment are not expected to have a significant impact with respect to TSS or pH when comparing the water quality in the dirty water management system to the site specific clean water triggers.

The elevated EC values within the dirty water management system suggest that discharges from the dirty water management system may result in elevated EC levels within the downstream environment. However, the system is designed such that sediment dams meet the Blue Book five day 90th percentile events and pumping rates exceed these design requirements and as a result discharges from the dirty water management system are only expected to occur under extreme wet conditions. Therefore, any discharges from the dirty water management system will be small compared to the flood flows within the surrounding watercourse system, resulting in dilution which will minimise the potential increase in EC values within the downstream environment.

- ***based on the water quality assessment against ANZECC (2000), a review of the suitability of sediment dam sizing and appropriate discharge levels for pH, salinity and relevant metals. Natural background levels of salinity and metals from a reference site unimpacted by the development should be considered in the assessment.***

Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines (2000) (ANZECC guidelines) provide default trigger values to characterise water quality in natural watercourses. The trigger values can be used to estimate the ecological integrity of the water resource. However, the ANZECC guidelines also indicate the preferred use of site specific trigger values. NPM has developed site specific water quality triggers for the clean water management system, including farm dams and watercourses both upstream and downstream of the NPM site. NPM do not have a licensed discharge point and as a result do not discharge into the downstream environment under normal operating conditions. As such the clean water management system triggers represent the natural background levels and as these are site specific should be used in place of ANZECC default triggers values.

In regard to sediment dam sizing, the dirty water management system includes provisions for internal transfers of intercepted dirty water runoff into emergency storages within mining voids. As a result NPM has a high degree of control within the dirty water management system.

The water quality summary charts included in Section 3.4.1 of Appendix 11 of the EA included the default ANZECC trigger values for comparative purposes. The summary charts for the clean water management system have been amended to include the site specific water quality trigger values derived by NPM (refer to Charts 3.3 to 3.6 in **Appendix 2**). From these charts it can be seen that some of the highest recordings of pH, EC and TSS occur at locations upstream of NPM (specifically WC6 and WC7). This indicates that pH, EC and TSS have background levels that are typically elevated.

NPM has also undertaken quarterly water quality analysis for a full range of water quality analytes for the clean water management system, including the farm dams and watercourses located outside of the NPM site (both upstream and downstream) at the locations shown on Figure 3.3 of Appendix 11 of the EA. A summary of the recorded ranges and site specific trigger values for each of the analytes is included in Tables 1.1 and 1.2 in **Appendix 3**).

Sediment Basin Sizing

- ***It is recommended that the proponent provide design calculations for all sediment basins***

  The Surface Water Assessment (refer to Appendix 11 of the EA) includes minimum design criteria for sediment basins based on the recommendations from the *Blue Book* Volume 1 (Landcom 2004) and Volume 2E (DECC 2008) (refer to Section 4.2.2 of Appendix 11 of the EA). The minimum design criteria for sediment basins at NPM include capacities sufficient to capture the 90th percentile five day duration rainfall event assuming fine (type F) soils (refer to Section 4.2.2 of Appendix 11 of the EA). Whilst it is expected that the required sediment basin capacities will be identified during the detailed design process, indicative sediment basin capacities for the proposed additional (or relocated) sediment dams (the locations of which are included in Figure 4.3 of Appendix 11 of the EA) are included in **Table 2.1**.

Table 2.1 – Estimated Sediment Dam Capacities

Dam Name	Estimated *Blue Book* Capacity	Estimated Surface Area
SD8 (New)	45 ML	Approximately 2.0 hectares
SD7 (Relocated)	34 ML	Approximately 0.8 hectares
RWD (Sediment dam capacity only)	19 ML	Approximately 0.5 hectares
E26 West	31 ML	Approximately 1.4 hectares
E26 East	11 ML	Approximately 0.4 hectares
E28	3 ML	Approximately 0.1 hectares

- ***It is recommended that if 'dirty water' is suitable for reuse the proponent consider increasing the new sediment basin sizes to maximise the potential for on-site capture and reuse and reduce the reliance on 'make-up' water.***

  The existing water management system includes sufficient pumping capacity to transfer runoff water captured by the sediment basins to other water storages for reuse on site. However, NPM will consider the recommendation as part of the detailed design process.

Water Reuse

- ***It is recommended that the proponent be required to prepare a Water Reuse Management Plan to ensure water to be reused onsite for uses such as dust suppression are 'fit for purpose, as set out in the 'Recommended Approval Conditions' in Attachment B.***

  A schematic showing the water management system is included as Figure 4.2 of the Surface Water Assessment (refer to Appendix 11 of the EA). The schematic indicates that water for dust suppression is sourced from the potable water tank and as such has limited potential to have cumulative impacts on soil and vegetation condition or the water quality in receiving waters.

  If the Project is approved the Water Management Plan (NPM 2013) for the operation will be updated to reflect the Project and any required Project Approval Conditions.

Contaminated Water System

The EPA request the EA clarify and include:

- ***What storm event the contaminated water management system has been designed to capture and contain runoff for; and***

  The Surface Water Assessment (refer to Appendix 11 of the EA) states that the process water dams within the contaminated water management system are designed and operated to maintain freeboard capable of containing the runoff generated by the 100 year 24 hour design storm event (refer to Section 4.2.3 of Appendix 11 of the EA).

- ***Details (including design calculations where appropriate) of all components of the contaminated water system to support the statement that the contaminated water system is a 'closed circuit'.***

  The Surface Water Assessment (refer to Appendix 11 of the EA) states that the contaminated water system is a closed circuit and is designed to maximum water reuse and minimise water discharge (refer to Section 4.2.3 of Appendix 11 of the EA).

  The contaminated water management system is considered to be a closed system under normal operating conditions. This means that the contaminated water management system is not expected to discharge for storm events up to and including the 100 year 24 hour design storm event. For storm events of a greater magnitude, the possibility discharges from the contaminated water management system may be minimised by utilising emergency water storages within mining voids.

  As stated in Appendix 11 of the EA, the water management dams within the contaminated water management system are designed to have the capacity to capture runoff generated by the 100 year ARI 24 hour design storm event.

  This infrastructure includes the pumps and pipes necessary to transfer contaminated water between the process water dams as required, as well as significant emergency contaminated water storages within mining voids.

Clean Water System

- ***The EPA requests the EA include consideration, and an assessment of the potential for clean water dams to contain contaminated water from the mining site. This should include consideration of the need to reclassify clean water dams as 'dirty' or 'contaminated' and the need for revised management procedures depending on the classification.***

  The Surface Water Assessment (refer to Appendix 11 of the EA) defines the clean, dirty and contaminated water management systems as follows (refer to Section 3.4 and Figure 3.3 of Appendix 11 of the EA). The clean water management system includes the surrounding watercourses and farm dams that are outside of the WMS. The dirty water system includes sediment dams that receive runoff from stockpile areas and tailings dam walls. The contaminated water system includes runoff from open cut mining areas, decant water from the tailings storage facilities and water that has potentially come into contact with ore, waste, tailings or operational areas.

There is limited potential for the clean water management system dams to receive contaminated water from site as these dams are generally located upslope of the current operations (refer to Figure 3.3 of Appendix 11 of the EA). However, with the expansion of operations, including construction of tailings facilities, several of the clean water dams will either be removed or be reclassified within the dirty water management system during construction. Section 4.0 of Appendix 11 of the EA identifies the changes required to the water management system with the Project, including identification of proposed changes to water management controls. Section 7.1 of Appendix 11 of the EA also identifies that erosion and sediment control works will be required to be installed for all construction works in accordance with the Blue Book (Landcom 2004 and DECC 2008), which includes requirements for delineation of disturbed areas as a key step in erosion and sediment control management.

In addition, the Site Water Management Plan (NPM 2013) identifies one of the key water related risks of the operations as water quality degradation as a result of NPM activities. As such NPM has in place a series of controls, including detailed network maps, routine monitoring and emergency response procedures to identify the need for revised management procedures. The Water Management Plan is reviewed annually and will be updated if this Project is approved.

Water Quality Monitoring:

- ***It is recommended that the proponent commit to monitoring the dirty water sediment basins for all contaminants potentially associated with runoff from waste rock stockpiles, the tailings dam walls, and other relevant mining activities until such time as it can be demonstrated that the sediment basins are just receiving 'dirty water' and not 'contaminated water'. The monitoring regime can be modified over time to reflect the presence or absence of contaminants based on the monitoring results.***

As stated in the Surface Water Assessment (refer to Appendix 11 of the EA), NPM currently undertake water quality monitoring for pH, EC, TSS and Cu within the dirty water management system, and pH, EC and TSS within the contaminated water management system on at least a quarterly basis, with a full characterisation of water quality analytes monitored on an annual basis within the contaminated water management system (refer to Table 3.4 in Appendix 11 of the EA).

Sediment dams within the contaminated water management system will not be reclassified as being within the dirty water management system unless the water quality monitoring indicates that the water quality is within the site specific trigger values for the dirty water management system.

In addition, NPM use monitoring of Cu concentrations as a reference point for monitoring within the dirty water management system. The Cu concentrations within the dirty water system (refer to Section 3.4.2.4 of Appendix 11 of the EA) are typically less than those within the contaminated water management system (refer to Section 3.4.3.3 of Appendix 11 of the EA), and comparable to those within the clean water management system (refer to Section 3.4.1.4 of Appendix 11 of the EA) indicating that the dirty water management system is currently unlikely to be receiving runoff from the contaminated water management system.

NPM has committed to the continued collection of this water quality monitoring data for the life of the Project as outlined in Table 3.4 of Appendix 11 of the EA.

- ***It is also recommended that the proponent commit to monitoring for a full suite of analytes after significant site changes or after periods when a risk may emerge such as accumulation of pollutants in basins through sedimentation or concentration via evaporation.***

  As stated in the Surface Water Assessment (refer to Appendix 11 of the EA for), NPM currently undertake water quality monitoring for pH, EC, TSS and Cu within the dirty water management system, and pH, EC and TSS within the contaminated water management system on at least a quarterly basis, with a full characterisation of water quality analytes monitored on an annual basis (refer to Table 3.4 in Appendix 11 of the EA).

  NPM has committed to the continued collection of this water quality monitoring data for the life of the Project as outlined in Table 3.4 of Appendix 11 of the EA.

- ***The recommendations for monitoring can also be removed if it is demonstrated that pH, salinity and relevant metal levels associated with runoff do not impact on the water quality objectives of receiving waters.***

  Runoff from within the clean water management system includes runoff from surrounding watercourses and farm dams that are outside of the WMS. As such the runoff from the clean water management system is not influenced by mining operations and is considered representative of runoff from local catchment areas.

  In addition, the Surface Water Assessment (refer to Appendix 11 of the EA) includes an assessment of the historical water quality of the clean water system, dirty water system and contaminated water system (refer to Section 3.4 of Appendix 11 of the EA). A comparison of the water quality within the clean water system upstream and downstream of the NPM site indicates that the current NPM operations do not have a significant impact on the water quality of the surrounding environment.

  NPM has committed to the continued collection of water quality monitoring data for the life of the Project as outlined Table 3.4 of Appendix 11 of the EA. The water quality data for the clean water management system will continue to provide a reference data set to identify potential water quality issues both within the NPM site and the receiving waters.

Water Quality Trigger Values:

- ***The EA should be amended to account for the issues outlined below:***

  - ***the pH range for upland stream is 6.5 to 8 (not 8.5);***

  - ***the lower EC value of 30 µs/cm is not relevant as there are not processes that could result in lowering EC below natural background conditions. The proposed upper value of 350 µs/cm is correct;***

  - ***the proposed TSS criterion of 40 mg/L is not relevant to aquatic ecosystem protection in the ephemeral watercourses downstream of the site. 40 mg/L relates to water quality in aquaculture systems above which production may be affected. The aquaculture criterion includes biological turbidity as a component of suspended solids. ANZECC (2000) uses turbidity criteria for aquatic ecosystem of 2-25 nephelometric turbidity units in ambient waters. “Blue Book” sediment and erosion control structures should be able to achieve a TSS discharge level of 50 mg/L TSS for any controlled discharges.***

- ***The copper trigger value is correct at 1.4 µg/L.***
- ***There are no trigger values presented for the range of other potential pollutants for the site.***

The Surface Water Assessment (refer to Appendix 11 of the EA) included the default ANZECC water quality trigger values in the water quality summary charts (refer to Section 3.4 of Appendix 11 of the EA). The changes to ANZECC water quality trigger values to be used for the site by the EPA are accepted. However, the default ANZECC water quality trigger values are intended to be used in the absence of site specific water quality trigger values. NPM has developed site specific water quality trigger values for the clean water system, dirty water system and contaminated water system based on historical water quality data.

The site specific water quality triggers were developed by NPM from observed water quality data for the period from 2009 to 2011. A two stage trigger system has been developed for each analyte (a full suite of analytes with the associated trigger values are listed in **Appendix 2**). The two stage water quality trigger system provides an initial warning of potential water quality issues (Stage 1), prior to the reaching analyte concentrations that are well above the observed historical averages (Stage 2). Stage 1 triggers are equivalent to the 95th percentile of the observed water quality values, whilst Stage 2 triggers are equivalent to the 99th percentile of the observed water quality values, however NPM also include the 99.9th percentile as an additional Stage 2 trigger level.

The water quality analysis has been updated to include the site specific water quality triggers for the clean water, dirty water and contaminated (process) water systems developed by NPM (refer to **Appendix 2**).

NPM propose to continue the monitoring program as outlined in Table 3.4 of the Appendix 11 of the EA with comparison to site specific triggers (see above).

Tailings Storage Facility Lining:

- ***Further information regarding the construction of the clay liner (or alternate geosynthetic liners) for the TSF extension is required. This includes the location of liners (e.g. floor and walls), overall thickness of liners, thickness of successive layers, gradients of sides of structures of clay liners etc for all structures. Alternatively impermeable geosynthetic liners could be considered.***
- ***Further information is required to demonstrate how the EPA's clay liner requirements for contaminated water storage structures (outlined below) will be met to ensure impacts do not occur.***
- ***The EPA's standard requirement for these types of liners (i.e. contaminated water storage structures) is to achieve a permeability of $1x10^{-9}$ m/s or less with a recompacted clay liner of at least 90 cm in thickness (or alternative geosynthetic liner of equivalence). Where the proposed liner will not meet this thickness and the natural geology of the site in conjunction with constructed clay liners is considered sufficient in meeting this requirement, sufficient evidence must be provided in support of this to demonstrate the construction will be adequate to prevent pollution of groundwater (e.g. geological evidence, appropriate groundwater modelling etc).***

- ***Even where the EPA's permeability requirements for contaminated water storage outlined above are met, any contaminants contained in contaminated water storages still have potential to permeate below clay linings albeit over a long period of time. Hence an assessment also needs to be provided including:***

    - ***An assessment of the long term fate of contaminants in contaminated water storages;***

    - ***An assessment of potential impacts on groundwater quality in the longer term, against ANZECC 2000 criteria for any beneficial uses likely to be impacted as well as the preservation of aquatic ecosystems; and***

    - ***Longer term arrangements for management, monitoring and response to any such impacts beyond the operational life of the proposed mine.***

The tailings facility outlined in the environmental assessment is the fourth such facility that has been constructed by Northparkes Mines since commencement of operations. As such, a considerable body of knowledge exists around the characteristics of the underlying geology of the area, and the parameters used in the design of tailings storage facilities.

When considering the potential impact on groundwater from the tailings storage facilities, design considers two key aspects, design of the floor of the TSF and that of the embankments. Standard floor construction entails the stripping of superficial soils to the regolith, which is a silty clay. The silty clays are generally CH/MH UCS classification with a permeability of 1×10^{-10} m/s. This clay material is then compacted to form the floor of the dam. There are areas within the basin where the clay cover over weathered altered rock is thin. These areas are intended to be exploited for construction materials. The borrow areas will be shaped and lined with clay before tailings is deposited in the basin. Where the clay cover is insufficient, clay will be obtained from within other areas of the basin to achieve the equivalent permeability of a 450 millimetre clay liner with a permeability of 10^{-9} m/s. The foundation soil properties are included in **Table 2.2**.

The embankments are not designed to be impermeable, but rather to deliberately allow water to flow through for controlled collection. Northparkes Mines tailings are non-acid-forming. By allowing drainage through the embankments the phreatic surface within the tailings is depressed. As the horizontal permeability of the tailings is higher than the vertical permeability, this encourages flow towards the embankments, relieving pressure on the basin floor and depressing the phreatic surface in the vicinity of the embankments which improves embankment stability. Further depressing the phreatic surface generally reduces the time for drainage following closure, and reduces the hydraulic gradient acting on the basin floor. Utilisation of this method promotes horizontal drainage and surface collection. Surface collection of seepage through the embankments is readily achievable and an established acceptable practice. This seepage will be directed to retention ponds for recycling to the processing plant. This practice, which is currently applied on site in addition to reducing time for drainage also reduces vertical seepage and thus minimises risk to groundwater quality.

The construction of the tailings facility uses a combination of Zone A, B and C materials, the characteristics of which are outlined in **Table 2.3**.

The external embankments for both cells of the Rosedale tailings facility will be constructed using a Zone C type material as a core, with a Zone B type material on the upstream side as lower permeability material. For the central bund the core will be constructed from Zone C material for the first stage, where no East Cell is yet being constructed. From the first lift onwards, the central bund will be constructed using a Zone

B type material with a layer of Zone C as erosion protection on both the east cell and west cell side. Zone A is a low permeability clay material and is envisaged to be used where at the intersection of the cause way/decant system and southern embankment. Zone C on the downstream face of the embankment controls erosion and provides a high permeability conductor for water that may pass through the Zone B upstream face.

These criteria are indicative based on TSFs constructed to date and preliminary design criteria. More detailed sampling and analysis of the soil properties will be conducted prior to final design and construction to confirm, however given the close proximity of the proposed Rosedale facility to the existing dams, minimal variability in foundation soil properties is anticipated.

Table 2.2 – Foundation Soil Properties

Parameter	Value
Classification	Foundation: 34 metre thick Regolith (Silty Clays generally CH/MH UCS classification) overlying 25 m thick oxidised zone underlain by competent bedrock.
Unit Weight	Dry = 17 kN/m^3 Moist =19.3 kN/m^3 Saturated =20.3 kN/m^3
Emerson Class	Class 6 (Non-dispersive)
Shear Strength	Su = 120 kPa
Permeability: Superficial soils (top) Regolith (CH/CL)soils Oxidised Zone Bedrock	 $k_v = 1 \times 10^{-7}$ m/s $k_v = 1 \times 10^{-10}$ m/s $k_v = 1.3 \times 10^{-8}$ m/s $k_v = 8.2 \times 10^{-11}$ m/s

Table 2.3 – Embankment Construction Material Properties

Parameter	Value
Crest With	8 metres
Material Types	Rockfill (Zone C) – selected strong “sulphide” waste Granular Fill (Zone B) – selected weak, altered “oxide" waste Clay Liner (Zone A) – non-dispersive clay from basin borrow areas Filters – sandy gravels sourced from mine waste dumps or processed from mining operations or borrow areas.
Weight & Strength: Rockfill (Zone C)	Unit Weight: γ = 17.2 kN/m³ Cohesion: c’ = 0 kPa Friction Angle: φ’ = 42°
Clay (Zone A)	Unit Weight: γ = 18.3 kN/m³ Undrained Shear Strength: S_u = 80 kPa
Saprolite (Zone B)	Unit Weight: γ = 18.3 kN/m³ Undrained Shear Strength: S_u = 80 kPa

Table 2.3 – Embankment Construction Material Properties (cont.)

Parameter	Value
Processed Filters	Unit Weight: $\gamma = 17.0$ kN/m³ Cohesion: c' = 0 kPa Friction Angle: φ' = 30°
Permeability	
Rockfill	Free draining
Granular Fill	K= 1 x 10^{-4} to 1 x 10^{-6} cm/s
Clay Liner	k = 1 x 10^{-9} m/s
Filters	Free draining

The consistent nature of the design of the Northparkes TSF's provides a clear indication of the likelihood of environmental impact from tailings storage facilities. NPM maintain a monitoring network surrounding all tailings storage facilities to detect impacts on groundwater levels, or contaminant concentrations.

Since 2009, the maximum observed copper concentration within the groundwater monitoring bores surrounding the current TSFs (including MB01 to MB07) is 0.04 mg/L (at MB03; refer to Figure 9 of Appendix 10 of the EA) with an 80th percentile concentration of approximately 0.01 mg/L. During this same period, the maximum observed copper concentration within the regional groundwater monitoring bores (including South Hillier, Far Hillier, Wright, Moss and Long Paddock) is 0.021 mg/L with an 80th percentile concentration of approximately 0.01 mg/L.

The analysis indicates that the 80th percentile copper concentration for groundwater bores surrounding the current TSFs is consistent with the regional groundwater monitoring data.

2.3.2 Noise

Further information to demonstrate that modifying factor adjustments are not applicable to operational noise resulting from the proposal;

Section 4 of the NSW *Industrial Noise Policy* (INP) (EPA 2000) notes that noise sources containing characteristics such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequencies can cause greater annoyance than other noise at the same noise level. As part of the EA, the Noise Impact Assessment (NIA) investigated the potential for the development to generate noise impacts with annoying characteristics, in accordance with the INP (EPA 2000). The results of this assessment are presented in **Appendix 4** of this document.

Further assessment of the acceptability of residual noise impacts at sensitive receiver locations above the Project Specific Noise Level (PSNL) in accordance with Chapters 8 and 9 of the INP;

As discussed in Section 5.4.4 of the EA, the operational noise modelling approach taken to assess impacts at NPM was to assess a number (3) of relevant operational scenarios that provide for the continuation of existing approved operations (Scenario 1), with additional project components that represent reasonable worst-case operational scenarios. The three operational scenarios modelled were used to determine the worst-case operational noise impacts from NPM.

The results of noise modelling, under worst-case operational scenarios, indicated that the potential for maximum exceedance of the PSNLs would be up to 5 dB at 'Hubberstone', up to 7 dB at 'Avondale', and up to 1 dB at 'Adavale'. The owner of the 'Avondale' property, which was modelled to potentially experience the most significant noise impacts, under worst-case operational conditions, currently has an agreement in place with NPM which covers the life of the Project.

In regard to controlling/mitigating noise, the three main strategies used to identify reasonable and feasible noise control/mitigation strategies are:

- **Controlling noise at the source** - There are three approaches to controlling noise generated by the source: source elimination; Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA).

- **Controlling the transmission of noise** - There are two approaches: the use of barriers and land-use controls which attenuate noise by increasing the distance between source and receiver.

- **Controlling noise at the receiver** - There are two approaches: negotiating an agreement with the landholder or acoustic treatment of dwellings to control noise.

To control/mitigate noise, NPM will undertake additional targeted noise monitoring during construction periods for TSFs, when there is concurrent campaign open cut mining operations occur during winter night time operations. This targeted monitoring program will include attended noise monitoring and associated alarming when the TSF construction activities are likely to have unacceptable noise impacts on sensitive receptors. When these situations are identified, NPM will review its onsite activities (specifically construction of the eastern wall of TSF3 and open cut mining at night) as a means to, where possible, avoid the predicted noise impacts. The specific mitigation options available to NPM will be outlined in the Construction Noise Management Plan (CNMP), to be developed prior to TSF construction, and include:

- active management of equipment operations, including positioning of exposed equipment to lower elevations during noise enhancing meteorological conditions;

- review of design options to incorporate passive noise attenuation measures into the construction process, such as provision for equipment use at lower elevations during winter evening and night periods;

- incorporation of active noise attenuation measures such as bunding and shielding around equipment during winter night time operations; and/or

- implementation of noise mitigation controls at private residences where monitoring indicates that noise generated by the Project is above the PSNL.

Furthermore, NPM will maintain an attended noise monitoring program in order to assess compliance with relevant noise impact assessment criteria over the life of the Project. The noise monitoring program will be based around a combination of routine attended noise monitoring to assess the performance of NPM as a whole and a targeted noise monitoring program to assess the impacts of specific activities associated with the open-cut mining and construction of the TSFs. Additionally, as part of the noise monitoring program, NPM will maintain the meteorological monitoring program in order to assess the occurrence of noise enhancing conditions. This will include the development of a procedure to determine relative Meteorological Stability Classes and the potential influence that F and G Class stability have on the measured noise levels. This information would then be used for predictive meteorological forecasting as a part of the TSF CNMP.

Section 8.2.1 of the INP, 'Residual level of impact: checklist', outlines four factors to be taken into consideration when determining the acceptability of the residual noise impacts of a Project. The acceptability factors for residual noise are listed below, with specific comment made regarding how each factor has been considered specifically within the noise assessment for the Project or more generally within the EA.

1. Characteristics of the area and receivers likely to be affected

A description of the area/existing environment has been provided throughout the EA, particularly in Section 5.0 where the existing environment has been outlined in relation to the specific issue being discussed. Furthermore, the noise assessment has provided details of the existing noise environment and relevant noise receivers.

It is important to note that the existing Northparkes Mine forms a dominant part of the existing land use for this locality, and whilst there is an extensive buffer of mine owned land around the site, existing operations are audible at some surrounding private residences.

As noted above, a noise agreement is in place with the owner of the Avondale property, which is the only significantly affected private residence. In relation to other the residences, it should be noted that short term exceedances of the current noise criterion of 35dB(A) have previously been assessed and provided for in the provisions of the existing Project Approval (PA06_0026). Specifically, Condition 18 of PA06_0026 provides for the exceedance of relevant noise criteria during the construction of the Rosedale (TSF3) and the Estcourt TSF in accordance with an approved Construction Noise Management Plan (CNMP). As outlined in Section 5.4.7 of the EA, NPM will commit to applying the Construction Noise Management Plan to manage potential noise impacts associated with these activities as part of the Project.

2. Characteristics of the proposal and its noise or vibrations

A detailed description of the Project has been provided in Section 2.0 of the EA main text. Detail on noise modelling parameters (i.e. noise sources, receiver locations, meteorological conditions) and noise impact predictions based on the modelled parameters is provided in Sections 4.0 and 5.0 of the NIA (Appendix 7 to the EA). The Project essentially involves continuation of mining and associated operations, which are not inconsistent with the characteristics of the existing and approved operations, both in their nature, and potential noise sources. The potential maximum exceedances would occur under worst-case scenario when both campaign open cut operations occur simultaneously with TSF3 construction, staged over approximately 12 months in the initial five to eight years of the Project.

3. The feasibility of additional mitigation or management measures

Project alternatives considered as part of the EA process have been discussed in Section 2.4 of the main text of the EA. As discussed in Section 5.4.7, the three main strategies used to identify reasonable and feasible noise control/mitigation strategies are:

- Controlling noise at the source.
- Controlling the transmission of noise.
- Controlling noise at the receiver.

The noise management and mitigation commitments for the Project, which have been outlined in Section 6.2 of Appendix 7 of the EA and Section 5.4.7 of the main text of the EA, are considered consistent with the reasonable and feasible noise mitigation controls outlined above.

The NIA identifies that operation noise levels of the existing NMP operation would not exceed respective PSNL in the region surrounding the Project. As noted in the NIA the predicted exceedances of the PSNL would only occur under adverse weather conditions (F Class stability conditions) during open-cut mining operations or during the construction of the TSF due to the additional sound power from the equipment used on site.

During those periods of time when the predicted noise levels could exceed the PSNL the noise impact would not result in noise levels that exceed the sleep disturbance criteria or exceed the amenity criteria for the region surrounding the Project

4. <u>Equity issues</u>

Cumulative noise issues are not applicable to the Northparkes Mine site which is not located within the vicinity of other industrial noise sources. As discussed in the EA, during periods of worst-case meteorological conditions and during construction, one private residence is likely to be subject to significant noise impacts and will likely have acquisition rights under the Project approval. NPM has committed to undertaking targeted monitoring during worst-case periods during construction and to implementing a hierarchy of controls to mitigate potential significant impacts. Details of this commitment are presented in the EA.

The EPA notes that "onsite road works were assessed against the Interim Construction Noise Guidelines (ICNG), rather than the usual practice of assessing construction associated with mining under the NSW Industrial Noise Policy".

It is understood that the Interim Construction Noise Guidelines is specifically aimed at managing noise from construction works regulated by the EPA (formerly DECC as noted in the guidelines), and are used to assist the EPA in setting statutory conditions in licences or other regulatory instruments. It is also understood from the Interim Construction Noise Guideline information sheet (09406cnginfo.pdf) that the Guideline is not mandatory but aims to 'inform the selection and application of work practices to minimise noise impacts based on the level and extent of impact expected taking into account site-specific considerations'.

Where the guidelines refer to noise from 'industrial sources (for example, factories, quarrying, mining, and including construction associated with quarrying and mining)' based on advice from DP&I it is understood the guideline is addressing quarrying or mining activities that are used to initiate the quarrying/mining process such as the construction of a box-cut. The construction of supportive infrastructure such as the access road is not quarrying or mining and it is therefore believed that that Interim Construction Noise Guideline is applicable.

An ENM noise model was used to assess the noise impacts associated with the development of McClintocks Land and construction the site access road. The construction noise levels at the nearest residential receiver was predicted to be at or below 37 dB(A). The construction noise management level for all residential receivers surrounding the Project is 40 dB(A).

A commitment to meeting the ANZEC (1990) criteria for blast overpressure and ground vibration, including a description of the measures that will be employed to meet the criteria

NPM commit to the following ANZEC (1990) criteria for blast over pressure and ground vibration:

- the maximum airblast should not exceed 115 dB for more than 5 per cent of blasts in any year, and should not exceed 120 dB for any blast; and

- the maximum peak particle ground velocity should not exceed 5 mm/s for more than 5 per cent of blasts in any one year, and should not exceed 10 mm/s for any blast.

As per Section 5.5.4 of the EA, NPM will revise its existing *Environmental Noise and Vibration Management Plan* and implement a monitoring program similar to that previously employed during the E22 open cut operations during periods when campaign open cut mining is undertaken. NPM will investigate opportunities to refine blast design to ensure compliance with all relevant airblast impact assessment criteria at surrounding private properties is achieved.

2.3.3 Waste

The Project will result in the closure of Northparkes Lane, the principal mine site access. Presumably this may result in the requirement for disposal of a significant quantity of waste such as bitumen. Further information is required on how this (and any other waste generated by the project) will be classified and disposed of.

Onsite waste will continue to be classified in accordance with Part 3 of Schedule 1 of the *Protection of the Environment Operations Act 1997* and managed operationally in accordance with NPM's Environment Protection Licence (EPL) 4784, Project Approval conditions and existing site wide management plans (updated as required).

As per Section 5.15.1 of the EA, management of mineral wastes will be undertaken in accordance with NPM's *Mineral Waste and Acid Rock Drainage Management Plan*.

As per Section 5.15.2 of the EA, any non-mineral waste resulting from the Project (i.e. bitumen from the closure of Northparkes Lane) will be managed in accordance with NPM's *Non-Mineral Waste Management Plan*. The Plan applies to the collection, transport, treatment, recycling/reuse and final use/disposal of all non-mineral waste generated onsite.

2.4 Office of Environment and Heritage

Recommendation 1.1: Further survey for the Pine Donkey Orchid and Sloane's Froglet is required. Should these species be confirmed as occurring at the Project site a suitable offset strategy will be required for both the orchid and the froglet.

As discussed in Section 5.6.7.3 of the EA, the Flora and Fauna Assessment (refer to Appendix 9 of the EA) indicates that two threatened species may potentially occur within the Proposed Disturbance Area, including the pine donkey orchid (*Diuris tricolor*) and Sloanes froglet (*Crinia sloanei*). To date, survey efforts have not identified these species, however if they are found to occur, there may be a potential significant impact on the two species. Both of these species have been recorded in proximity to the Project Area, with potential habitat occurring within relatively defined areas within the proposed disturbance areas, as described below.

In the case of the pine donkey orchid, 37 hectares of potential habitat for this species is limited to areas of white cypress pine vegetation located to the north and south of Northparkes Lane within the Proposed Disturbance Area. Potential habitat for Sloanes froglet includes all non-disturbed areas susceptible to inundation after heavy rainfall. In this regard, this habitat is taken to be within proximity to drainage lines, and other areas of localised inundation within woodland and native grasslands areas within the Proposed Disturbance Area.

Furthermore, as discussed in more detail below, NPM is committed to undertaking additional targeted survey to establish the presence, or lack thereof, of pine donkey orchid and Sloanes froglet.

<u>Pine Donkey Orchid (*Diuris tricolor*)</u>

As indicated in the Statement of Commitments in the EA (see Section 6.8.1) Umwelt will undertake further survey for *Diuris tricolor* across the Project Disturbance Area. Surveys will be undertaken during the likely flowering period of late September/early October 2013. The population known to occur 2.5 kilometres to the north of the Project Disturbance Area will be used as a flowering time reference site to determine the appropriate time to survey. The *Diuris tricolor* population will be surveyed by the NPM farm manager twice a week from the 3rd week in September (starting 16 September 2013) to detect the commencement of flowering. The NPM farm manager will notify Umwelt when the first *Diuris tricolor* flower is identified. Following this identification, Umwelt will seek to undertake field survey in the subsequent two week period. Further survey will comprise meandering transects throughout potential habitat areas. Surveys for *Diuris tricolor* will also be undertaken across the Kokoda Offset Site in conjunction with the Project Disturbance Area surveys. Additionally Umwelt will consult with Garry Germon from OEH Dubbo regarding the flowering time of *Diuris tricolor* at the South Dubbo oval in 2013 as a secondary flowering time reference site.

If *Diuris tricolor* is identified in the Project Disturbance Area, a survey of the adjoining areas will also be undertaken to assess the species' occurrence beyond the Project Disturbance Area. In the event that *Diuris tricolor* is not recorded flowering at the NPM *Diuris tricolor* site or at South Dubbo Oval by mid October 2013, Umwelt will undertake a survey of the Project Disturbance Area in late October 2013 when the species' typical flowering period finishes.

<u>Sloanes Froglet (*Crinia sloanei*)</u>

Umwelt will undertake survey for Sloanes froglet when the appropriate weather conditions of heavy rainfall occur at the NPM site. Sloanes froglet is only detectable after heavy period of rain that results in inundation of habitat areas. Umwelt is monitoring the recorded and predicted rainfall patterns of the NPM site and surrounding area on a daily basis. A field survey for Sloanes froglet will be undertaken, where possible the day after, or shortly after, 30 millimetres or more of rain is recorded in a 24 hour period at the NPM site. A 30 millimetre level was selected following a review of daily rainfall data at NPM (from 1 April 2012 to 26 August 2013) that identified that 30 millimetres or more rainfall (in a 24 hour period) is a notably large rainfall event for the area.

The known occurrence of Sloanes froglet along McClintocks Lane (where it crosses the Bogan River) will be used as a reference site to determine if the weather conditions are suitable for the species to appear and be detectable. If identified in the Project Disturbance Area, surveys for Sloanes froglet will extend beyond the Project Disturbance Area and into adjacent habitat areas to determine the level of the species' presence in the local area.

Consequence of Occurrence

If either species are recorded in the Project Disturbance Area or adjacent habitat areas, NPM will attempt where possible to minimise impacts on both species through avoidance and mitigation measures. Mitigation measures developed for either species will be dependent on the number of individuals recorded, the location of the species within the Project Disturbance Footprint and the level of any adjacent off-site occurrences. A seven-part test will be undertaken to determine the level of impact on either or both species (excluding any proposed mitigation measures).

For *Diuris tricolor,* if there is a potential significant impact, the impact will be offset. As part of the planned September/October surveys, surveys for *Diuris tricolor* will also be undertaken across the Kokoda Offset Site and if present, this site could provide a suitable offset for any potential impacts on the species in the Project Disturbance Area.

For Sloanes froglet, the Kokoda Offset Site is unlikely to provide suitable habitat for the species and a suitable offset would be difficult to identify given the general lack of knowledge about the species' distribution patterns and the species' highly irruptive nature. Potential mitigation and offset measures for this species, if it is confirmed to occur in the Proposed Disturbance Area and be subject to a potential significant impact, would likely focus on the management of identified areas within NPM land holdings. This may include habitat management and monitoring measures along the Bogan River and associated low lying areas, outside of the Proposed Disturbance Area, to contribute to the conservation and knowledge of this very cryptic species.

The outcomes of the surveys for *Diuris tricolor* in the Project Disturbance Area will be considered as part of the development and implementation of the Biodiversity Offset Strategy (BOS). For the Sloanes Froglet, if there has not been seasonal opportunity for surveys to be undertaken prior to completion of the BOS, this process will be committed in the Strategy.

Recommendation 2.1 - An additional area of Grey Box Grassy Woodland EEC should be secured to satisfy biodiversity offset requirements. The quantum of the offset should be determined using a robust assessment methodology. The offset strategy may include the conservation of a vegetation type/s of equal or higher conservation value to the Grey Box Grassy Woodland EEC.

In accordance with the Director-General's Requirements (DGRs) for the Project, a BioBanking assessment of the Project was not required and thus was not used to determine the quantum of offsets required. In the absence of a BioBanking assessment the NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) project provides guidance on the likely level of offset required. The relevant approach, termed Tier 3, of the OEH interim policy requires a minimum land offset to clearing ratio of 2:1.

For this Project, 23 hectares of Grey Box Grassy Woodland EEC in woodland form and 15 hectares of Grey Box Grassy Woodland EEC in derived native grassland (DNG) form will be removed. Thus, a total of 38 hectares of the Grey Box Grassy Woodland EEC will removed for the Project. In comparison 108 hectares of Grey Box Grassy Woodland EEC (12 hectares in woodland form and 96 hectares in DNG form) will be conserved at the Kokoda Offset Site, representing an offset to clearing ratio of 2.8:1, above the minimum Tier 3 requirement.

Additionally a total of 52 hectares of naturally occurring native vegetation communities will be removed from the Project Disturbance Footprint and offset with 348 hectares of naturally occurring native vegetation communities at Kokoda, representing an offset to clearing ratio of 6.7:1.

The likely level of offsetting required is also determined on a case-by-case basis via consultation with OEH and DP&I (and also DSEWPC). During case-by-case assessments of the value of offset packages the quantum of the offset package required is generally determined by a comparison of the ecological values of the impact area and the proposed offset site, including but not limited to the following:

- the area to area ratio of impacts to offset areas;

As indicated above Grey Box Grassy Woodland EEC would be offset at an offset to clearing ratio of 2.8:1 and naturally occurring native vegetation communities would be offset at an offset to clearing ratio of 6.7:1.

- the habitat quality of the impact and offset areas;

The habitat quality of Grey Box Grassy Woodland EEC woodland areas in the impact area and offset area are similar. Both areas are tall woodlands dominated by western grey box (*Eucalyptus microcarpa*) with other tree species sub-dominant in the canopy. Both areas had sparse shrub layers, diverse ground layers and understorey weeds were common.

- the level of habitat fragmentation;

In the Project Disturbance Area, Grey Box Grassy Woodland EEC woodland areas were typically fragmented from other areas of Grey Box Grassy Woodland EEC woodland areas and other woodland areas in general (refer to **Figure 2.1**). Grey Box Grassy Woodland EEC woodland areas of the Project Disturbance Area have a high degree of fragmentation in the local area.

At the Kokoda Offset Area, Grey Box Grassy Woodland EEC woodland areas were also typically fragmented from other adjacent woodland areas, however the degree of fragmentation of woodland areas in the local areas was much lower than that of the Project Disturbance Area due to large areas of woodland occurring on and to the south and south-west of the Kokoda Offset Site (refer to **Figure 2.2**). Additionally in the medium to long term the level of fragmentation of Grey Box Grassy Woodland EEC woodland areas will decrease significantly as the grassland areas of the Kokoda Offset Site are returned to woodland form (via both natural and active revegetation) and provide a consolidated area of Grey Box Grassy Woodland EEC woodland and other woodland types.

Grey Box Grassy Woodland EEC woodland habitats of the Kokoda Offset Site are less fragmented than those of the Project Disturbance Area.

- the landscape context;

Woodland habitats of the Project Disturbance Area occur in a landscape dominated by agricultural land with the remaining woodland remnants highly isolated and fragmented. The Project Disturbance Area is approximately 10 kilometres east of the nearest moderate sized (>500 hectares) landscape woodland remnant and approximately 25 kilometres west of the nearest large sized (>1000 hectares) woodland remnant (Goobang National Park). The woodland remnants of the Project Disturbance Area and surrounding area represent small potential ‘stepping stones’ of habitat for species in a landscape dominated by agricultural crops and pastures.

Source: Google Earth (2010), NPM (2011) and NPM (2012)

0 0.5 1 1.5km
1:35 000

Legend

- Project Area
- Wider Study Area
- Referral Area
- Bimble Box-White Cypress Pine Woodland
- Bimble Box-White Cypress Pine Woodland-DNG
- Bimble Box-White Cypress Pine Woodland-Exotic Understorey
- Disturbed Land
- Exotic Grassland
- Grey Box Grassy Woodland (EEC - TSC Act/EEC - EPBC Act)
- Grey Box Grassy Woodland-DNG (EEC - TSC Act/EEC - EPBC Act)
- Plantation
- River Red Gum Woodland
- River Red Gum Woodland-DNG
- White Box-Yellow Box-Blakelys Red Gum Woodland (EEC - TSC Act/CEEC - EPBC Act)
- Cultivated Agricultural Land

FIGURE 2.1

Vegetation Communities

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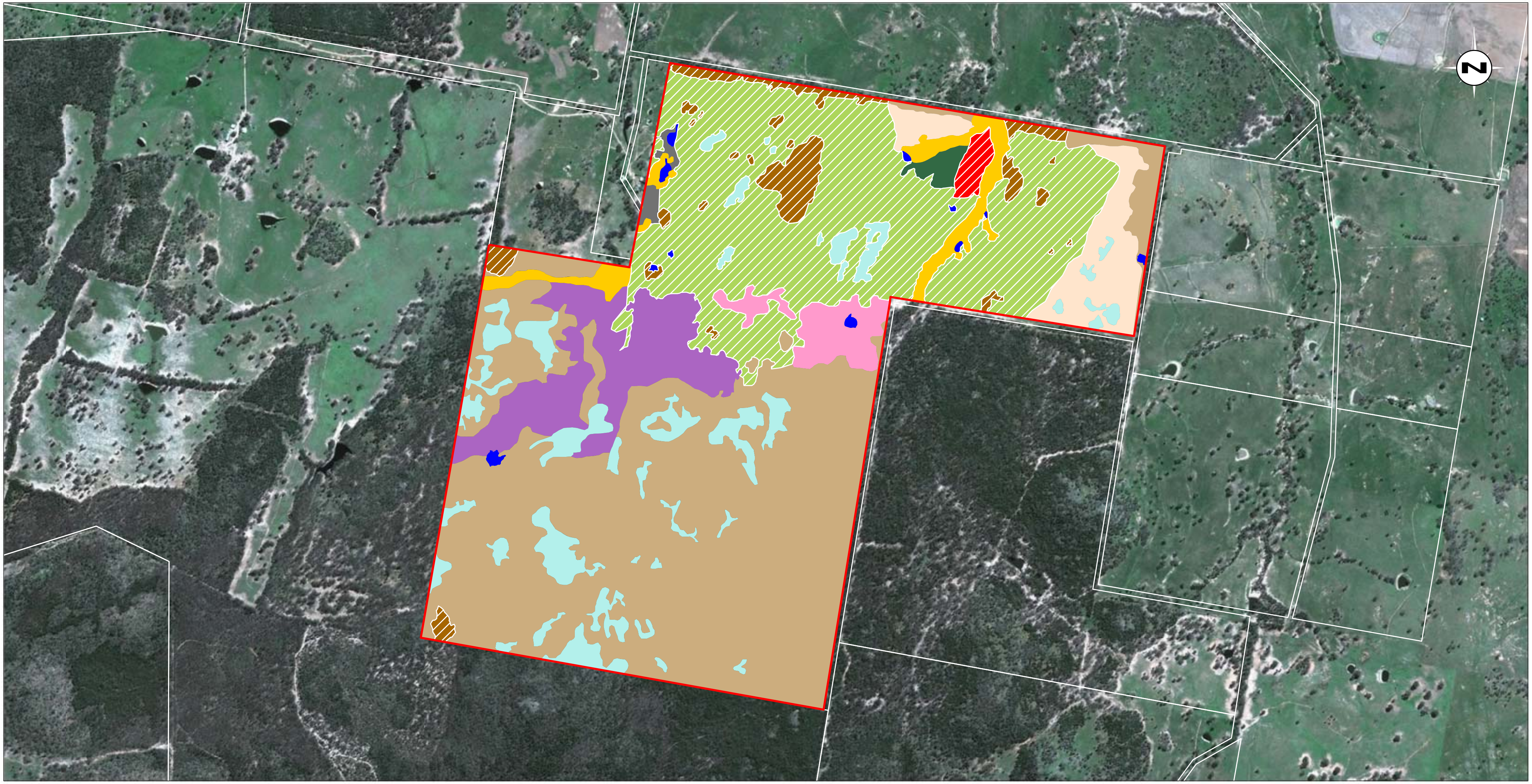


Source: Google Earth (2010), Department of Planning (2009) and Umwelt (2013)

0 0.25 0.5 1.0km
1:20 000

Legend

- Proposed Kokoda Offset Site Boundary
- Grey Box Grassy Woodland (EEC - TSC Act/CEEC - EPBC Act)
- Grey Box Grassy Woodland - DNG (EEC - TSC Act/CEEC - EPBC Act)
- White Box Grassy Woodland (EEC - TSC Act/CEEC - EPBC Act)
- Dwyer's Red Gum Creekline Woodland
- Dwyer's Red Gum - Grey Box - Mugga Ironbark - Black Cypress Pine Forest
- Dwyer's Red Gum - Grey Box - Mugga Ironbark - Black Cypress Pine Forest DNG
- Dwyer's Red Gum - Grey Box - Mugga Ironbark - Black Cypress Woodland Low Quality
- Farm Dam
- Farm Track - Disturbed Land
- Grey Box - Ironbark Woodland
- Mugga Ironbark Woodland
- Rocky Rise Shrubby Woodland

FIGURE 2.2

Vegetation Community Mapping
Proposed Kokoda Offset Site

File Name (A4): R16/2949_371.dgn
20130916 14.07

In contrast the woodland habitats of the Kokoda Offset Site occurs along a north-south potential corridor of remnant woodland and forest vegetation that runs along ridges and hills from north of Eugowra in the south to east of Narromine in the north (refer to **Figure 2.3**). The north-south potential corridor includes Goobang National Park, the largest conserved remnant of woodland and forest vegetation in the Central West region of NSW. Additionally, areas of the north-south potential corridor include existing conservation areas, increasing the value of the potential corridor. The regional value of the north-south potential corridor would be further increased by the inclusion of the Kokoda property as an offset area within the potential corridor. The Kokoda offset site occurs approximately 12 kilometres north-west of Nangar National Park, approximately 8 kilometres south of Goobang National Park, approximately 12 kilometres west of Mandagery State Forest, approximately 17 kilometres east of Cookamidgera State Forest, and approximately 20 kilometres east of Back Yamma State Forest (refer to **Figure 2.3**). The Grey Box Grassy Woodland EEC areas of the Kokoda Offset Site have a much higher landscape context value than those in the Project Disturbance Area.

- the recovery potential of Grey Box Grassy Woodland EEC areas to be regenerated/revegetated; and

Further site inspections of the Grey Box Grassy Woodland EEC DNG areas of the Kokoda Offset Site were completed in September 2013. These surveys investigated the recovery potential of Grey Box Grassy Woodland DNG areas. Given the existence of saplings in some DNG areas while under grazing pressure from sheep and cattle it is highly likely that the removal of sheep and cattle from the Kokoda Offset Site would promote the further recovery of some DNG areas across the site. However, not all areas are expected to recover naturally to woodland and some areas will require active revegetation works.

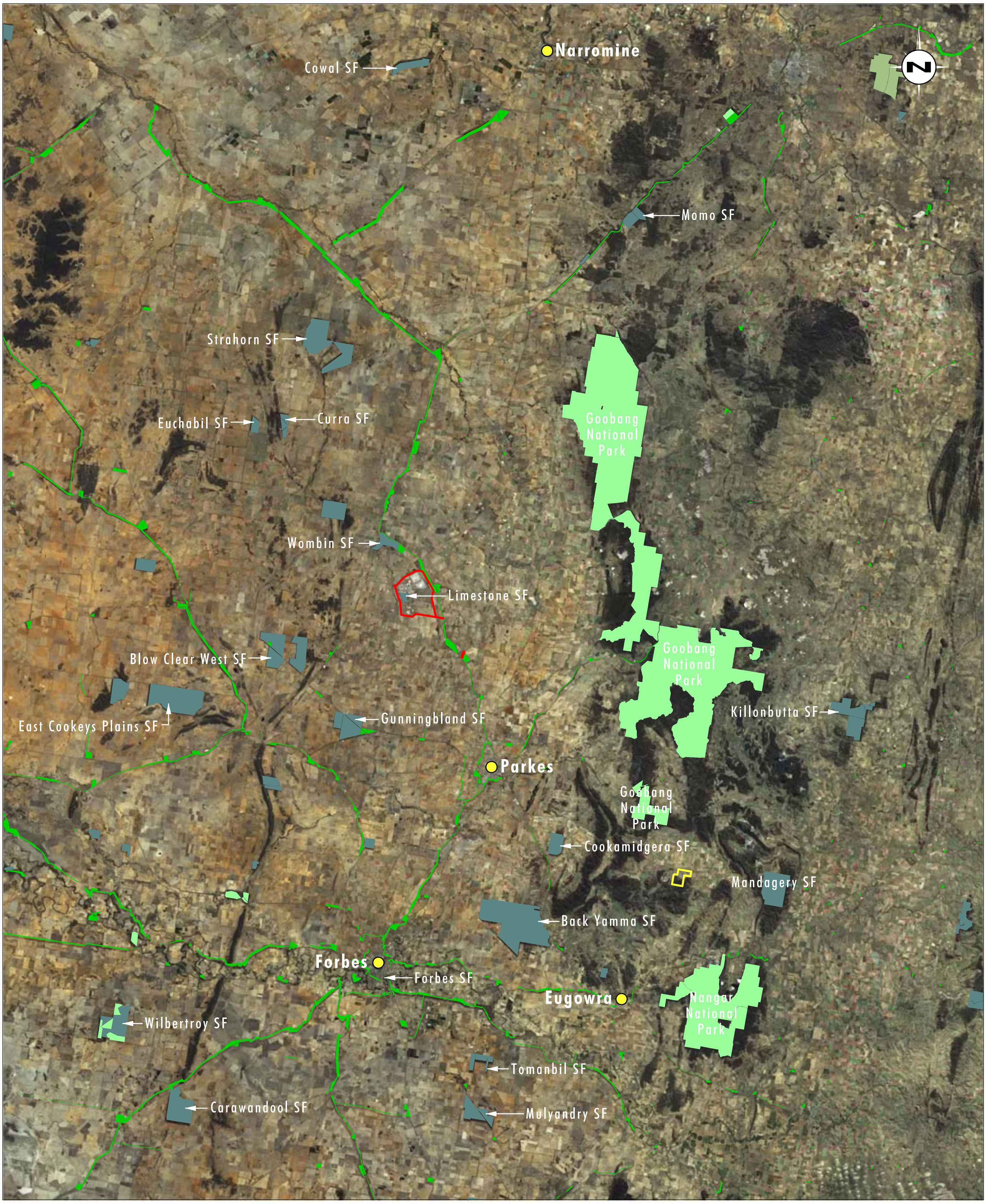
Five additional quadrats and two meandering transects across DNG areas were completed during September 2013. **Figure 2.4** shows total flora survey effort undertaken across the Kokoda Offset Site.

Three Grassy Grey Box Woodland DNG management zones were identified at a conceptual level during the September survey. These management areas will be further refined during the preparation of the Biodiversity Offset Management Plan.

Grassy Grey Box Woodland DNG <u>Natural Regeneration Zones</u> will be allowed to regenerate naturally following the removal of domestic stock (refer to **Figure 2.5**). Based on results of the September survey, the identified Natural Regeneration Zone is anticipated to have a good potential recovery. Grassy Grey Box Woodland DNG Natural Regeneration Zones were identified with the potential for natural recovery via the presence of saplings in DNG areas (prior to the removal of domestic stock).

Grassy Grey Box Woodland DNG <u>Potential Regeneration Zones</u> will be allowed to regenerate naturally following the removal of domestic stock (refer to **Figure 2.5**). An area of Farm Track Disturbed Land will also be managed to regenerate naturally as part of a Potential Regeneration Zone (refer to **Figure 2.5**). Grassy Grey Box Woodland DNG Potential Regeneration Zones were identified as areas that did not contain saplings but have the potential to recover naturally (potential is based on proximity to natural regeneration zones and woodland areas) following the removal of domestic stock.

Grassy Grey Box Woodland DNG <u>Active Revegetation Zones</u> will be actively planted to replace the DNG areas with Grassy Grey Box Woodland (refer to **Figure 2.5**). Grassy Grey Box Woodland DNG Active Revegetation Zones were identified as areas with poor recovery potential that did not contain saplings, had been heavily grazed and were distant from woodland areas that could provide a seed source.



Source: Google Earth (2012), NPM (2011), Department of Lands (2011)

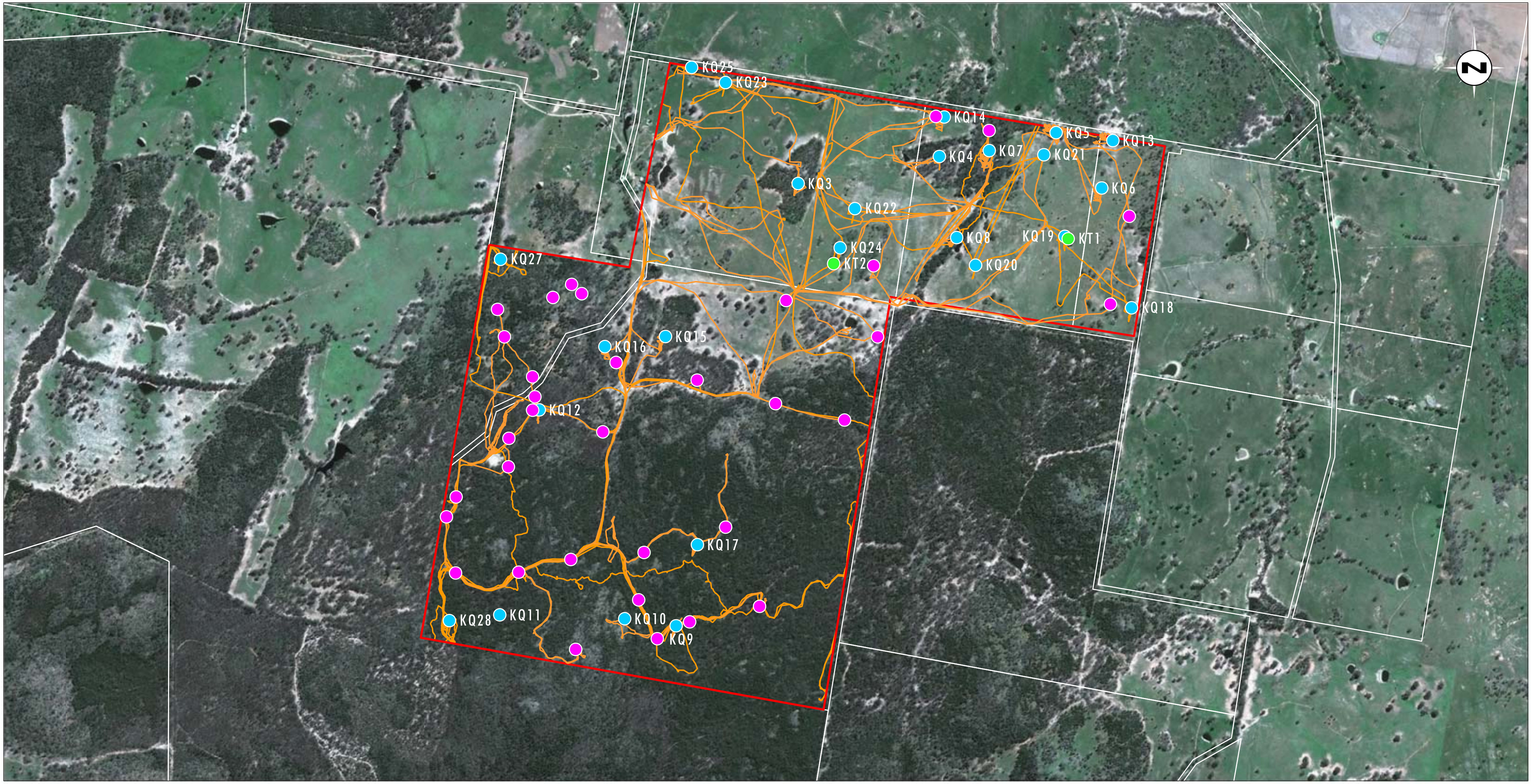
0 10 20 40km
1:750 000

Legend

- Project Area
- Proposed Kokoda Offset Site
- National Parks and Nature Reserves
- State Forest
- Travelling Stock Reserves
- Towns

FIGURE 2.3

Proposed Kokoda Offset Site Regional Location



Source: Google Earth (2010), Department of Planning (2009) and Umwelt (2013)

0 0.25 0.5 1.0km

Legend

- Proposed Kokoda Offset Site Boundary
- Systematic Flora Quadrats
- Rapid Flora Quadrats
- Meandering Transects
- General Floristic Transects

FIGURE 2.4

Flora Survey Effort

File Name (A4): R16/2949_377.dgn
20130916 14.31

Umwelt
Environmental Consultants

Source: Google Earth (2010), Department of Planning (2009) and Umwelt (2013)

0 100 250 500m
1:10 000

Legend

- Proposed Kokoda Offset Site Boundary
- Grey Box Grassy Woodland - DNG (EEC - TSC Act/CEEC - EPBC Act): Active Revegetation Areas
- Grey Box Grassy Woodland - DNG (EEC - TSC Act/CEEC - EPBC Act): Natural Regeneration Areas
- Grey Box Grassy Woodland - DNG (EEC - TSC Act/CEEC - EPBC Act): Potential Regeneration Areas
- Dwyer's Red Gum - Grey Box - Mugga Ironbark - Black Cypress Pine Forest DNG: Active Revegetation Areas
- Dwyer's Red Gum - Grey Box - Mugga Ironbark - Black Cypress Pine Forest DNG: Natural Regeneration Areas
- Farm Track - Disturbed Land: Potential Regeneration Areas

FIGURE 2.5

Conceptual Vegetation Management Areas Proposed Kokoda Offset Site

File Name (A4): R16/2949_376.dgn
20130916 16.40

It is anticipated that the active revegetation of DNG areas across the Kokoda Offset Site by NPM will be successful based on NPM's past and present tree planting history (see the following point regarding NPM's track record with tree planting and re-vegetation works) and the implementation of a Biodiversity Offset Management Plan (see recommendation 3.1 below).

- the proponents revegetation experience and history.

NPM has been undertaking tree planting operations annually since 1994 across the NPM landholdings. Approximately 517 hectares of tree planting has been completed between 1994 and 2012, with approximately 10,000 trees planted per annum and more than 150,000 trees having been planted to date across the NPM landholdings. The majority of the 517 hectares were planted at NPM's initiation and were not required by previous approvals or other regulatory requirements. All tree plantings observed during surveys for the EIS were of high quality, in good condition and tube stock survival rates appeared high. Revegetation works undertaken by NPM across the Kokoda Offset Site are likely to be as successful as those undertaken across the NPM landholdings given NPM's history of successful revegetation works at the NPM site. As discussed in Section 5.6.9 of the EA, NPM proposes the planting of DNG areas with poor recovery potential and monitoring the success of plantings and the recovery of DNG areas that have a high natural recovery potential as part of the proposed Biodiversity Offset Strategy (BOS).

Revegetation works at the Kokoda Offset Site are likely to be highly successful given NPM's extensive tree planting history in the region.

In summary, the proposed Kokoda Offset Site is considered adequate to offset the impacts on Grey Box Grassy Woodland EEC as it provides a higher quality outcome for the community. The Grey Box Grassy Woodland EEC areas of the offset site are less fragmented and have a better landscape context than the Project Disturbance Area. DNG areas of the Kokoda Offset Site contain signs of natural regeneration potential and where recovery potential is poor will be actively revegetated back to woodland form by a proponent with extensive revegetation experience.

The offsetting of 38 hectares of impact on Grey Box Grassy Woodland EEC with 106 hectares of Grey Box Grassy Woodland EEC is considered adequate given the above considerations.

Recommendation 3.1 – A Biodiversity Offset Management Plan should be developed for the biodiversity offset strategy. OEH requests input into the development of the plan. The plan should include a detailed restoration plan with clear targets and outcomes that will assist in the establishment of an ecologically sustainable Grey Box Grassy Woodland EEC.

As acknowledged by OEH, Section 5.6.9 of the EA indicates that a Biodiversity Offset Management Plan (BOMP) will be developed for the Kokoda Offset Site and it is anticipated that any Project Approval will condition the development of a BOMP. The BOMP will include a concise and auditable strategy for the implementation of the offset (e.g. removal of stock and identification and management of regeneration and active revegetation zones), which will provide for the ongoing measurement of the performance of the proposed management initiatives and an adaptive approach to management in response to monitoring outcomes. On-ground works are proposed to involve:

- weed and pest control programs;
- access management and exclusion of stock from the Kokoda Offset Site;

- works to encourage passive regeneration of DNG areas with adequate recovery potential;
- planting of DNG areas with poor recovery potential; and
- ecological monitoring across the Kokoda Offset Site to monitor the success of plantings and to monitor the recovery of DNG areas that have a high natural recovery potential.

Weed Management

Of the 103 flora species recorded during survey at Kokoda, 18 (17 per cent) were introduced species. Introduced species recorded that are considered environmental weeds comprised black-berry nightshade (*Solanum nigrum*) and blackberry (*Rubus fruticosus* sp. agg.). Blackberry (*Rubus fruticosus* sp. agg.) is the only noxious weed species recorded on the Kokoda Offset Site, listed in the Cabonne Local Government Area control area.

The success of the Kokoda Offset Site in enhancing ecological values will depend in part on the appropriate management of blackberry and other weeds, if present, in areas of ecological significance. A weed control program will be implemented to limit the spread and colonisation of noxious and environmental weeds (where identified as a potential threat to native vegetation establishment) within the Kokoda Offset Site, and this will include:

- an (initial) annual weed control program across the Kokoda Offset Site targeting noxious weeds (frequency to be refined through ongoing monitoring program);
- the implementation of weed management measures including hand removal, mechanical removal and application of herbicides in authorised areas when favourable conditions prevail;
- control of noxious weeds in accordance with the relevant legislation;
- monitoring and inspection of areas to assess the effectiveness of the weed control program and to ascertain the requirement for further work; and
- ongoing consultation with the relevant authorities regarding weed listings, weed occurrence and management technologies.

Pest Management

The BOMP will include measures to control and manage feral fauna species. Feral animals can have an impact on native fauna species through predation and competition for resources such as food, shelter, and breeding sites. Feral animals can also have a detrimental effect on regenerating areas as well as soil stability. Pest management will comprise baiting control programs for foxes and rabbits, on an as needed basis as determined through monitoring. Where other pest species are identified at moderate to high densities control measures appropriate for the species will be undertaken.

Monitoring and collaboration with neighbours will occur to identify the presence of significant populations of feral fauna species. Records of significant populations of such species would trigger appropriate control strategies to reduce and control numbers.

Access Management and Exclusion of Stock

All domestic stock will be excluded from the Kokoda Offset Site. Approximately 300 metres of internal fencing will be required to exclude stock from the Kokoda Offset Site. All fences will be suitably signposted to identify the purpose and conservation status of the Kokoda Offset Site.

Any new fencing (other than the boundary fences with adjoining neighbours) used within, or on the boundary of, the Kokoda Offset Site will use plain (i.e. non-barbed) wire on the upper strands, and as little barbed wire generally as possible to minimise the impact on native fauna species. As part of the ongoing management program, if a restricted level of barbed wire on fencing is shown to fail to exclude stock, additional measures that pose minimal impact to native fauna will be investigated and implemented.

Appropriate signage will be used to demarcate the Kokoda Offset Site from the remaining area of the Kokoda property.

<u>Recovery of Derived Native Grasslands to Woodlands</u>

Following the removal of domestic stock, Grassy Grey Box Woodland DNG zones will be managed according to their likely regeneration potential.

Weed monitoring (and control where necessary) will be undertaken across all three zones at 6, 12 and 24 months to ensure that weed species do not out-compete native species. Monitoring of the level of success of natural regeneration in natural regeneration zones and potential regeneration zones would be undertaken at 6, 12 and 24 months to assess the recovery of DNG zones. Where regeneration zones are found to be recovering poorly or not recovering, recommendations will be made to improve the recovery of the zones and may include the active planting of areas previously identified as regeneration zones.

Active planting of Grassy Grey Box Woodland DNG Active Revegetation Zones will comprise supplementary planting of inland grey box (*Eucalyptus microcarpa*) tubestock or as per recommendations of a consultant botanist and consistent with key species of Grey Box Grassy Woodland EEC.

All DNG areas will be monitored at least annually for the first three years to assess the success of the revegetation works and to, where necessary, identify additional management actions that may be required to promote the success of the regeneration and revegetation areas. The frequency of monitoring events after three years will be determined based on the status of the revegetation works during the initial three year period.

The BOMP will document the regeneration and revegetation management zones and the management actions to be undertaken across each zone.

Management actions across the Kokoda Offset Site will begin in year 1 and will include the removal of domestic stock, the planting of DNG revegetation zones, establishment of boundary fencing, and weed and pest management. Years 2 to 20 will comprise ongoing management actions including the planting of DNG areas which show poor recovery and the monitoring and maintenance of all regeneration areas.

NPM will draw upon its extensive experience in the successful revegetation of 517 hectares of land since 1994 across NPM landholdings. Revegetation works undertaken by NPM across the Kokoda Offset Site are anticipated to be as successful as those undertaken across the NPM landholdings.

<u>Ecological Monitoring</u>

Ecological monitoring of revegetation works and regeneration areas at the NPM site will utilise the methodology already employed within the NPM site (refer to **Table 2.4**). As outlined in **Table 2.4**, biodiversity monitoring will utilise the Landscape Function Analysis methodology, whose indicators can be utilised to assess status of vegetation communities, and subsequent habitat values.

Table 2.4 – Biodiversity Monitoring and Reporting

Mitigation Component	Mitigation Details
Objective	To identify and quantify ongoing environmental impacts that may occur both on and off site.
Phase	Before, during and after construction, during operation, decommissioning and rehabilitation.
Methodology for Implementation	The monitoring and reporting program is designed to measure the effectiveness of control measures and ensure compliance with consent and licence conditions, relevant standards and corporate requirements. Biodiversity monitoring will be conducted as part of the annual rehabilitation monitoring program, where rehabilitation and reference sites are monitored utilising the Landscape Function Analysis methodology, whose indicators can be utilised to assess status of vegetation communities, and subsequent habitat values. These results will be utilised as an indicator as to whether more extensive monitoring is required. Results of monitoring will be reviewed to identify where improvements are required in design works, annual rehabilitation plans or where maintenance is required to existing rehabilitation.
Justification of Location and Design	Undertaken in areas of remnant vegetation and native vegetation re-establishment within and adjacent to the NPM site and offset sites.
Expected Effectiveness	It is expected that the biodiversity monitoring and reporting is effective at documenting the ecological characteristics of the NML sites and identifying areas where intervention (e.g. weed management, erosion controls) may be required.
Threshold for Corrective Actions	Based on the outcomes of the monitoring program.
Corrective Actions	The monitoring program is reviewed on an annual basis.
Responsibility for Implementation	North Mining Limited.

Additionally, the ecological monitoring program of the Kokoda Offset Site will include a combination of condition assessments, floristic sampling, sapling survivorship counts and stratified quadrat sampling. Revegetation areas will be monitored by sapling survivorship counts of planted tubestock and condition assessments of surviving tubestock. Regeneration areas (DNG areas where grazing pressure from domestic stock has been removed) will be monitored via stratified and permanent quadrats. Floristic assessments will be undertaken using representative plots and standard botanical survey approaches (e.g. cover-abundance measures) to assess the floristic recovery of the DNG in comparison to the floristic composition of reference sites. Stratified quadrats will be established in nearby target communities to provide reference sites to which the success of regeneration/revegetation works can be compared. In the event that regeneration/revegetation sites fail to trend towards the ecological values of the reference sites, adaptive management will be undertaken and management actions will be modified or supplemented with new or additional techniques to promote the recovery of regeneration/revegetation sites towards the values of reference sites.

Fauna monitoring will be undertaken at Kokoda, focussing on key threatened species. Fauna monitoring will comprise bird and micro-bat echolocation surveys of existing woodland and recovering DNG areas focusing on the presence of threatened bird and bat species. Fauna monitoring will cover both the existing remnant vegetation areas as well as the recovering DNG areas, once there has been several years' of growth. The Biodiversity Offset Management Plan will detail the fauna monitoring techniques to be undertaken, the frequency of monitoring events and the seasonal timing of monitoring events across the Kokoda Offset Site.

The Biodiversity Offset Management Plan will include a detailed restoration plan including clear restoration targets and triggers for remedial works or additional management actions should the targets not be achieved. Restoration targets will be created for ecologically appropriate time periods (e.g. 2, 5, 10 years, etc). Ecological monitoring will initially focus on the remnant areas of Kokoda, and the establishment of sites within the DNG areas, to form a baseline of data against which future monitoring will occur. Monitoring will initially have a higher frequency (e.g. annual/biennial), and then, subject to the reasonable recovery of DNG areas, monitoring frequency would be reduced to triennial or quadrennial frequency. The monitoring program would be comprehensively reviewed after 10 years to determine the outcomes of the ecosystem re-establishment, and the need for and frequency of future monitoring.

Additional field survey of the Kokoda Offset Site has been undertaken during September 2013 and will feed into the development of the BOMP. Areas of derived native grasslands will be further investigated in September focusing on the mapping of the recovery potential of derived native grassland areas across the Kokoda Offset Site.

A draft BOMP will be provided to OEH for comment and upon completion the Plan will be submitted to DP&I for approval.

Recommendation 4.1 – The Bimble Box – White Cypress Pine Woodland vegetation type should be offset at a quantum to be determined using a robust assessment methodology. The offset may include the conservation of a vegetation type/s of equal or higher conservation value to the Bimble Box – White Cypress Pine Woodland.

The Project Disturbance Area contains a total of 13.7 hectares of Bimble Box Woodland, comprising:

- 12 hectares of Bimble Box – White Cypress Pine Woodland; and
- 1.7 hectares of Bimble Box – White Cypress Pine Woodland – Exotic Understorey.

The Kokoda Offset Site contains 151 hectares of a vegetation community, Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest, which has a higher conservation value than Bimble Box Woodland (refer to **Table 2.5**). Conservation status has been assessed by comparing the regional level of clearing for the Biometric Vegetation Type as recorded on the BioBanking Vegetation Types Database (OEH 2013).

Table 2.5 – Conservation Status of Impact and Offset Vegetation Communities

Vegetation Community	Biometric Vegetation Type	Area (ha)	Per Cent Cleared in Lachlan CMA (OEH 2013)
Bimble Box Woodland	LA152 - Inland Grey Box - Poplar Box - White Cypress Pine Tall Woodland on Red Loams Mainly of the Eastern Cobar Peneplain Bioregion (Benson 82)	13.7	75
Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest	LA165 - Mugga Ironbark – Inland Grey Box – pine tall woodland of the NSW South Western Slopes Bioregion (Benson 217)	151	85

CMA = Catchment Management Authority
ha = hectares

Bimble Box Woodland is most similar to Biometric Vegetation Type LA152 - Inland Grey Box – Poplar Box - White Cypress Pine Tall Woodland on Red Loams Mainly of the Eastern Cobar Peneplain Bioregion (Benson 82). LA152 is 75 per cent cleared in the Lachlan Catchment Management Authority area.

Approximately 151 hectares of Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest occurs across the Kokoda Offset Site and corresponds to Biometric Vegetation Type LA165 - Mugga Ironbark – Inland Grey Box – pine tall woodland of the NSW South Western Slopes Bioregion (Benson 217). LA165 is 85 per cent cleared in the Lachlan Catchment Management Authority area and represents a community with a higher conservation value than Bimble Box – White Cypress Pine Woodland.

The 151 hectares of Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest at the Kokoda Offset Site provides a suitable offset for the potential impacts on 13.7 hectares of Bimble Box Woodland. Additionally a further 8.6 hectares of low quality Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest and 15 hectares of Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest derived native grasslands also occur within the Kokoda Offset Site and could also be suitable offsets for impacts on Bimble Box Woodland in the Project Disturbance Area.

Recommendation 5.1 – Further details are required regarding the mechanism to secure in-perpetuity conservation of the biodiversity offset. Details are required of how appropriate funding will be secured in the medium to long term to deliver agreed management actions, and how the responsibility of the delivery of management actions will be captured over time.

The following responses are specifically made with respect to how in perpetuity conservation will be provided for the offset properties, specific comment below is made with respect to both the security and implementation of the offset.

Security

Security will be provided by the registration of the covenant on title with requirements in the covenant to implement the BOMP. The Courts have held that positive obligations in covenants that run with the land legally require the person burdened by the covenant to expend money. In the event that the responsible person is not undertaking its obligations, the covenant can be enforced by a Court.

This would apply to any document registered on title and that runs with the land such as a planning agreement, conservation agreement or property vegetation plan and there is no legal difference between using the different forms of documentation. There is no one method that gives the OEH more certainty or security over the other methods.

Implementation

As the covenant runs with the land, the Kokoda landowner is legally bound to comply with the covenant. However, it is proposed that NPM will enter into deed with the Kokoda landowner that will require NPM to comply with the terms of the covenant over the life of the mine. Once the mining has been completed, the obligations under the covenant will revert to the landowner. Those obligations cannot be released or varied without the consent of the Minister administering the *National Parks and Wildlife Act 1979*.

Again, this mechanism is the same as would apply to other documents registered on title such as a planning agreement, conservation agreement or property vegetation plan.

NPM's suggested scheme will satisfy DP&I's standard condition requiring that the Director-General be satisfied that biodiversity offsets are to be protected in perpetuity.

2.5 Roads and Maritime Services

The Roads and Maritime Services (RMS) have resolved to not object to the project, however comment has been provided regarding the adequacy of assessment of relocating access from Northparkes Lane to McClintocks Lane in regard to how the proposed amended access might impact low traffic volume local roads from staff travelling to and from the west. Response to this comment is provided in **Section 2.5.1**.

Further to providing comment on the Traffic Assessment the RMS have provided two suggested conditions to be applied to the Project, should it be approved, and comment on these conditions is provided in **Section 2.5.2**.

2.5.1 Comments on Adequacy of the Traffic Assessment

RMS in their submission made the following comment with respect to the adequacy of the Traffic Impact Assessment:

'The EA and accompanying Traffic Study generally address the above-mentioned traffic impacts, however the study fails to properly address the impact of relocating the mine access from Northparkes Lane to McClintocks Lane. In particular, the study does not identify the routes staff accessing the mine site from centres such as Trundle, Bogan Gate, Bedgerebong and other localities to the west of the mine site will use. Staff from these areas accounts for 5.3% of mine staff generating 74 vehicle movements per day. It could be assumed that these vehicles will use roads which currently average as low as 2 vehicles per day (e.g. McClintocks Lane west of the proposed mine access) presenting a significant increase in traffic on these local roads.'

As noted in **Sections 2.1** and **2.2**, NPM have received support from both PSC, who are responsible for the management of the regions local roads raised in this submission. That is, the Council's responsible for these local roads are comfortable with the assessed impact and proposed mitigation measures, and an agreement has been reached with the PSC regarding NPM's contribution to upgrade and maintenance of the local road system. Notwithstanding, the following additional information is provided to clarify the matters raised in the above comment from RMS.

The change to access arrangements, through the replacement of Northparkes Lane with amended access to Bogan Road via McClintocks lane will have minimal impact on lower volume roads in the vicinity of the mine site. As discussed in the Traffic Impact Assessment (TIA) prepared by Transport and Urban Planning (refer to Appendix 10 of the EA), the majority of staff exiting NPM operations commute to Parkes via Bogan Road. Anecdotal evidence from conversations with employees residing to the south/west of the site (Bogan Gate and Bedgerebong) indicates that commuting to and from NPM is most efficiently achieved via Bogan Road (sealed) to Parkes and then Bogan Gate or Bedgerebong. This route, via Bogan Road and Parkes, is the preferred route for commuters from Trundle during wet conditions. Under normal (dry) conditions, anecdotal evidence suggests, commuters to Trundle currently commute via Adavale Lane (refer to **Figure 2.6**). Under Project conditions, it is possible that commuters from/to Trundle may connect to Five Chain Lane via McClintocks Lane with a change in traffic arrangements as shown in **Figure 2.6**. The volume of this change in traffic movements will not be at the scale suggested by RMS, due to the small number of NPM employees reported in the NPM 2012

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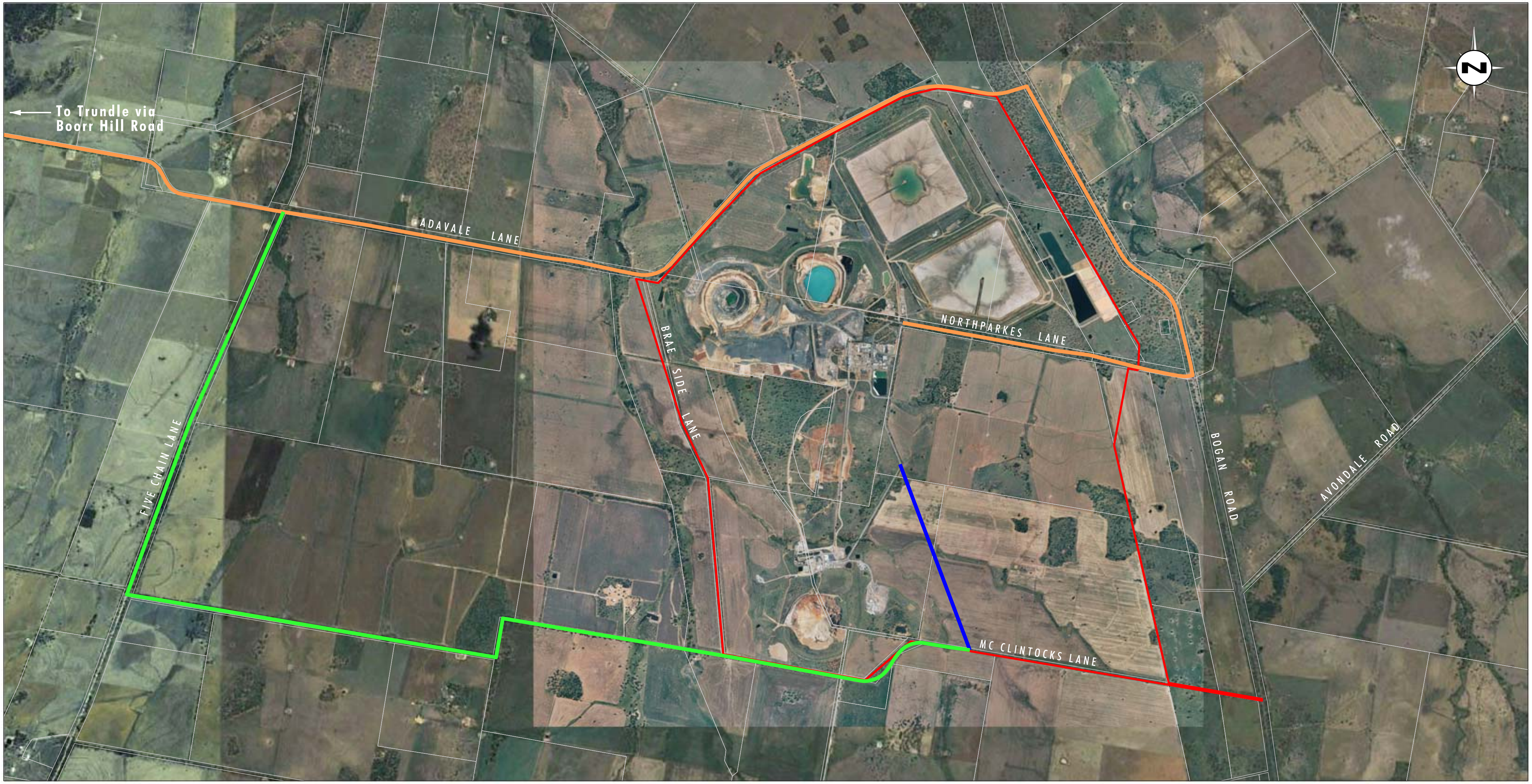

Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)

0 1 2 3km
1:60 000

Legend

- Project Area
- Existing (anecdotal) Dry Weather Route to Trundle
- Proposed (anecdotal) Dry Weather Route to Trundle
- Proposed Access Road

FIGURE 2.6

Driving Routes to Trundle (Dry Weather Scenario)

File Name (A4): R16/2949_354.dgn
20130916 13.37

Sustainable Development Report, dwelling in Trundle (7). Additionally, NPM run awareness programs, whereby car pooling is encouraged to improve driver safety and reduce traffic movements, so this number is likely to be less than seven employees potentially using this route. These awareness programs will continue in the lead up to the change to the Mine Access Road, to inform staff of the alternative site access routes. Finally the difference in the quality of the existing and proposed routes indicated in **Figure 2.6** are minimal and therefore the proposed change is considered unlikely to pose a significant impact to the operation of the regions local roads.

2.5.2 Proposed Conditions of Consent

'Prior to relocation of the mine access to McClintocks Lane, a road safety audit of the local road network providing access to the mine site shall be prepared by a level 3 recognised road safety auditor and submitted to Parkes Shire Council and RMS for review. Corrective Action Requests identified in the audit shall be closed out in consultation with Parkes Shire Council. A level 3 road safety auditor can be located by visiting www.roadsafetyredistercom.au For more information on preparing a road safety audit, the proponent should also visit www.roadsafety.transport.nsw.dov.au/downloads/road safety audit practices.html'

PSC has jurisdiction for the local roads in the area surrounding NPM. The formalised Voluntary Planning Agreement (VPA) with PSC provides an agreed mechanism for NPM to specifically contribute to road maintenance and upgrades within Parkes LGA. Furthermore, PSC have provided a submission (refer to **Section 2.1**) supporting the proposed Project. Accordingly, NPM request that this proposed condition not be applied to any project approval which might be granted by DP&I on the basis that roads in the local area are under the jurisdiction of PSC, and there is a formal mechanism in place to ensure appropriate contribution to local road maintenance and upgrades. As part of the EA, NPM have also committed to consulting with PSC and local landholders, prior to relocation of the mine access to McClintocks Lane, as part of the process of finalising the design of the proposed intersection. NPM suggest that this commitment, including PSC approval of final intersection design, would be an appropriate approval condition.

'Prior to any haulage requiring oversize/overmass vehicles and loads the proponent will be required to obtain special permits. To obtain a permit, the proponent will need to contact RMS Special Permits Unit in Glen Innes on 1300 656 371. The requirements outlined in the RTA publication Operating Conditions: specific permits for oversize and overmass vehicles and loads are to be followed. This publication is available online at: www.rta.nsw.gov.au/heavyvehicles/oversizeovermass'

This is an existing requirement for all oversize/overmass vehicle haulage on the public road system, and NPM would have no issue with the intent of the above condition being included in the project approval conditions.

2.6 Department of Primary Industries

A submission has been received from the Department of Primary Industries, which includes comment from the following governmental departments: Crown Lands, NSW Office of Water and Fisheries NSW. The Department of Primary Industries have an arrangement with the Office of Agriculture Sustainability and Food Security for mining Projects, whereby response is provide directly from this office to the department of planning. As of September 2013, no comment had been received from the Office of Agriculture Sustainability and Food Security.

Comments provided from each Agency are dealt with in **Sections 2.6.1** to **2.6.3** below.

2.6.1 Crown Lands

Crown Lands advise:

- ***use of any Crown road area will require that road to be closed under the Roads Act 1993 and either purchased or some other access/occupation arrangement authorised. The proponent should make early contact with Crown lands in relation to the occupation of any crown road.***

- ***Any activity that affects Travelling Stock reserves or associated tenures should be referred to both the local Livestock Health & Pest Authority and Crown Land's prior to commencement of the activity.***

NPM acknowledges comments received by Crown Lands and will continue to implement this guidance as a part of continued operations.

2.6.2 NSW Office of Water

2.6.2.1 General

Section 5.8.1 of the main EA provides detail on the proposed water sources, however a breakdown of water demands is not included. A detailed breakdown of water demands and their sources is requested including annual volumes for activities such as ore processing, construction, dust suppression, amenities and potable supply.

The Surface Water Assessment for the Project indicates that NPM will continue to have a net water deficit in the order of 4050 ML per year (refer to Appendix 11 of the EA). Total water demands for the site are in the order of 6900 ML per year. The majority of site water demand is for ore processing (primarily associated with entrainment of water with tailings) and evaporation from open water storages. The remaining water demands/losses on site include water used in the open cut and underground mining activities, dust suppression, construction activities, potable water and evaporation.

Major site demands, as listed in the Annual Environmental Management Report for 2012, are approximately 1800 ML for ore processing and approximately 2700 ML for evaporative losses.

The site water demands are expected to be relatively constant over the life of the Project with only minor variations in demand as a result of production variations associated with the timing of mining campaigns. The major construction works associated with the Project is the construction of tailings facilities. However, the water demand for construction of the tailings facilities is considered to be consistent within the current annual water demand for the site as tailings dam construction forms part of current operations.

Approximately one third of the water demands for site are met by recycling water (refer to Table 5.2 of Appendix 11 of the EA). The remaining water demands are met by on-site surface water runoff, groundwater inflows and external water sources. On-site surface runoff (i.e. runoff within the dirty water and contaminated water management systems) and groundwater are used first to meet water demands. This water is supplemented by external water sources, including: licensed bores; high security river licences; and external supply from PSC.

2.6.2.2 Groundwater

Groundwater Licensing

The estimated groundwater inflows detailed in Table C8 of Appendix C to the Groundwater Assessment have defined the water take for all existing and proposed operations at Northparkes Mine (NPM) until 2032 in the Lachlan Ford Belt Groundwater Source. This indicates the current water take is 292 ML/yr (0.8 ML/d) and this is to increase to a maximum groundwater take of 766 ML (2.1 ML/d) in 2026. It needs to be recognised that the maximum peak inflow of 5 ML/d in 2026 was ignored for the analysis. NPM currently hold an entitlement of 232 unit shares in the Lachlan Ford Belt water source. Additional entitlement therefore needs to be purchased to account for existing annual water take in addition to the predicted maximum water take. A breakdown of groundwater inflows based on each mining area is requested to further define the water take requirements.

As discussed in the Golders response in Section 2.1 of **Appendix 1**, there were errors contained in Table C8 of Appendix C of the Groundwater Impact Assessment (Appendix 10 of the EA); with the maximum simulated peak inflow projected to have occurred in 2011 and not 2026 as previously advised in the EA.

As a result of simulated hydraulic gradients between the surrounding area and the pit/mining lift being an order of magnitude high than the actual hydraulic gradients as mining areas are modelled to instantly be lowered to terminal depths, the simulated inflow rates at the start of the pit/mining lift development are an order of magnitude higher than the actual inflow rates. As such, the simulated peak groundwater inflow rate of 4.3 ML/day in April 2011 (refer to Table C8 of **Appendix 1**) to E26 Lift 1 is higher than the actual inflow rate, which is likely between 1 ML/day and 2 ML/day.

The revised Table C8, with the simulated total inflows and a breakdown of groundwater inflows for each mining area is provided in Section 2.1 of **Appendix 1**.

The groundwater modelling has not assessed the groundwater take after mine closure. During this period it is recognised groundwater will enter the voids as they fill and water take will continue when an equilibrium is reach due to evaporation. The NSW Office of Water requests predictions of water take during the mine closure period and cross-sections to represent the water table levels in relation to the mining operations.

Golders have provided model cross-sections (refer to Figure C6b of **Appendix 1**), showing the water table and hydraulic head contours (in mAHD), are included for the years 2032 and 2079; with 2032 selected as it has been assumed that all the mining operations will remain dewatered until 2032. The modelling for Year 2079 indicates:

- within the E26 open pit area, the groundwater table will have recovered to within approximately 80 per cent of the pre-mining level;
- in the area immediately surrounding the E26 Lift 2 workings, unsaturated groundwater levels would still occur. With the hydraulic gradient expected to decrease towards the level of the E26 Lift 2 workings, it is expected groundwater would discharge toward the voids;
- groundwater flow is expected to be directed toward the E48 Lift 1 workings; and
- at the E27 open pit and E28 open pit, the groundwater table is projected to have recovered to pre-mining levels.

Refer to Section 2.2 and Figure C6b of **Appendix 1** for detail.

Licensing under the Water Act 1912 will be required for additional monitoring bores.

Noted.

<u>**Groundwater Impacts**</u>

The EA has not directly addressed the Aquifer Interference Policy minimal impact considerations. It is requested the proponent clarify that there will not be a drawdown in the water table or pressure head of greater than a cumulative 2m at any water supply work. Based on the maximum predicted groundwater drawdown extent the EA has indicated no private groundwater users will be affected. This conclusion requires further justification.

The closest private groundwater bore is GW002860 and, based on the maximum predicted drawdown, is not within the 2 m-drawdown zone (refer to Section 2.3 and Figure 34b of **Appendix 1** for detail).

The groundwater modelling by Golders also indicates that there will not be a drawdown in the water table or pressure head of greater than the cumulative 2m at any of the existing private bores within the 8 kilometre radius search area (refer to Section 2.3 of **Appendix 1**).

The EA has determined the impacts to groundwater due to the project will not have a measurable impact on the surface water systems. The closest high priority Groundwater Dependent Ecosystem (GDE) is located more than 50 km from the site which is outside of the modelled drawdown extent.

Noted

It is recognised there is uncertainty as to the management of the final voids, with NPM highlighting the potential to use the voids to dispose of tailings into the future. However, as the use of the voids for tailings disposal has not been confirmed or assessed within the EA, the NSW Office of Water has assumed this option is not part of the current extension project. If this is not the case, further assessment will be required on potential groundwater impacts.

Section 2.3.10.2 of the EA notes that:

> 'On completion of mining each void, the option of utilising the voids as emplacement areas for tailings disposal will be investigated, and where considered viable will be developed in accordance with relevant approvals for tailings emplacement. This would result in complete or partial filling of the voids and subsequent capping and rehabilitation to the final landform'

In acknowledgement of the NSW Office of Water's concern in relation to assessment requirements, NPM advise that they no longer seek flexibility for tailings disposal in the final voids and will undertake further assessment prior to seeking approval for this option.

Section 5.14.2 of the main EA indicates the subsidence monitoring is to use groundwater modelling to determine whether the voids will act as groundwater sinks or sources and the potential impacts. As these are potential project impacts it is recommended these be assessed prior to determination and to include confirmation of predicted final groundwater levels and water quality.

The voids are predicted to act as groundwater sinks during the mining and post-mining period (refer to Figure C6b of **Appendix 1**), with the simulated hydraulic gradients decreasing toward the mine voids. Groundwater impact, in relation to planned surface subsidence, would be localised to the mine operations areas and, given the low hydraulic conductivity and low flow rates within the aquifers, it is not anticipated that subsidence will not have a detrimental impact on the regional groundwater flow regime.

An assessment of Acid Rock Drainage (ARD) and control has also been undertaken by NPM. The assessment results indicated that there is no significant risk in relation to ARD and that ARD is unlikely to have adverse impacts on regional groundwater quality.

Refer to Section 2.4 of **Appendix 1** for detail.

Figure 34 referred to in Section 6.3.4 of the Groundwater Assessment (Appendix 10) could not be identified. As this figure depicts the locations of existing registered bores and the one-metre drawdown contour, it is requested this be provided for review.

Refer to Figure 34 of **Appendix 1**.

Section 6.4.3 of the Groundwater Assessment indicates the potential for oxidation to occur following dewatering with resultant increase levels of TDS and metals in the groundwater system. The changes to water quality however have not been quantified hence it is requested these impact be further assessed. Further to this it is requested a description be provided of the baseline water quality at the site including a graphical presentation of historical analyte concentration change with time (including a minimum of TDS, AS, Pb, and Zn). It is request the graphs include sites in the vicinity of existing open pits/underground activities and existing/proposed tailings facilities. This information will assist in its assessment of potential groundwater quality impacts.

Graphs of TDS, As, Pb and Zn have been prepared, to present the historical analyte concentrate change with time, and have been provided in Figures 16d to 16g of **Appendix 1**. Spatial distribution of groundwater quality for regional and mine monitoring sites are shown in Figures 16b and 16c of **Appendix** 1. Additionally, baseline water quality at the site has been provided in Attachment A of **Appendix 1**.

Groundwater Modelling

The groundwater modelling section has not provided a confidence classification according to the Australian Groundwater Modelling Guidelines (2012) (AGMG) and does not specify if the site model has been independently reviewed by a hydrogeologist. The suitability of the model for the intended purpose is therefore uncertain. The NSW Office of Water therefore requests the proponent provide an independent review of the model and justify the confidence classification and its suitability for the proposed development according to AGMG.

The modelling by Golders was performed to satisfy the requirements of a Class 2 model as described in the Australian Groundwater Modelling Guidelines, and outlined in Table 2-1 of the guidelines.

Noel Merrick has been engaged to undertake an independent peer review of the Groundwater Impact Assessment (refer to Appendix 10 of the EA) to confirm the confidence classification is justified and suitable for the proposed development. The outcomes of this peer review will be sent to the NSW Office of Water and DP&I, when complete.

With the exception of monitoring bores W12 to W16, Figure C8 in Appendix C of Appendix 10 shows an overall trend where the computed drawdowns underestimate the measured drawdowns. This indicates the predictive runs presented in the EA may have underestimated impacts to groundwater pressures. It is therefore not possible to accurately determine the maximum impacts to water supply works.

Golders advise that pre-2007 computed hydraulic heads are higher than observed heads, meaning the computed hydraulic gradients behind the pit/lift walls are likely to be, most of the time, higher than the actual hydraulic gradients. This implies that the actual pit-groundwater inflow rates are likely to be lower than the computer pit-groundwater inflow rates. Additionally, the observed drawdown rate in most of the wells (including wells P139 and P149 in the vicinity of E26) is lower than the simulated drawdown rate between 1994 and 2007; suggesting the model can be used to provide conservative future projections of mining induced groundwater drawdown. Refer to Section 2.7 of **Appendix 1** for detail.

The model has not incorporated baseline data from observation bores MB19/20 and P149. Clarification is requested for the basis of not incorporating data from these bores and/or inclusion in the model for further analysis.

In regard to MB19 and MB20, at the time the model was prepared, information on the bore depth and screen depths of these bores was not available and as such these bores were not incorporated into the model.

A graph of observed and computer heads at P149 is provided in Figure C8 of **Appendix 1**. It is noted that no record of pre-mining groundwater level monitoring at P149 is available prior to 2004. Analysis of results indicates that the initial drawdown rate is comparable to the initial observed drawdown rate.

2.6.2.3 Groundwater – Attachment C of Appendix 10 of the EA

Section 4.7: Table 12 – Bore water entry design (screen vs slots), bore license numbers, and bore collar (measuring point) elevations are not included.

Bore licence (monitoring) for NPM pits are:

- E22 Pit: Bore Licence 80BL241019;
- E26 Pit: Bore Licence 80BL241042;
- E27 Pit: Bore Licence 80BL241023; and
- E48 Pit: Bore Licence 80BL241020.

Where available, bore collar elevations, licence numbers and bore entry design information have been provided in Table 12 of Section 3.1 of **Appendix 1**.

Section 4.7: Figure 9 – Requires a map 'insert' panel so site bores may be differentiated in vicinity of "E22 and E27" mining area.

Refer to the revised Figure 9 provided in Section 3.2 of **Appendix 1**.

Section 4.7: Figures 12 and 13 require an additional hydrograph each to separate hydroplots for the purpose of enabling differentiation of individual bores.

Refer to Figures 12a to 12d and Figures 13a to 13d of **Appendix 1**.

Section 4.7: Figures 10, 11, 12, and 13 require adjustment to horizontal 'data'scales to enable hydrograph interpretation. In addition, the asterisk marks on Figures 10, I1 and 13 require explanation.

Refer to the revised Figures 10 to 13 in Section 3.4 of **Appendix 1**.

Section 4.8.3: does not clearly state what water quality analytes have been tested for, from which bores in past at the site. The EA requires revision including summary table presentation of analytes tested from which locations.

The sampling sites for the pre-mining (prior to 1993) and during-mining (2009 to 2013) water quality are presented in Tables 17b and 17c of **Appendix 1** respectively. Water quality monitoring data in the pre-mining and during-mining periods are provided in Tables A1 and A2 of Attachment A of **Appendix 1**. Refer to Section 3.7 of **Appendix 1** for detail.

Section 4.8.3: In order to make assessment of potential impacts, the EA requires addition of water quality data collected to date presented via graph form to show individual analytes including at a minimum Total Dissolved Solids (TDS), Arsenic (As), Lead (Pb), and Zinc (Zn) concentration change with time in each monitoring bore/sample point.

Graphs of TDS, As, Pb and Zn have been prepared, to present the historical analyte concentrate change with time, and have been provided in Figures 16d to 16g of **Appendix 1**. Refer to Section 3.7 of **Appendix 1** for detail.

Section 4.8.3: required pre-mining and post-mining spatial distribution maps of groundwater quality including at a minimum TDS, As, Pb, and Zn concentrations.

The spatial distribution of water quality in regard to TDS, for water samples within NPM and up-gradient of NPM were shown in Figure 16 of Appendix 10 of the EA; showing the spatial distribution of water quality observed in 2009 to 2010. Additional spatial water quality distribution maps of groundwater quality have been prepared and are included as Figures 16b and 16c of **Appendix 1**. Refer to Section 3.7 of **Appendix 1** for detail.

Section 4.8.4: Table 17 – requires addition of both Pb and As concentration comparison to guidelines.

Table 17 has been updated by Golders using the monitoring data from 2009 to 2013, resulting in the number of water samples in the statistical summary in Table 17 increasing. Refer to the revised Table 17 in Section 3.8 of **Appendix 1**.

Section 7.3.2.: Locations of proposed additional monitoring bores around the proposed waste facilities (Tailings Storage Facility [TSF] 3, new waste rock stockpiles) require detailing.

The locations for the proposed additional monitoring bores will be identified upon Project Approval in consultation with the NSW Office of Water.

The monitoring recommendations are included in Section 7.3.2 of the Groundwater Impact Assessment (refer to Appendix 10 of the EA) and Section 3.9 of **Appendix 1**.

Section 2.2.1: Figure C8 – With the exception of monitoring bores W12 through W16 the overall trends that computed drawdown's underestimate measured drawdowns. This implies any predictive runs from this model may underestimate impacts to groundwater pressures.

Golders advise that pre-2007 computed hydraulic heads are higher than observed heads, meaning the computed hydraulic gradients behind the pit/lift walls are likely to be, most of the time, higher than the actual hydraulic gradients. This implies that the actual pit-groundwater inflow rates are likely to be lower than the computer pit-groundwater inflow rates. Additionally, the observed drawdown rate in most of the wells (including wells P139 and P149 in the vicinity of E26) is lower than the simulated drawdown rate between 1994 and 2007; suggesting the model can be used to provide conservative future projections of mining induced groundwater drawdown. Refer to Section 2.7 of **Appendix 1** for detail.

Section 2.2.1: Figure C8 – Requires addition of regularized data intervals for each plot, for example Jan 2005, Jan 2000, Jan 2005, etc.

Figure C8 has been revised and is provided in Section 5.2 of **Appendix 1** as Figures C8a to C8q.

Section 2.2.1: Figure C8 – Requires addition of events such as when mining starts to each plot.

Figure C8 has been revised and is provided in Section 5.2 of **Appendix 1** as Figures C8a to C8q.

Section 2.2.1: Figure C8 – Vertical scale requires division into reasonable sub-increments, for example 10 m or 20 m.

Figure C8 has been revised and is provided in Section 5.2 of **Appendix 1** as Figures C8a to C8q.

Section 2.2.1: Figure C8 – Asterisk assigned to select bores requires explanation.

Figure C8 has been revised by Golders and is provided in Section 5.2 of **Appendix 1** as Figures C8a to C8q, with the asterisk removed.

Section 2.2.1: Figure C8 - Overestimation at bore W12 in excess of 80 metres of drawdown indicates calibration in immediate vicinity of E22 resource is poorly calibrated or vertical model profiling may require adjustment.

As discussed in Section 5.6 of **Appendix 1**, W12 is located in the immediate vicinity of the E22 pit. When mining operations at E22 ceased in 1998 dewatering was stopped, with dewatering recommencing ahead of the second mining campaign in 2007 and ceasing at the completion of that campaign in 2010. Since the pit was allowed to fill at the end of mining, groundwater levels would have been in recovery in the period from 1998 to 2007. However, in the groundwater model, mining operations (and hence dewatering activities) at E22 were assumed to continue until 2003. This would explain why computed heads in 2001 are much lower than observed heads.

Section 2.2.1: Explanation or deletion of comment that groundwater pressure rise is evident from computed measurements in bores MBl, MB2, MB4, MB5, MB13 and MB14 is required. Figure C8 does not indicate level rise in these bores in its current format. In addition, monitoring bore MB10 is mentioned in this section but not included in Figure C8.

The hydrograph for MB10 is included as Figure C8l in **Appendix 1**.

Further explanation of observed and modelled groundwater levels in the vicinity of the TSF are document in Section 5.7 of **Appendix 1**.

Section 2.2.1: Table C7 Model layers require depth intervals (in metres).

The thickness (in metres) and mean top elevation (in mAHD) for each model layer are shown in Table C4. Depth intervals (in metres) have been added and are included in Table C7 in Section 5.8 of **Appendix 1**.

Section 2.2.1: If any parameters presented in Table C7 have been verified with aquifer testing analysis, explanation is required.

Model parameters presented in Table C7 were defined based on calibrated model values from MER (2006) and corroborated with other previous modelling and site investigation data at NPM. For further detail refer to Table 10, Table 11, Section 4.6.4 and Table 20 of Appendix 10 of the EA.

Inadequate existing monitoring information utilization in the MODFLOW model both east and west of the proposed extension to the E26 resource. As indicated from Figure C7 monitoring bores MB 19/20 to the east of E26 and PI39 west of E26 were not utilized as "observation" bores in the model.

As indicated in Figure C8r in Section 5.10 of **Appendix 1**, the simulated groundwater heads at P139 indicate a reduction in groundwater heads in response to dewatering.

At the time the model was prepared, the bore depths and screen depths for MB19 and MB20 were not available. As such, these observation bores were not incorporated into the model.

A graph of observed and computed heads at P149 is provided as Figure C8 in Section 2.8 of **Appendix 1**, with the results indicating that the initial simulated drawdown rate is comparable to the initial observed drawdown rate.

2.6.2.4 Groundwater – Attachment B of Appendix 10 of the EA

Bore licenses 80BL241019, 80BL24102, 80BL241023, and 80BL241020 are incorrectly described as dewatering purpose. According to Office of Water records these bores are currently licensed for monitoring purposes. Also, it is not clearly defined for what licenses 70SA009535 and 70AL600028 are to be utilized.

Table 1 has been updated and provided in Section 4.1 of **Appendix 1**. License 70AL600028 is a River Water License, while licenses 70SA009535 and 70BL226867 are no longer active and have been removed from the table.

2.6.2.5 Surface Water

<u>Surface Water Impacts</u>

The project will result in a reduction in catchment area by 203ha which represents a 0.2% reduction in the Bogan River catchment and a 0.8% reduction in the Cookapie Creek catchment. This catchment area reduction represents a reduction in average yearly runoff to downstream water users and the environment of 123ML. There are no licensed water users on Cookapie Creek downstream of the mine site, hence impacts would be to water users with riparian rights and the environment. The impacts of this stream flow reduction have not been clearly assessed within the EA.

Within the vicinity of NPM, the Bogan River is considered to be generally ephemeral whilst Cookapie Creek is ephemeral. Neither the Bogan River or Cookapie Creek can therefore be considered a reliable source of water for downstream land holders.

Extraction from the Bogan River and Cookapie Creek by downstream water users (under basic landholder rights) can only occur during and following rainfall events. During such events, flow rates within the Bogan River ad Cookapie Creek will typically be higher than the pumping capacity of the downstream users. As a result, the small reduction to the catchment area that would occur as a result of NPM is unlikely to have an appreciable impact on the harvestable rights of the downstream landholders.

Similarly, the ephemeral nature of the Bogan River and Cookapie Creek system means that the downstream environment is subject to a cycle of wetting and drying. This cycle will not be altered by NPM.

The EA has indicated all proposed mining activities and associated infrastructure will be located outside of the 100 year ARI flood extent, or in the case of the new road crossing will be able to convey the 100 year ARI flows. A conceptual plan is requested of the proposed road crossing of Goonumbla Creek with details of the road formations in relation to the existing ground level and the flood extents. Potential redistribution of flood flows and mitigating measures to ensure channel and floodplain stability are also requested. Based on this information the NSW Office of Water will be able to determine the applicability of a Part 8 approval under the Water Act 1912 and the potential for consistency with the Guidelines for Controlled Activities on Waterfront Land (July 2012).

The design for the Goonumbla Creek crossing includes a culvert/s (or equivalent) that:

- minimises the potential for erosion and scouring of the bed and banks of Goonumbla Creek;
- minimises the potential impacts on the flood extents both upstream and downstream of the crossing point;
- includes a base that is aligned with the natural level of the stream bed;
- includes an effective flow area under the waterway crossing at a minimum equivalent to the existing flow area of the channel;
- includes a total width that does not reduce the cross sectional area of the channel;
- is aligned parallel with the direction of flow; and

- is located away from local low points, bends and unstable reaches of Goonumbla Creek.

A detailed design of the road crossing of Goonumbla Creek will be determined during the detailed design phase if this Project is approved.

2.6.3 Fisheries NSW

Fisheries NSW have advised that they have no issues in relation to the Project.

2.7 Private Resident (Annette Moss – Hillview Property)

2.7.1 Residence Location

As noted in the submission made by Annette Moss, property owner ‘Hillview’, Figure 1.4 of the EA, depicts only a ‘derelict’ dwelling being located on the ‘Walma Hillview’ property. The derelict dwelling, visible from Bogan Road at the time of residence mapping is situated approximately 200 metres to the North of a new dwelling which was built by the Moss family, the location of which is shown on **Figure 2.7**.

In addition to the location of the existing dwelling on the ‘Walma Hillview’ property, The Moss family have lodged a Development Application (DA12020) with PSC for the development of a dwelling at Lot 44 DP 753998 (Refer to **Figure 2.7**). NPM at the time of DA lodgement (10 April 2012), made a submission on the proposed development of the dwelling to PSC. This position was confirmed through a further submission by NPM in relation to the Moss dwelling Statement of Environment Effects (SEE) (received by PSC 23 August 2013) The submission noted that NPM’s concern that the SEE had not adequately addressed Clause 13 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP). Notwithstanding the fact that the DA is still subject to approval, further assessment (refer to **Section 2.7.2**) has been provided with respect to the impacts of the Project on the location of both the existing and proposed Moss dwellings.

2.7.2 Environmental Impact Assessment

The submission received from Annette Moss, property owner ‘Hillview’ raised a number of concerns in relation to the Project, in particular:

‘The EA has not taken into consideration the air quality from the close location of our home to the proposed tailings dam and the visual impact of the Northparkes Extension Project on our property. I am also concerned over the effect of noise and vibration from the new open cut mines (E31N and E31) and the impact on our bore water supply that we are dependent on to water our stock.’

With respect to these concerns, **Sections 2.7.2.1** to **2.7.2.8** below specifically assesses the impacts of the Project on the Hillview Property.

2.7.2.1 Noise Impacts from the Project

To determine impacts resulting from the Project in its entirety, the Project EA included a Noise Impact Assessment (NIA) (refer to Appendix 7 of the EA).

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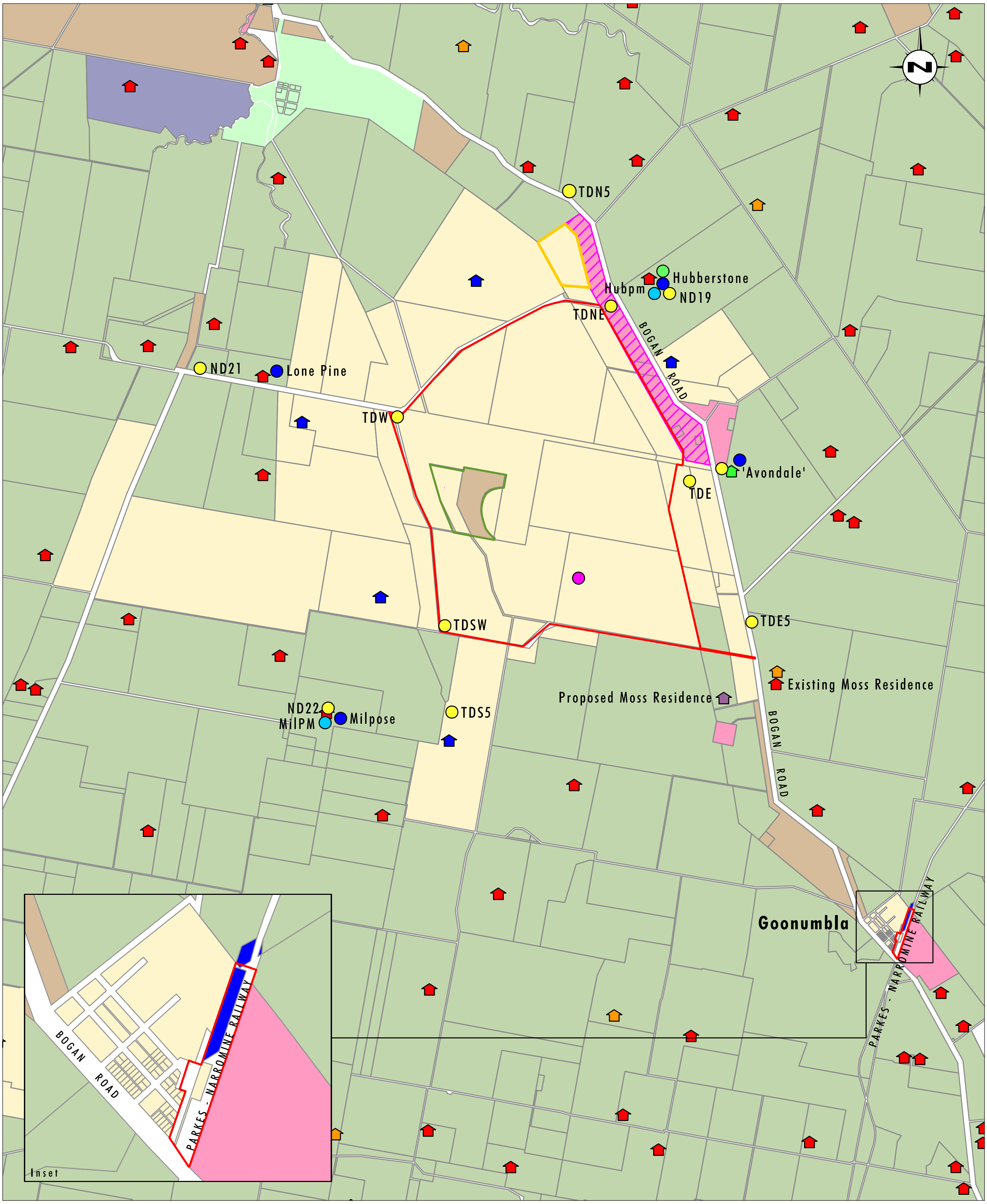

Source: NPM (2013), LPMA (2011)

0 250 625 1250m
Inset 1:25 000

0 1 2.5 5km
1:100 000

Legend

- Project Area
- Existing Biodiversity Offset Area
- Limestone State Forest Boundary
- State Forest of NSW
- Mine Owned
- Parkes Shire Council
- Private
- Department of Lands - Crown
- State of NSW
- State Rail Authority of NSW
- Travelling Stock Route
- Private Residence
- Agreement Residence
- Mine Owned Residence
- Derelict Residence
- Proposed Residence (Pending Development Aproval)
- Noise Monitoring Location
- Depositional Dust Monitoring Location
- PM10 Monitoring Location
- Blast Monitoring Location
- Meteorological Station

FIGURE 2.7

Land Ownership and Existing Monitoring Locations

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Whilst identified as a 'Derelict' building in the EA, the NIA identified the derelict dwelling at Hillview as sensitive noise receiver 10. On the basis that the derelict dwelling is situated approximately 200 metres closer to mining operations than the active dwelling (refer to **Figure 2.7**), the results of both the NIA with respect to this location remain applicable, with no adverse noise or blasting impacts predicted.

The proposed development of a residence at Lot 44 DP 753998, was not specifically considered in the NIA. As shown in **Figures 2.8** and **2.9**, the proposed dwelling subject to PSC DA12020 is located outside of the project specific noise criteria of 35 dB(A), with modelling assuming worst case atmospheric conditions.

2.7.2.2 Vibration Impacts from the Project

The detailed Blasting Impact Assessment (BIA) (refer to Appendix 7 of the EA) completed as a part of the EA, utilised an established site law to predict vibration impacts resulting from the Project. The small scale of the proposed blasts (maximum instantaneous charge (MIC) 50 kg), coupled with significant NPM owned buffer land, resulted in all sensitive receivers assessed being in compliance with the specified vibration criteria (refer to Section 5.5.3 of the EA). The proposed Moss dwelling (PSC DA12020) (refer to **Figure 2.7**) is located at a comparative distance (approximately 3 kilometres) as an assessed sensitive receiver (Milpose) from the E26 blasting area. The BIA predicts compliance to specified vibration criteria at all private receivers and given the comparative distances to the proposed dwelling and Milpose, it is anticipated that similar vibration levels will apply at this residence. Furthermore, as a statement of commitment for the Project NPM commit to:

> 'design and undertake blasts to ensure the relevant vibration and blast overpressure criteria are met at private residences (EA Commitment 6.7.1) and will undertake monitoring of all blasts at surrounding private receivers during campaign open cut mining operations to measure compliance with relevant criteria and to further refine blast site laws (EA Commitment 6.7.1).'

2.7.2.3 Visual Impacts of the Project

The submission made by Annette Moss, property owner 'Hillview' refers to the potential for the Project to have visual impacts on their existing dwelling.

As noted in Section 2.3 of the EA, the majority of potentially visible disturbance footprints are either existing or approved as part of existing NPM operations. The key change in potential visual impacts are associated with the modified footprint and proposed increased height of TSF3, the proposed increase in height of the Estcourt TSF (increased height of 3 metres from 25 to 28 for all TSF's), and the development of additional waste dumps adjacent to E26 with a height of approximately 30 metres above ground. Significant NPM land holding provide substantial visual buffering, between the project components and residences.

Radial analyses were completed as part of the assessment process for the Project, with **Figures 2.10** to **2.14** (reproduced from EA Figures 5.29 to 5.33) providing radial analyses (based on topography without consideration of vegetation) of the principal visual components of the Project. As indicated in these figures, the view from the existing Moss property under the proposed Project is generally consistent with the existing approved visual environment. Further analysis of the landscape surrounding the Moss's existing dwelling indicates significant vegetation, particularly within the Bogan Road Travelling Stock Reserve (TSR) situated between the Moss property and the Project area, which along with distance to NPM operations (greater than 5 kilometres) will provide significant visual buffering to the Project.

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Source: NPM (2013), LPMA (2011)

0 1 2.5 5km
1:100 000

Legend

- Project Area
- Existing Biodiversity Offset Area
- Limestone State Forest Boundary
- Predicted Noise Impact Contour, dB(A)
- State Forest of NSW
- Mine Owned
- Parkes Shire Council
- Private
- Department of Lands - Crown
- State of NSW
- State Rail Authority of NSW
- Travelling Stock Route
- Private Residence
- Agreement Residence
- Mine Owned Residence
- Derelict Residence
- Proposed Residence (Pending Development Approval)
- Noise Monitoring Location
- Meteorological Station

FIGURE 2.8

Predicted Noise Impacts for Continued Existing Operations (Scenario 1) Under Southerly Drainage Flow and F Class Stability Conditions

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Source: NPM (2013), LPMA (2011)

0 1 2.5 5km
1:100 000

Legend

- Project Area
- Existing Biodiversity Offset Area
- Limestone State Forest Boundary
- Predicted Noise Impact Contour, dB(A)
- State Forest of NSW
- Mine Owned
- Parkes Shire Council
- Private
- Department of Lands - Crown
- State of NSW
- State Rail Authority of NSW
- Travelling Stock Route
- Private Residence
- Agreement Residence
- Mine Owned Residence
- Derelict Residence
- Proposed Residence (Pending Development Approval)
- Noise Monitoring Location
- Meteorological Station

FIGURE 2.9

Predicted Noise Impacts for Proposed Operations (Scenario 2) Under Southerly Drainage Flow and F Class Stability Conditions

File Name (A4): R16/2949_356.dgn
20130916 13.39

Umwelt
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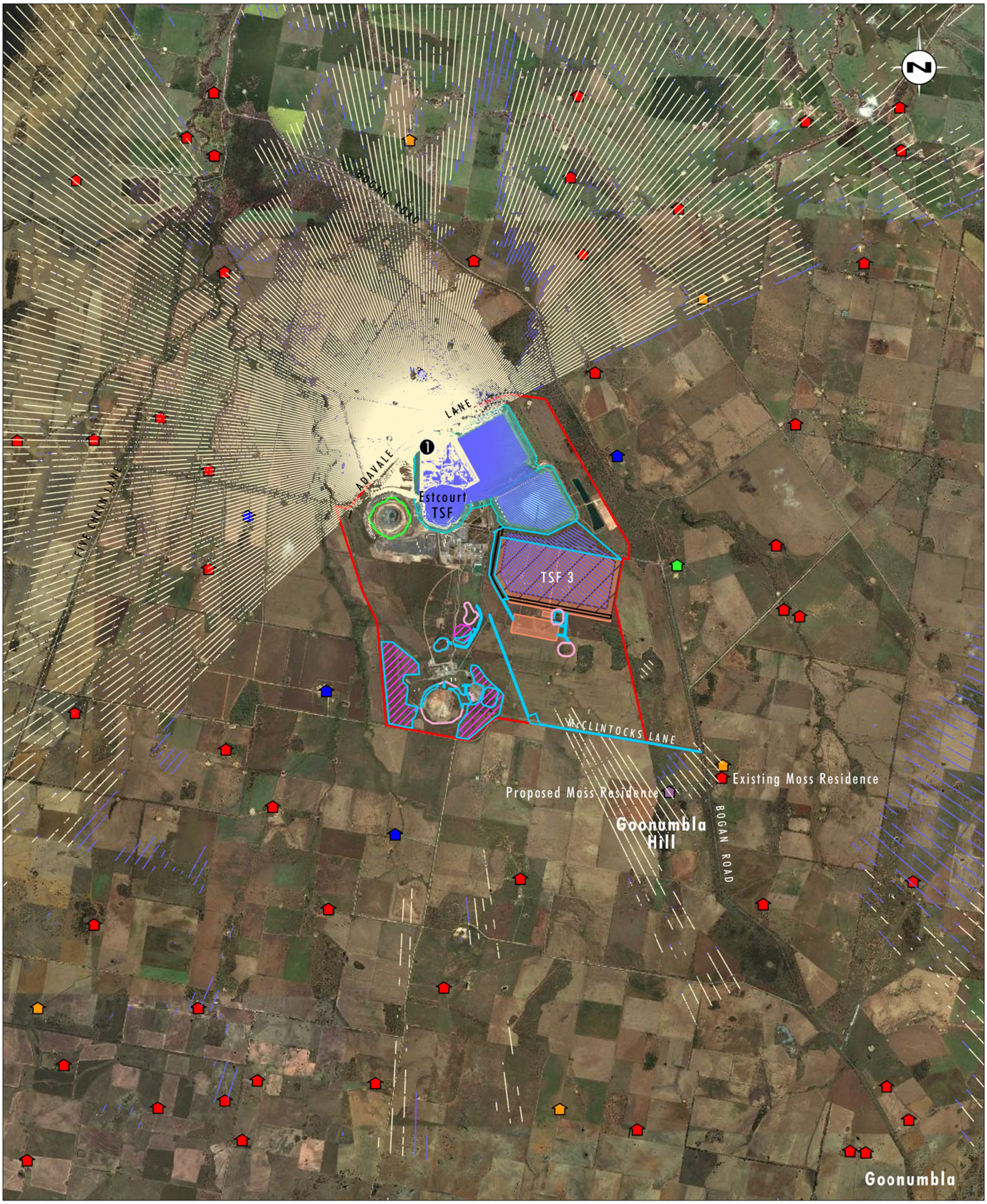


Source: NPM (2013), Google Earth (2010)

0 1.0 2.5 5.0km
1:100 000

Legend

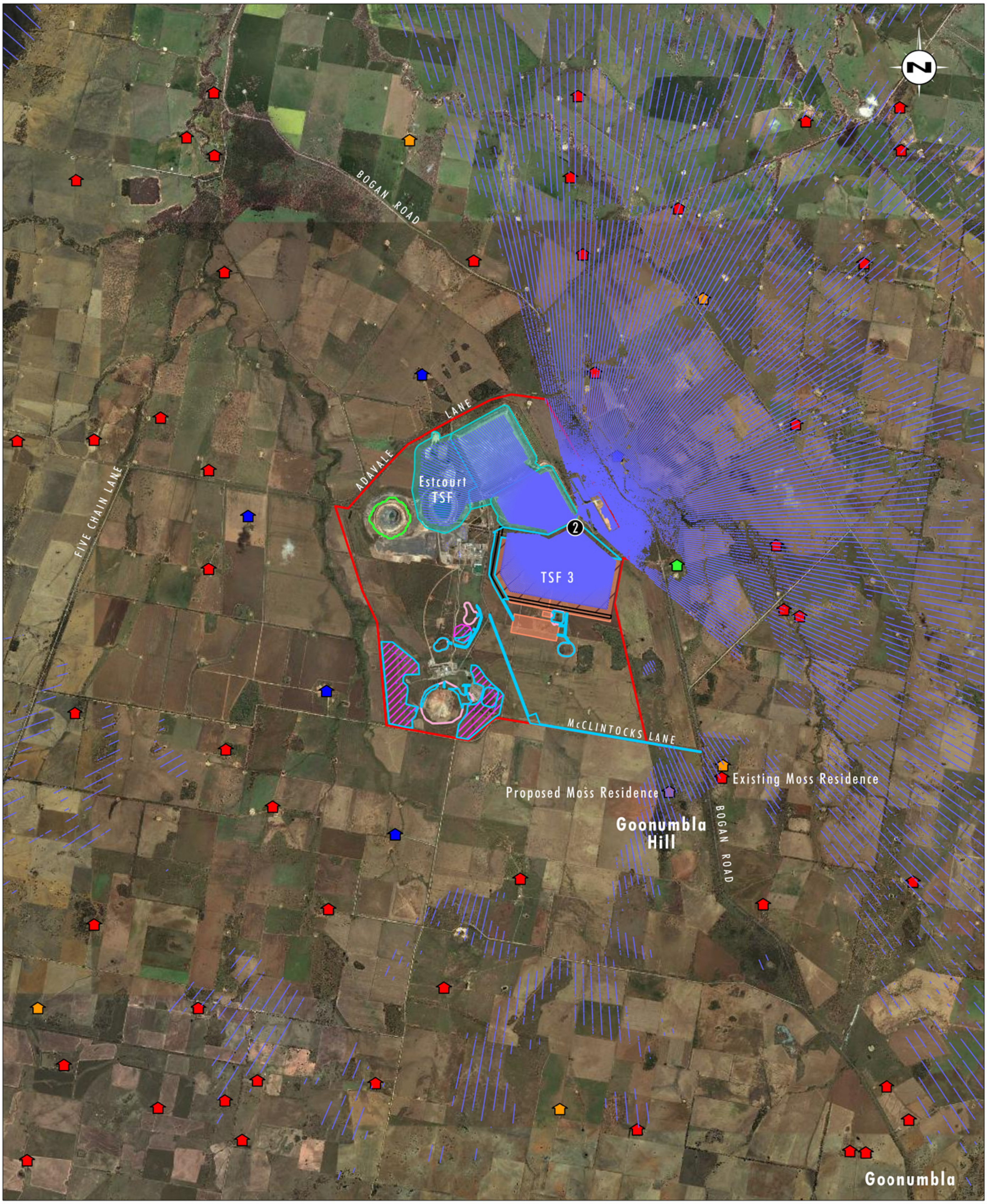
- Project Area
- Proposed Additional Disturbance Area
- Approved Tailings Storage Facility (Rosedale)
- Existing Tailings Storage Facility
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Waste Dumps
- Visual Assessment Location
- Visual Catchment-Approved Operations
- Visual Catchment-Proposed Operations
- Private Residence
- Mined Owned Residence
- Agreement Residence
- Derelict Residence
- Proposed Residence (Pending Development Aproval)

FIGURE 2.10

Existing and Proposed Landform Radial Analysis Location 1

File Name (A4): R16/2949_362.dgn
20130916 13.40

Umwelt
Environmental Consultants



Source: NPM (2013), Google Earth (2010)

0 1.0 2.5 5.0km
1:100 000

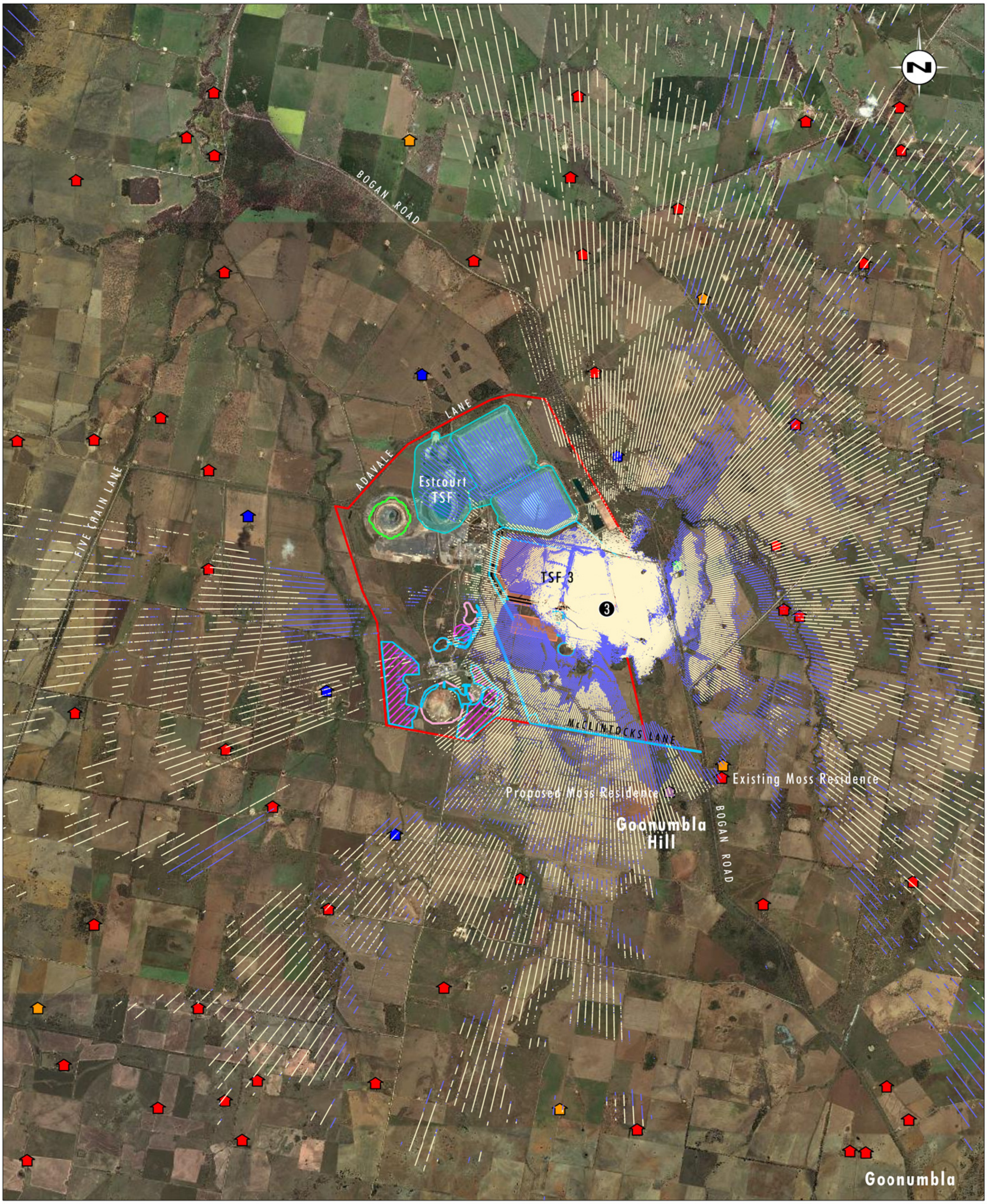
Legend

- Project Area
- Proposed Additional Disturbance Area
- Approved Tailings Storage Facility (Rosedale)
- Existing Tailings Storage Facility
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Waste Dumps
- Visual Assessment Location
- Visual Catchment-Proposed Operations
- Private Residence
- Mined Owned Residence
- Agreement Residence
- Derelict Residence
- Proposed Residence (Pending Development Aproval)

FIGURE 2.11

Proposed TSF 3 Extension Radial Analysis Location 2

File Name (A4): R16/2949_363.dgn
20130916 13.42



Source: NPM (2013), Google Earth (2010)

0 1.0 2.5 5.0km
1:100 000

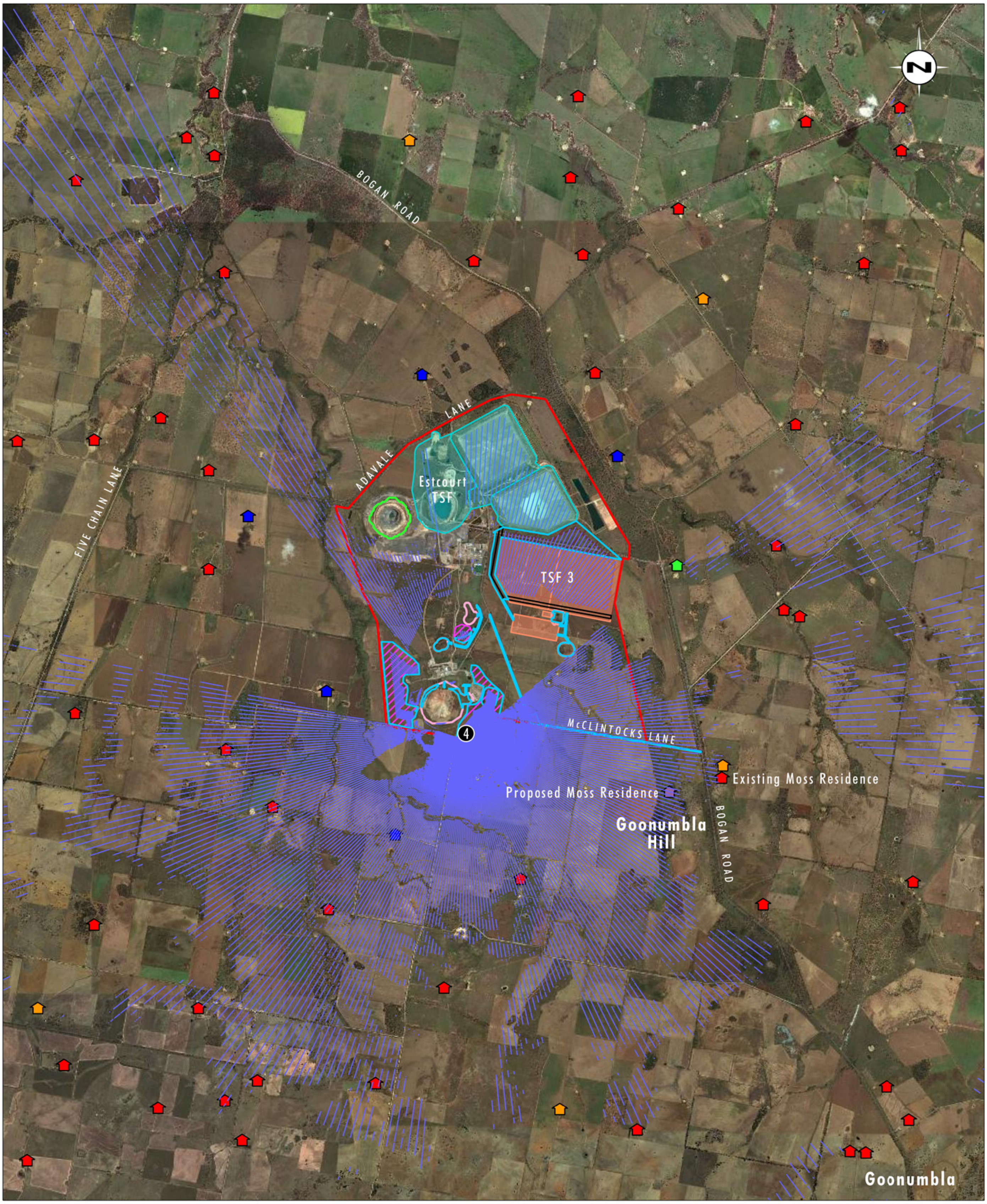
Legend

- Project Area
- Proposed Additional Disturbance Area
- Approved Tailings Storage Facility (Rosedale)
- Existing Tailings Storage Facility
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Waste Dumps
- Visual Assessment Location
- Visual Catchment-Approved Operations
- Visual Catchment-Proposed Operations
- Private Residence
- Mined Owned Residence
- Agreement Residence
- Derelict Residence
- Proposed Residence (Pending Development Aproval)

FIGURE 2.12

Existing and Proposed TSF 3 Radial Analysis Location 3

File Name (A4): R16/2949_364.dgn
20130916 13.43



Source: NPM (2013), Google Earth (2010)

0 1.0 2.5 5.0km

Legend

- Project Area
- Proposed Additional Disturbance Area
- Approved Tailings Storage Facility (Rosedale)
- Existing Tailings Storage Facility
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Waste Dumps
- Visual Assessment Location
- Visual Catchment-Proposed Operations
- Private Residence
- Mined Owned Residence
- Agreement Residence
- Derelict Residence
- Proposed Residence (Pending Development Aproval)

FIGURE 2.13

Proposed Waste Stockpile Radial Analysis Location 4

File Name (A4): R16/2949_365.dgn
20130916 13.44

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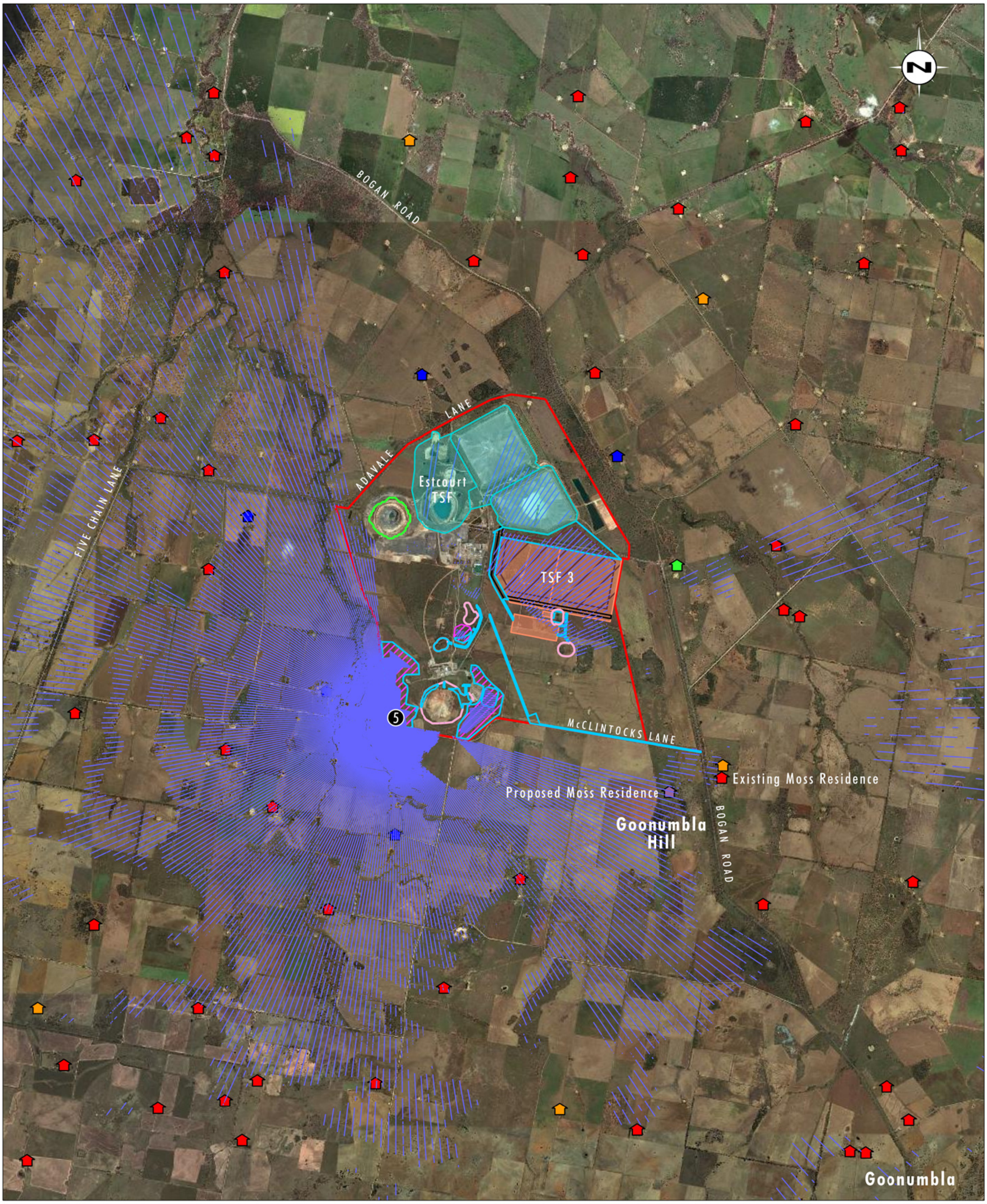

Source: NPM (2013), Google Earth (2010)

0 1.0 2.5 5.0km
1:100 000

Legend

- Project Area
- Proposed Additional Disturbance Area
- Approved Tailings Storage Facility (Rosedale)
- Existing Tailings Storage Facility
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Waste Dumps
- Visual Assessment Location
- Visual Catchment-Proposed Operations
- Private Residence
- Mined Owned Residence
- Agreement Residence
- Derelict Residence
- Proposed Residence (Pending Development Aproval)

FIGURE 2.14

Proposed Waste Dump Radial Analysis Location 5

File Name (A4): R16/2949_366.dgn
20130916 13.45

The proposed residence (PSC DA12020) at Lot 44 DP 753998, is likely to have views of Project related infrastructure, as shown in the revised radial analyses (**Figures 2.10** to **2.14**) and visual transects developed specifically from the mine site to the proposed dwelling (refer to **Figures 2.15** to **Figure 2.18**). These views are a result of the elevation for the proposed dwelling and the lack of vegetative screening between the proposed dwelling and NPM's operations. As per **Section 2.7.1**, NPM have lodged a submission on the DA12020.

As noted in Section 5.12.5 of the EA, NPM will commit to the following mitigation measures to mitigate the potential visual impacts from the project:

- maintenance of existing vegetation where possible for visual screening, including infill planting where necessary;
- additional screening plantings will be utilised in strategically located positions to augment existing plantings and limit views into the Project from public roads, in particular McClintock's Lane;
- continued establishment of revegetation corridors outside the active mine area through ongoing land management practices;
- ensuring that areas of disturbance are kept to the minimum practicable at any one point in time;
- rehabilitation of disturbed areas is undertaken as soon as practical; and
- aiming to minimise night lighting impacts on surrounding land owners and road users by ensuring, where practicable, that lighting plants are positioned such that light is directed towards work areas and not towards private residences and roads.

The Moss submission additionally makes specific reference to visual impacts associated with upgrades to the Bogan Road/McClintocks Lane intersection, please refer to **Section 2.7.2.5** for comment on this matter.

2.7.2.4 Impacts of the Project on Water Bores

As part of the EA for the Project a comprehensive Groundwater Impact Assessment (GIA) was prepared by Golder Associates (refer to Appendix 10 of the EA). The GIA indicated predicted drawdown impacts associated with the Project would be generally confined to Northparkes owned land and bores, with no private bores located within the modelled 1 metre drawdown. Refer to Figure 34b of **Appendix 1** for Figure 34 of the Groundwater Assessment, (inadvertently not included in the GIA as exhibited) which demonstrates that groundwater drawdown are not predicted to impact private bores. Accordingly, it is predicted that the Project will not result in any adverse impacts to groundwater bores which support the Moss's farming operations.

2.7.2.5 Upgraded McClintocks Lane Intersection

The submission made by Annette Moss, property owner 'Hillview' (refer to **Figure 2.7**) raises a number of issues with respect to the Project's amended access arrangement; specifically McClintock's Lane replacing Northparkes Lane as the mine sites principal access to Bogan Road. NPM has committed through Section 6.11.1 of the EA for the intersection to be:

> 'designed in accordance with appropriate guidelines and standards and finalised in consultation with PSC and local landholders/neighbours as appropriate.'

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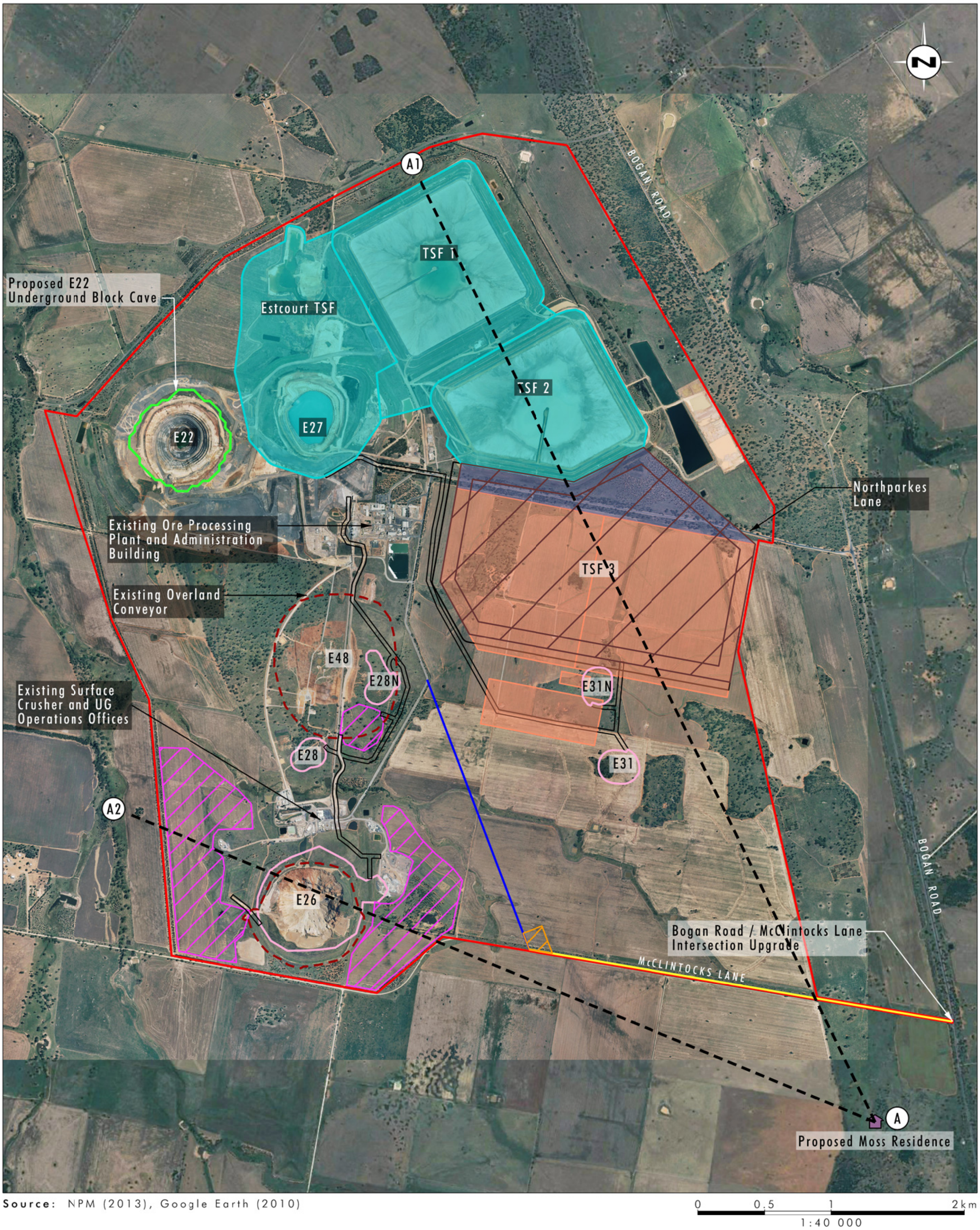


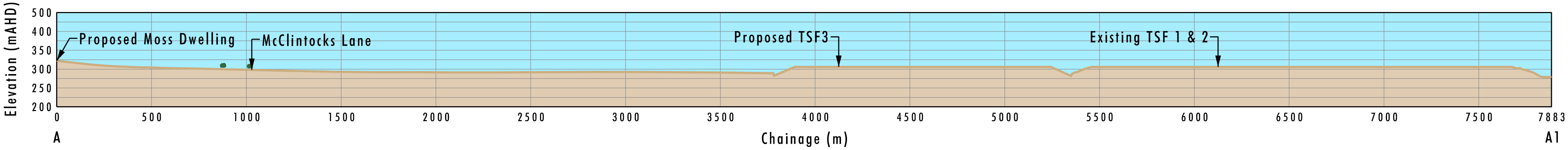
Legend

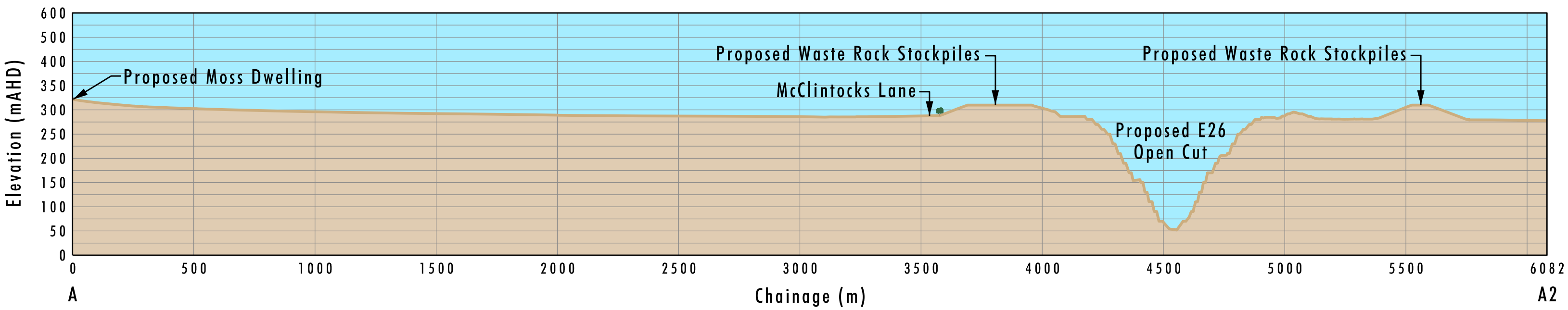
- Project Area
- Approved Tailings Storage Facility (Rosedale)
- Approved Subsidence Management Areas
- Existing Tailings Storage Facility
- Proposed Tailings Storage Facility Extension
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Upgrade to McClintocks Lane
- Proposed Access Control and Visitor Car Park
- Proposed Waste Dumps
- Proposed Site Access Road
- Proposed Haul Road
- Transect Location

FIGURE 2.15

Conceptual Visual Transect Locations from Proposed Moss Residence

File Name (A4): R16/2949_367.dgn
20130916 13.46





0 250 500 750m
Vertical Scale 1:15 000

0 0.5 1.0 1.5km
Horizontal Scale 1:30 000

FIGURE 2.16

Conceptual Visual Transects from Proposed Moss Residence to NPM Operations

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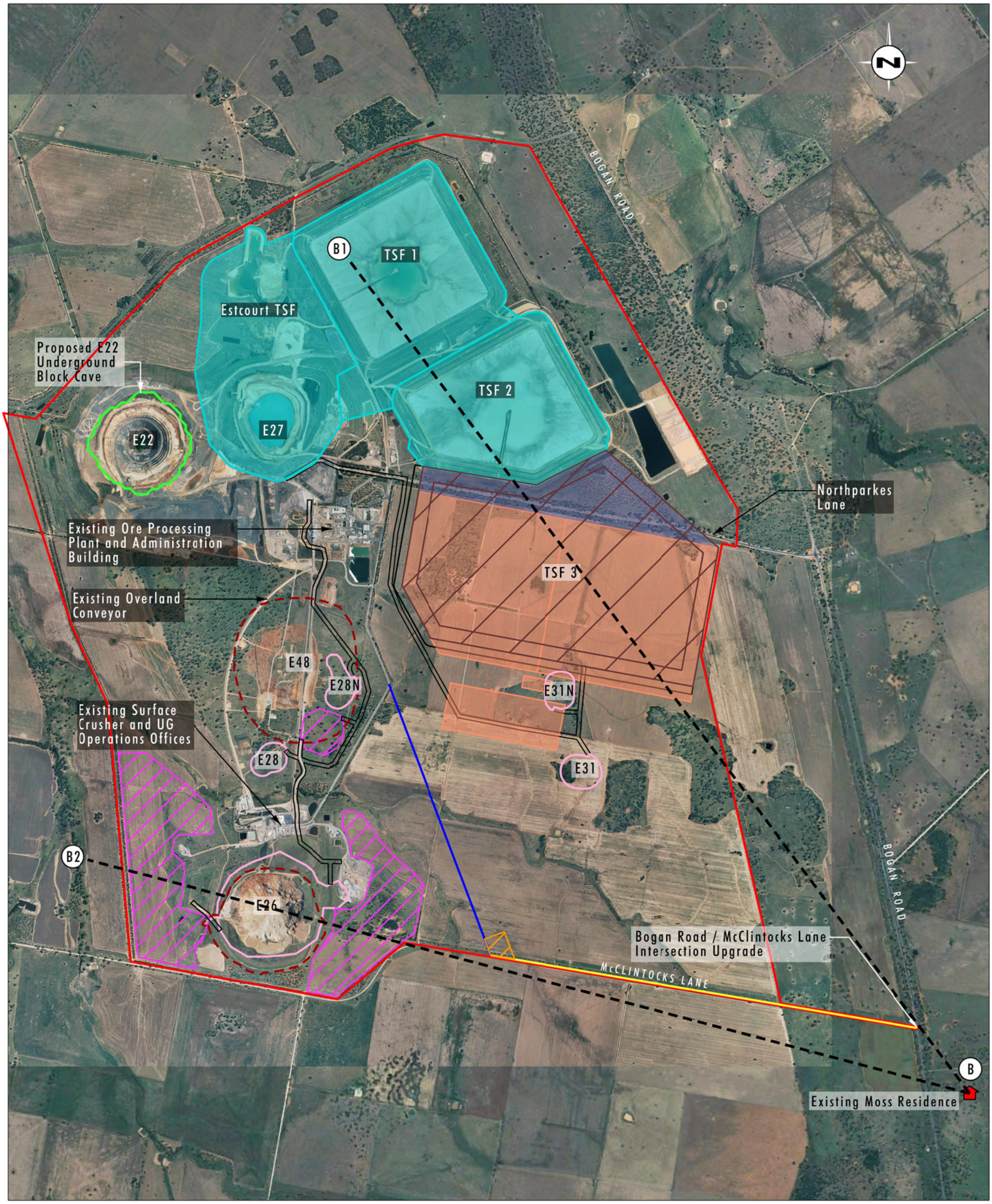


Source: NPM (2013), Google Earth (2010)

Legend

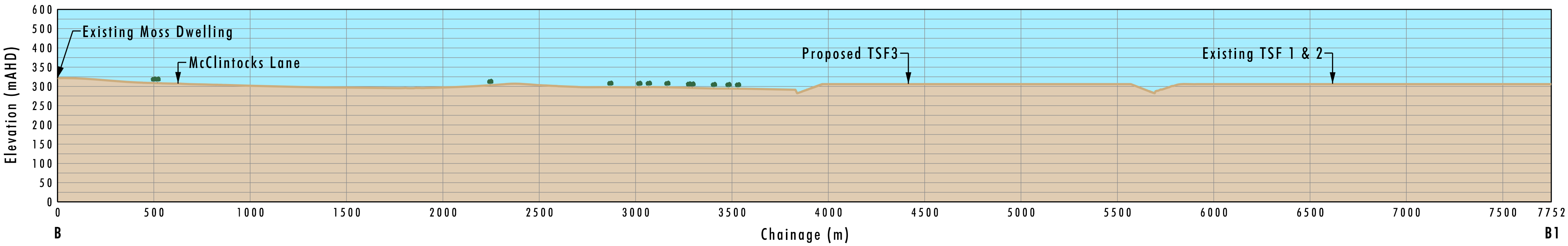
- Project Area
- Approved Tailings Storage Facility (Rosedale)
- Approved Subsidence Management Areas
- Existing Tailings Storage Facility
- Proposed Tailings Storage Facility Extension
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Upgrade to McClintocks Lane
- Proposed Access Control and Visitor Car Park
- Proposed Waste Dumps
- Proposed Site Access Road
- Proposed Haul Road
- Transect Location

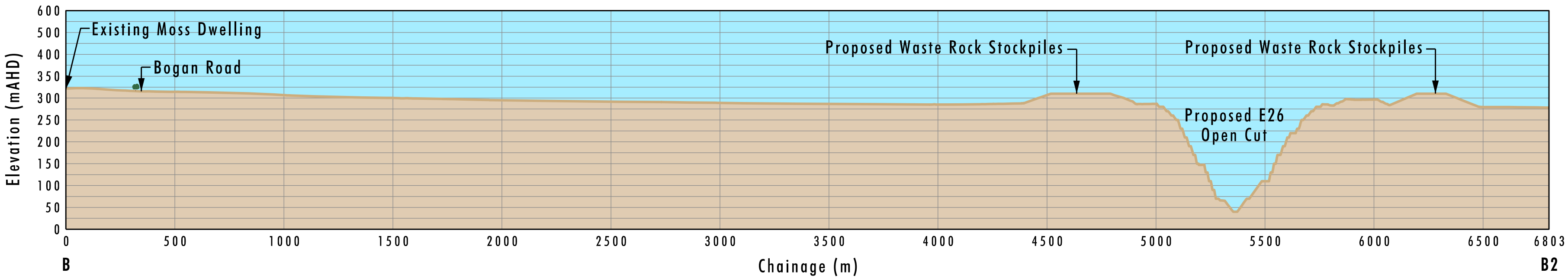
FIGURE 2.17

Conceptual Visual Transect Locations from Existing Moss Residence

File Name (A4): R16/2949_369.dgn
20130916 13.48

Umwelt
Environmental Consultants





0 250 500 750m
Vertical Scale 1:15 000

0 0.5 1.0 1.5km
Horizontal Scale 1:30 000

FIGURE 2.18

Conceptual Visual Transects from Existing Moss Residence to NPM Operations

File Name (A4): R16/2949_370.dgn
20130916 13.50

The specific issues with respect to the upgrade of the intersection raised in the Moss Submission are specifically addressed below.

Traffic Noise

'We are concerned that traffic accessing/exiting the mine being moved from Northparkes Lane to McClintocks Lane will affect our quiet rural home, Vehicles (particularly heavy vehicles) slowing down to turn into McClintocks Lane, and vehicles accelerating out of McClintocks Lane will increase noise in the locale'

As part of the EA, a comprehensive Noise Impact Assessment (NIA) has been prepared by Umwelt (Australia) Pty Limited (included as Appendix 7 to the EA). The NIA considered road noise impacts associated with traffic movements generated by the Project on Bogan Road and McClintocks Lane. In the EA, the road traffic noise impacts were modelled using the US Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5. TNM is a highway traffic noise prediction and analysis model used to analyse highway geometries including vehicle speeds, vehicle type, setback distances and the effectiveness of barriers.

Due to the issues raised in relation to road traffic noise by Annette Moss (Hillview Property, 1966 Bogan Road), specific assessment of road traffic noise has been conducted in relation to the property identified as Receiver 10 - Walma Hillview and the proposed (but not approved) residential property on Lot 44 DP753998. The further assessment has used an ENM (Environmental Noise Model) noise model in addition to the TNM (U.S. Department of Transportation 2004) to predict the noise impacts of accelerating and decelerating vehicles entering and exiting an upgraded McClintocks Lane/ Bogan Road intersection. The ENM noise model is a computer-based modelling package that can be used to analyse 'non-steady state' road traffic noise. The ENM noise model incorporates road traffic sound power levels, the location and activity of road traffic noise sources, a digital terrain map of the region surrounding the Project and prevailing meteorological conditions of the area. The ENM noise model takes into account the different noise characteristics of vehicles driven at speed on Bogan Road and McClintocks Lane as well as braking and accelerating when vehicles enter and leave Bogan Road at McClintocks Lane.

Three residences, Receiver 10 – Walma Hillview to the east of Bogan Road, Receiver 12 – Coradgery to the south of McClintocks Lane and the proposed Moss Residence also to the south of McClintocks Lane have the potential to be impacted by the changed traffic volumes along McClintocks Lane. Receiver 10 – Walma Hillview is set back approximately 170 metres from Bogan Road, Receiver 12 - Coradgery is setback approximately 3.5 kilometres from Bogan Road and 2.5 kilometres from McClintocks Lane and the proposed Moss Residence is setback approximately 680 metres from Bogan Road and 740 metres from McClintocks Lane

Traffic volume information collected in 2012 for existing operations as a part of the Traffic Impact Assessment (Appendix 12 to the EA) has been used as the basis for the road traffic noise assessment. The assumptions used for the purpose of the road traffic noise impact assessment are outlined in Section 4.4 of the NIA (attached as Appendix 7 to the EA).

<u>Road Traffic Noise Criteria</u>

The relevant criteria for road traffic noise assessment for the amended site access arrangement is set out in the NSW Road Noise Policy (DECCW 2011) which is specifically considered in Section 3.6 of the NIA (attached as Appendix 7 to the EA).

The proposed Moss residence at Lot 44 DP753998 has been specifically considered in respect of Appendix C10 of the NSW Road Noise Policy (DECCW 2011), which outlines night-time noise limits in accordance with the Infrastructure SEPP (Department of Planning NSW 2007) for new residential developments affected by noise from existing roads. In the instance of this proposed development, the provisions of the Infrastructure SEPP do not apply as they relate only to residential developments near specific highly trafficked roads listed in the supporting guidelines (Department of Planning 2008) and neither Bogan Road nor McClintocks Lane are listed in these guidelines. Therefore the relevant noise criteria for new residential developments surrounding the Project are the same as for existing residences as outlined in Section 3.6 of the NIA (attached as Appendix 7 to the EA).

Road Traffic Noise Predictions

The ENM noise model (amended modelling as described above) has predicted noise levels lower than those predicted by the TNM (assessment methodology applied to road traffic noise in the EA's NIA). Lower predictions as evidenced by the ENM model are not unexpected. The TNM model, as used in the NIA of the EA, was conservatively applied and the ENM noise model is able to consider a number of additional specific variables including, the differing road traffic noise characteristics based on vehicle type and activity, barrier effects of the surrounding terrain and the prevailing meteorological conditions. The road traffic noise impacts predicted by the TNM (U.S. Department of Transportation 2004) are presented below in Table 2.6 and represent a conservative estimate of the worst-case road traffic noise impacts.

Table 2.6 – Predicted Day and Night Road Traffic Noise Levels, dB(A)

Receiver	**Period** [1]	**Predicted LAeq, 1hour**			**Assessment Criteria** [2]
		Bogan Road	McClintocks Lane	Cumulative	
Receiver 10 – Walma Hillview	Peak AM	48	<30	48	55
	Peak PM	40	<30	40	50
Receiver 12 – Coradgery	Peak AM	<30	<30	<30	55
	Peak PM	<30	<30	<30	50
Proposed Moss Residence	Peak AM	35	33	37	55
	Peak PM	32	31	34	50

Note 1: Where 'Peak AM' represents worst case for day (7.00 am – 10.00 pm) and 'Peak PM' represents worst case for night (10.00 pm – 7.00 am)
Note 2: Criteria for new and existing residences affected by noise from redevelopment of existing local roads

The results presented in **Table 2.6** indicate the predicted road traffic noise levels from light and heavy vehicles travelling to or from NPM via McClintocks Lane do not exceed the day time and the night time road traffic noise criteria outlined in the NSW Road Noise Policy (DECC 2011) and as presented in Section 4.4 of the NIA.

2.7.2.6 Vehicle Lights Impacting Property

'Vehicles accelerating out of McClintocks Lane ...will impact on us as well as lights shining into our property'

A buffer distance of approximately 600 metres is provided between the Moss property and the proposed McClintocks Lane/Bogan Road intersection upgrade. This buffer distance includes the significant quantities of established vegetation within the Bogan Road TSR, which provides a barrier to mitigate impacts associated with lights shining into the moss property.

As committed to in the Traffic and Transport Project Commitments (Section 6.11.1 of the EA):

> '...upgrades to McClintocks Lane and its intersection with Bogan Road ... will... be designed in accordance with appropriate guidelines and standards and finalised in conjunction with Parkes Shire Council and local landholders/neighbours as appropriate.'

Additionally NPM have a well established driver awareness program, as a means to reduce the potential for traffic light impacts on the Moss property, the driver awareness program will include advice to staff that when turning right from McClintocks Lane onto Bogan Road that the 'Low beam' function of their vehicle lights should be used.

2.7.2.7 Interaction with School Bus and Road Safety

'The change of this intersection also increases the danger of my children getting on and off the school bus at our entrance as well as us turning into our property 250 m before McClintocks Lane.'

As stated in the Road Traffic Management Commitments (Section 6.11.1 of the EA) NPM will work with both Council and surrounding landholders on the design of the proposed intersection to ensure, as far as practicable, safety outcomes are maximised. Furthermore, NPM is committed to ongoing employee awareness program, whereby roads safety is a significant focus; with this awareness program to be maintained under the Project.

2.7.2.8 Movement of Stock along Bogan Road and McClintocks Lane

'We are concerned how we will continue to move stock across the Bogan Road to our paddocks down McClintocks Lane in very busy traffic'

Under the *Rural Lands Protection Act 1998*, a permit is required for stock to walk along a road or TSR. This permitting process prescribes the management mechanism required to manage interaction between the stock and other road users. It is anticipated that a permit (obtained from local Livestock Health Pest Authorities) will continue to be applied for future movement of stock along the road or TSR. Additionally, NPM will continue to work with its neighbours, as far as practicable, to facilitate the movement of stock along neighbouring roads and TSR's. NPM encourages its neighbours to contact NPM, when moving stock along roads in the vicinity of the mine site, to allow the instigation of staff awareness to minimise mine related traffic during periods when stock will be on the roads.

3.0 References

Australian and New Zealand Environmental Council (ANZECC). (1990). *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

Department of Environment and Climate Change (DECC). (2011). *NSW Road Noise Policy*.

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OEH, NSW Office of Environment and Heritage, (2013). *Vegetation Types Database – internet resource*. http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm. Accessed 27 August 2013.

U.S. Department of Transportation. (2004). *US Federal Highway Administration Traffic Noise Model Version 2.5 Look-Up Tables*.

Umwelt (Australia) Pty Limited (Umwelt). (2013). *Surface Water Assessment: Northparkes Mines Step Change Project*

APPENDIX 1

Golder Associates: Northparkes Step Change Project –
Response to Review Comments

TECHNICAL MEMORANDUM

DATE 18 September 2013 **PROJECT No.** 117626007-023-REV1

TO Barbara Crossley, Elliot Holland

CC

FROM Scott Dinkelman / Dr Detlef Bringemeier **EMAIL** sdinkelman@golder.com.au

NORTHPARKES STEP CHANGE PROJECT – RESPONSES TO REVIEW COMMENTS

1.0 INTRODUCTION

Umwelt (Australia) Pty Ltd has requested that Golder Associates Pty Ltd (Golder) provide response to review comments from the New South Wales (NSW) Department of Primary Industries (NSW DPI) and the NSW Environmental Protection Authority (NSW EPA) regarding the Northparkes Mine (NPM) Step Change project (the Project).

The original deliverable for this project was issued as a final report, Groundwater Impact Assessment (GWIA) dated July 2013 (Reference Number 117626007-007-Rev1) (the GWIA Report).

The comments in the NSW DPI review letter dated 21 August 2013 (Reference Number OUT13/23681) and in the NSW EPA review letter dated 20 August 2013 (Reference Number LIC07/80-12) are presented in bold italic in Section 2.0. Our response follows the comments.

2.0 RESPONSES TO REVIEW COMMENTS OF NSW DEPARTMENT OF PRIMARY INDUSTRIES, ATTACHMENT A

Our responses to review comments in the NSW DPI review letter dated 21 August 2013 (Reference Number OUT13/23681) are presented below.

2.1 Item 2(i)

2(i) The estimated groundwater inflows detailed in Table C8 of Appendix C to the Groundwater Assessment have defined the water take from the Lachlan Fold Belt Groundwater Source for all existing and proposed operations at North Parkes Mine (NPM) until 2032. This indicates the current water take is 292 ML/yr (0.8ML/d) and this is to increase to a maximum take of 766ML/yr (2.1ML/d) in 2026. It needs to be recognised that the maximum peak inflow of 5ML/d in 2026 was ignored for the analysis. NPM currently hold an entitlement of 232 unit shares in the Lachlan Fold Belt Groundwater Source. Additional entitlement therefore needs to be purchased to account for existing annual water take in addition to the predicted maximum water take. A breakdown of groundwater inflows based on each mining area is requested to further define the water take requirements.

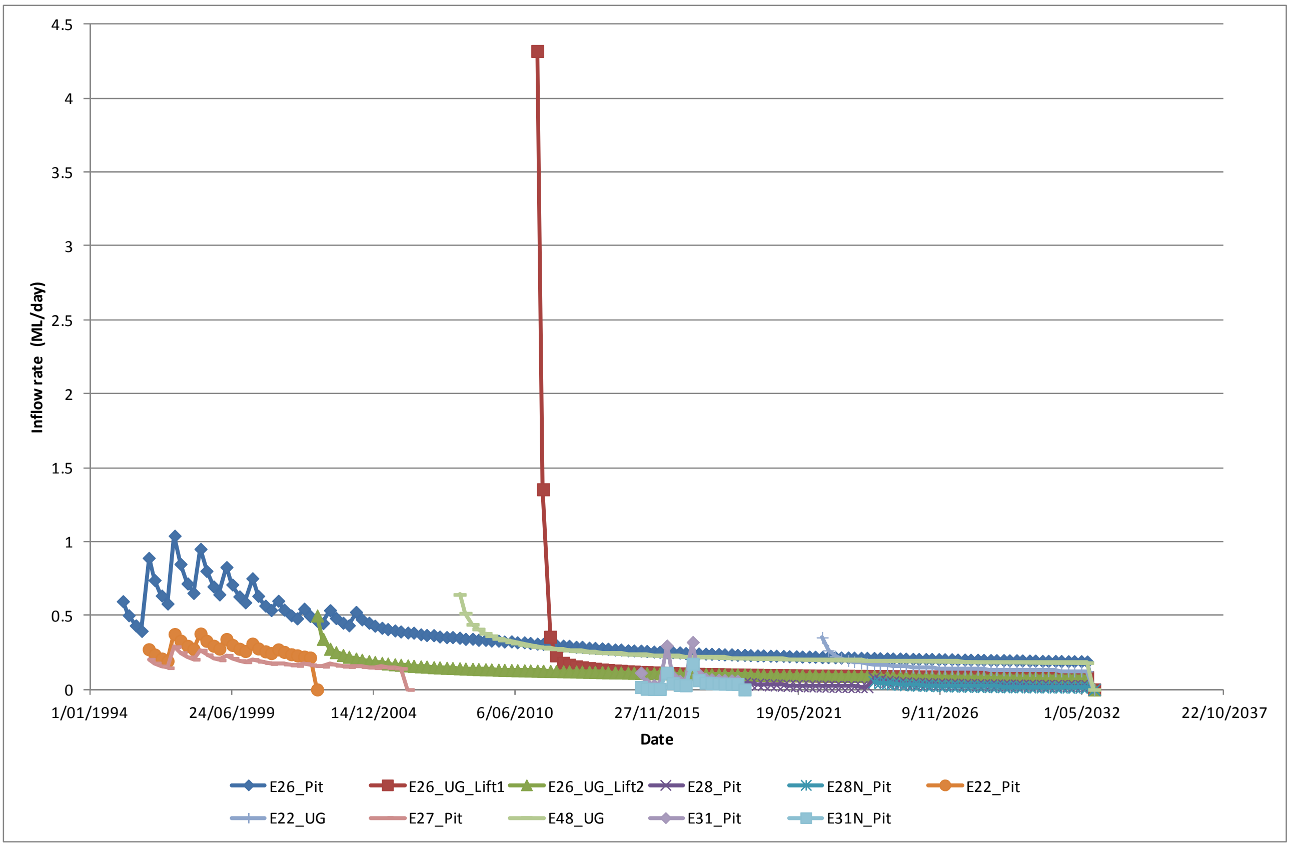
There were word processing errors in the column ‘Model Time’ entry in Table C8 of the Report and we have revised this table. The maximum simulated peak inflow indicated in Table C8 is projected to have occurred in 2011 and not 2026.

Golder has reviewed the groundwater model and the maximum simulated peak inflow indicated in Table C8 is projected to have occurred in 2011 as indicated in Figure C10 and the revised Table C8 (see table below). The simulated total inflows and a breakdown of groundwater inflows for each mining area are presented in Table C8.

For the groundwater model it has been assumed that groundwater heads in the mining areas are lowered instantly to the terminal depth (pit/mining lift bottom elevation) at the onset of pit /mining lift development. In reality, the groundwater heads are lowered gradually during pit/ mining lift development. The effect of the computed rapid groundwater drawdown at the start of the mining is that the simulated hydraulic gradients between the surrounding area and the pit/ mining lift are an order of magnitude higher than the actual hydraulic gradients. As a result, the simulated inflow rates at the start of the pit/ mining lift development are an order of magnitude higher than the actual inflow rates. Therefore, the simulated peak groundwater inflow rate to E26 Lift 1, of approximately 4.3 ML/day in April 2011 (refer to the revised Table C8 below), is a model artefact and higher than the actual inflow rate to E26 Lift 1. Our experience is that the actual peak inflow rate is expected to be two to three times higher than the steady- state inflow rates. This suggests that maximum inflow rate associated with E26 Lift 1 is between 1ML/day and 2ML/day.

Golder has retrieved a breakdown of groundwater inflows based on each mining area and present the model results in the revised Table C8. The inflow rates (ML/day) into the Pits (E22, E26, E27, E28, E28N, E31, E31N), E22 (underground), E48 (underground), E26 Lift 1, and E26 Lift 2 are shown in Figure C10.

The volume of water taken as a result of mining activities (including the dewatering from open pits and the inflow volumes to the mine) was modelled prior to project approval (please refer to the GWIA Report) and it is recommended that NPM will measure and report actual flow rates in annual returns or environmental management reports.



Notes: The model simulated peak inflow rate to E22 Lift 1 of 4.3 ML/day in April 2011 is an artefact of the modelling. The modelled peak inflow rate to E26 Lift 1 during the initial stages of development is reasonably estimated between 1 ML/day and 2 ML/day. For the remainder of the operation period, the modelled inflow rate to E26 Lift 1 is projected to be less than 0.3 ML/day for most of the time

Figure C10: Modelled inflows to each mining area *(± 20%)*.

Revised Table C8: Simulated total inflows to the Mine and inflows to each mining area *(± 20%)*.

Model Time		Total Model Inflows	E26	E22	E27	E26 Lift 2	E48 UG	E26 Lift 1	E31	E31N	E28	E22 UG	E28N
days	dd/mm/yy	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d
465	11/04/95	0.6	0.60										
548	3/07/95	0.5	0.50										
648	11/10/95	0.4	0.43										
731	1/01/96	0.4	0.40										
831	10/04/96	1.4	0.89	0.27	0.20								
914	2/07/96	1.2	0.74	0.24	0.18								
1014	10/10/96	1.0	0.64	0.21	0.16								
1096	1/01/97	0.9	0.58	0.19	0.15								
1196	11/04/97	1.7	1.04	0.38	0.29								
1279	2/07/97	1.4	0.85	0.33	0.25								
1379	10/10/97	1.2	0.72	0.30	0.22								
1462	1/01/98	1.1	0.65	0.27	0.20								
1562	11/04/98	1.6	0.95	0.38	0.27								
1644	3/07/98	1.4	0.80	0.33	0.24								
1744	11/10/98	1.2	0.70	0.30	0.21								
1827	2/01/99	1.1	0.64	0.28	0.20								
1927	12/04/99	1.4	0.83	0.34	0.23								
2010	3/07/99	1.2	0.71	0.30	0.21								
2110	11/10/99	1.1	0.63	0.28	0.20								
2192	2/01/00	1.0	0.59	0.26	0.19								
2292	11/04/00	1.3	0.75	0.31	0.20								
2375	3/07/00	1.1	0.63	0.28	0.19								
2475	11/10/00	1.0	0.57	0.26	0.18								
2558	1/01/01	1.0	0.54	0.25	0.18								
2658	11/04/01	1.1	0.60	0.27	0.18								
2741	3/07/01	1.0	0.54	0.25	0.17								
2841	11/10/01	0.9	0.50	0.24	0.17								
2923	2/01/02	0.9	0.48	0.23	0.16								
3023	12/04/02	0.9	0.55	0.22	0.18								
3106	3/07/02	0.9	0.50	0.22	0.17								
3206	11/10/02	1.1	0.46	0.00	0.16	0.50							
3289	2/01/03	0.9	0.45		0.16	0.34							
3389	12/04/03	1.0	0.54		0.17	0.27							
3471	4/07/03	0.9	0.48		0.16	0.25							
3571	12/10/03	0.8	0.45		0.16	0.23							
3654	3/01/04	0.8	0.43		0.15	0.22							
3754	12/04/04	0.9	0.52		0.16	0.21							
3837	3/07/04	0.8	0.47		0.15	0.20							
3937	11/10/04	0.8	0.45		0.15	0.19							
4019	2/01/05	0.8	0.43		0.15	0.19							
4119	12/04/05	0.7	0.42		0.15	0.18							
4202	4/07/05	0.7	0.41		0.15	0.18							
4302	12/10/05	0.7	0.40		0.15	0.17							
4385	2/01/06	0.7	0.39		0.14	0.17							
4485	12/04/06	0.5	0.39		0.00	0.16							
4568	4/07/06	0.5	0.38			0.16							
4668	12/10/06	0.5	0.37			0.16							
4750	3/01/07	0.5	0.37			0.15							
4850	13/04/07	0.5	0.37			0.15							
4933	4/07/07	0.5	0.36			0.15							

Model Time		Total Model Inflows	E26	E22	E27	E26 Lift 2	E48 UG	E26 Lift 1	E31	E31N	E28	E22 UG	E28N
days	dd/mm/yy	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d
5033	12/10/07	0.5	0.35			0.15							
5116	3/01/08	0.5	0.35			0.14							
5216	12/04/08	1.1	0.35			0.14	0.64						
5298	4/07/08	1.0	0.34			0.14	0.52						
5398	12/10/08	0.9	0.34			0.14	0.44						
5481	3/01/09	0.9	0.34			0.14	0.41						
5581	13/04/09	0.9	0.34			0.14	0.38						
5664	4/07/09	0.8	0.33			0.13	0.36						
5764	12/10/09	0.8	0.33			0.13	0.35						
5846	3/01/10	0.8	0.32			0.13	0.33						
5946	13/04/10	0.8	0.33			0.13	0.32						
6029	5/07/10	0.8	0.32			0.13	0.31						
6129	13/10/10	0.8	0.32			0.13	0.30						
6212	3/01/11	0.7	0.31			0.13	0.30						
6312	13/04/11	5.0	0.31			0.13	0.29	4.32					
6395	5/07/11	2.1	0.31			0.13	0.29	1.35					
6495	13/10/11	1.1	0.31			0.12	0.28	0.36					
6577	4/01/12	0.9	0.30			0.12	0.28	0.23					
6677	13/04/12	0.9	0.30			0.12	0.27	0.18					
6760	4/07/12	0.8	0.30			0.12	0.27	0.17					
6860	12/10/12	0.8	0.29			0.12	0.26	0.16					
6943	3/01/13	0.8	0.29			0.12	0.26	0.15					
7043	13/04/13	0.8	0.28			0.12	0.26	0.14					
7125	5/07/13	0.8	0.28			0.12	0.25	0.14					
7225	13/10/13	0.8	0.28			0.12	0.25	0.13					
7308	4/01/14	0.8	0.28			0.12	0.25	0.13					
7408	14/04/14	0.8	0.27			0.12	0.24	0.13					
7491	5/07/14	0.8	0.27			0.11	0.24	0.13					
7591	13/10/14	0.7	0.27			0.11	0.24	0.12					
7673	4/01/15	0.7	0.26			0.11	0.24	0.12					
7773	14/04/15	0.9	0.26			0.11	0.24	0.12	0.11	0.02			
7856	6/07/15	0.8	0.26			0.11	0.23	0.12	0.04	0.00			
7956	14/10/15	0.7	0.26			0.11	0.23	0.11	0.03	0.00			
8039	4/01/16	0.7	0.26			0.11	0.23	0.11	0.03	0.00			
8139	13/04/16	1.1	0.25			0.11	0.23	0.11	0.30	0.11			
8222	5/07/16	0.8	0.25			0.11	0.23	0.11	0.09	0.04			
8322	13/10/16	0.8	0.25			0.11	0.22	0.11	0.06	0.03			
8404	4/01/17	0.8	0.25			0.11	0.22	0.11	0.05	0.03			
8504	14/04/17	1.2	0.25			0.11	0.22	0.11	0.32	0.17			
8587	5/07/17	0.8	0.24			0.10	0.22	0.11	0.10	0.06			
8687	13/10/17	0.8	0.24			0.10	0.22	0.10	0.07	0.05			
8770	4/01/18	0.8	0.24			0.10	0.22	0.10	0.07	0.04			
8870	14/04/18	0.8	0.24			0.10	0.22	0.10	0.07	0.04			
8952	6/07/18	0.8	0.24			0.10	0.22	0.10	0.06	0.04			
9052	14/10/18	0.8	0.24			0.10	0.21	0.10	0.06	0.04			
9135	5/01/19	0.7	0.23			0.10	0.21	0.10	0.06	0.04			
9235	15/04/19	0.7	0.23			0.10	0.21	0.10	0.00	0.00	0.04		
9318	6/07/19	0.7	0.23			0.10	0.21	0.10			0.04		
9418	14/10/19	0.7	0.23			0.10	0.21	0.10			0.04		
9500	5/01/20	0.7	0.23			0.10	0.21	0.10			0.03		
9600	14/04/20	0.7	0.23			0.10	0.21	0.10			0.03		
9683	6/07/20	0.7	0.23			0.10	0.21	0.10			0.03		

Model Time		Total Model Inflows	E26	E22	E27	E26 Lift 2	E48 UG	E26 Lift 1	E31	E31N	E28	E22 UG	E28N
days	dd/mm/yy	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d	ML/d
9783	14/10/20	0.7	0.23			0.10	0.21	0.10			0.03		
9866	4/01/21	0.6	0.23			0.10	0.21	0.10			0.03		
9966	14/04/21	0.6	0.22			0.10	0.20	0.10			0.03		
10049	6/07/21	0.6	0.22			0.10	0.20	0.09			0.03		
10149	14/10/21	0.6	0.22			0.10	0.20	0.09			0.02		
10231	5/01/22	0.6	0.22			0.09	0.20	0.09			0.02		
10331	15/04/22	1.0	0.22			0.09	0.20	0.09			0.02	0.35	
10414	6/07/22	0.9	0.22			0.09	0.20	0.09			0.02	0.26	
10514	14/10/22	0.8	0.22			0.09	0.20	0.09			0.02	0.23	
10597	5/01/23	0.8	0.22			0.09	0.20	0.09			0.02	0.21	
10697	15/04/23	0.8	0.22			0.09	0.20	0.09			0.02	0.20	
10779	7/07/23	0.8	0.22			0.09	0.20	0.09			0.02	0.19	
10879	15/10/23	0.8	0.21			0.09	0.20	0.09			0.02	0.18	
10962	6/01/24	0.8	0.21			0.09	0.20	0.09			0.02	0.18	
11062	15/04/24	0.9	0.21			0.09	0.20	0.09			0.08	0.17	0.05
11145	6/07/24	0.9	0.21			0.09	0.20	0.09			0.06	0.17	0.05
11245	14/10/24	0.8	0.21			0.09	0.19	0.09			0.06	0.16	0.04
11327	5/01/25	0.8	0.21			0.09	0.19	0.09			0.05	0.16	0.04
11427	15/04/25	0.8	0.21			0.09	0.19	0.09			0.05	0.16	0.03
11510	7/07/25	0.8	0.21			0.09	0.19	0.09			0.04	0.15	0.03
11610	15/10/25	0.8	0.21			0.09	0.19	0.09			0.04	0.15	0.03
11693	5/01/26	0.8	0.21			0.09	0.19	0.09			0.04	0.15	0.03
11793	15/04/26	0.8	0.21			0.09	0.19	0.09			0.04	0.15	0.03
11876	7/07/26	0.8	0.21			0.09	0.19	0.09			0.04	0.15	0.03
11976	15/10/26	0.8	0.21			0.09	0.19	0.09			0.04	0.14	0.03
12058	6/01/27	0.8	0.20			0.09	0.19	0.09			0.04	0.14	0.02
12158	16/04/27	0.8	0.20			0.09	0.19	0.09			0.04	0.14	0.02
12241	7/07/27	0.8	0.20			0.09	0.19	0.09			0.03	0.14	0.02
12341	15/10/27	0.8	0.20			0.09	0.19	0.09			0.03	0.14	0.02
12424	6/01/28	0.8	0.20			0.09	0.19	0.09			0.03	0.14	0.02
12524	15/04/28	0.7	0.20			0.09	0.19	0.09			0.03	0.14	0.02
12606	7/07/28	0.7	0.20			0.09	0.19	0.09			0.03	0.14	0.02
12706	15/10/28	0.7	0.20			0.09	0.19	0.09			0.03	0.13	0.02
12789	6/01/29	0.7	0.20			0.09	0.19	0.09			0.03	0.13	0.02
12889	16/04/29	0.7	0.20			0.08	0.19	0.09			0.03	0.13	0.02
12972	7/07/29	0.7	0.20			0.08	0.19	0.09			0.03	0.13	0.02
13072	15/10/29	0.7	0.20			0.08	0.19	0.09			0.03	0.13	0.02
13154	6/01/30	0.7	0.20			0.08	0.19	0.08			0.03	0.13	0.02
13254	16/04/30	0.7	0.20			0.08	0.18	0.08			0.03	0.13	0.02
13337	8/07/30	0.7	0.20			0.08	0.18	0.08			0.03	0.13	0.02
13437	16/10/30	0.7	0.19			0.08	0.18	0.08			0.03	0.13	0.02
13520	6/01/31	0.7	0.19			0.08	0.18	0.08			0.03	0.13	0.02
13620	16/04/31	0.7	0.19			0.08	0.18	0.08			0.03	0.13	0.02
13703	8/07/31	0.7	0.19			0.08	0.18	0.08			0.03	0.13	0.02
13803	16/10/31	0.7	0.19			0.08	0.18	0.08			0.03	0.13	0.02
13885	7/01/32	0.7	0.19			0.08	0.18	0.08			0.03	0.12	0.02
13985	16/04/32	0.7	0.19			0.08	0.18	0.08			0.03	0.12	0.02
14068	7/07/32	0.7	0.19			0.08	0.18	0.08			0.03	0.12	0.02

2.2 Item 2(ii)

2(ii) The groundwater modelling had not assessed the groundwater take after mine closure. During this period it is recognised groundwater will enter the voids as they fill and water take will continue when an equilibrium is reached due to evaporation. The NSW Office of Water requests predictions of water take during the mine closure period and cross-sections to represent the water table levels in relation to the mine operations

Golder used computed water levels from the original model in this response.

Although the groundwater model has not been set up to specifically calculate post-mining inflow rates to the mining areas and does not include a pit water balance or evaporation losses, the post-mining groundwater inflow rates are expected to be less than the inflow rates at mine closure. The model simulated inflow rates to mining areas at mine closure are presented in Table C8b below:

Table C8b: Inflow rates - Mine closure stage

Mining area	Inflow rate at mine closure (ML/day)
E26 Pit	0.19
E26 Lift 1	0.08
E26 Lift 2	0.08
E28 Pit	0.03
E28N Pit	0.02
E22 Pit	0.22
E22 Lift 1	0.12
E27 Pit	0.14
E48 Lift 1	0.18
E31 Pit	0.06
E31N	0.04

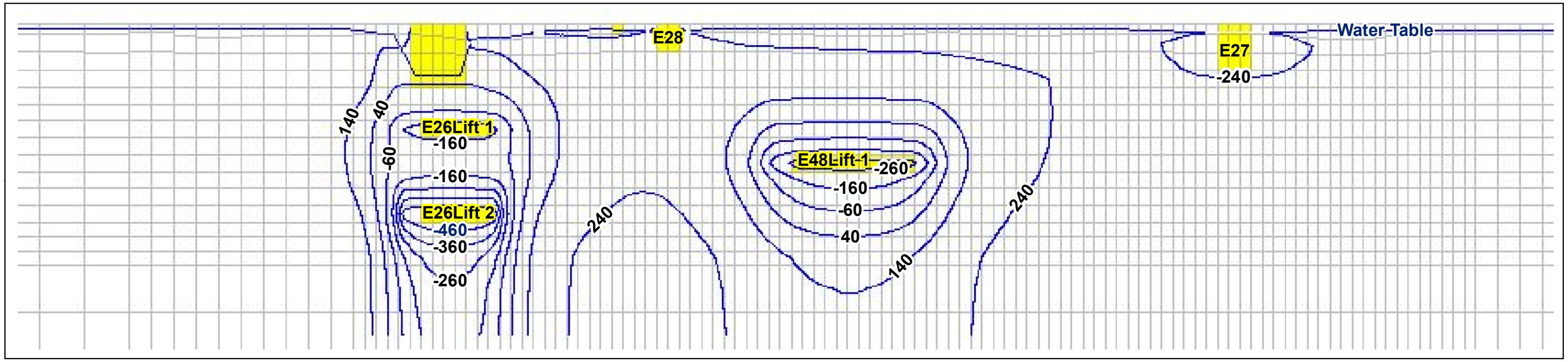
Golder has prepared new cross sections taken along Column 59 of the model. The model cross sections (Figure C6b) show the water table and hydraulic head contours (in mAHD) for Year 2032 and Year 2079.

- Year 2032 was selected because, in the modelling, it has been assumed that all the mining operations remain dewatered until 2032.
- Year 2079 represents the end of the simulated period.

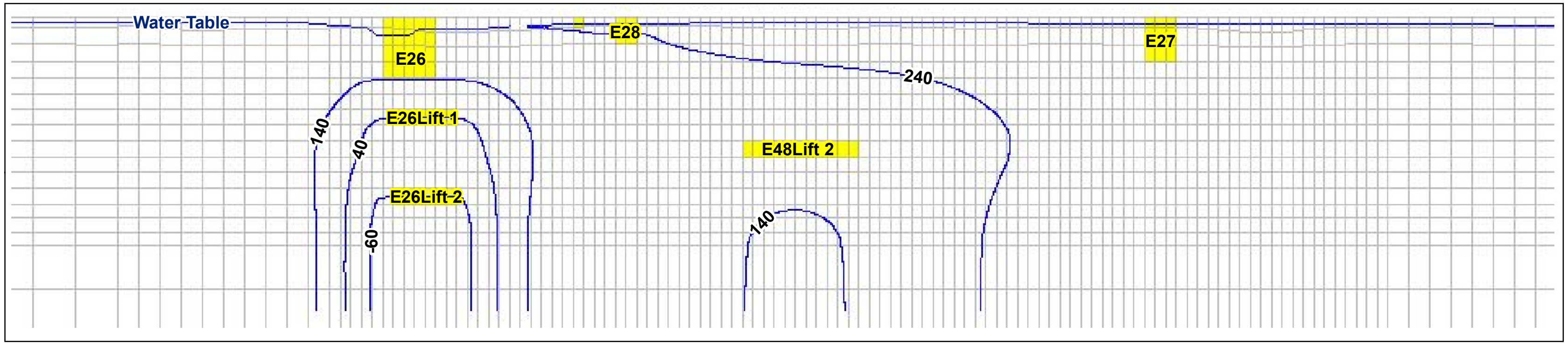
Figure C6b indicates that by the year 2079:

- The groundwater table in the E26 Open Pit area would have recovered to within approximately 80% of the pre-mining level.
- Unsaturated groundwater conditions would still occur in the area immediately surrounding the E26 Lift 2 workings. In 2079, the hydraulic gradient is expected to decrease towards the level of the E26 Lift 2 workings. Therefore, it is expected that groundwater would discharge towards the voids.
- Groundwater flow is also expected to be directed towards the E48 Lift 1 workings.
- The groundwater table at Open Pit E27 and Open Pit E28 is projected to have recovered to pre-mining levels.

YEAR 2032



YEAR 2079



NORTHPARKES MINE GWIA

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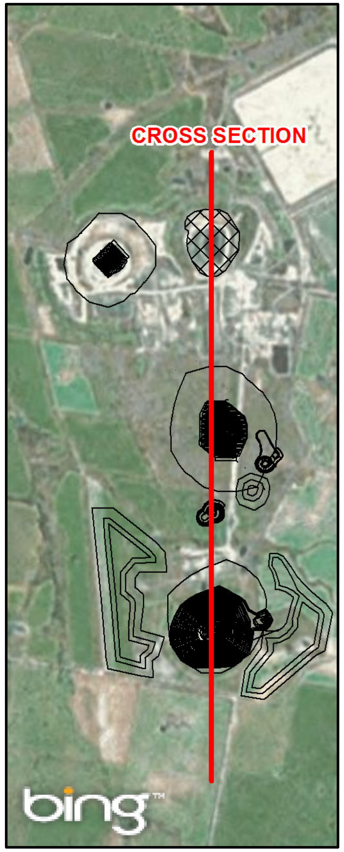
MODEL CROSS SECTIONS



NOTES

Model cross sections show the water table and hydraulic head contours (in mAHD) for year 2032 & year 2079

PROJECT: **117626007**
DATE: **09 SEP 2013**
DRAWN: **SL**
CHECKED: **SD**

FIGURE C6b

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2.3 Item 3(i)

3(i) The EA has not directly addressed the Aquifer Interface Policy minimal impact considerations. It is requested the proponent clarify that there will not be a drawdown in the water table or pressure head of greater than the cumulative 2 m at any water supply work. Based on the maximum predicted groundwater drawdown extent the EA has indicated no private groundwater users are affected. This requires further justification as requested in the next section on groundwater modelling.

The closest private groundwater bore is GW002860. Based on the maximum computed groundwater drawdown extent, this bore is not within the 2m-drawdown zone. Based on the modelled results, there will not be a drawdown in the water table or pressure head of greater than the cumulative 2 m at any existing private bores.

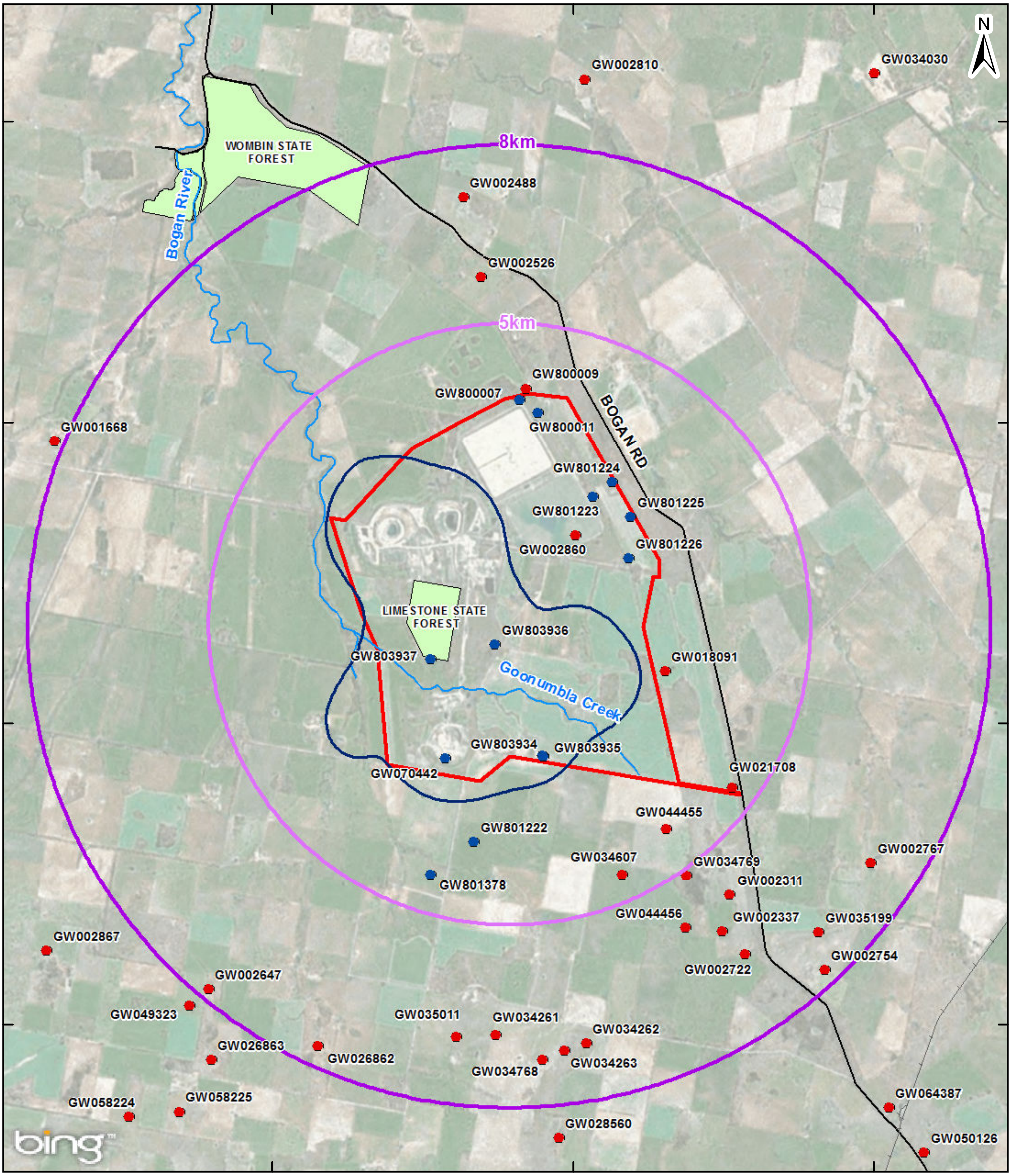
The modelled drawdown cone is predicted to be at its maximum extent in 2032 because the dewatering of the mining areas is assumed to extend to this year. Figure 34b shows the contours of 2 m predicted drawdown for Year 2032 in Layer 2 (Bedrock Saprock). Locations of registered groundwater users within the 8 km radius search area are also shown in this figure.

Golder recommends that a monitoring program be implemented with groundwater level and water quality monitoring data analysed to identify potential impact of dewatering on aquifers. Expanded monitoring should be triggered if monitoring of the existing monitoring network suggested a significant variation from modelling results.

Refinement and calibration of the groundwater model may be carried out using the acquired monitoring data (i.e. one year's monitoring data after the commencement of the proposed Project) if required.

NPM acknowledged the need for continued and enhanced groundwater monitoring. As indicated in the EA, NPM has committed to the following additional groundwater monitoring and management measures in addition to the continuation of the existing groundwater monitoring program.

- The extent of dewatering, impacts on current users and future resources will be monitored throughout the life of the Project in accordance with a revised groundwater monitoring program.
- Monitor dewatering volumes to verify that volumes are within licenced allocations.
- Trigger levels, regarding declines in groundwater levels and the degradation of groundwater quality, will be reviewed to manage the potential impacts as part of updated monitoring program. Where monitoring results indicate levels in excess of the trigger values, an investigation appropriate for the situation will be conducted to assess the need to implement management/mitigation/remedial measures.
- The existing water monitoring program will be updated for the Project in accordance with relevant Project Approval requirements.



NORTHPARKES MINE GWIA

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REGISTERED BORE LOCATIONS IN PROXIMITY TO MINE PLAN AND MODELLED DRAWDOWN

NOTES

The model projected 2m-drawdown contour data for Layer 2, Year 2032. In 2032 the drawdown cone is projected to be at its maximum extent.

LEGEND

- Railroad
- Main Road
- Watercourse
- 2m Drawdown Layer 2 (model result of 2032)
- Project Area
- 5km Radius
- 8km Radius

Registered Bores

- Mines
- Private

0 1 2 3 km

SCALE (at A4) 1:90,000

Coordinate System: GDA 1994 MGA Zone 55

PROJECT:	117626007
DATE:	11/09/2013
DRAWN:	SL
CHECKED:	SD

FIGURE 34b

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2.4 Item 3(iv)

3(iv) Section 5.14.2 of the main EA indicates the subsidence monitoring is to use groundwater modelling to determine whether the voids will act as groundwater sinks or sources and the potential impacts. As these are potential project impacts, these should be assessed prior to determination and to include confirmation of predicted final groundwater levels and water quality.

The groundwater voids are predicted to act as groundwater sinks during the mining and post-mining period (see groundwater cross-sections (Figure C6b) provided in response to item 2(ii)) (Section 2.2 of this memo). The simulated hydraulic gradients decrease towards the mine voids.

Surface subsidence is a planned long-term outcome of NPM operations. The groundwater impact in relation to the surface subsidence would be localised to the mine operation areas. It is envisaged that the anticipated zone of subsidence will be confined to the locations of underground workings and within the Project Area boundaries. Given the low hydraulic conductivity and low flow rates within the aquifers, it is not anticipated that subsidence will detrimentally impact the regional groundwater flow regime.

The assessment of Acid Rock Drainage (ARD) and Control has been carried out at NPM (Ryan (NPM), 2003; Rio Tinto, 2011). The assessment results indicated that there is no significant risk in relation to ARD and the ARD is unlikely to have adversely impact on regional groundwater quality.

As described in the GWIA Report, a key risk is related oxidising of the caved waste rocks that subsidised (Rio Tinto, 2011). The block caves at closure will be filled with a large mass of weakly mineralised waste rock rubble. The rubble in the crater created by block cave mining and the rocks at the surface of other mine workings, including drifts, contains sulphur minerals that will be exposed to oxygen and water. The mine dewatering can created a zone of groundwater drawdown and exposure of mineralisation in the halo aquifer to oxygen. The oxidation products will enter the groundwater when the groundwater flows into these areas and solubilise the oxidation products. This impact may cause elevated TDS, sulphate and metal/metalloid concentrations at neutral pH in groundwater. However, results of the ARD assessment indicated that the rock has a considerable amount of neutralising capacity.

Throughout the life of the operation NPM has conducted testing programs to characterise the nature of the soil and rock material generated by mining, the geochemical work undertaken to date indicates that ARD does not pose a high risk at NPM (Ryan, 2003). No potential for ARD development from the open cut and tailings disposal areas have been identified. The geochemical characterisation of waste rocks is in progress at the mine, and management will derive from the results of these studies. Conservative management approaches will continue to be utilised for all material identified as having potential geochemical concerns.

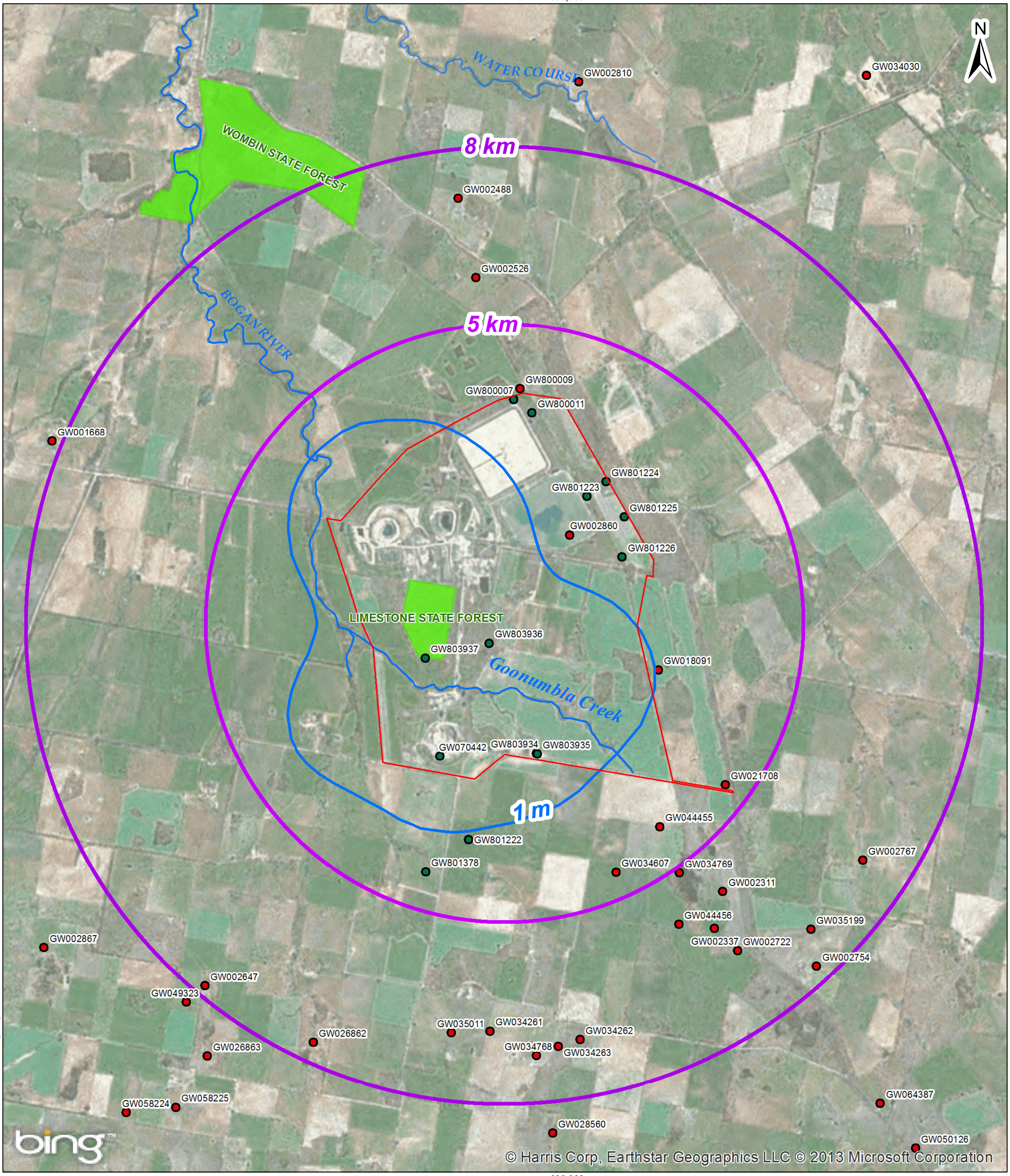
As indicated in the EA, NPM has committed to the following groundwater monitoring and management measures:

"Trigger levels, regarding declines in groundwater levels and the degradation of groundwater quality, will be reviewed to manage the potential impacts as part of updated monitoring program. Where monitoring results indicate levels in excess of the trigger values, an investigation appropriate for the situation will be conducted to assess the need to implement management/mitigation/remedial measures."

2.5 Item 3(v)

3(v) Figure 34 referred to in Section 6.3.4 of the Groundwater Assessment (Appendix 10) could not be identified.

Figure 34 was omitted from our report due to a copying error. A copy is attached.



NORTHPARKES MINE GWA

UMWELT (AUSTRALIA) PTY. LTD.

REGISTERED BORES LOCATIONS IN PROXIMITY TO MINE PLAN AND MODELLED DRAWDOWN

LEGEND

- Study Area
- Project Area
- Five km Radius
- Eight km Radius
- 1m Drawdown (model result of 2013)
- River
- State Forest

Registered Bores

OWNER

- Mines
- Private

NOTES

0 0.45 0.9 1.8 2.7 Kilometers

SCALE (at A4) 1:90,000

Coordinate System: GDA 1994 MGA Zone 55

PROJECT:	117626007
DATE:	30/04/2013
DRAWN:	RS
CHECKED:	MN

FIGURE 34

Golder Associates

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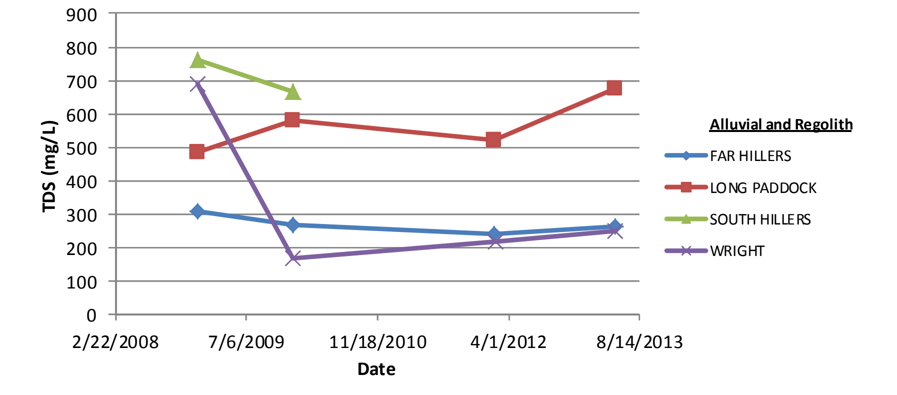
2.6 Item 3(vi)

3(vi) Section 6.4.3 of the Groundwater Assessment indicates the potential for oxidation to occur following dewatering with resultant increased levels of TDS and metals in the groundwater system. The changes to water quality however have not been quantified hence it is requested these impacts be further assessed. Further to this it is requested a description be provided of the baseline water quality at the site including a graphical presentation of historical analyte concentration change with time (including a minimum of TDS, As, Pb and Zn). It is requested the graphs include sites in the vicinity of existing open pits/underground activities and existing/proposed tailing facilities.

The baseline water quality is presented in Attachment A.
As requested, graphs of TDS, As, Pb and Zn have been prepared to present the changes of analyte concentrations with time (refer to Figures 16d to 16g) using data from 2009 to 2013 of NPM monitoring site at the Mine. The spatial distribution of groundwater quality for regional and mine monitoring sites are shown in Figures 16b and 16c in Section 3.7.

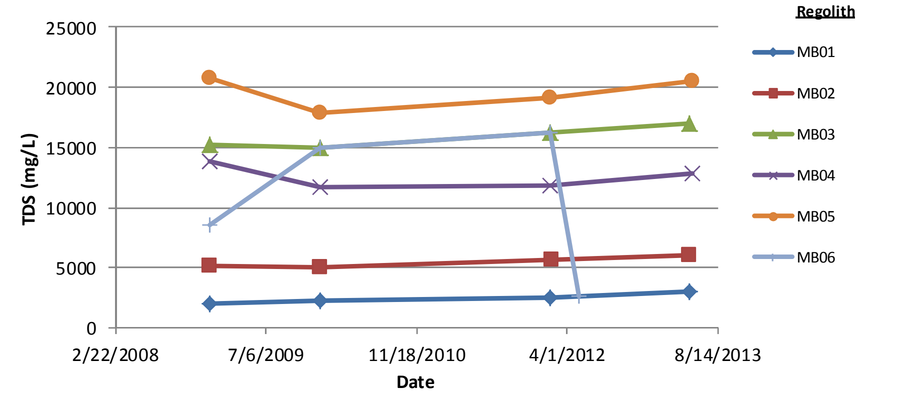
NPM monitoring bores (Alluvial and Regolith)

Far Hillers, Long Paddock, South Hillers, Wright: located upgradient from the Mine site and outside the Project Area.

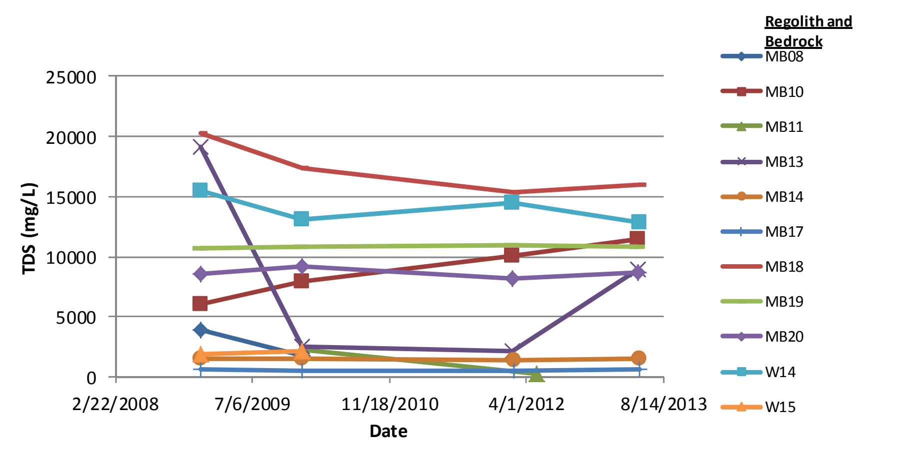


NPM monitoring bores (Regolith)

MB01 to MB06: surrounding the current TSFs (TSF1 and TSF2)



NPM monitoring bores (Regolith and Bedrock)
W14: west of TSF2
W15: located between E22 Pit and E27 Pit
MB08: west of TSF1
MB10, MB11: north of E22 Pit and E27 Pit
MB13: located between Bogan River and southwest of E22 Pit
MB14: west of PTSF3
MB17:southwest of PTSF3
MB18: south of E48 Pit
MB19, MB20: east of E26 Pit



NPM monitoring bores (Bedrock)

P102, P103, P104, P145: located upgradient from the Mine site and outside the Project Area
P071, P139: south of E26 Pit
P149: north of E26 Pit
P100: south of E48 Pit
W16, W17: south of E27 Pit

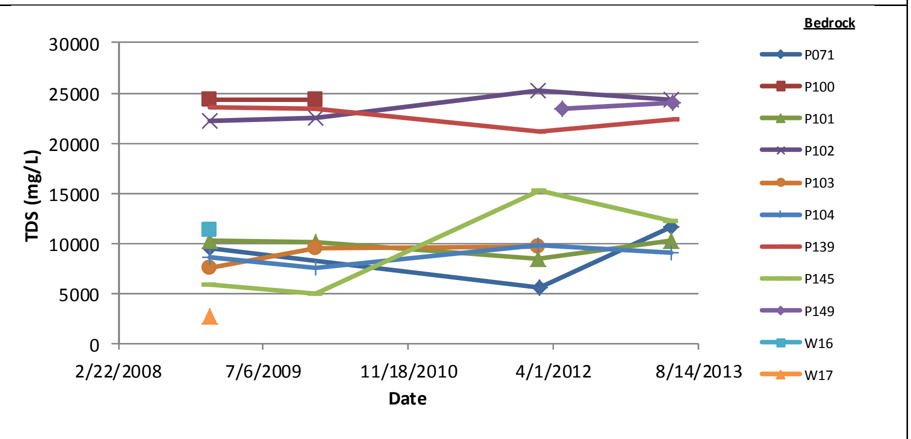
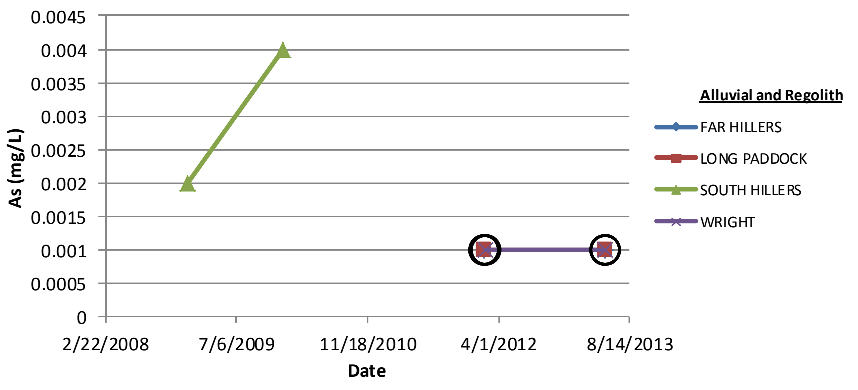
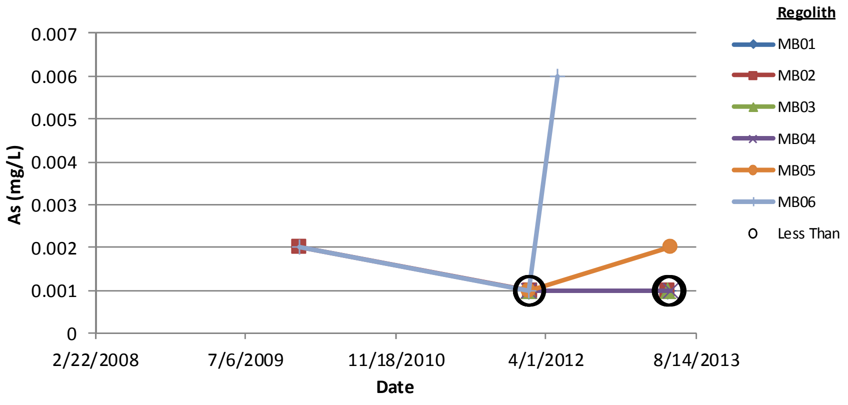


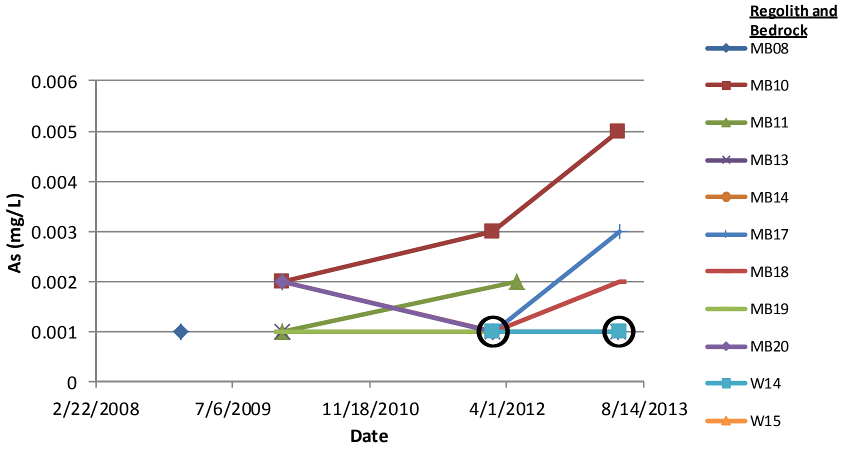
Figure 16d: Groundwater Quality data (During Mining) - Temporal variations of TDS

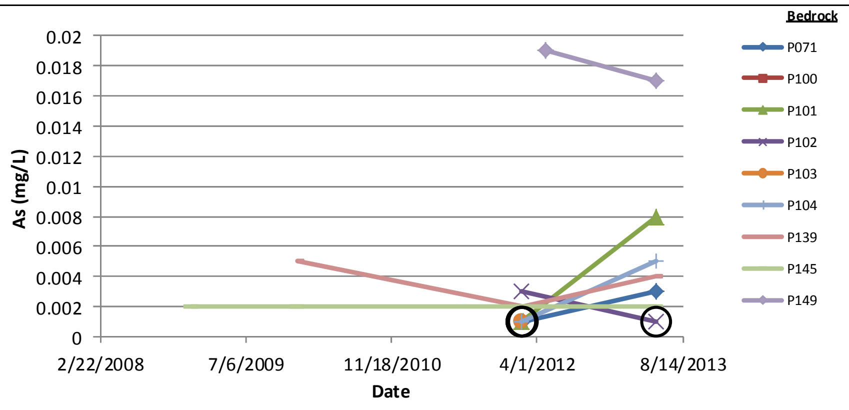
During Mining Groundwater Quality Data

Arsenic (As)









Notes:

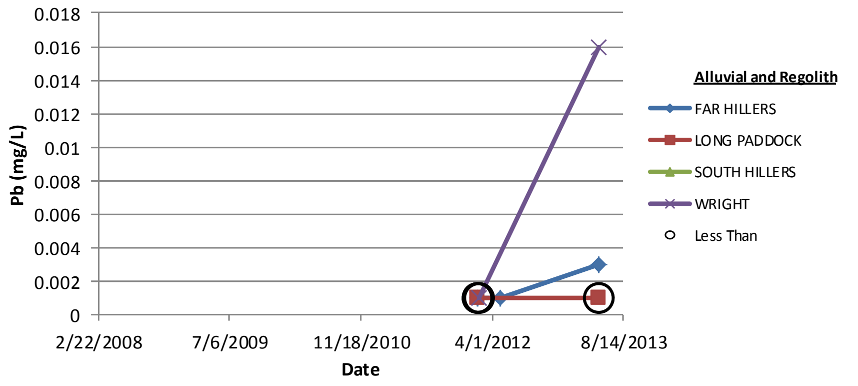
Refer to Figure 16c and Figure 16d for bore information and locations

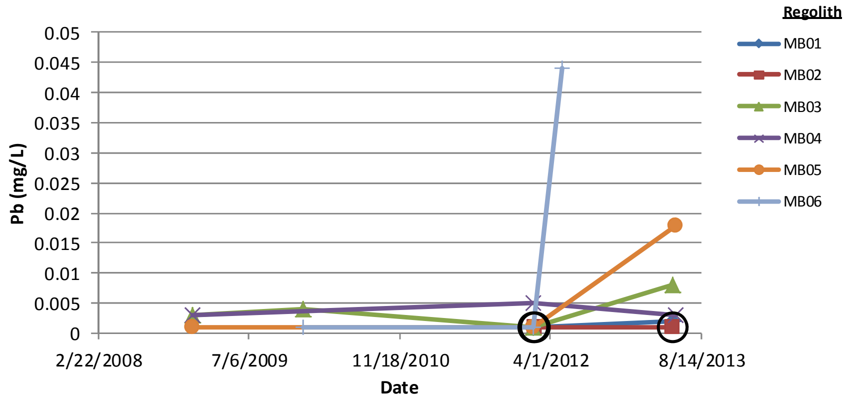
Data points outlined with a black circle, indicates concentration values reported as less than the respective concentration value in the graph, e.g. <0.001mg/L is represented as 0.001mg/L in the graphs.

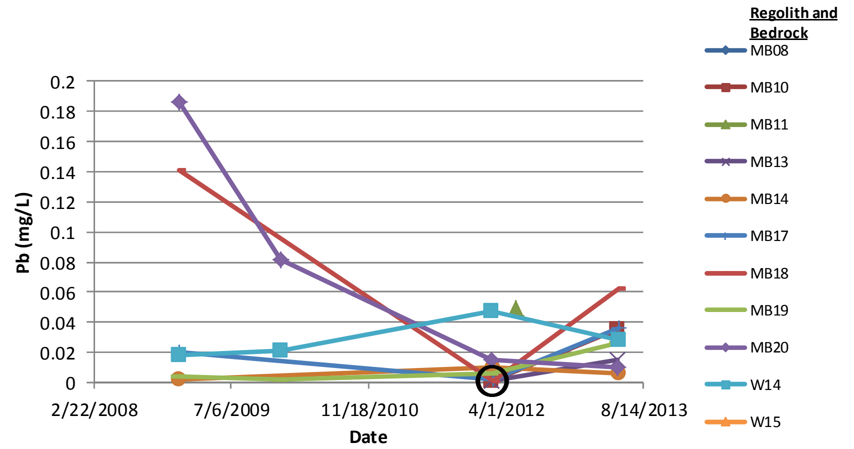
Figure 16e: Groundwater Quality data (During Mining) - Temporal variation of Arsenic (As)

During Mining Groundwater Quality Data

Lead (Pb)







Notes:

Refer to Figure 16c and Figure 16d for bore information and locations

Data points outlined with a black circle, indicates concentration values reported as less than the respective concentration value in the graph, e.g. <0.001mg/L is represented as 0.001mg/L in the graphs.

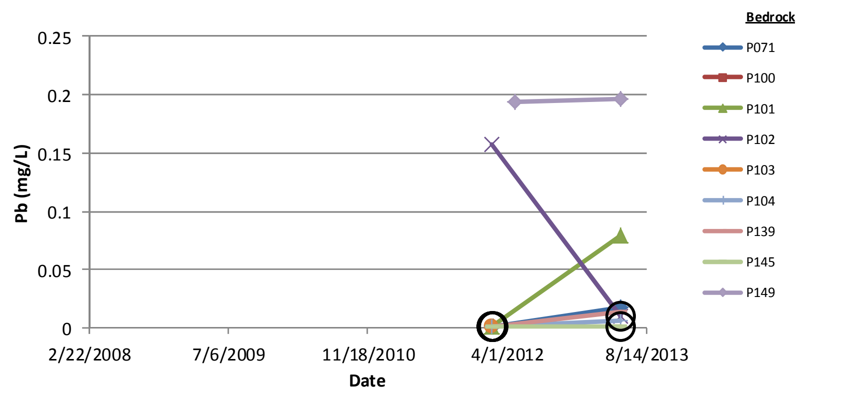
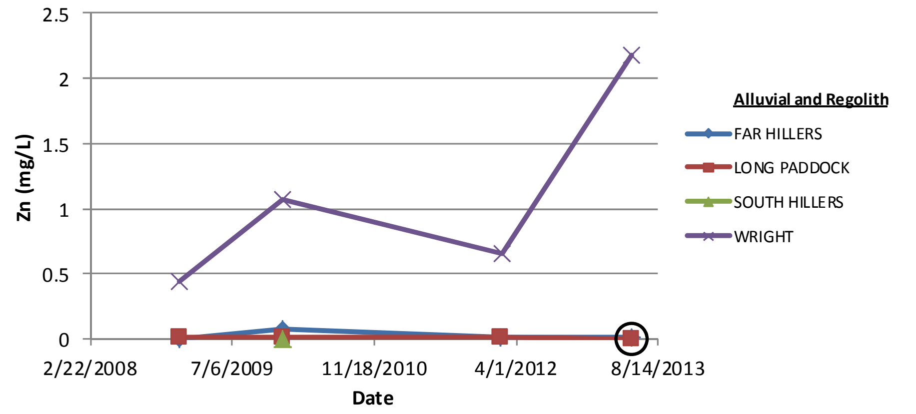
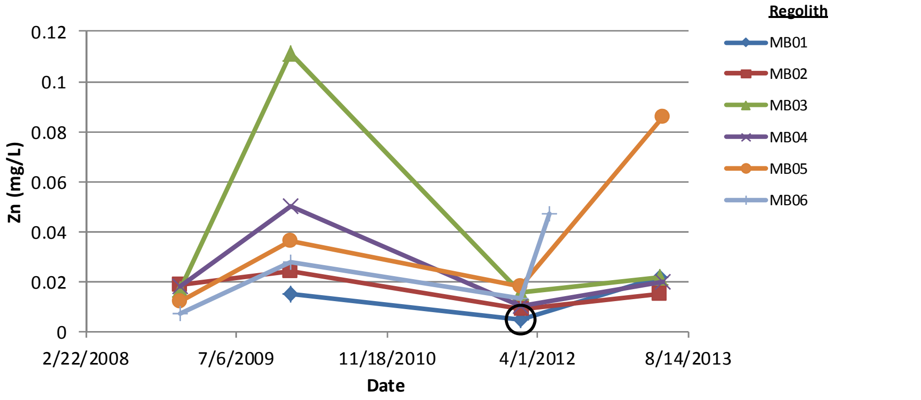
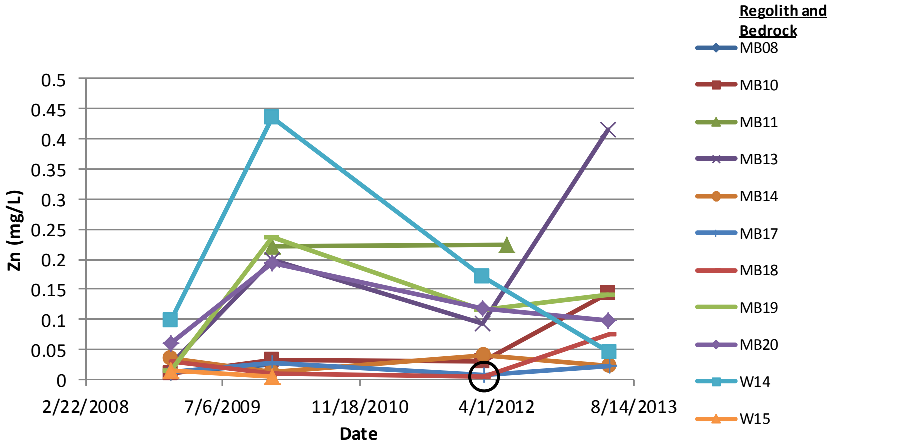


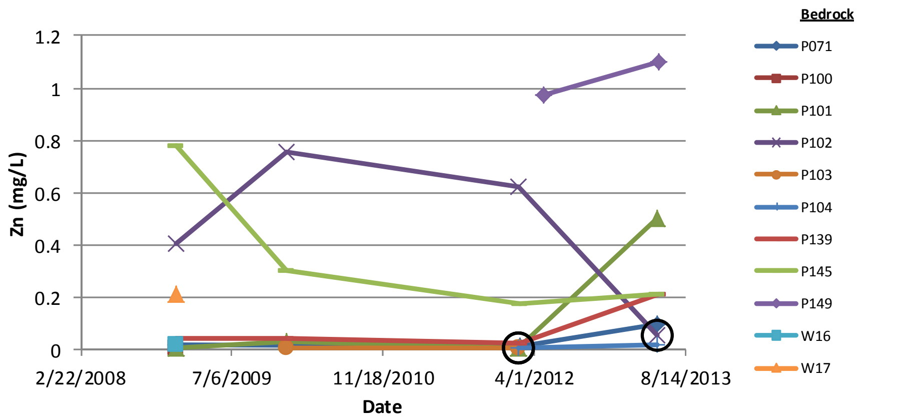
Figure 16f: Groundwater Quality data (During Mining) - Temporal variation of Lead (Pb)

During Mining Groundwater Quality Data
Zinc (Zn)









Notes:

Refer to Figure 16c and Figure 16d for bore information and locations

Data points outlined with a black circle, indicates concentration values reported as less than the respective concentration value in the graph, e.g. <0.001mg/L is represented as 0.001mg/L in the graphs.

Figure 16g: Groundwater Quality data (During Mining) - Temporal variation of Zinc (Zn)

2.7 Item 4(ii)

4(ii) With the exception of monitoring bores W12 to W16, Figure C8 in Appendix C of Appendix 10 shows an overall trend where the computed drawdowns underestimate the measured drawdowns. This indicates the predictive runs presented in the EA may have underestimated impacts to groundwater pressures. It is therefore not possible to accurately determine the maximum impacts to water supply works.

For reasons that will be outlined below, the model is suitable for:

- Calculating conservative estimates of projected groundwater inflow rates to the mine workings.
- Assessing the maximum impacts of mining-induced groundwater drawdown on wells located on surrounding properties.

1) <u>Calculation of conservative estimates of projected groundwater inflow rates to the mine workings.</u>

The early (pre-2007) computed hydraulic heads are higher than observed heads. Therefore, the computed hydraulic gradients behind the pit/lift walls are likely to be higher than the actual hydraulic gradients for most of the time. This implies that the computed pit-groundwater inflow rates are likely to be higher than the actual pit-groundwater inflow rates.

2) <u>Assessing the maximum impacts of mining-induced groundwater drawdown on wells located on surrounding properties.</u>

For most of the observation wells, the early (pre-2007) computed groundwater heads are higher than simulated heads. However, for most of the wells, including the wells in the vicinity of E26 (wells (P139 and P149), the simulated drawdown rate between 1994 and 2007 is higher than the observed drawdown rate. This suggests that the model can be used to provide conservative future projections of mining-induced groundwater drawdown.

2.8 Item 4(iii)

4(iii) The model has not incorporated baseline data from observation bores MB 19/20 and P149. Clarification is requested for the basis of not incorporating data from these bores and/or inclusion in the model for further analysis.

Well MB19 and MB20

- At the time the model was prepared, the bore depths and screen depths for MB19 and MB20 were not provided to Golder; therefore, these observation bores were not incorporated into the model. This information is available now and can be included as part of the ongoing operations model in the future.

Well P149

A graph of observed and computed heads at P149 is provided in this memo. An analysis of the results indicates the following:

- There is no record of pre-mining groundwater level monitoring at P149. The groundwater level monitoring data is from 2004 onwards.
- The initial simulated drawdown rate is comparable to the initial observed drawdown rate.

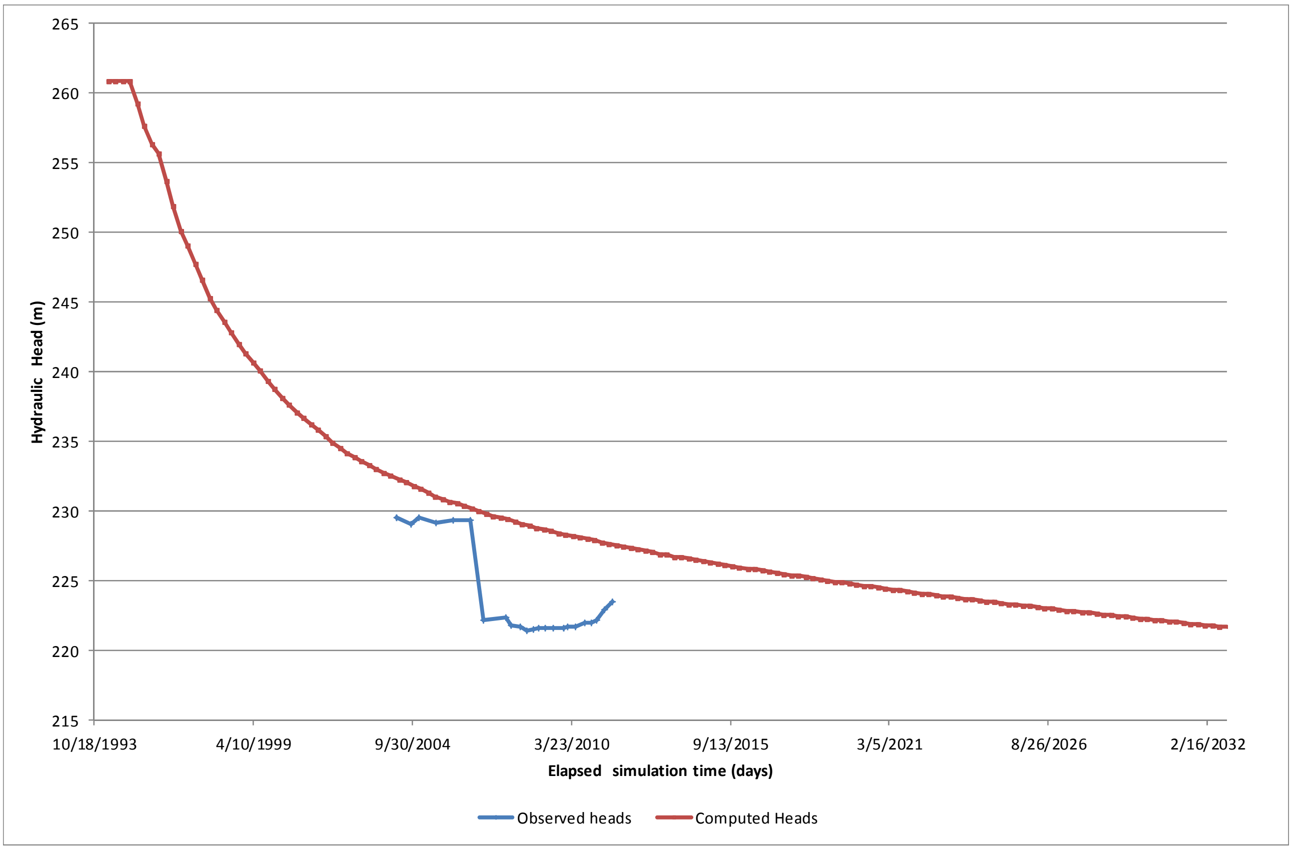


Figure C8: Observed and computed heads at P149

3.0 RESPONSE TO REVIEW COMMENTS OF NSW DEPARTMENT OF PRIMARY INDUSTRIES

3.1 Item (i) Section 4.7

(i) Section 4.7: Table 12 – bore water entry design (screen vs slots), bore license numbers, and bore collar (measuring point) elevations are not included.

We have added the bore licenses, bore collar elevations and water entry design to the revised Table 12 (see below). Data that were not provided by NPM are noted as N/A (not available) in Table 12.

Table 12: Groundwater Monitoring Network in the vicinity of the Project Area

Bore Reference	Bore License	Collar Elevation [mAHD]	Drilled Depth [m]	Target Monitoring Strata	Water Entry Design [slots/screens]
P71	80BL241021	381.86	130	Bedrock	Slotted
P100	80BL155122	285.45	250	Bedrock	N/A
P101	80BL155122	289.82	250	Bedrock	N/A
P102	80BL155122	282.75	250	Bedrock	N/A
P103	80BL155192	291.85	250	Bedrock	N/A
P104	80BL155193	N/A	18	Bedrock	N/A
P139	80BL241042	N/A	108	Bedrock	Slotted
P145	80BL241040	N/A	120	Bedrock	N/A
P149	80BL241042	N/A	90	Bedrock	N/A
MB01	80BL236021	N/A	36.5	Regolith / Saprock	Slotted, 4.5 mm vertical
MB02	80BL236022	N/A	60	Regolith / Saprock	Slotted, 4.5 mm vertical
MB03	80BL236023	N/A	66	Regolith / Saprock	Slotted, 4.5 mm vertical
MB04	80BL237290	N/A	60	Regolith / Saprock	Slotted, 4.5 mm vertical
MB05	80BL237290	N/A	-	Regolith / Saprock	N/A
MB06	80BL237290	N/A	-	Regolith / Saprock	N/A
MB07	80BL237290	N/A	-	Regolith / Saprock	N/A
MB08	80BL241023	280.25*	59.55	Bedrock (OTZ)	Slotted, 0.4 mm
MB08A		281.11*	62.6	Bedrock (OTZ)	N/A
MB10	80BL241023	278.73*	-	Bedrock (OTZ)	Slotted, 0.4 mm
MB11	80BL241039	278.2*	44.6	Bedrock (OTZ)	Slotted, 0.3 mm
MB12	80BL241039	278.45*	57	Saprock	Slotted, 0.4 mm
MB13	80BL241019	277.88*	45.2	Saprock	N/A
MB14		288.37*	60.15	Bedrock (OTZ)	N/A
MB16	80BL241022	283.52*	50.55	Regolith / Bedrock?	Slotted, 0.4 mm
MB 17	80BL244991	N/A	66	Regolith / Bedrock?	Slotted, 2 mm
MB 18	80BL244992	N/A	90	Regolith / Bedrock?	Slotted, 2 mm
MB 19	80BL244990	N/A	102	Regolith / Bedrock?	N/A
MB 20	80BL244990	N/A	54	Regolith / Bedrock?	N/A
W1	80BL241023	250.87	100	Bedrock (OTZ)	Slotted
W2	N/A	249.91	100	Bedrock (OTZ)	N/A

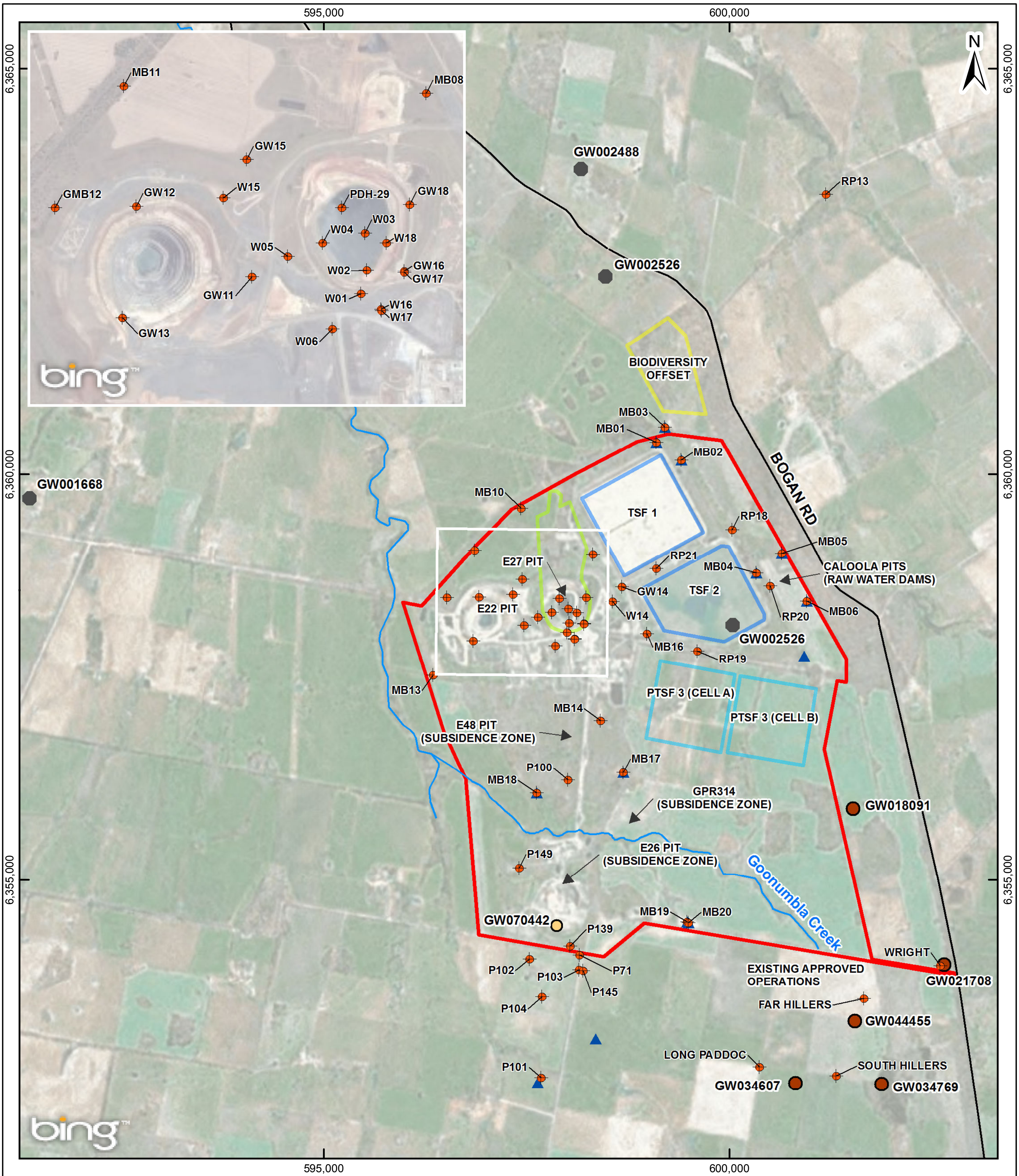
Bore Reference	Bore License	Collar Elevation [mAHD]	Drilled Depth [m]	Target Monitoring Strata	Water Entry Design [slots/screens]
W3	N/A	250.61	100	Regolith / Bedrock	N/A
W4	N/A	240	120	Regolith / Bedrock	N/A
W5	80BL241023	281.31	102	Regolith / Bedrock	N/A
W6	80BL241019	283.7	108	Bedrock (OTZ)	Slotted
W11	80BL241019	282.12	150	Bedrock (OTZ)	Alternating 6m blank, 3m slotted (9mm)
W12	N/A	285.38	150	Bedrock (OTZ)	Alternating 6m blank, 3m slotted (9mm)
W13	80BL241019	280.53	150	Bedrock (OTZ)	Alternating 6m blank, 3m slotted (9mm)
W14	80BL241023	283	150	Bedrock (OTZ)	Alternating 6m blank, 3m slotted (9mm)
W15	80BL241039	281.36	150	Bedrock (OTZ)	Alternating 6m blank, 3m slotted (9mm)
W16	N/A	283.81	100	Bedrock	N/A
W17	N/A	283.64	60	Bedrock	N/A
W18	N/A	282.02	100	Regolith / Bedrock	N/A
Far Hilliers	N/A	N/A	N/A	Alluvial / Regolith?	N/A
Long Paddock	N/A	N/A	N/A	Alluvial / Regolith?	N/A
South Hilliers	N/A	N/A	N/A	Alluvial / Regolith?	N/A
Wright	N/A	N/A	N/A	Alluvial / Regolith?	N/A
Moss	N/A	N/A	N/A	Alluvial / Regolith?	N/A
PDH-29	N/A	N/A	>200	Bedrock	N/A

Notes:
* Ground level, collar elevation not available
N/A, data not available

3.2 Item (ii) Section 4.7

(ii) Section 4.7: Figure 9 – requires a map 'insert' panel so site bores may be differentiated in vicinity of "E22 and E27" mining area.

A revised copy of Figure 9 is provided below.



NORTHPARKES MINE GWIA

UMWELT (AUSTRALIA) PTY. LTD.

MINE SITE MONITORING BORE LOCATIONS

LEGEND

- Mine Site Monitoring Bore
- Railroad
- Main Road
- Watercourse
- Project Area
- Existing Approved Permit
- Tailings Storage Facility
- Potential Tailings Storage Facility
- Biodiversity Offset Area

Now Registered Bores

- General Use
- Monitoring Bore
- Not Known
- Stock
- Test Bore

0 1 2 km

SCALE (at A4) 1:65,000

Coordinate System: GDA 1994 MGA Zone 55

PROJECT: 117626007
DATE: 13/09/2013
DRAWN: SL
CHECKED: SD

FIGURE 9

COPYRIGHT

1. Base vector data copyright MapInfo Pty Ltd.
2. Base Map Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013
© 2010 DigitalGlobe © 2010 GeoEye © 2013 Microsoft Corporation

Golder Associates

File Location: R:\01 Client\Umwelt\117626007\Programs\ArcGIS\117626007-007-R-F009-Rev0-MineBores2.mxd

3.3 Item (iii) Section 4.7

(iii) Section 4.7: Figures 12 and 13 require an additional hydrograph each to separate hydroplots for the purpose of enabling differentiation of individual bores.

We have plotted separate hydroplots as required. Please see Figure 12 (a to d) and Figure 13 (a to d) shown in Section 3.4 below.

3.4 Item (iv) Section 4.7

(iv) Section 4.7 Figures 10, 11, 12, and 13 require adjustment to horizontal 'data' scales to enable hydrograph interpretation. In addition, the asterisk marks on Figures 10, 11 and 13 require explanation.

We have edited the scales on Figure 10, 11, 12 (a to d) and Figure 13 (a to d) as requested. The asterisks shown on Figures 10 to 13 of the GWIA Report are not relevant and we have removed them from the revised Figures in the memo. Please see Figures 10 to 13d below.

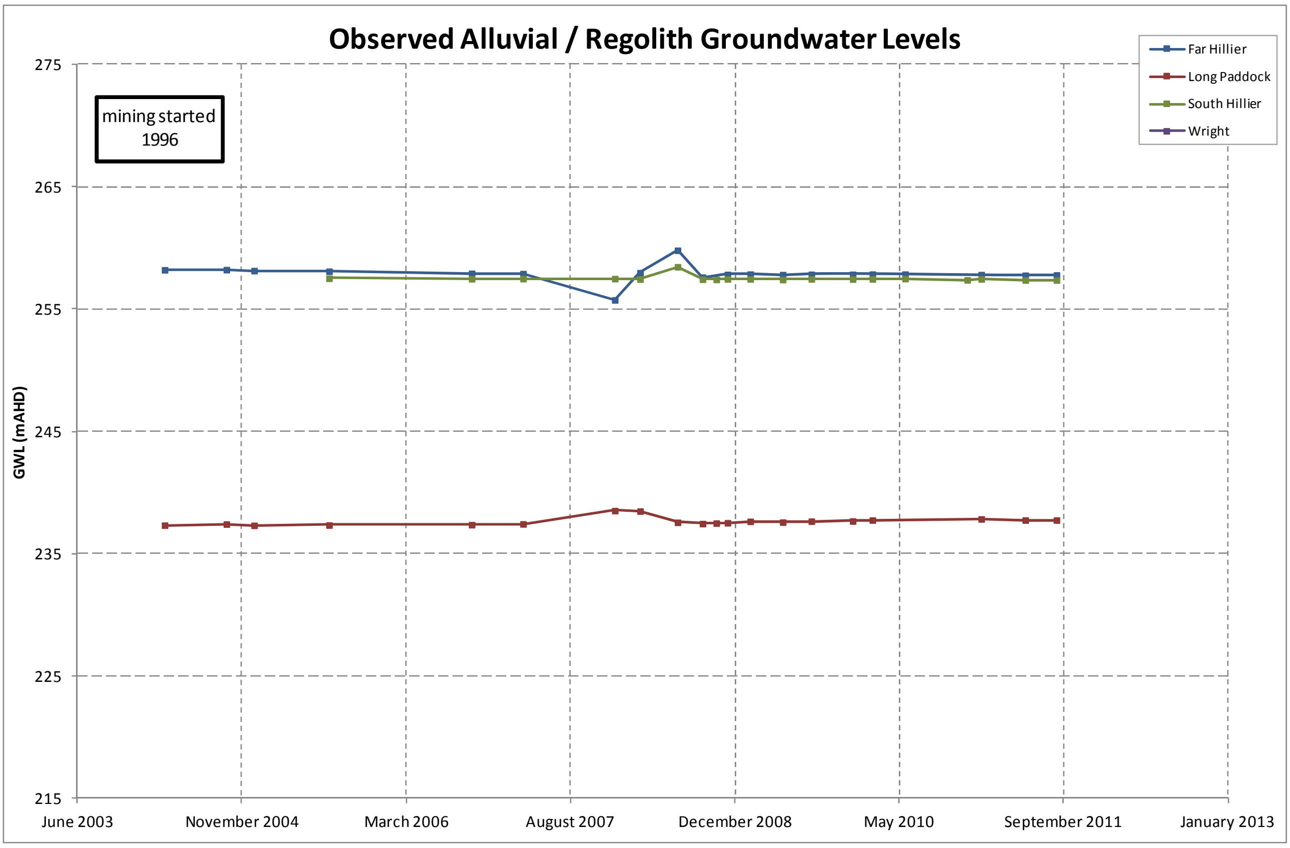


Figure 10: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Alluvial and Regolith

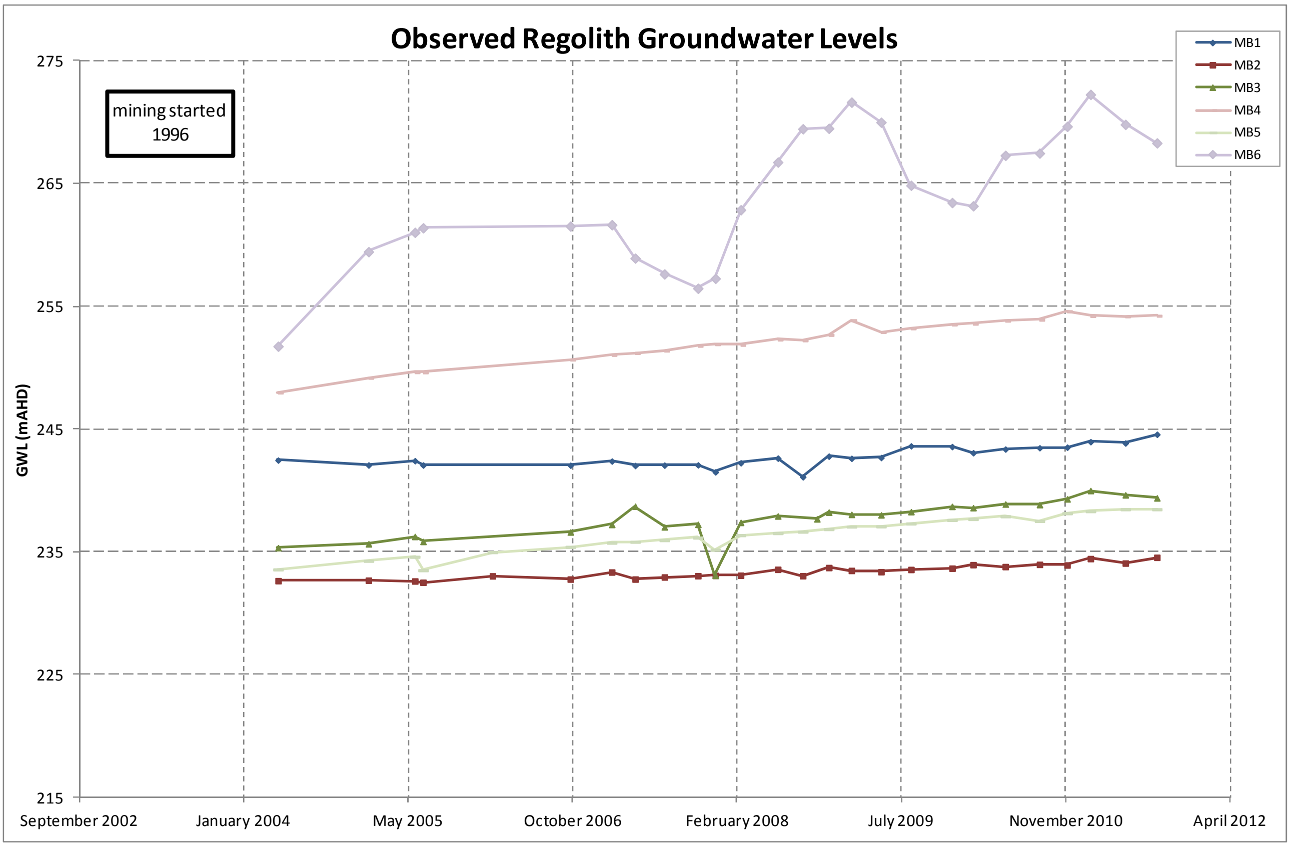


Figure 11: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Regolith

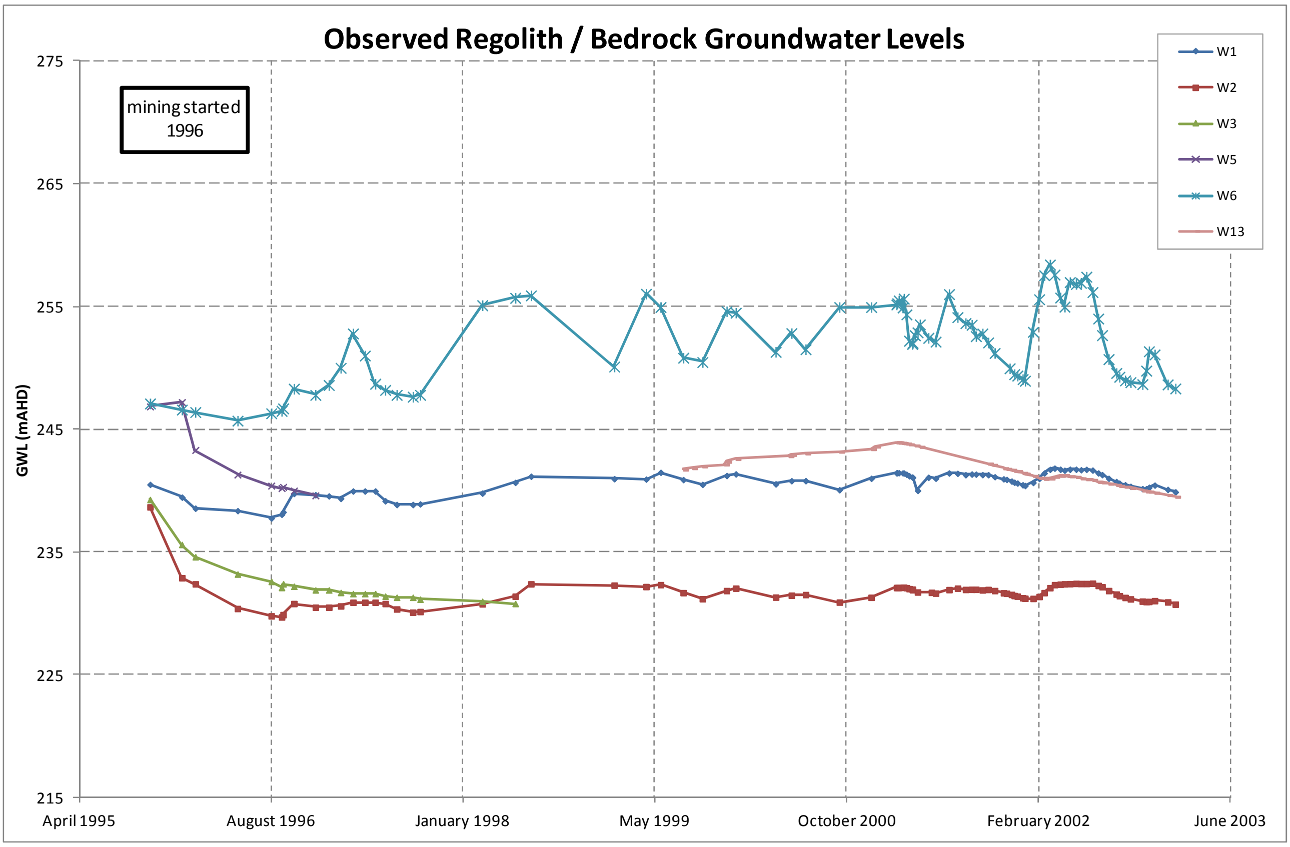


Figure 12a: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Regolith and Bedrock

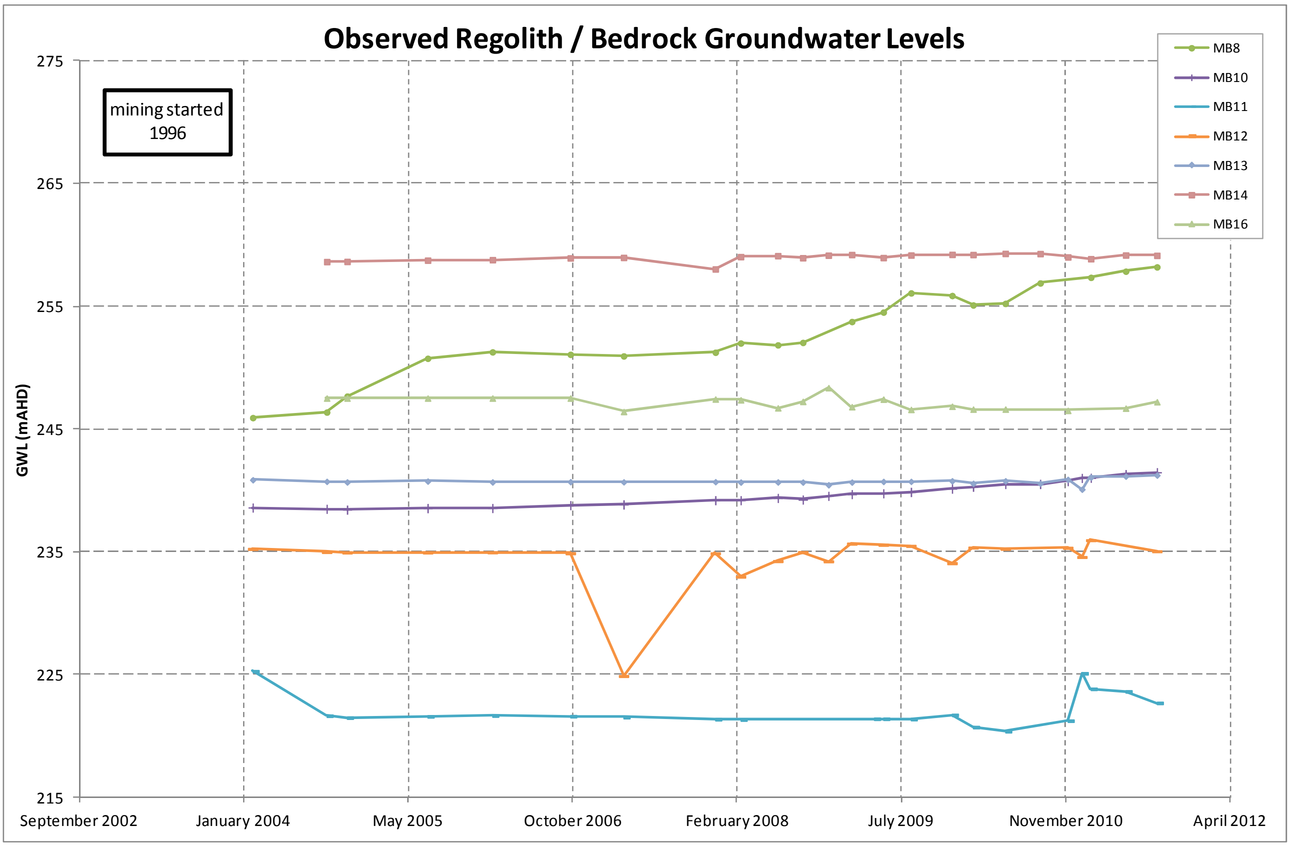


Figure 12b: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Regolith and Bedrock

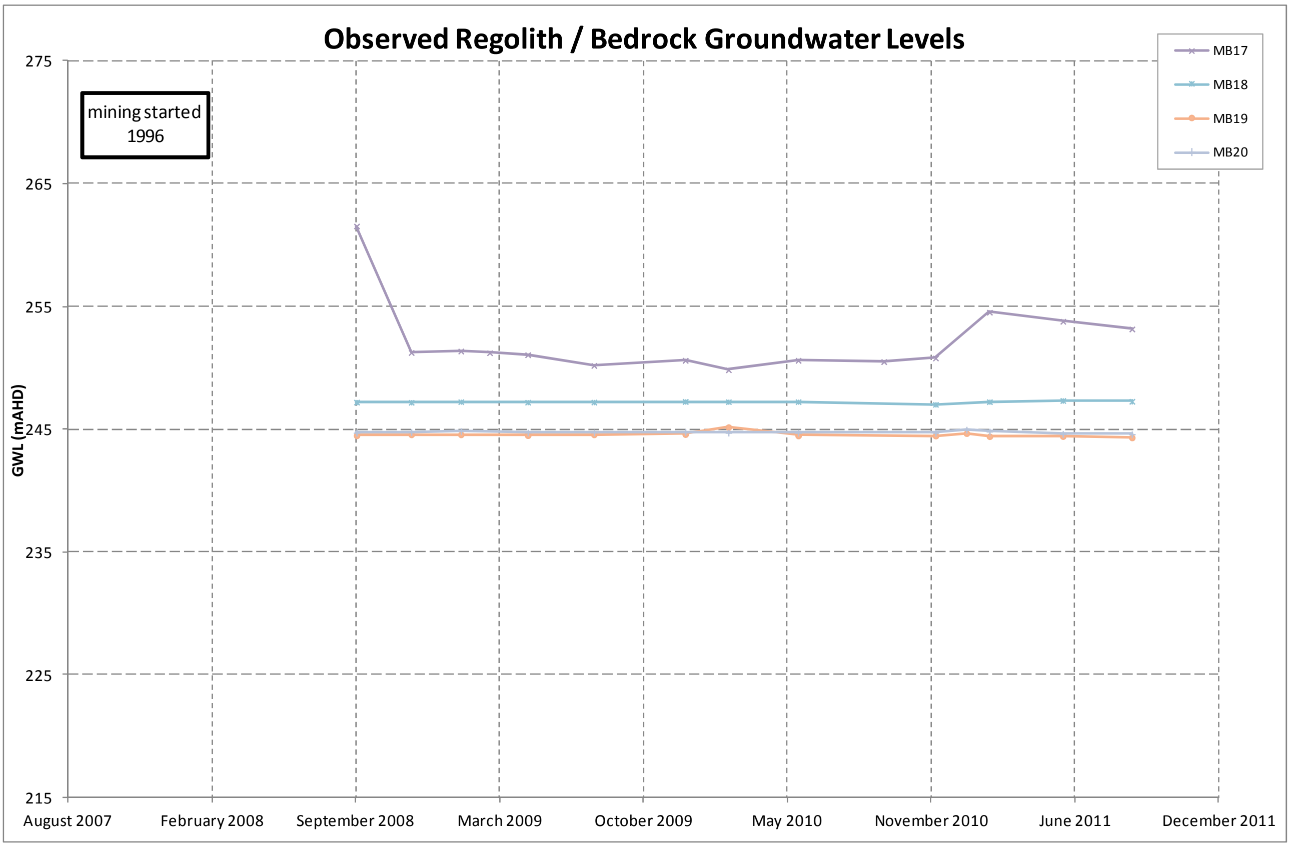


Figure 12c: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Regolith and Bedrock

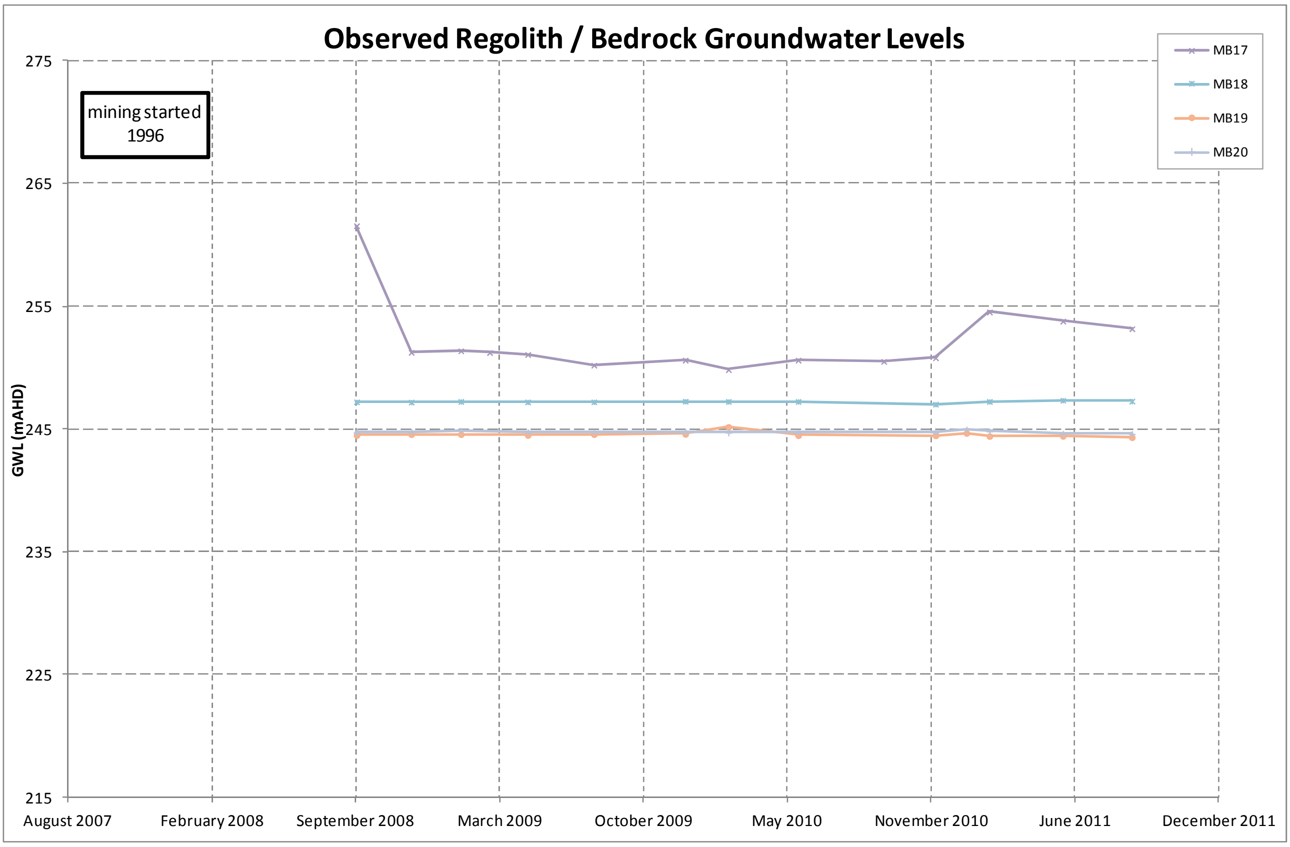


Figure 12d: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Regolith and Bedrock

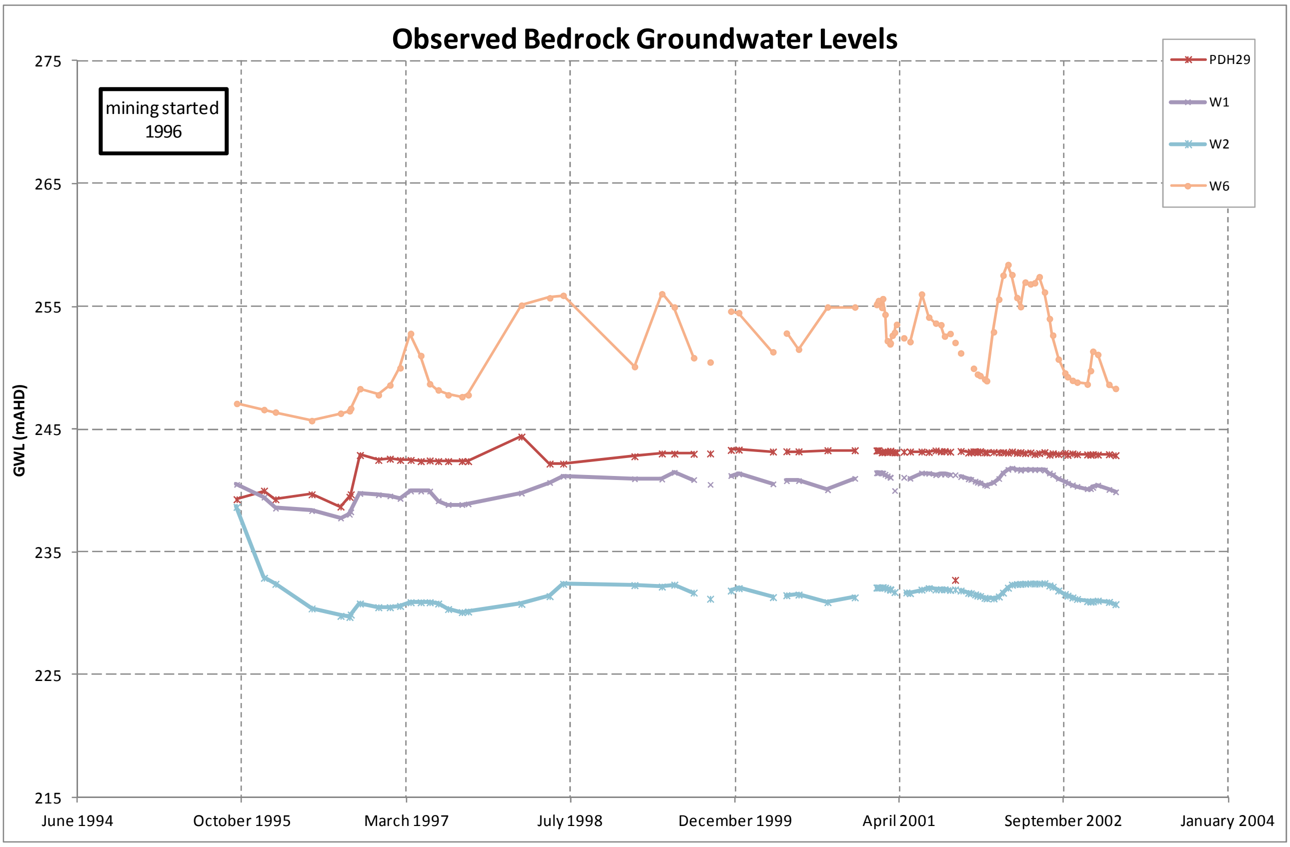


Figure 13a: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Bedrock

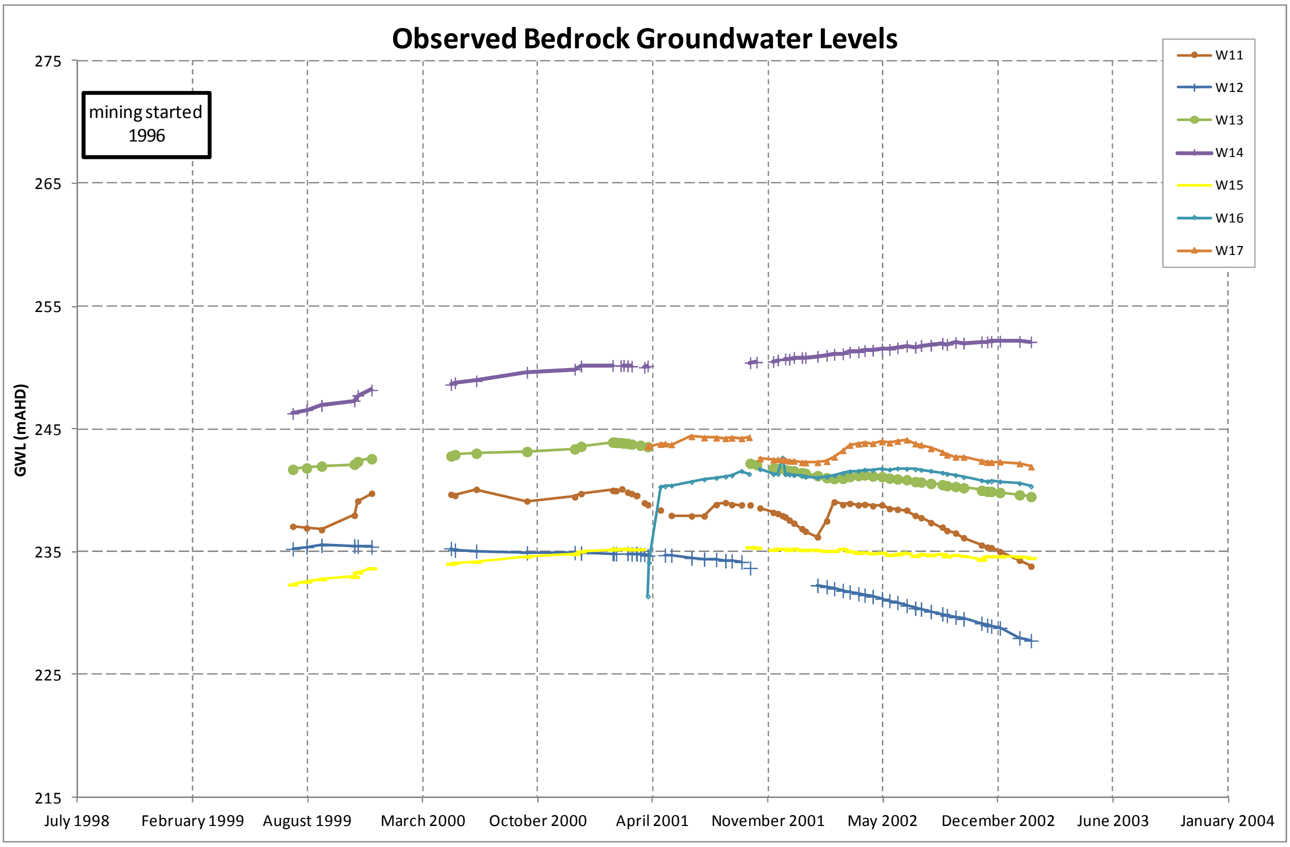


Figure 13b: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Bedrock

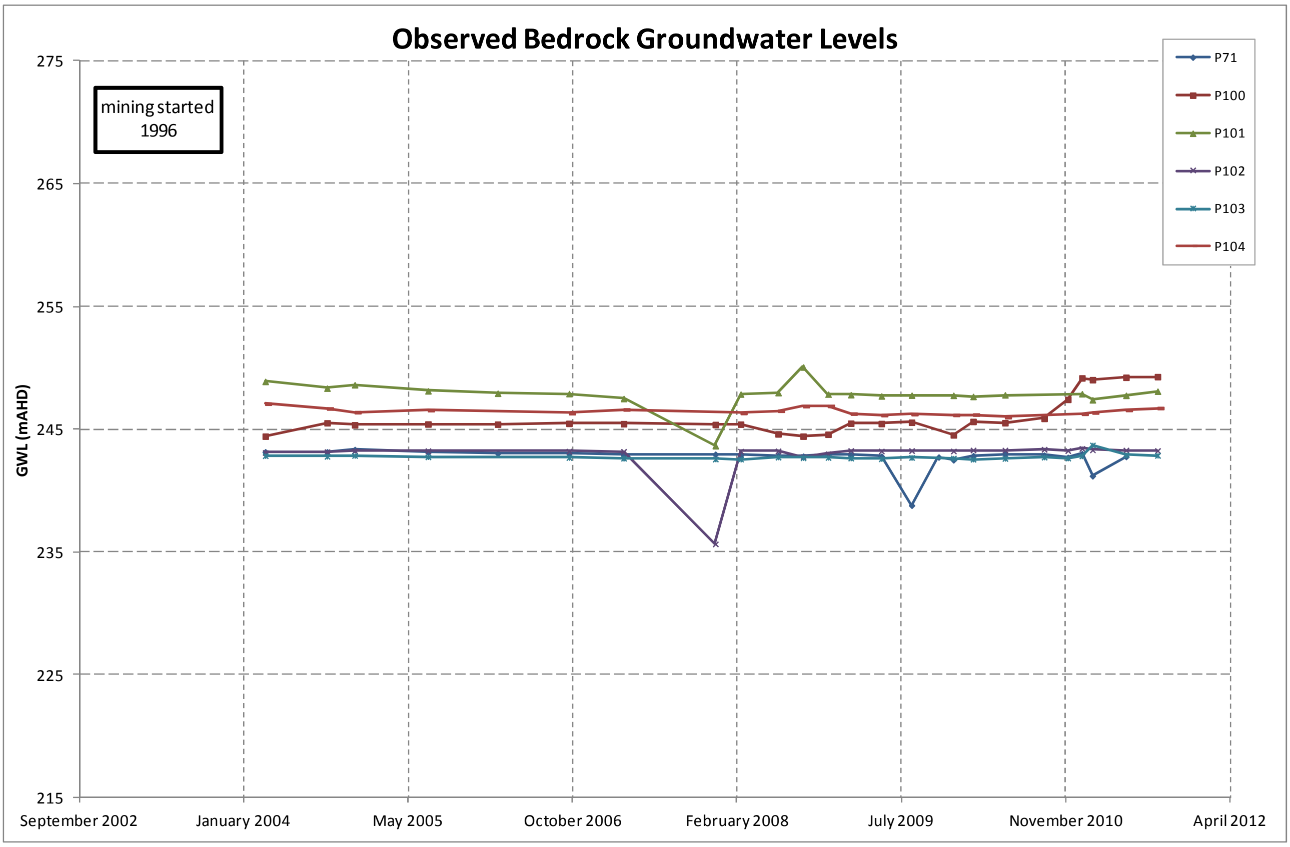


Figure 13c: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Bedrock

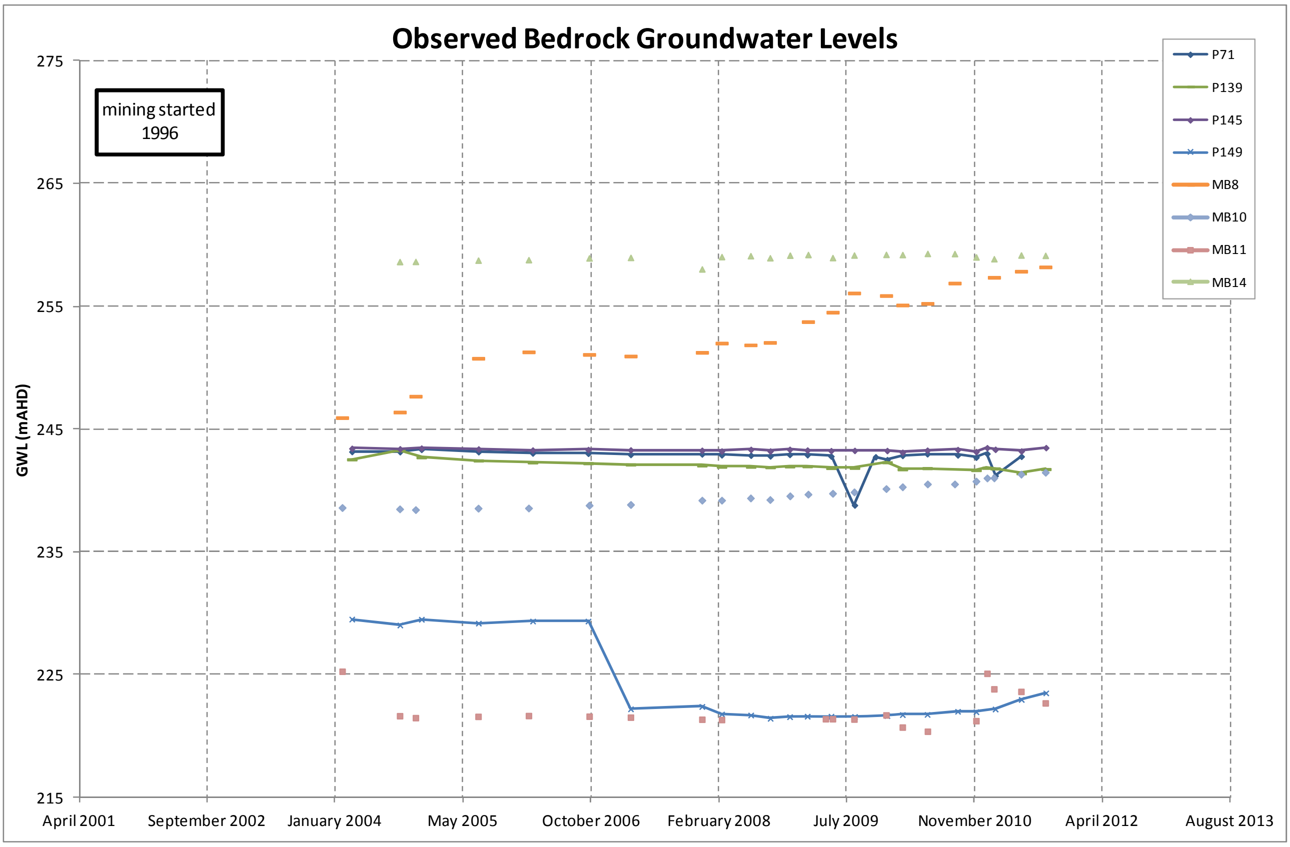


Figure 13d: Monitored Groundwater Levels in the vicinity of the Project Area for Observed Bedrock

3.5 Item (v) Section 4.8.3

(v) Section 4.8.3: does not clearly state what water quality analytes have been tested for, from which bores in past at the site. The EA requires revision including summary table presentation of analytes tested from which locations.

We have prepared tables summarising water sampling sites and the analytes tested. Table 17b and Table 17c present the sampling sites for the pre-mining water quality (prior to 1993) and NPM monitoring site for the 'During mining' period (2009 to 2013), respectively. Please refer to Attachment A Table A1 and Table A2 for water quality monitoring data in the Pre-mining and During Mining periods.

- Available pre-mining water quality data (pre 1993) includes pH, electrical conductivity, TDS, Ca, Mg, Na, K, Cl, HCO_3, SO_4, F, hardness, total Cu and total Si (refer to Table 17b).
- Available water quality data (laboratory analysis) of NPM monitoring sites include pH, electrical conductivity, turbidity, alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, fluoride, aluminium, arsenic, strontium, barium, beryllium, cadmium, cobalt, uranium, chromium, copper, thorium, manganese, molybdenum, nickel, lead, antimony, selenium, tin, thallium, zinc, iron, mercury, fluoride (refer to Table 17c).

Table 17b: Sampling sites for pre-mining water quality

Sample ID	Bore ID	Sample Date	Northing	Easting	Completed Bore Depth	Location
			m	m		
DDH3	DDH330666	16/12/1983	N/A	N/A	N/A	Cross Gradient
DDH30	DDH3030666	16/12/1983	N/A	N/A	49.23	Cross Gradient
DDH7	DDH730666	16/12/1983	N/A	N/A		Cross Gradient
PDH18	PDH1830666	16/12/1983	N/A	N/A	41.5	Cross Gradient
PDH26	PDH2630666	16/12/1983	N/A	N/A	35.67	Cross Gradient
PDH70	PDH7030666	16/12/1983	N/A	N/A	35.55	Cross Gradient
PDH72	PDH7230666	16/12/1983	N/A	N/A	42.17	Cross Gradient
GW017192	N/A	23/04/1958	613028	6344417	57.9	Up Gradient
GW045589	N/A	25/06/1964	592688	6347124	20	Up Gradient
GW048731	N/A	30/10/1978	594161	6341074	20.6	Up Gradient
GW058224	N/A	11/04/1982	592623	6348480	20.7	Up Gradient
GW045591	N/A	21/01/1957	593719	6346375	20	Up Gradient
GW001827	N/A	2/10/1979	593293	6345209	26.8	Up Gradient
GW050025	N/A	8/03/1979	591011	6345292	24.2	Up Gradient
GW036927	N/A	5/11/1993	591088	6346140	75	Up Gradient
GW002920	N/A	N/A	590413	6347977	35.4	Up Gradient

Notes:

Available pre-mining water quality data (pre 1993) includes pH, electrical conductivity, TDS, Ca, Mg, Na, K, Cl, HCO_3, SO_4, F, hardness, total Cu and total Si

Sampling sites with no coordinates are not shown on the new Figure 16b.

Data of pre-mining samples shown in Table 17 are from the DDH and PDH bores (sample date 1983)

N/A: data not available

Table 17c: Sampling sites for water quality data during mining operations (Data source: Umwelt/NPM, 2012, 2013)

Sample ID	ID	Monitoring start date	Northing	Easting	Completed Bore Depth	Location	Formation
Far Hillier	Far Hillier39814	1/01/2009	601656	6353541	N/A	Up Gradient	*Alluvial and Regolith*
Long Pad	Long Pad39814	1/01/2009	600370	6352695	N/A	Up Gradient	*Alluvial and Regolith*
South Hillier	South Hillier39814	1/01/2009	601315	6352587	N/A	Up Gradient	*Alluvial and Regolith*
South Hillier	South Hillier40179	1/01/2010	601315	6352587	N/A	Up Gradient	*Alluvial and Regolith*
Wright	Wright39814	1/01/2009	602600	6353946	N/A	Up Gradient	*Alluvial and Regolith*
MB1	MB139814	1/01/2009	599101	6360398	36.5	Cross Gradient	MONZONITE, weathered
MB2	MB239814	1/01/2009	599411	6360179	66	Cross Gradient	MONZONITE, weathered
MB3	MB339814	1/01/2009	599207	6360582	60	Cross Gradient	MONZONITE, weathered
MB4	MB439814	1/01/2009	600332	6358784	60	Cross Gradient	VOLCANICS, weathered and fresh
MB5	MB539814	1/01/2009	600647	6359027	60	Cross Gradient	VOLCANICS, weathered and fresh
MB6	MB639814	1/01/2009	600952	6358439	43	Cross Gradient	VOLCANICS, weathered
MB8	MB839814	1/01/2009	598322	6359016	59.55	Cross Gradient	SAPROCK and BEDROCK
MB10	MB1039814	1/01/2009	597434	6359586	44.6	Down Gradient	ANDESITE, weathered
MB11	MB1140179	1/01/2010	596862	6359066	57	Down Gradient	ANDESITE, weathered
MB13	MB1339814	1/01/2009	596348	6357524	60.15	Cross Gradient	SAPROCK
MB14	MB1439814	1/01/2009	598413	6356964	50.55	Cross Gradient	ANDESITE, weathered
MB17	MB1739814	1/01/2009	598696	6356326	66	Cross Gradient	TRACHYTE
MB18	MB1839814	1/01/2009	597627	6356075	90	Cross Gradient	SANDSTONE
MB19	MB1939814	1/01/2009	599481	6354484	102	Cross Gradient	LATITE
MB20	MB2039814	1/01/2009	599498	6354474	54	Cross Gradient	SAPROCK
P71	P7139814	1/01/2009	598154	6354079	130	Cross Gradient	*Bedrock*
P100	P10039814	1/01/2009	598014	6356234	30	Cross Gradient	*Bedrock*
P101	P10139814	1/01/2009	597683	6352566	24	Up Gradient	*Bedrock*
P102	P10239814	1/01/2009	597536	6354028	18	Cross Gradient	*Bedrock*
P103	P10339814	1/01/2009	598150	6353898	24	Cross Gradient	*Bedrock*
P104	P10439814	1/01/2009	597692	6353563	97	Cross Gradient	*Bedrock*
P139	P13939814	1/01/2009	598039	6354188	108	Cross Gradient	*Bedrock*
P145	P14539814	1/01/2009	598196	6353888	120	Cross Gradient	*Bedrock*
P149	P14940179	1/01/2010	597410	6355150	90	Cross Gradient	*Bedrock*
W14	W1439814	1/01/2009	598561	6358433	150	Cross Gradient	*Regolith and Bedrock*
W15	W1539814	1/01/2009	597337	6358523	150	Cross Gradient	*Regolith and Bedrock*
W16	W1639814	1/01/2009	598094	6357979	100	Cross Gradient	*Bedrock*
W17	W1739814	1/01/2009	598094	6357972	60	Cross Gradient	*Bedrock*
W18	W1839814	1/01/2009	598123	6358299	100	Cross Gradient	

Notes:

Available water quality data includes pH, electrical conductivity, turbidity, alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, fluoride, aluminium, arsenic, strontium, barium, beryllium, cadmium, cobalt, uranium, chromium, copper, thorium, manganese, molybdenum, nickel, lead, antimony, selenium, tin, thallium, zinc, iron, mercury, fluoride

N/A: data not available

3.6 Item (vi) Section 4.8.3

(vi) Section 4.8.3: In order to make assessment of potential impacts, the EA requires addition of water quality data collected to date presented via graph form to show individual analytes including at a minimum Total Dissolved Solids (TDS), Arsenic (As), Lead (Pb), and Zinc (Zn) concentration change with time in each monitoring bore/sample point.

As requested, graphs of TDS, As, Pb and Zn have been prepared to present the historical analyte concentration change with time (see Figures 16d to 16g in Section 2.6 and Table 17c). Please note that the sampling sites for the baseline water quality in 1983 (Table 17b) are not part of the NPM monitoring program and there are no graphs showing the temporal fluctuations for these sites.

Ranges of water quality data are shown in the revised Table 17 (refer to Section 3.8 of this memo).

The water quality sampling information is presented in Table 17a, Table 17b, Table 17c and Attachment A of this memo.

3.7 Item (vii) Section 4.8.3

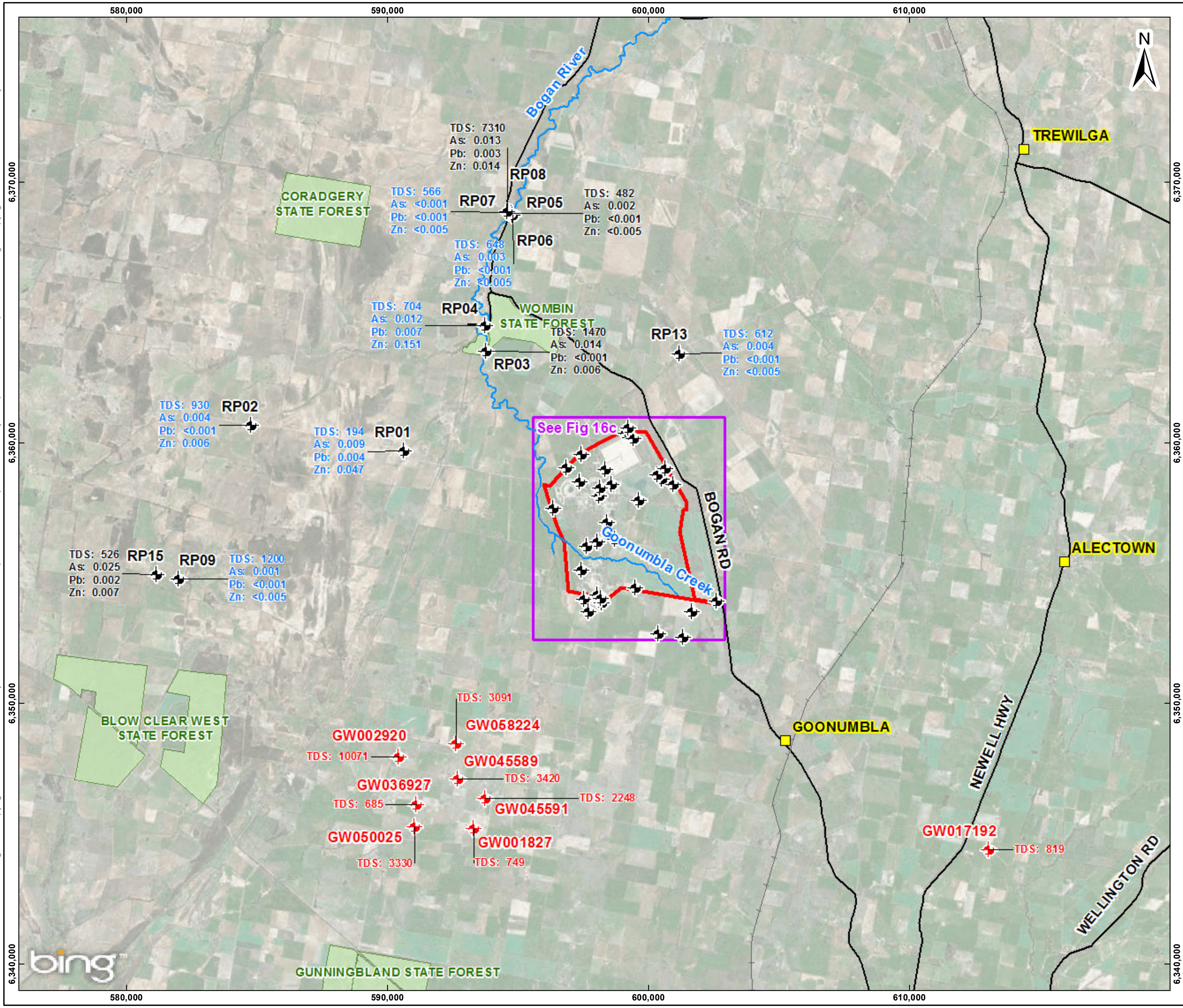
(vii) Section 4.8.3: required pre-mining and post-mining spatial distribution maps of groundwater quality including at a minimum TDS, As, Pb, and Zn concentrations.

The spatial distribution of water quality (TDS) for water samples within the Mine and up-gradient of the Mine site is shown in Figure 16 of the GWIA Report. Figure 16 show the spatial distribution of water quality observed in 2009-2010.

As requested, additional spatial water quality distribution maps of groundwater quality have been prepared (Please see the new Figure 16b and Figure 16c).

The spatial water quality distribution from NPM regional monitoring bores and the pre-mining sampling site (pre 1993) are shown in Figure 16b. Please note that TDS values are available for some water samples for the pre-mining sampling sites (1983) but there are no data for As, Pb and Zn (Figure 16b). Some sites have no TDS data and some TDS values shown in Figure 16b were converted from the available electrical conductivity.

NPM monitoring data for the ‘during mining’ period is available for the period from 2009 to 2013. Figure 16c show the spatial distribution water quality observed in May 2013. Some monitoring sites do not have water quality data in May 2013 and water quality data in earlier years (2009, 2010, 2011 or 2012) was used and noted in Figure 16b and Figure 16c.



NORTHPARKES MINE GWIA

UMWELT (AUSTRALIA) PTY. LTD.

SPATIAL DISTRIBUTION OF WATER QUALITY (REGIONAL MONITORING BORES)

LEGEND

- Pre-mining, not within the NPM Monitoring Network
- Northparkes Mine Monitoring Bore
- Town
- Railway
- Main Road
- Watercourse
- State Forest
- Figure 16c Extent
- Project Area

Water Quality Data

2013
2010 - 2012
Pre 1993

COPYRIGHT

0 1 2 3 4 5 km

SCALE (at A4) 1:200,000

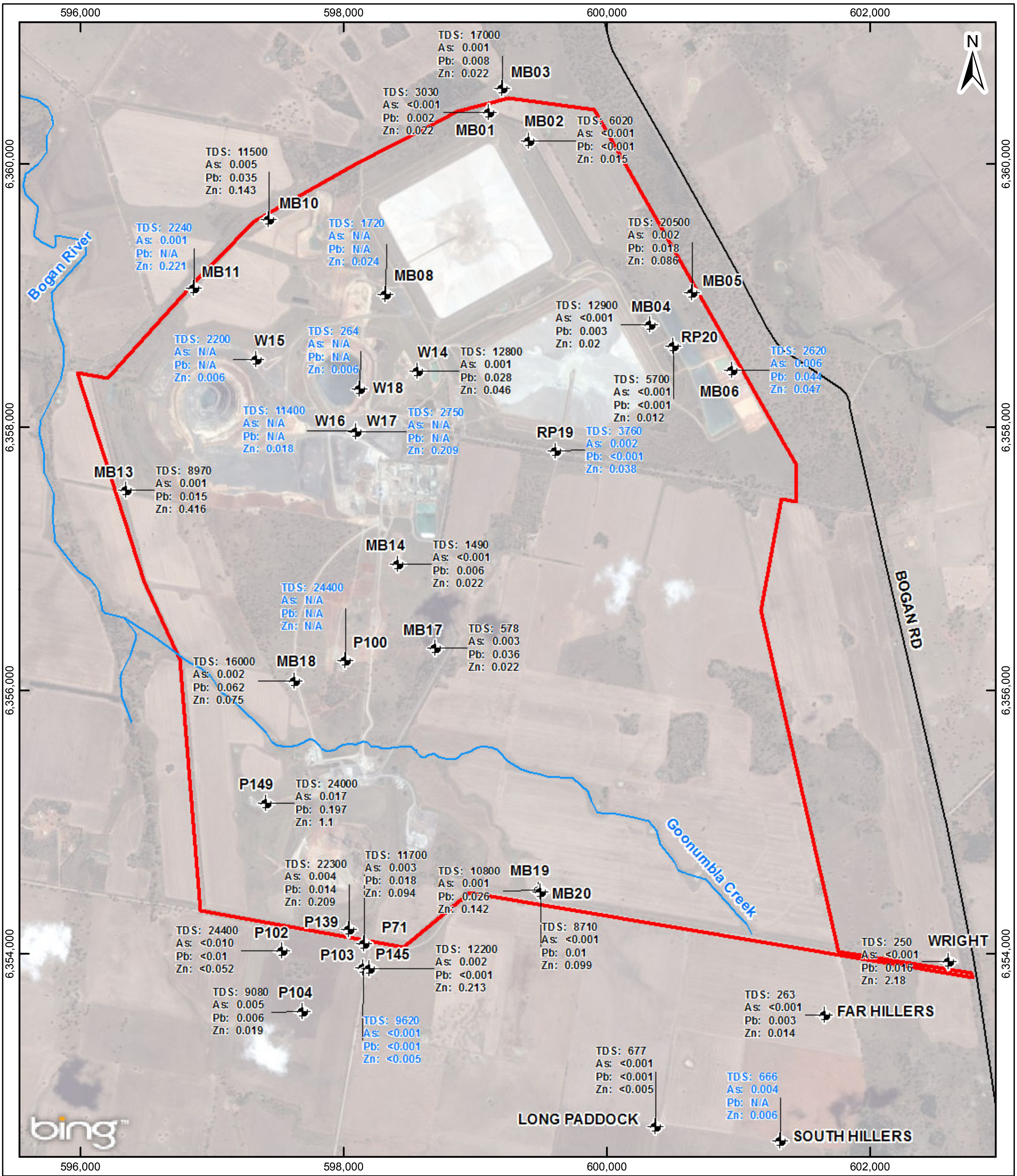
DATUM GDA 94, PROJECTION MGA Zone 55

PROJECT: 117626007
DATE: 17 SEP 2013
DRAWN: SL
CHECKED: SD

FIGURE 16b

Golder Associates

File Location: R:\01 Client\Umwelt\117626007\Programs\ArcGIS\117626007-007-R-F016b-Rev0-WaterQualityRegional.mxd



NORTHPARKES MINE GWIA

UMWELT (AUSTRALIA) PTY. LTD.

SPATIAL DISTRIBUTION OF WATER QUALITY (MINE SITE MONITORING BORES)

LEGEND

- Northparkes Mine Monitoring Bore
- Main Road
- Watercourse
- Project Area

Water Quality Data

2013

2009 - 2012

0 200 400 600 800 1,000 metres

SCALE (at A4) 1:40,000

Coordinate System: GDA 1994 MGA Zone 55

PROJECT:	117626007
DATE:	17/09/2013
DRAWN:	SL
CHECKED:	SD

FIGURE 16c

Golder Associates

File Location: R:\01 Client\Umwelt\117626007\Programs\ArcGIS\117626007-007-R-F016c-Rev0-WaterQualityMine.mxd

3.8 Item (viii) Section 4.8.4

(viii) Section 4.8.4: Table 17 – requires addition of both Pb and As concentration comparison to guidelines.

As requested, parameters Lead (Pb) and Arsenic (As) concentrations comparison to guidelines have been added to the revised Table 17. We have updated Table 17 using the updated monitoring data from 2009 to 2013 and the number of water samples in the statistical summary in the revised Table 17 has increased.

Table 17 presents number of samples exceeding the drinking water criteria for pH, chloride, soldium, sulphate, fluoride, copper, iron, manganese, zinc, nitrate, lead and arsenic (ADWG, 2011). Table 17 also shows numbers of samples that have TDS categorised as good quality (TDS<600 mg/L), acceptable (TDS = 600-900 mg/L), poor quality (TDS = 900-1,200 mg/L) and excessive scaling, corrosion, unsatisfactory taste (TDS >1,200 mg/L).

Revised Table 17: Comparison of groundwater quality to Australian drinking water criteria for Project Area (ADWG, 2011)

Analyte	Drinking water standard	'Pre-mining' (Cross-Gradient)	'During Mining' (Cross - Gradient)
	(mg/L; except pH)	**No of samples exceeding standard*** **	**No of samples exceeding standard*** **
pH	6.5 - 8.5	0% (0 out of 7 samples)	9% (5 out of 54 samples)
Chloride	250**	100% (7 out of 7 samples)	91% (90 out of 99 samples)
Sodium	180**	100% (7 out of 7 samples)	92% (91 out of 99 samples)
Sulphate	250**	86% (6 out of 7 samples)	73% (71 out of 97 samples)
	500*	86% (6 out of 7 samples)	62% (60 out of 97 samples)
TDS	< 600 – good quality	0% (0 out of 7 samples has TDS <600)	7% (7 out of 99 samples have TDS <600)
	600-900 – acceptable based on taste	0% (0 out of 7 samples has TDS = 600-900)	1% (1 out of 99 samples has TDS = 600-900)
	900-1,200 – poor quality	0% (0 out of 7 samples has TDS=900-1,200)	0% (0 out of 99 samples has TDS=900-1,200)
	>1,200 – excessive scaling, corrosion, unsatisfactory taste	100% (7 out of 7 samples have TDS>1,200)	92% (91 out of 99 samples have TDS>1,200)
Fluoride	1.5*	50% (3 out of 6)	9.6% (8 out of 83 samples)
Copper	1**	20% (1 out of 5 samples)	0% (0 out of 102 samples)
	2*	0% (0 out of 5 samples)	0% (0 out of 102 samples)
Iron	0.3	N/A	59% (34 out of 57 samples)
Manganese	0.1**	N/A	63% (61 out of 96 samples)
	0.5*	N/A	41% (40 out of 96 samples)
Zinc	3	N/A	0% (0 out of 94 samples)
Nitrate	50*	N/A	NA
Lead (Pb)	0.01*	N/A	7.9% (5 out of 63 samples)
Arsenic (As)	0.01*	N/A	3% (2 out of 62 samples)

Notes: ADWG: Australian Drinking Water Guidelines (2011)
Monitoring data (2009-2013) provided by Umwelt/ NPM
* health value; ** aesthetic value;; ***TDS concentrations complying with standard

N/A – data not available

Data of pre-mining samples shown in this Table 17 are from the DDH and PDH bores (Table 17b, sample date 1983).

3.9 Item (ix) Section 7.3.2

(ix) Section 7.3.2.: Locations of proposed additional monitoring bores around the proposed waste facilities (Tailings Storage Facility [TSF] 3, new waste rock stockpiles) require detailing.

The following monitoring is recommended:

Additional monitoring bores will be installed around the proposed waste facilities (TSF3, new waste rock stockpiles) for the purpose of leak detection and for monitoring the potential impact to groundwater. Groundwater level and quality monitoring will be conducted adjacent to the water storage facilities to ensure the effectiveness of design, maintenance, and management. Monitoring recommendations include:

- Existing boreholes will be used, both up and down gradient of the storage facilities where possible, alternatively, new monitoring boreholes will be constructed. The monitoring network will be enhanced with installations of multi-level vibrating wire piezometers (VWP) style data loggers, in order to establish detailed vertical and horizontal hydraulic gradient profiles.
- If existing monitoring sites around the proposed waste facilities are destroyed or damaged during the mining operation, they will be replaced at an adjacent site.

4.0 RESPONSE TO REVIEW COMMENTS OF NSW DEPARTMENT OF PRIMARY INDUSTRIES (APPENDIX B WITHIN APPENDIX 10 OF THE EA)

4.1 Item (i)

(i) Bore licenses 80BL241019, 80BL24102, 80BL241023, and 80BL241020 are incorrectly described as dewatering purpose. According to Office of Water records these bores are currently licensed for monitoring purposes. Also, it is not clearly defined for what licenses 70SA009535 and 70AL600028 are to be utilized.

We have updated the existing water licences in the revised Table 1. Licence 70AL600028 is a River Water Licence.

Water Licence 70SA009535 (granted 6 May 1998) and Licence 70BL226867 are no longer active and have been removed from the following table.

Table 1: NPM Water Licences

Licence Type	Licence Number	Entitlement (ML/Year)
Bore licence – high security (Avondale, Bore 6) GW 700801	70BL226550	1600
Bore licence – high security (Avondale, Bore 7)	70BL230929	1600
Bore licence – high security (Avondale)	70BL229975	14
Bore licence – high security (Dawes, Bore 8)	70BL226584	1050
Bore licence – dewatering (E26 and E48)	80BL245448	232
Bore licence – dewatering (E22)	80BL245449	
Bore licence – dewatering (E27)	80BL245450	
Bore licence – monitoring (E22 Pit)	80BL241019	-
Bore licence – monitoring (E26 Pit)	80BL241042	-
Bore licence – monitoring (E27 Pit)	80BL241023	-
Bore licence – monitoring (E48 Pit)	80BL241020	-
River water licence – general	70AL600028	2976

5.0 RESPONSE TO REVIEW COMMENTS OF NSW DEPARTMENT OF PRIMARY INDUSTRIES (APPENDIX C WITHIN APPENDIX 10 OF THE EA)

5.1 Item (i) Section 2.2.1

(i) Section 2.2.1: Figure C8 - With the exception of monitoring bores W12 through W16 the overall trend is that computed drawdown's underestimate measured drawdowns. This implies any predictive runs from this model may underestimate impacts to groundwater pressures.

For reasons that will be outlined below, the model is suitable for:

- Calculating conservative estimates of projected groundwater inflow rates to the mine workings.
- Assessing the maximum impacts of mining-induced groundwater drawdown on wells located on surrounding properties.

1) <u>Calculation of conservative estimates of projected groundwater inflow rates to the mine workings.</u>

The early (pre-2007) computed hydraulic heads are higher than observed heads. Therefore, the computed hydraulic gradients behind the pit/lift walls are likely to be higher than the actual hydraulic gradients for most of the time. This implies that the computed pit-groundwater inflow rates are likely to be higher than the actual pit-groundwater inflow rates.

2) <u>Assessing the maximum impacts of mining-induced groundwater drawdown on wells located on surrounding properties.</u>

For most of the observation wells, the early (pre-2007) computed groundwater heads are higher than simulated heads. However, for most of the wells, including the wells in the vicinity of E26 (wells (P139 and P149), the simulated drawdown rate between 1994 and 2007 is higher than the observed drawdown rate. This suggests that the model can be used to provide conservative future projections of mining-induced groundwater drawdown.

5.2 Item (ii) Section 2.2.1

(ii) Section 2.2.1: Figure C8 – Requires addition of regularized data intervals for each plot, for example Jan 2005, Jan 2000, Jan 2005, etc.

We have revised Figure C8. Regularised data intervals (January 1994, January 2004, etc) were used for each plot. The starting date of mine operations was added to the graphs. The model starts on 1 January 1994. Monitoring in most of the bores started on 12 October 1995.

Please see the revised Figure C8(a to q) for the observed and computed heads at the sites W1, W2, W5, W12, W14, W15, MB1, MB2, MB4, MB5, MB10, MB13, MB14, P103, P104 and P139.

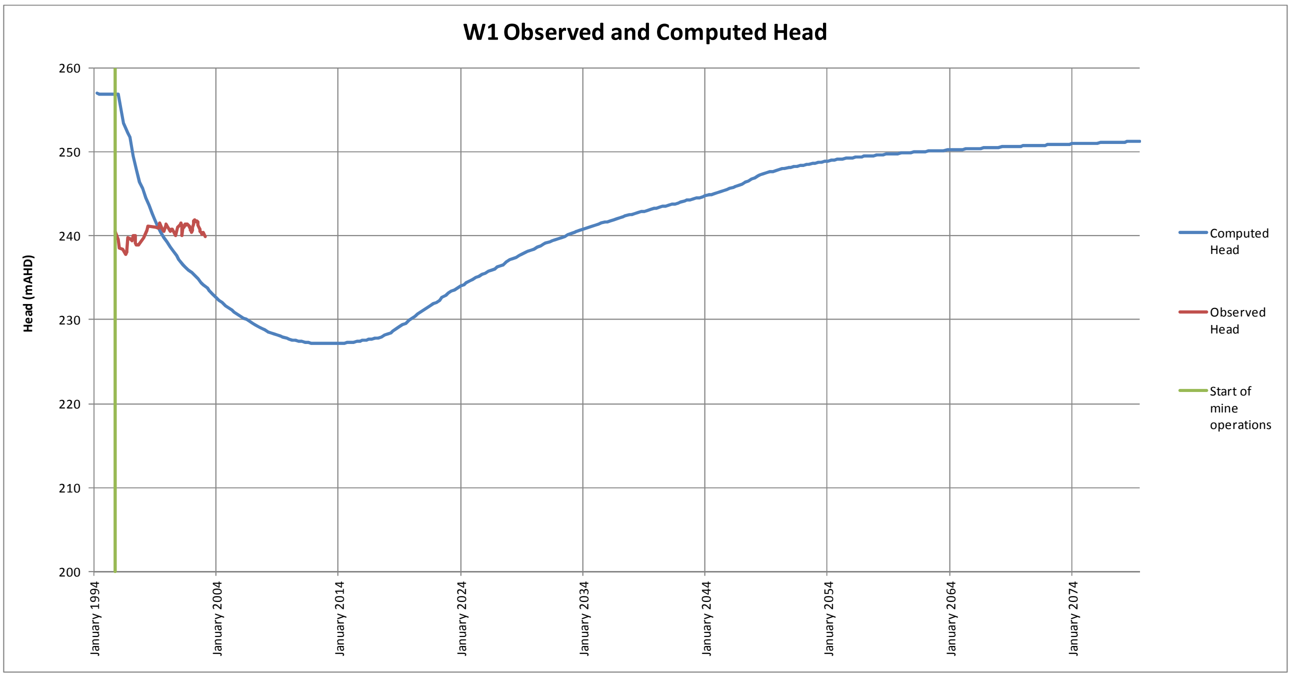


Figure C8a: Observed and Computed Head Hydrograph for Well W1

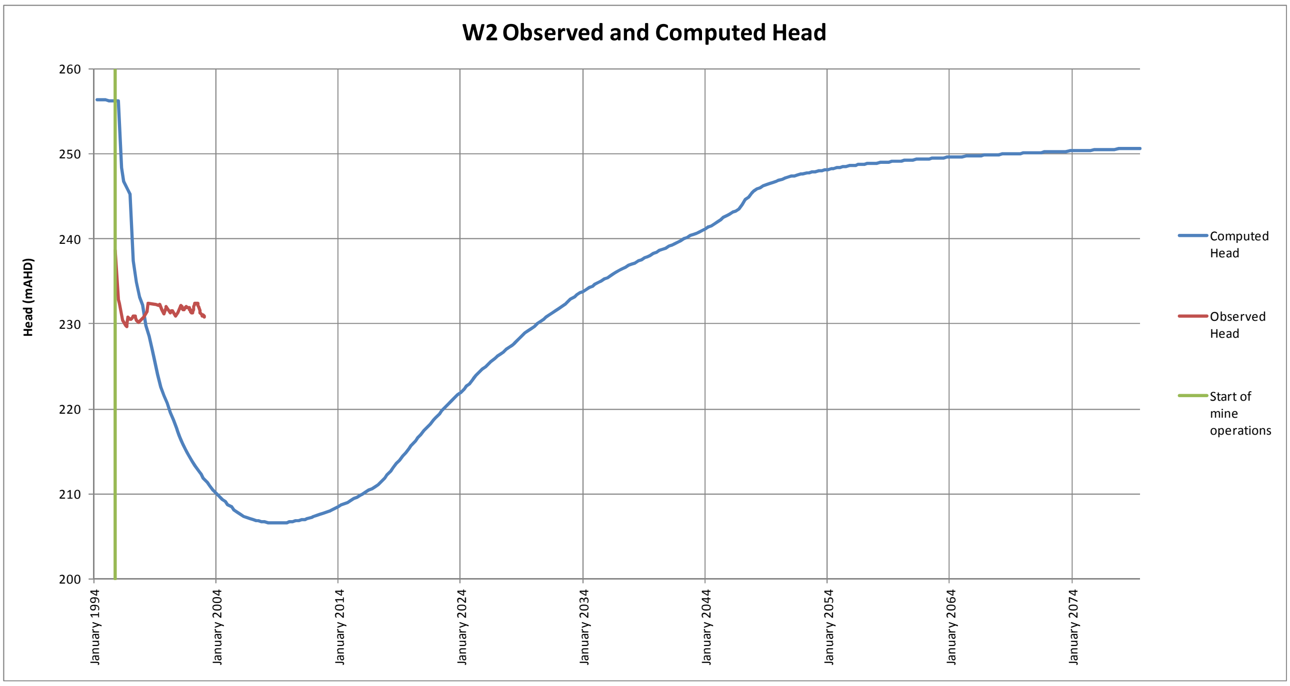


Figure C8b: Observed and Computed Head Hydrograph for Well W2

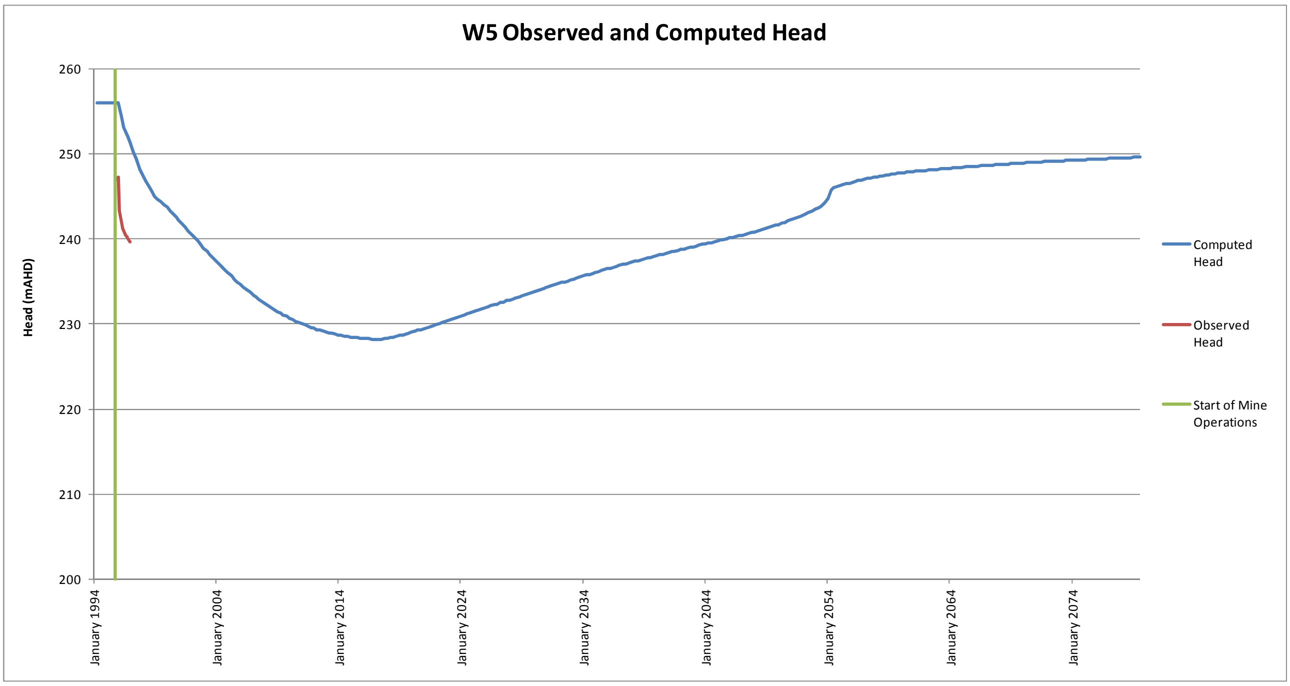


Figure C8c: Observed and Computed Head Hydrograph for Well W5

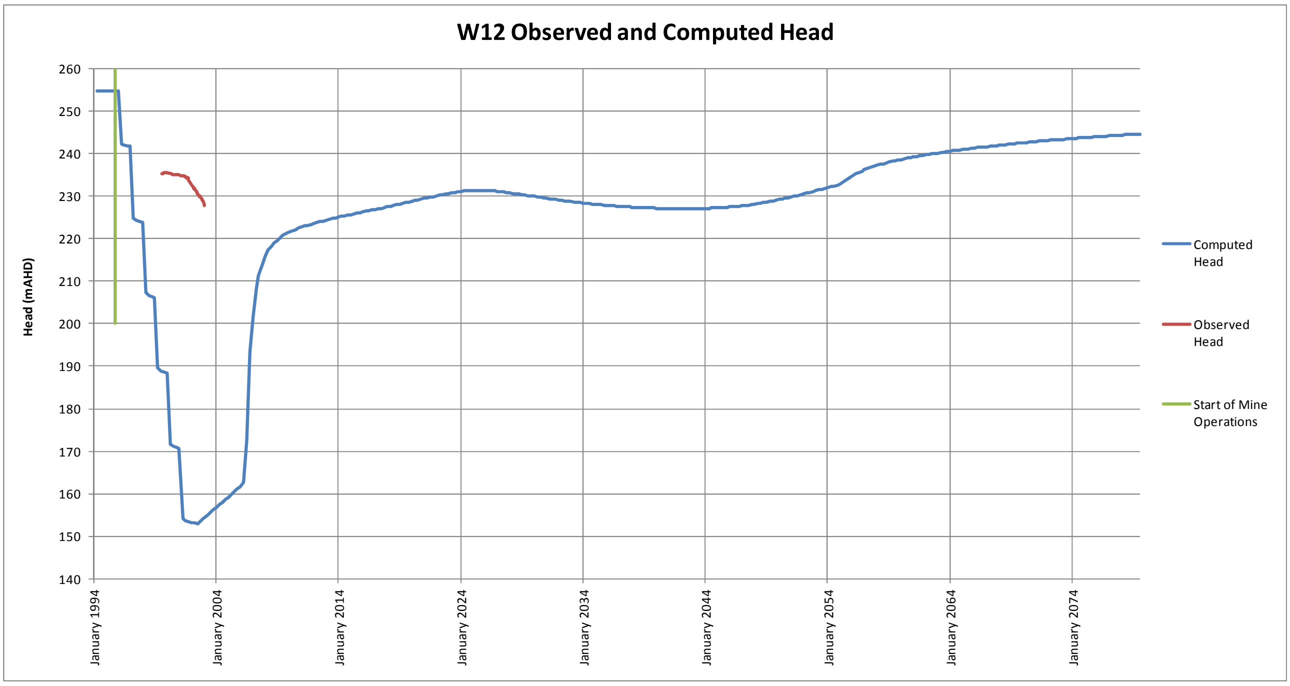


Figure C8d: Observed and Computed Head Hydrograph for Well W12

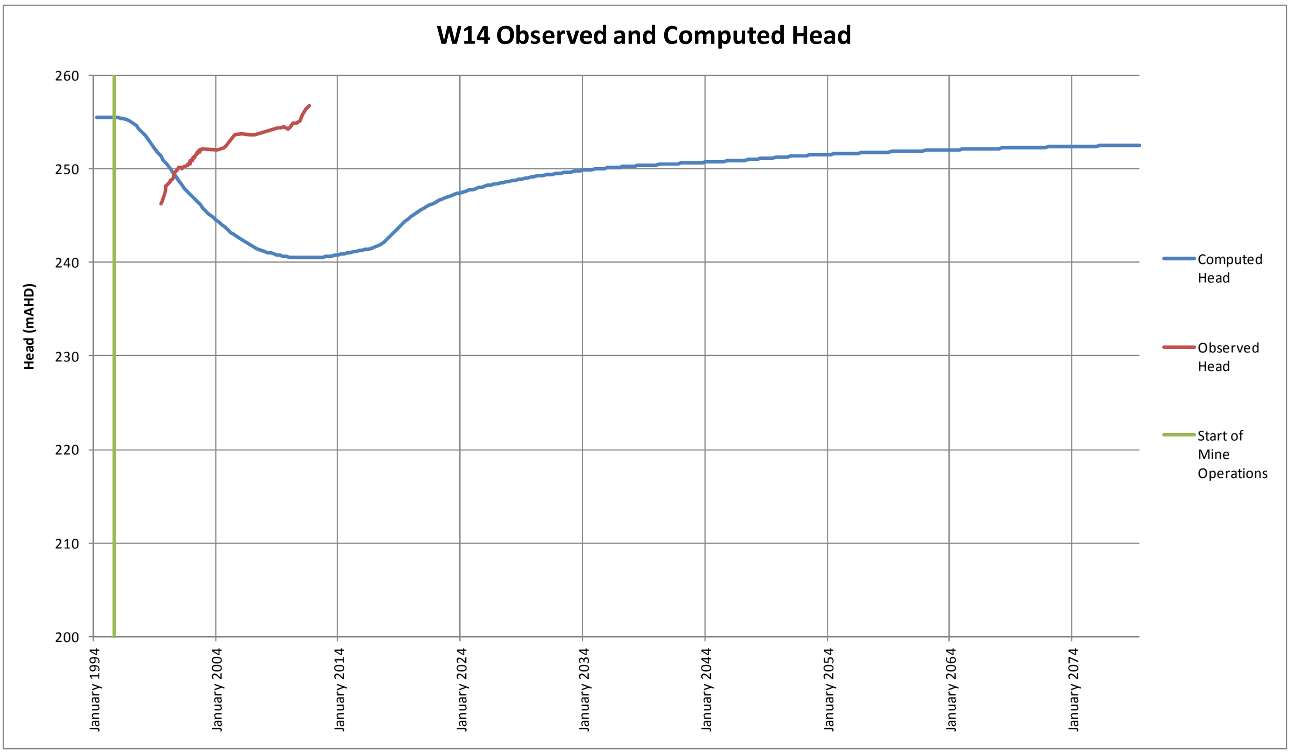


Figure C8e: Observed and Computed Head Hydrograph for Well W14

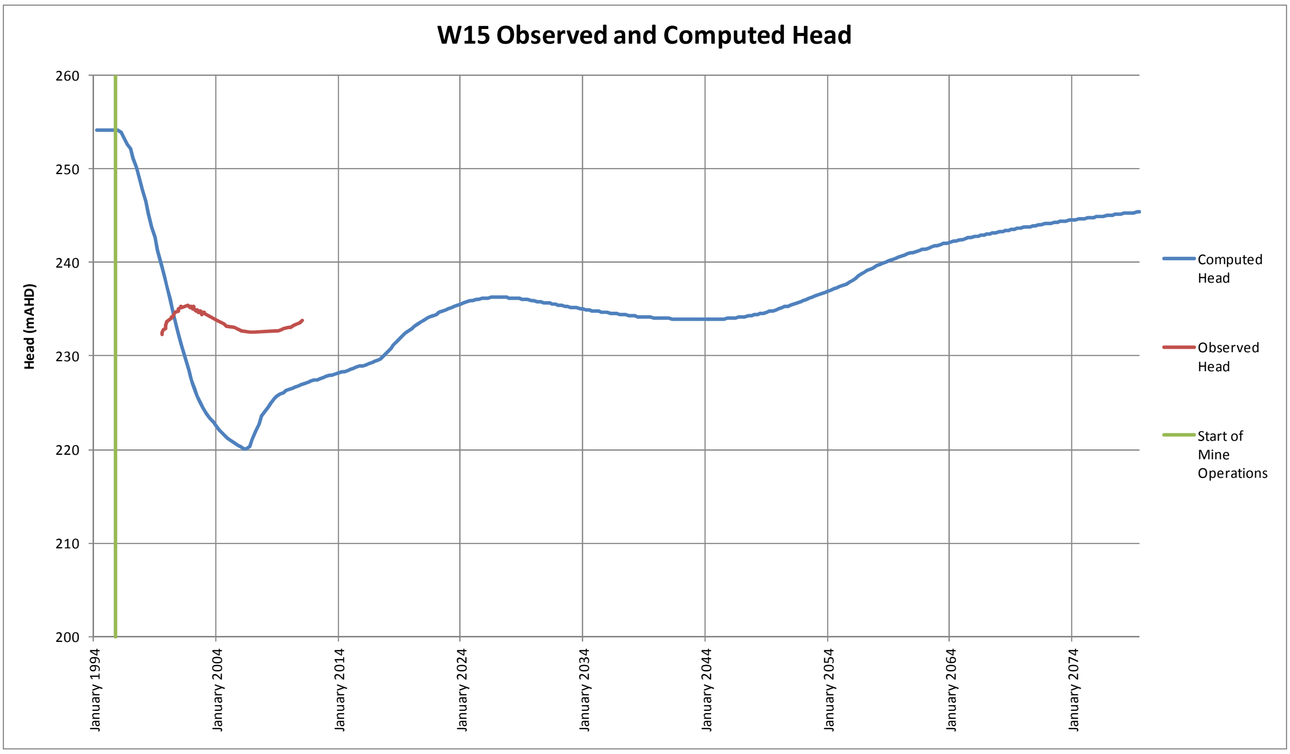


Figure C8f: Observed and Computed Head Hydrograph for Well W15

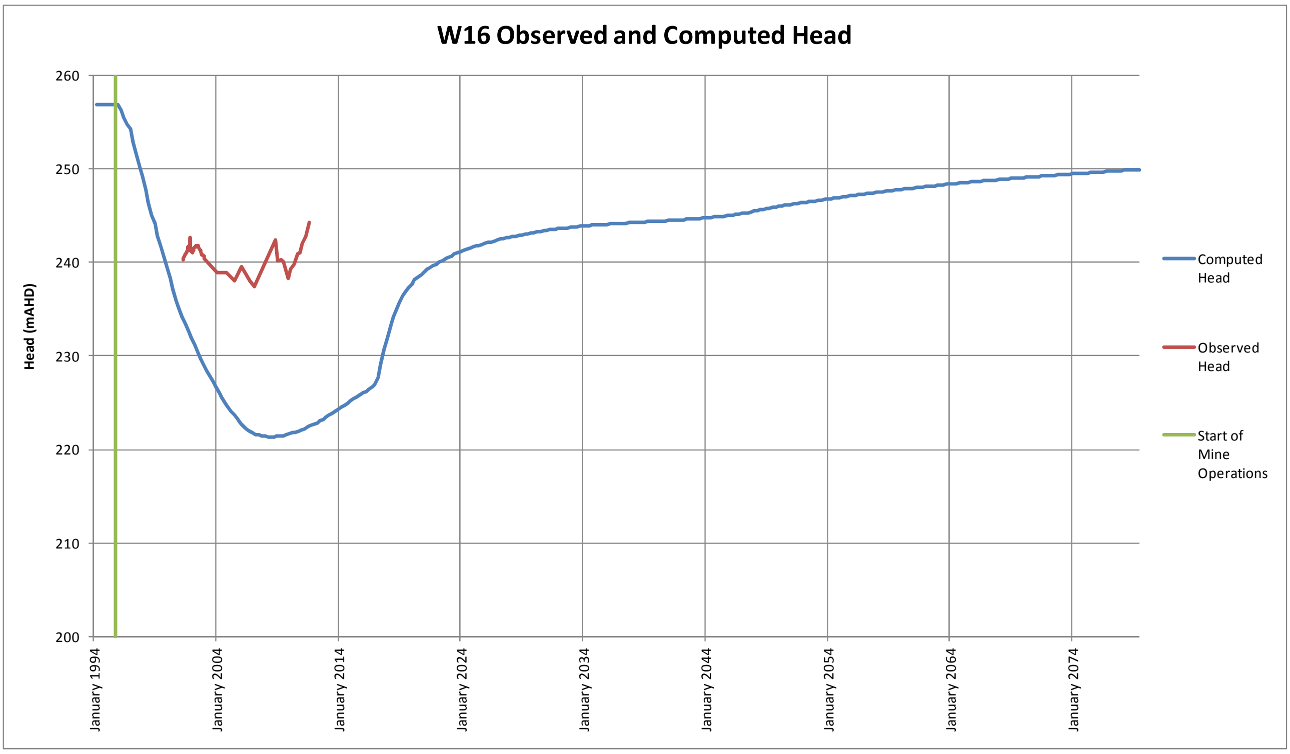


Figure C8g: Observed and Computed Head Hydrograph for Well W16

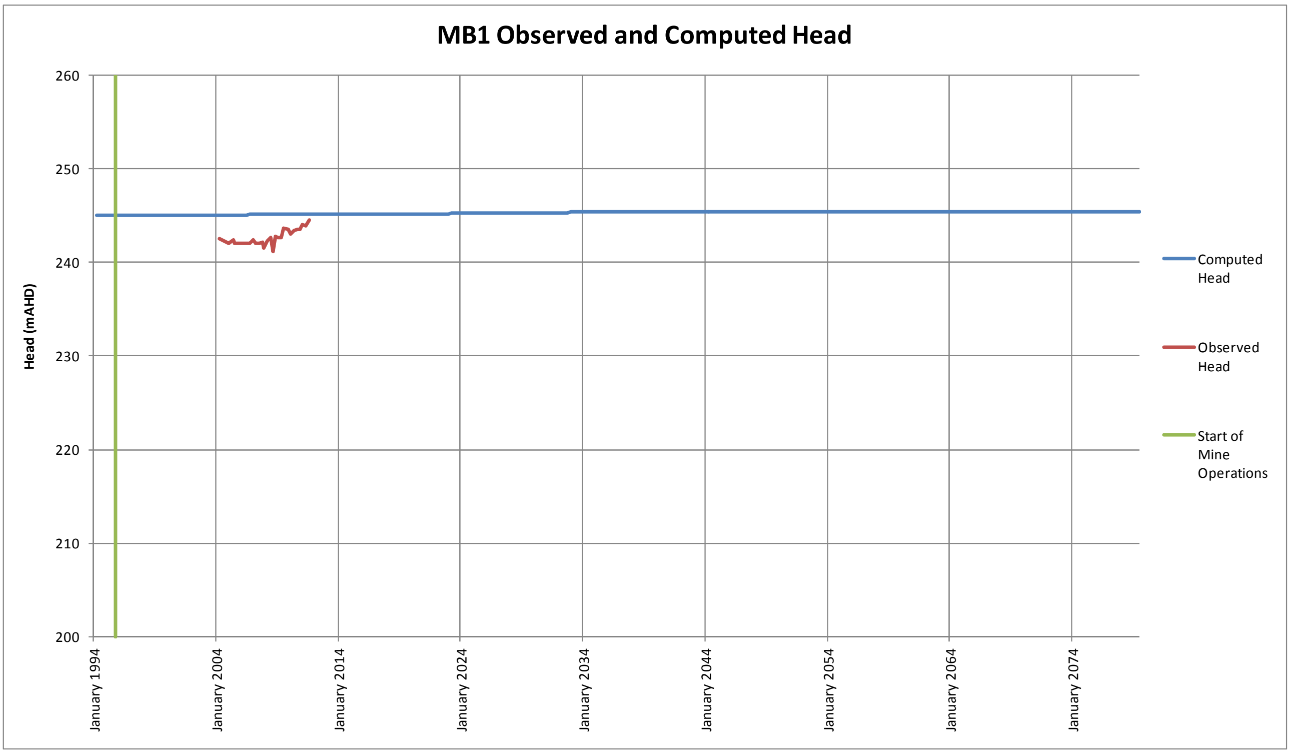


Figure C8h: Observed and Computed Head Hydrograph for Well MB1

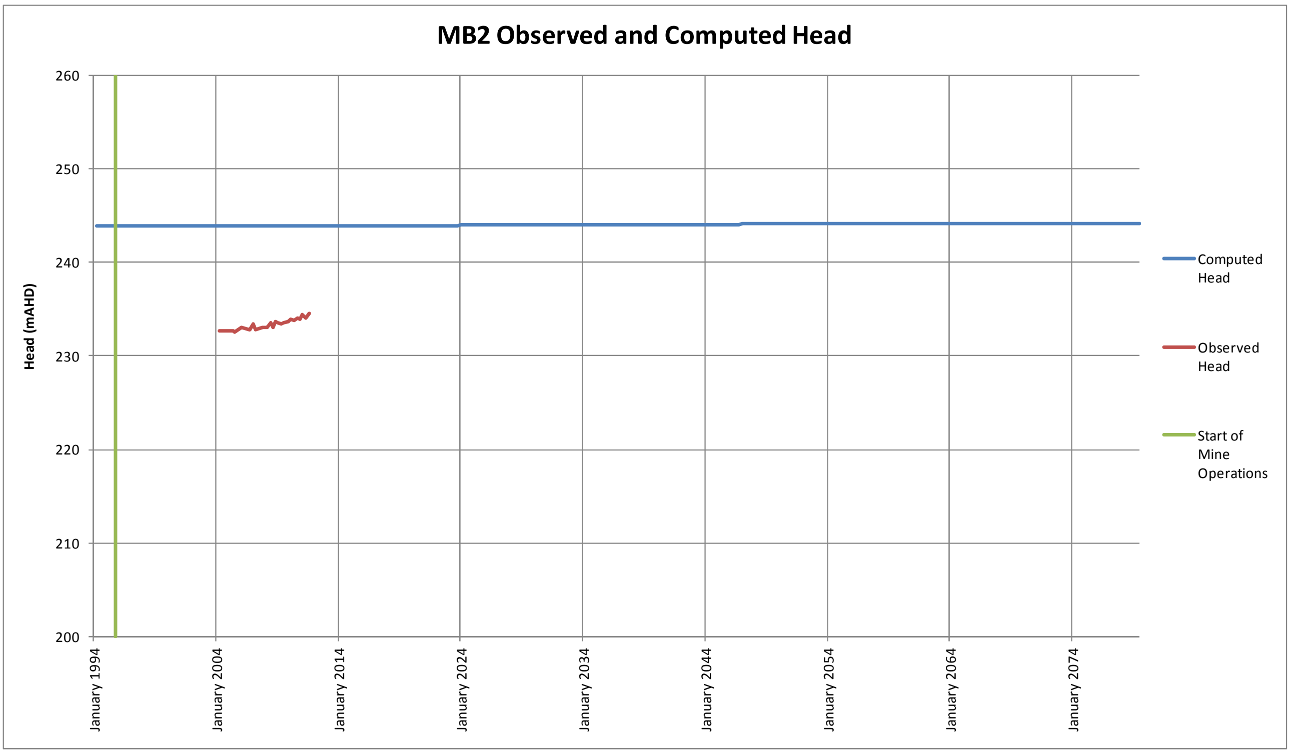


Figure C8i: Observed and Computed Head Hydrograph for Well MB2

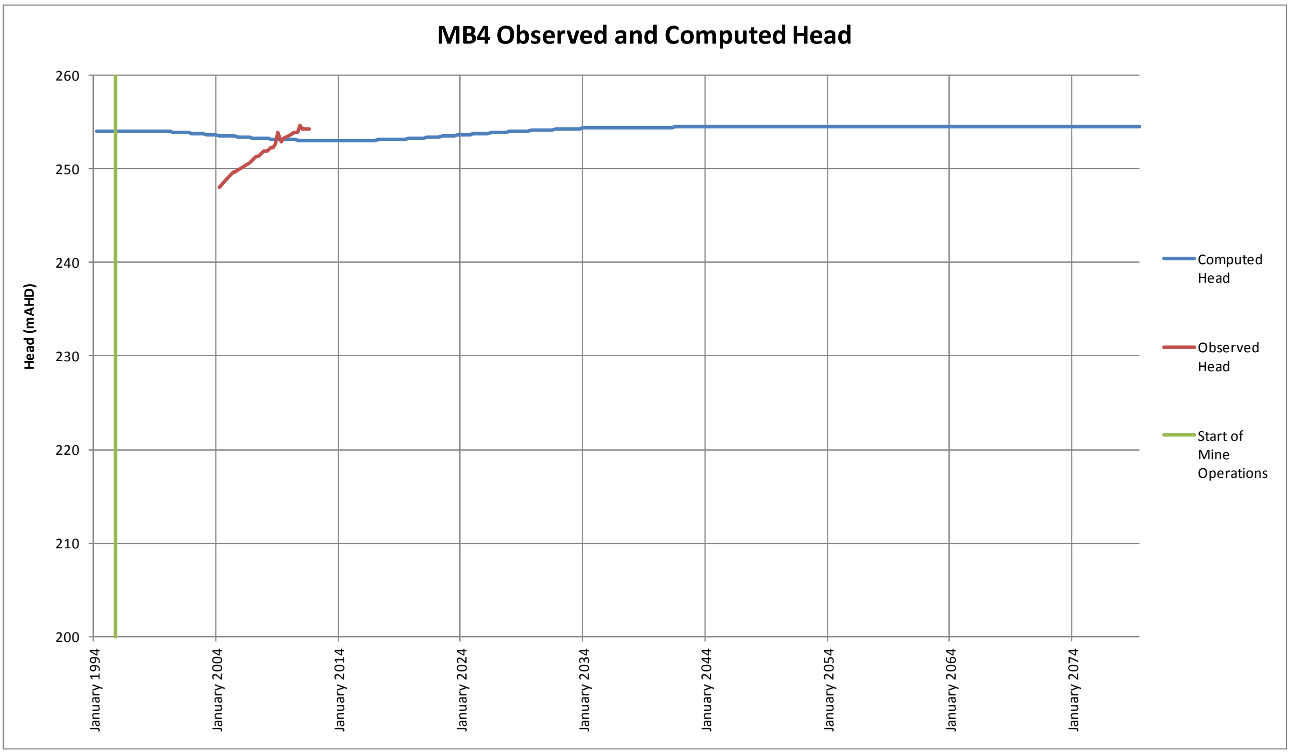


Figure C8j: Observed and Computed Head Hydrograph for Well MB4

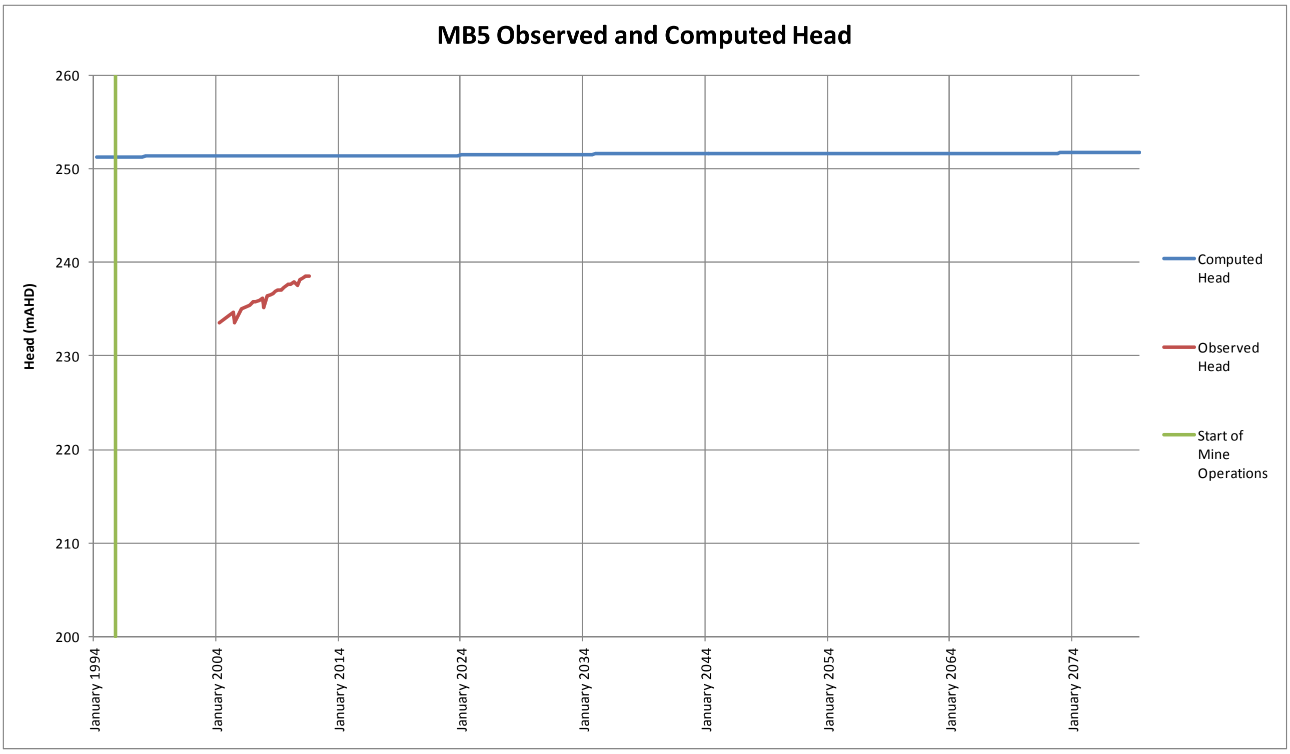


Figure C8k: Observed and Computed Head Hydrograph for Well MB5

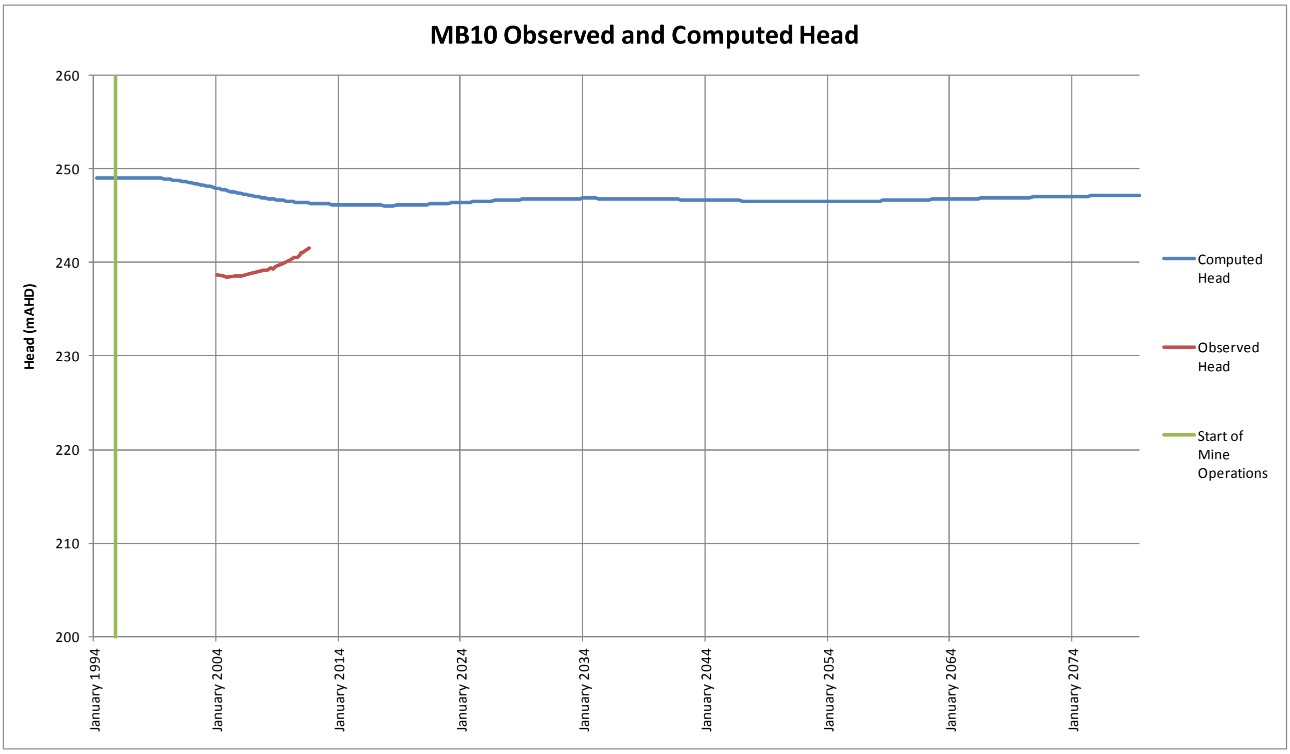


Figure C8l: Observed and Computed Head Hydrograph for Well MB10

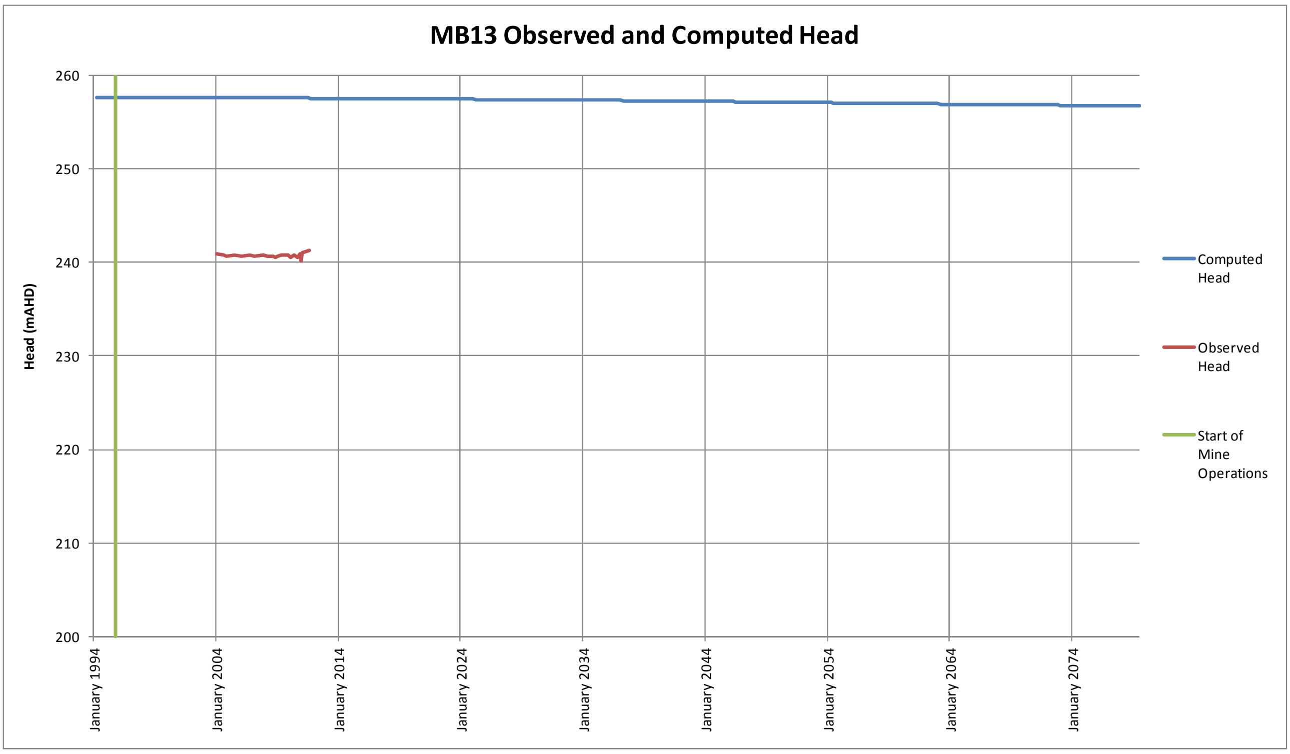


Figure C8m: Observed and Computed Head Hydrograph for Well MB13

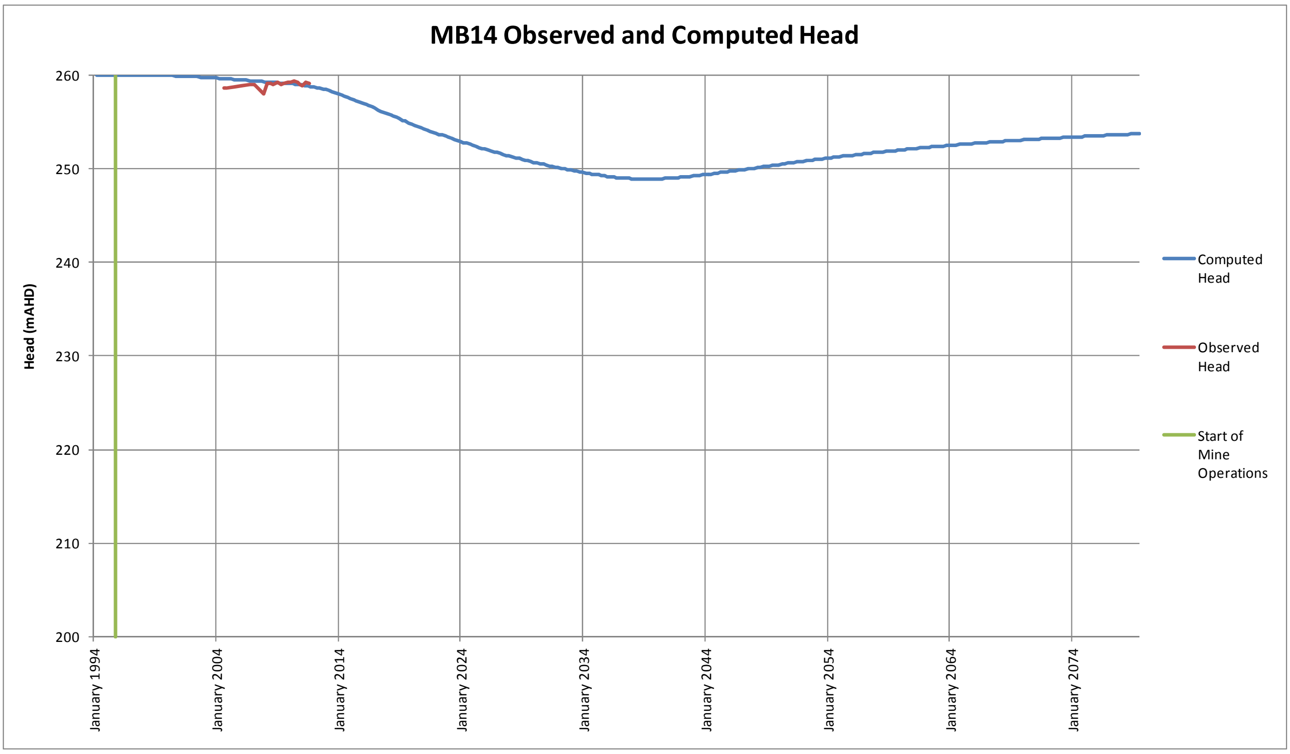


Figure C8n: Observed and Computed Head Hydrograph for Well MB14

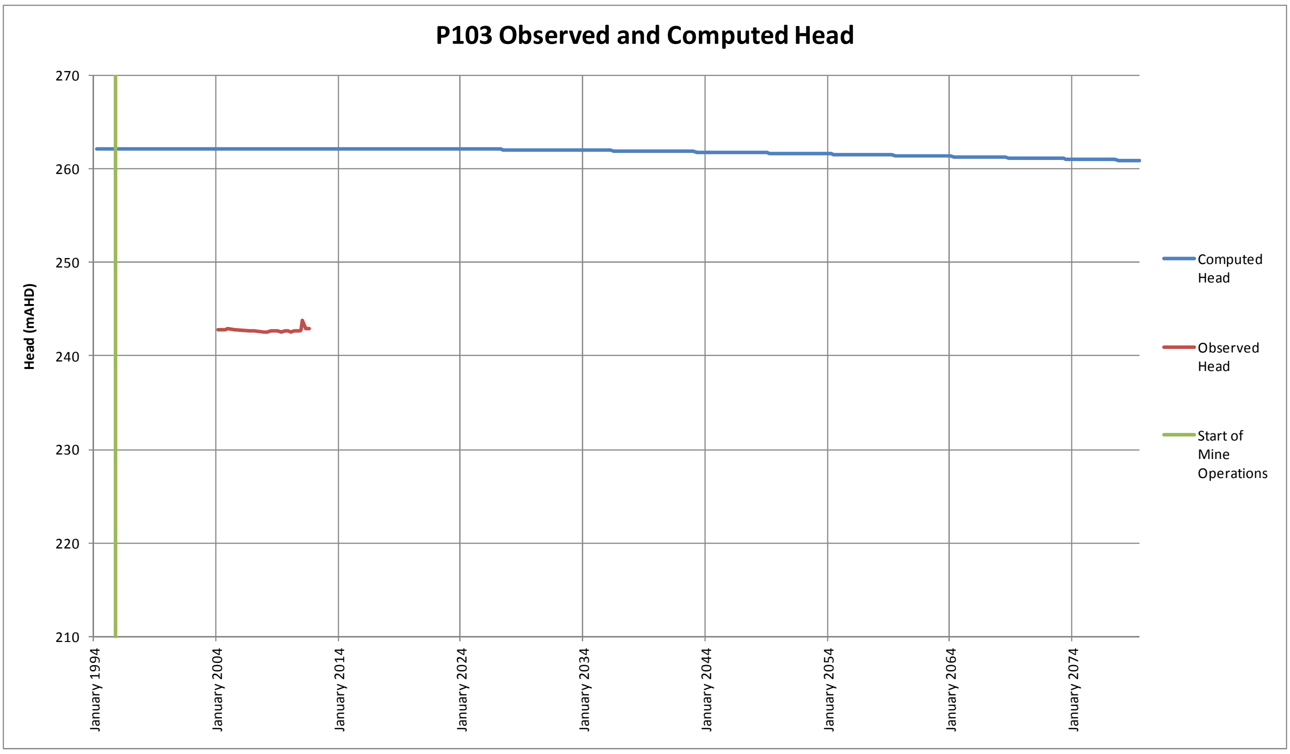


Figure C8o: Observed and Computed Head Hydrograph for Well P103

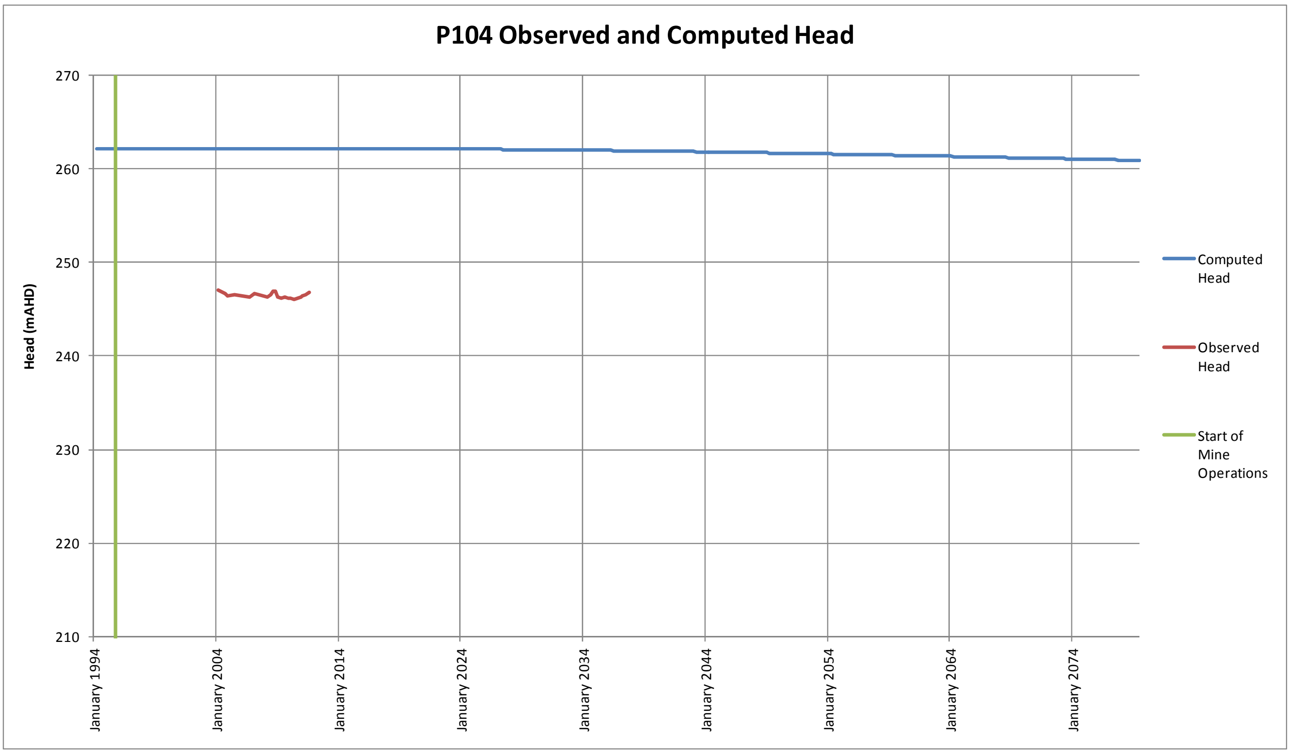


Figure C8p: Observed and Computed Head Hydrograph for Well P104

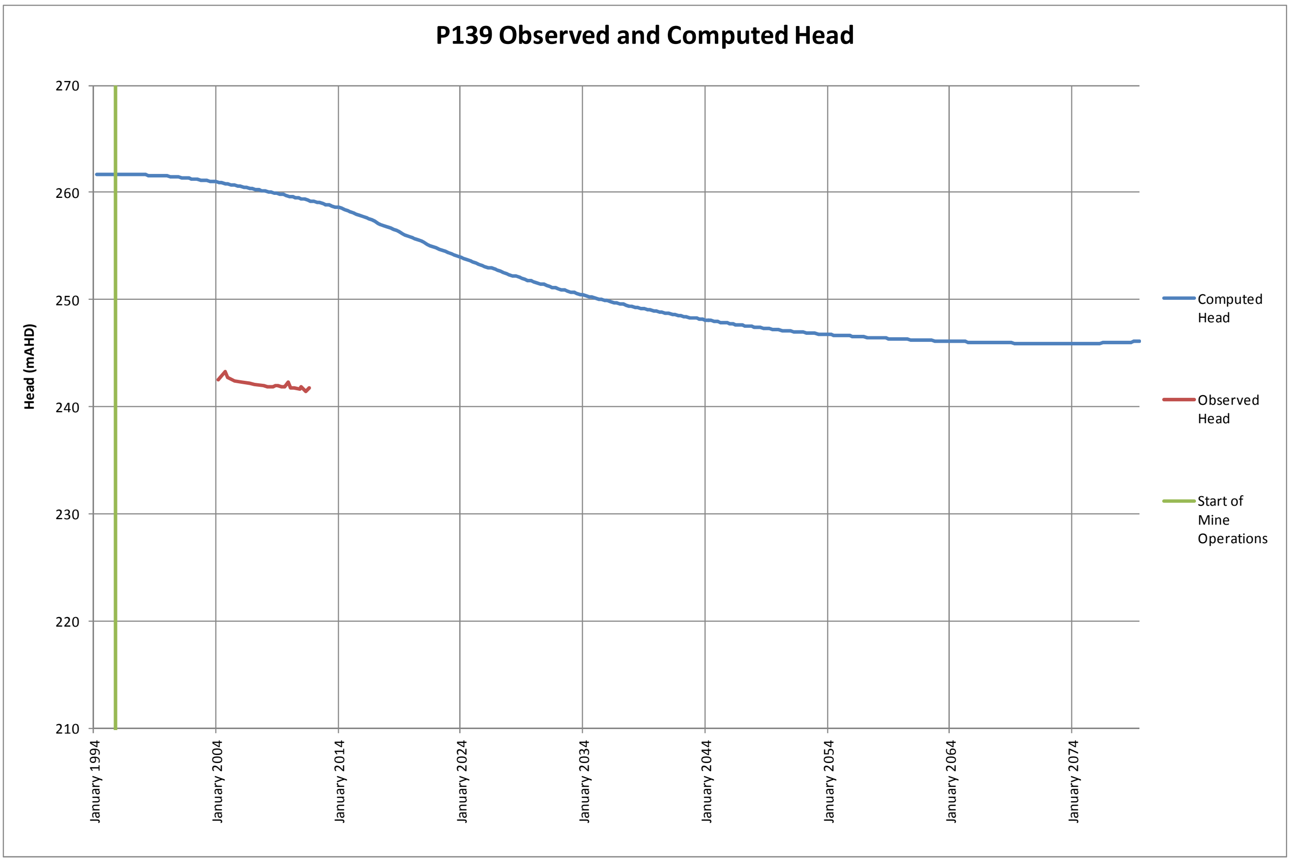


Figure C8q: Observed and Computed Head Hydrograph for Well P139

5.3 Item (iii) Section 2.2.1

(iii) Section 2.2.1: Figure C8 – Requires addition of events such as when mining starts to each plot.

Please refer to the revised Figure C8 in Section 5.2 of this memo.

We have revised Figure C8. The starting date of mine operations was added to the graphs.

Please see the revised Figure C8 (a to q) for the observed and computed heads at the sites W1, W2, W5, W12, W14, W15, MB1, MB2, MB4, MB5, MB10, MB13, MB14, P103, P104 and P139.

5.4 Item (iv) Section 2.2.1

(iv) Section 2.2.1: Figure C8 – Vertical scale requires division into reasonable sub-increments, for example 10 m or 20 m.

Please refer to the revised Figure C8 in Section 5.2 of this memo.

We have revised Figure C8. Vertical scale has been revised.

Please see the revised Figure C8 (a to q) for the observed and computed heads at the sites W1, W2, W5, W12, W14, W15, MB1, MB2, MB4, MB5, MB10, MB13, MB14, P103, P104 and P139.

5.5 Item (v) Section 2.2.1

(v) Section 2.2.1: Figure C8 – Asterisk assigned to select bores requires explanation.

Please refer to the revised Figure C8 in Section 5.2 of this memo.

We have revised Figure C8. The asterisks shown on Figure C8 of the GWIA Report are not relevant and we have removed them from the revised Figure in the memo.The asterisks have been removed.

Please see the revised Figure C8 (a to q) for the observed and computed heads at the sites W1, W2, W5, W12, W14, W15, MB1, MB2, MB4, MB5, MB10, MB13, MB14, P103, P104 and P139.

5.6 Item (vi) Section 2.2.1

(vi) Section 2.2.1: Figure C8 – Overestimation at bore W12 in excess of 80 meters of drawdown indicates calibration in immediate vicinity of E22 resource is poorly calibrated or vertical model profiling may require adjustment.

We have reviewed the observed head data at Well W12 and the computed heads for W12. There are a number of assumptions made when undertaking the numerical modelling and for the Project. Model assumptions should be considered when interpreting the modelling results. These assumptions are in addition to those given in MER (2006) and include the assumption that each operation continues to be dewatered. This is considered a conservative scenario in terms of inflows to the mine and extent of depressurisation as both results will be higher due to the potentially extended period of dewatering.

W12 is located in immediate vicinity of Pit E22 (see the revised Figure 9). NPM indicated that when mining operations at E22 ceased in 1998 (please refer to Table C2 of the GWIA Report), dewatering was stopped. Dewatering recommenced ahead of the second mining campaign in 2007, but since completion of that campaign in 2010, no further dewatering has occurred.

Since the pit was allowed to fill at the end of mining, groundwater levels would have been in recovery in the period from 1998 to 2007. However, in the groundwater model, mining operations (and hence dewatering activities) at E22 were assumed to continue until Year 2003 (please refer to Table 21 of the GWIA Report). This would explain why computed heads in Year 2001 are much lower than observed heads.

For the period between 1988 and 2007, the simulated hydraulic gradients behind the walls of Pit E22 were higher than the actual hydraulic gradients. This is because in the model simulation it has been assumed that the pit was empty when in actual fact, the pit would have been partly filled. Therefore, the simulated pit-inflow rates during this period were higher than the actual inflow rates. This approach results in conservative estimates of groundwater inflow rates to E22 during the period between 1988 and 2007.

5.7 Item (vii) Section 2.2.1

(vii) Section 2.2.1: Explanation or deletion of comment that groundwater pressure rise is evident from computed measurements in bores MB1, MB2, MB4, MB5, MB13 and MB14 is required. Figure C8 does not indicate level rise in these bores in its current format. In addition, monitoring bore MB10 is mentioned in this section but not included in Figure C8.

- We have included the hydrograph for MB10 in this memo (please refer to Figure C8l in Section 5.2 of this memo).
- The simulated heads at MB1 and MB2 have increased since 1994 (See Figure C8(h) and C8(i) in Section 3.4 of this memo). At both wells the simulated increase in heads from 1994 to 2013 has been less than 1 m. There has been an overall increase of approximately 2 m in observed heads at wells MB1 & MB2 between 2004 and 2012. Simulated heads are higher than observed heads at both MB1 and MB2. The difference between simulated and observed heads at MB1 decreases from approximately 3 m in 2005 to less than 0.5 m in October 2011. The difference between simulated and observed heads at MB2 decreases from approximately 12 m in 2005 to approximately 10 m in October 2011. Well MB1 and Well MB2 are located immediately to the north of TSF1 and, therefore, groundwater heads at these two wells are affected by the limited seepage of tailings water to the groundwater system. The embankments at NPM are not designed to be impermeable and they allow water to flow through for controlled collection and horizontal drainage (please refer to NPM’s response to the question regarding the Tailings Storage Facility Lining in Section 2.3.1.2 of the Response to Submissions Report).
- In the model simulation of groundwater levels at well locations MB4 and MB05, located to the east of TSF2, are not affected by seepages from TSF2.

- Simulated groundwater heads at MB14 decrease between 2001 and 2012 due to groundwater dewatering at E26. Please refer to Section 5.2.7 and Table 21 of the GWIA Report for the assumed simplified mine progression and dewatering activities.
- Simulated groundwater heads at MB13 decrease slightly between 2001 and 2012 due to groundwater dewatering at E22. Please refer to Section 5.2.7 and Table 21 of the GWIA Report for the assumed simplified mine progression and dewatering activities.

5.8 Item (viii) Section 2.2.1

(viii) Section 2.2.1: Table C7 Model layers require depth intervals (in meters).

The thickness (in meters) and mean top elevation (in mAHD) for each model layer are shown in Table C4. As requested, we have added the depth intervals (in meters) to Table C7.

Revised Table C7: Calibrated Hydraulic Parameters for the Project Model

Strata / feature	Model Layers	Model Layer/s Thickness (m)	Horizontal Hydraulic Conductivity: Kxy (m/d)	Vertical Hydraulic Conductivity: Kz (m/d)	Specific Storage (Ss)	Specific Yield (Sy)
Regolith	1	53m (variable) average thickness of 50m	$9.0x10^{-3}$	$9.0x10^{-4}$	$5.0x10^{-4}$	0.15
Caved Zone	1	53m (variable) average thickness of 50m	$6.0x10^{-3}$	$6.0x10^{-3}$	$9.0x10^{-4}$	0.0015
Open Pit Zone	1 to 4	0 to 234m (48mAHD)	0.1	0.1	$5.0x10^{-4}$	0.15
Bedrock: Saprock/OTZ and the top of the moderately fractured bedrock	2 to 4	229m (variable)	$1.0x10^{-3}$	$1.0x10^{-3}$	$7.5x10^{-4}$	0.015
Enhanced k features in vicinity of E22 and E26	2 to 4	229m (variable)	$6.0x10^{-3}$	$6.0x10^{-3}$	(as bedrock layers: 2 to 4)	
Low k fault to south of E26	2 to 4	229m (variable)	$1.0x10^{-6}$	$1.0x10^{-6}$		
Mineralized zone	2 to 12	829m (variable)	$9.0x10^{-4}$	$9.0x10^{-4}$	(As bedrock of corresponding layers)	
Bedrock: moderately fractured	5 to 10	450m	$9.0x10^{-5}$	$9.0x10^{-5}$	$7.5x10^{-4}$	0.015
Bedrock: occasionally fractured	11 to 17	755m	$7.0x10^{-6}$	$7.0x10^{-6}$	$8.0x10^{-4}$	0.0015

Notes:Refer to Table C4 for more information about the layer thickness
* As the hydraulic parameters of the caved zone are not well defined, conservative values were selected

5.9 Item (ix) Section 2.2.1

(ix) Section 2.2.1: If any parameters presented in Table C7 have been verified with aquifer testing analysis, explanation is required.

Model parameters presented in Table C7 were defined based on calibrated model values from MER (2006) and corroborated with other previous modelling and site investigation data at NPM. Please refer to Table 10, Table 11, Section 4.6.4 Hydraulic Parameters and Table 20 in Section 5.1 Conceptual Groundwater Model of the GWIA Report.

5.10 Item (x)

(x) Inadequate existing monitoring information utilization in the MODFLOW model both east and west of the proposed extension to the E26 resource. As indicated from Figure C7 monitoring bores MB 19/20 to the east of E26 and P139 west of E26 were not utilized as "observation" bores in the model.

Well P139

- Simulated groundwater heads at P139 clearly indicate a reduction in groundwater heads in response to dewatering (Please refer to Figure C8(r) below).

Well MB19 and MB20

- At the time the model was prepared, the bore depths and screen depths for MB19 and MB20 were not provided to Golder; therefore, these observation bores were not incorporated into the model. This information is available now and can be included as part of the ongoing operations model in the future.

Well P149

A graph of observed and computed heads at P149 is provided in Section 2.8 of this memo. An analysis of the results indicates the following:

- There is no record of pre-mining groundwater level monitoring at P149 for calibrating. The groundwater level monitoring data is from 2004 onwards.
- The initial simulated drawdown rate is comparable to the initial observed drawdown rate.

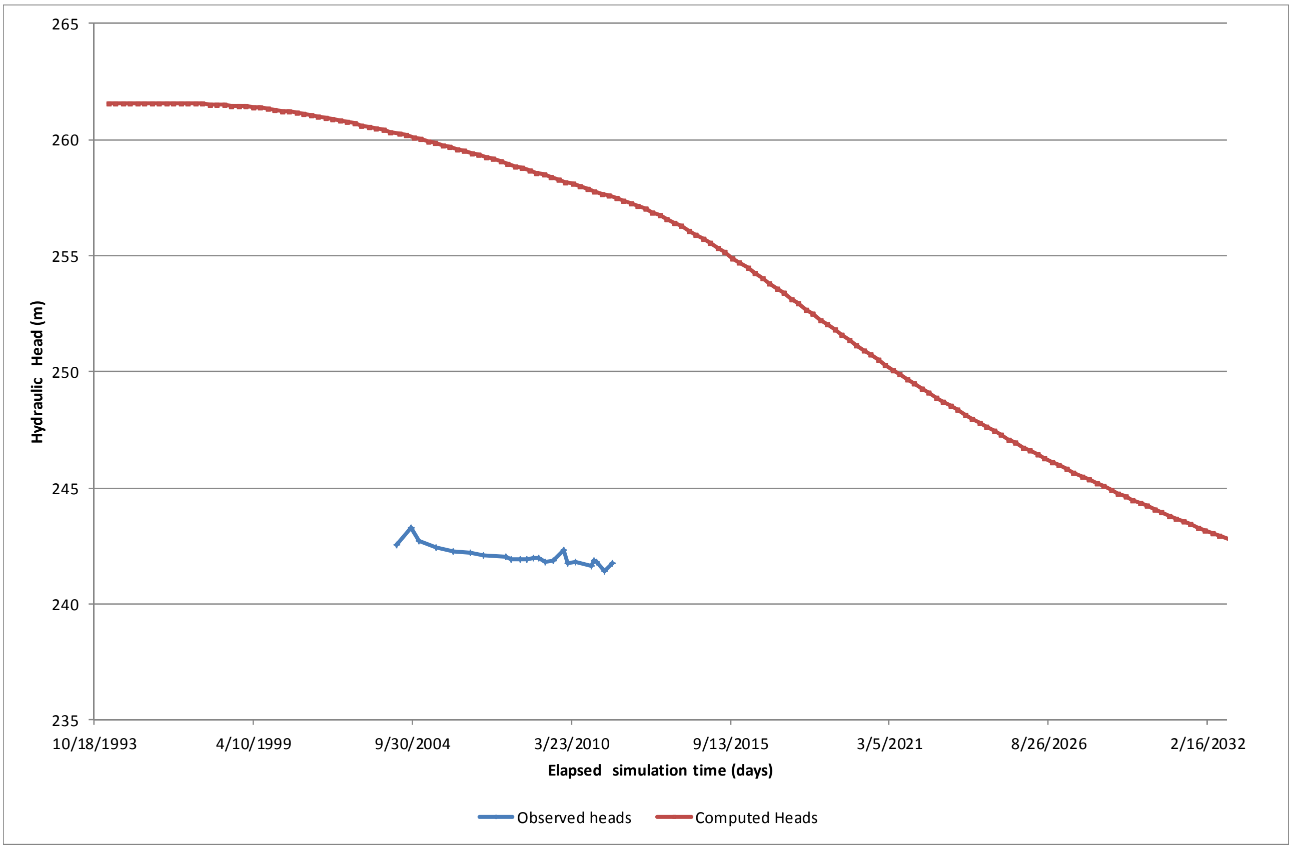


Figure C8r: Observed head and computed head at P139

6.0 RESPONSE TO REVIEW COMMENTS OF NSW ENVIRONMENTAL PROTECTION AUTHORITY, ATTACHMENT A

The comments in the NSW EPA review letter dated 20 August 2013 (Reference Number LIC07/80-12) are presented below in bold italics. Golder's responses follow.

The EPA requests the EA include an assessment of the potential for contaminated water and groundwater impacts on local surface water resources for all downstream uses.

There is no measureable groundwater impact on the surface water resources within, and in the vicinity of, the Project Area as a result of the Project activities. The groundwater levels are below the base of the creek (MER, 2006). Due to the depth of encountered groundwater, it is inferred that the nearby streams and/or river tributaries do not have baseflow conditions.

As discussed in the GWIA Report, the Bogan River and associated tributaries were considered not to be in hydraulic continuity with the groundwater. The local surface water bodies are ephemeral (PB, 2003) and inferred to receive no baseflow contribution from groundwater. This is replicated in the model as the water table does not intersect the upper surface of the model at any point. MER (2006) concluded that:

"Impact of sub-surface depressurisation on surface drainages including the Bogan River is predicted to be negligible. Based on the interpolated regional groundwater table, an unsaturated zone prevails between local drainages and deeper groundwater within the regolith. This zone is of the order of 30m. With the exception of bank storage, this scenario represents an influent river. Any increase in the depth to groundwater as a result of mining operations would not affect the leakage rate from the river channel and tributaries in a measurable way."

There may be potential for spills and contamination by metals and hydrocarbons from mine workshop, waste disposal and fuel storage areas; however adequate bunding to the relevant Australian Standards and immediate clean-up of spills which is standard practice and/or a legislated requirement at mine sites, should prevent contamination of shallow strata and/or runoff to local surface water bodies.

Geochemical testing work conducted by NPM has identified no potential for Acid Rock Drainage (ARD) development from the open pits and tailings disposal areas (NPM, 2003). The assessment of Acid Rock Drainage and Control carried out by Rio Tinto (2011) indicated that there is no significant risk in relation to acidic drainage and ARD is unlikely to have adversely impacted regional water quality.

The waste containment dams will be sized to prevent overflow and adhere to regulations, which require the consideration of flood events, and constructed to limit or prevent underground leakage. There will be careful site design and planning to ensure that the subsidence zone does not encroach on the current and proposed tailings and water storage facilities. This prevention/ management measures will reduce the potential for uncontrolled seepage of contaminated water and/or runoff to local surface water bodies.

The groundwater monitoring plan should assess the need for specific monitoring bores and depths established for the purpose of leak detection. There may be preferential pathways in upper strata layers which should be targeted if deemed necessary with consideration to the site specific hydrogeology.

The following monitoring is recommended:

Additional monitoring bores will be installed around the proposed waste facilities (TSF3, new waste rock stockpiles) for the purpose of leak detection and for monitoring the potential impact to groundwater. Groundwater level and quality monitoring will be conducted adjacent to the water storage facilities to ensure the effectiveness of design, maintenance, and management. Monitoring recommendations include:

- Existing boreholes will be used, both up and down gradient of the storage facilities where possible, alternatively, new monitoring boreholes will be constructed. The monitoring network will be enhanced with installations of multi-level vibrating wire piezometers (VWP) style data loggers, in order to establish detailed vertical and horizontal hydraulic gradient profiles.
- If existing monitoring sites around the proposed waste facilities are destroyed or damaged during the mining operation, they will be replaced at an adjacent site.

Further assessment is required to identify whether the existing groundwater monitoring network is sufficient in detecting leakage from TSF's and other contaminated water structures and to identify the need for additional monitoring at different monitoring locations and depths. The findings of the assessment should form part of a revised groundwater monitoring program for the site as recommended in Attachment B.

Golder assessed the existing groundwater monitoring network at the mine site to identify the need for additional monitoring sites. In addition to the existing groundwater monitoring bores shown in the GWIA Report (refer to Table 12 and the revised Figure 9), NPM also has a comprehensive regional monitoring network as summarised in Table 17 and the attached spreadsheet. Spatial distribution of available groundwater quality data (TDS, As, Pb, and Zn) of the regional and mine monitoring sites can be viewed in Figure 16b and Figure 16c.

It is assessed that the existing groundwater monitoring data suites are adequate. NPM has been collecting field parameters (pH and electrical conductivity) and a comprehensive laboratory monitoring suite including pH, TDS, turbidity, alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, fluoride, aluminium, arsenic, strontium, barium, beryllium, cadmium, cobalt, uranium, chromium, copper, thorium, manganese, molybdenum, nickel, lead, antimony, selenium, tin, thallium, zinc, iron, mercury, fluoride (please refer to Section 3.5 of this memo).
As described in Section 7.3.2 of the GWIA Report, additional monitoring is recommended.

- Extended monitoring would be triggered if monitoring data in the existing monitoring network (sites MB1 and MB10 located north of TSF1 and RP3 located south of the Wombin State Forest) suggests a variation from the predicted modelling results. Monitoring site located in the area between the Wombin State Forest and to the north of TSF1 may be considered depending on the data review within one year of the Project commencement.

- Additional monitoring bores will be installed around the proposed waste facilities (TSF3, new waste rock stockpiles) to monitor the potential impact to groundwater. Groundwater level and quality monitoring is required adjacent to the water storage facilities to ensure the effectiveness of design, maintenance, and management. Monitoring recommendations include:
  - Existing boreholes should be used, both up and down gradient of the storage facilities where possible, alternatively, new monitoring boreholes should be constructed.
  - If existing monitoring sites around the proposed waste facilities are destroyed or damaged during the mining operation, they will need to be replaced at an adjacent site.
- The existing groundwater monitoring program, both in monitoring bores and from groundwater inflows to the mine, will be maintained as part of the overall mine environmental monitoring. This would assist in the further assessment of groundwater flow, water quality and allow the groundwater hydraulic model to be refined.

Item 4(i): "…justify the confidence classification and its suitability for the proposed development according to the AGMG"

The modelling is deemed to satisfy the requirements of a Class 2 model as described in the Australian Groundwater Modelling Guidelines, and outlined in Table 2-1 of the guidelines. Specifically:

<u>Data</u>

- Groundwater pressure data and borehole logs were accessed and documented for model calibration purposes.

<u>Calibration</u>

- A calibration process was undertaken on the model, followed up by a validation process.
- The calibration / validation process covered a observation record from 1994 to 2011.
- The transient record was adequately simulated through to 2011, which is effectively present day.
- The long-term trends were acceptably replicated in the sections of the model for which observation data is available for calibration.

<u>Prediction</u>

- The prediction period is out to 2032. This period is approximately the same as the calibration period.
- The major hydraulic stress period simulated has already passed (during 2013).

<u>Key indicators</u>

- Mass balance closure indicator is <1% of the total.
- The model predictive timeframe is of the same duration as the calibration period.
- The mass parameters applied to the model are reasonably consistent with the conceptualisation.
- The spatial refinement of the model grid in the critical areas is acceptable for the purposes of the model.
- The temporal discretisation is the same for the calibration period as for the prediction period.
- The maximum stress point has already passed, so future stresses do not exceed those already observed.

The reasonable calibration achieved with the more recent observation data indicates the model can be used to predict future behaviour of the groundwater system due to the proposed mine development.

7.0 REFERENCES

Golder, 2013. Northparkes Mine Step Change Project Groundwater Impact Assessment Report. Report Number 117626007-007-Rev1

MER, 2006. Northparkes Mines E48 Project: Groundwater Studies. In Northparkes Mines E48 Project Environmental Assessment, R.W. Corkery, 2006. Mackie Environmental Research , April 2006.

Parsons Brinkerhoff (PB), 2003: Northparkes Mine In-Pit Tailings Disposal Hydrogeology.

Rio Tinto Technology and Innovation (RTTI), 2011; ARD (Acid Rock Drainage) Risk Review – Northparkes. Dated 22 August 2011.

Ryan, 2003; Geochemical Assessment and Acid Rock Drainage background, results and report summaries. Northparkes Mine report.

8.0 LIMITATIONS

Your attention is drawn to the document - "Limitations", which is included as Attachment B. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

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SD/MN/DB/js

Attachments: A1 – Pre-Mining Water Quality Data
A2 – During-Mining Water Quality Data
B – Limitations

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Attachment A1 – Pre-Mining Water Quality Data

Sample ID	Bore ID	Sample Date	Northing	Easting	Completed Bore Depth	Data-Source	Location	pH_lab	Cond	TDS	Ca	Mg	Na	K	Cl	HCO3	SO4	F	Cu_tot	Meas_ Hardness	Calc. Total Hardness	Si_tot
			m	m					uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DDH3	DDH330666	16/12/1983				GEOPEKO	Cross Gradient	7.3	2100	1460	115	100	245	21	460	630	11	70	1.2		697.5	
DDH30	DDH3030666	16/12/1983			49.23	GEOPEKO	Cross Gradient	7.3	4200	23820	94	1060	6450	24	11120	275	3170		0.96		4581	7
DDH7	DDH730666	16/12/1983				GEOPEKO	Cross Gradient	7.5	5900	4210	370	264	590	22	1690	365	580	57			2007.4	7.6
PDH18	PDH1830666	16/12/1983			41.5	GEOPEKO	Cross Gradient	7.3	42000	24640	870	1170	6200	30	11400	380	3230	6	0.1		6972	
PDH26	PDH2630666	16/12/1983			35.67	GEOPEKO	Cross Gradient	7.3	17100	10410	1300	129	2100	6.6	5420	72	900	1.2	0.12		3778.9	
PDH70	PDH7030666	16/12/1983			35.55	GEOPEKO	Cross Gradient	7.2	48000	26950	128	1180	6900	29	12600	240	3810	0.32	0.12		5158	14
PDH72	PDH7230666	16/12/1983			42.17	GEOPEKO	Cross Gradient	7.8	48000	28440	84	1340	7300	27	13270	275	3790				5704	13
GW017192		23/04/1958	613028	6344417	57.9	NOW (Kenneth)	Up Gradient	6.8	1280											480		
GW045589		25/06/1964	592688	6347124	20	NOW (Kenneth)	Up Gradient	6.8	5340											1250		
GW048731		30/10/1978	594161	6341074	20.6	NOW (Kenneth)	Up Gradient	7.3												750		
GW058224		11/04/1982	592623	6348480	20.7	NOW (Kenneth)	Up Gradient	7.24	4830	3091	224.9999	202.6	518.2998	1.1999								
GW045591		21/01/1957	593719	6346375	20	NOW (Kenneth)	Up Gradient	6.7		2248					738.5888							
GW001827		2/10/1979	593293	6345209	26.8	NOW (Kenneth)	Up Gradient	7.6	1170		51	53	170.0002	1.9999	94.9999	743.6						
GW050025		8/03/1979	591011	6345292	24.2	NOW (Kenneth)	Up Gradient	6.6	5200		413.9999	250	409.9996	3	1199.999	981.5						
GW036927		5/11/1993	591088	6346140	75	NOW (Kenneth)	Up Gradient	7.6	1070	685		31.5	110	6.6	60	628.3		0.6				
GW002920		-	590413	6347977	35.4	NOW (Kenneth)	Up Gradient			10071					4200.642	899.3						

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Attachment A2 – During-Mining Water Quality Data

SampleID		Sample_Date	Y	X	Completed Bore Depth	Location	pH_lab	Cond	TDS	Ca	Mg	Na	K	Cl	HCO3	SO4
			m	m				uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
MB1	MB139814	1/01/2009	599101	6360398	36.5	Cross Gradient	7.52	3570	2060	60	83	655	5	684	1163.88	48
MB1	MB140179	1/01/2010	599101	6360398	36.5	Cross Gradient	7.69	3640	2300	64	92	696	6	864	965.02	63
MB1	MB01	6/02/2012	599101	6360398	36.5	Cross Gradient			2520	68	107	792	6	1050	779	77
MB1	MB01	13/05/2013	599101	6360398	36.5	Cross Gradient			3030	101	152	793	7	1190	626	143
MB13	MB1339814	1/01/2009	596348	6357524	60.15	Cross Gradient	6.87	22800	19100	1250	1430	2230	11	7710	539.24	2920
MB13	MB1340179	1/01/2010	596348	6357524	60.15	Cross Gradient	6.64	18500	2530	116	56	338	5	474	346.48	200
MB13	MB13	8/02/2012	596348	6357524	60.15	Cross Gradient			2200	150	110	442	7	889	287	296
MB13	MB13	13/05/2013	596348	6357524	60.15	Cross Gradient			8970	581	635	1160	15	3550	319	1180
MB14	MB1439814	1/01/2009	598413	6356964	50.55	Cross Gradient	7.23	2630	1570	63	58	440	8	413	888.16	43
MB14	MB1440179	1/01/2010	598413	6356964	50.55	Cross Gradient	7.17	2360	1450	65	59	424	9	368	796.66	46
MB14	MB14	13/02/2012	598413	6356964	50.55	Cross Gradient			1390	64	64	449	10	405	670	49
MB14	MB14	15/05/2013	598413	6356964	50.55	Cross Gradient			1490	57	59	400	8	374	651	45
MB17	MB1739814	1/01/2009	598696	6356326	66	Cross Gradient	7.74	948	600	57	24	114	4	71	459.94	26
MB17	MB1740179	1/01/2010	598696	6356326	66	Cross Gradient	7.31	874	484	55	22	116	4	60	429.44	20
MB17	MB17	13/02/2012	598696	6356326	66	Cross Gradient			536	57	26	136	5	69	397	23
MB17	MB17	15/05/2013	598696	6356326	66	Cross Gradient			578	41	27	130	3	62	384	30
MB18	MB1839814	1/01/2009	597627	6356075	90	Cross Gradient	7.25	26500	20300	752	944	4830	137	8490	466.04	3180
MB18	MB1840179	1/01/2010	597627	6356075	90	Cross Gradient	6.88	23100	17400	651	880	3620	137	7520	699.06	1940
MB18	MB18	13/02/2012	597627	6356075	90	Cross Gradient			15400	391	804	4380	538	7730	364	2050
MB18	MB18	15/05/2013	597627	6356075	90	Cross Gradient			16000	450	792	3650	368	6990	352	2580
MB19	MB1939814	1/01/2009	599481	6354484	102	Cross Gradient	7.34	15700	10700	356	305	2930	23	4580	741.76	1260
MB19	MB1940179	1/01/2010	599481	6354484	102	Cross Gradient	7.32	13500	10800	361	284	2640	20	3690	512.4	1420
MB19	MB19	9/02/2012	599481	6354484	102	Cross Gradient			10900	356	300	2800	21	4840	603	1450
MB19	MB19	13/05/2013	599481	6354484	102	Cross Gradient			10800	396	326	2710	26	4560	542	1290
MB2	MB239814	1/01/2009	599411	6360179	66	Cross Gradient	7.31	8180	5170	64	96	1740	4	1980	1256.6	449
MB2	MB240179	1/01/2010	599411	6360179	66	Cross Gradient	7.43	7850	4990	73	107	1750	4	2420	1034.56	485
MB2	MB02	8/02/2012	599411	6360179	66	Cross Gradient			5620	73	114	1860	4	2580	854	441
MB2	MB02	13/05/2013	599411	6360179	66	Cross Gradient			6020	82	128	1920	5	2560	756	486
MB20	MB2039814	1/01/2009	599498	6354474	54	Cross Gradient	7.07	13300	8590	259	233	2600	10	3900	856.44	940
MB20	MB2040179	1/01/2010	599498	6354474	54	Cross Gradient	7.36	11600	9160	252	215	2350	18	3690	856.44	1420
MB20	MB20	9/02/2012	599498	6354474	54	Cross Gradient			8220	265	239	2440	84	4200	767	1030
MB20	MB20	13/05/2013	599498	6354474	54	Cross Gradient			8710	289	250	2450	58	3870	691	1040
MB3	MB339814	1/01/2009	599207	6360582	60	Cross Gradient	6.74	21200	15200	421	627	4530	14	7200	380.64	1710
MB3	MB340179	1/01/2010	599207	6360582	60	Cross Gradient	7.2	22000	15000	452	628	3730	17	7620	294.02	1530
MB3	MB03	6/02/2012	599207	6360582	60	Cross Gradient			16200	491	652	4850	17	8190	253	1580
MB3	MB03	13/05/2013	599207	6360582	60	Cross Gradient			17000	489	690	4840	20	8150	217	1480
MB4	MB439814	1/01/2009	600332	6358784	60	Cross Gradient	6.94	18800	13800	323	692	3830	7	6440	1066.28	949
MB4	MB440179	1/01/2010	600332	6358784	60	Cross Gradient	7.11	16100	11700	296	585	2930	8	5810	1067.5	1150
MB4	MB04	6/02/2012	600332	6358784	60	Cross Gradient			11800	372	550	2890	7	5890	709	1220
MB4	MB04	20/05/2013	600332	6358784	60	Cross Gradient			12900	410	618	3700	9	6250	822	1020
MB5	MB539814	1/01/2009	600647	6359027	60	Cross Gradient	6.89	26200	20800	775	1060	4840	10	9570	583.16	1470
MB5	MB540179	1/01/2010	600647	6359027	60	Cross Gradient	6.93	22100	17900	744	928	3750	10	8910	523.38	1610
MB5	MB05	6/02/2012	600647	6359027	60	Cross Gradient			19200	851	985	4740	10	9560	364	1820
MB5	MB05	20/05/2013	600647	6359027	60	Cross Gradient			20500	844	950	4670	12	8840	433	1680
MB6	MB639814	1/01/2009	600952	6358439	43	Cross Gradient	6.94	10500	8610	465	425	1740	3	1980	207.4	3830
MB6	MB640179	1/01/2010	600952	6358439	43	Cross Gradient	6.88	19200	15000	756	883	2990	2	6850	87.84	2800

SampleID		Sample_Date	Y	X	Completed Bore Depth	Location	pH_lab	Cond	TDS	Ca	Mg	Na	K	Cl	HCO3	SO4
MB6	MB06	6/02/2012	600952	6358439	43	Cross Gradient			16300	822	997	3900	2	7880	87	2410
MB6	MB06	8/05/2012	600952	6358439	43	Cross Gradient			2620	239	98	528	7	1140	149	487
MB6B	MB06B	20/05/2013				Cross Gradient			4040	301	141	759	8	1440	238	486
MB8	MB839814	1/01/2009	598322	6359016	59.55	Cross Gradient	7.48	5860	3850	47	84	1260	4	786	793	1280
MB8	MB840179	1/01/2010	598322	6359016	59.55	Cross Gradient	7.5	5500	1720	101	60	426	4	167	440.42	738
P100	P10039814	1/01/2009	598014	6356234	30	Cross Gradient	7.17	31600	24400	472	1060	6370	44	11300	1057.74	1900
P100	P10040179	1/01/2010	598014	6356234	30	Cross Gradient	7.44	28700	24400	560	940	5010	36	8490	723.46	2130
P100	P100	7/02/2012	598014	6356234	30	Cross Gradient			84	20	2	6	5	4	84	3
P102	P10239814	1/01/2009	597536	6354028	18	Cross Gradient	6.67	25600	22200	1590	656	4810	45	9540	174.46	2080
P102	P10240179	1/01/2010	597536	6354028	18	Cross Gradient	6.93	26700	22500	1430	605	4570	36	9120	162.26	1890
P102	P102	7/02/2012	597536	6354028	18	Cross Gradient			25300	1600	661	5430	46	10500	162	2060
P102	P102	12/05/2013	597536	6354028	18	Cross Gradient			24400	1770	774	5020	43	10400	156	2010
P103	P10339814	1/01/2009	598150	6353898	24	Cross Gradient	8.8	12600	7630	4	169	2720	20	3960	102.48	266
P103	P10340179	1/01/2010	598150	6353898	24	Cross Gradient	9.63	12800	9480	9	180	2830	22	4050	268.4	438
P103	P103	7/02/2012	598150	6353898	24	Cross Gradient			9620	30	217	4070	24	5970	104	435
P104	P10439814	1/01/2009	597692	6353563	97	Cross Gradient	8.67	14300	8610	288	188	2350	51	5170	18.3	30
P104	P10440179	1/01/2010	597692	6353563	97	Cross Gradient	8.95	12200	7590	91	57	2280	54	3540		10
P104	P104	7/02/2012	597692	6353563	97	Cross Gradient			9840	364	145	2480	54	5280	107	45
P104	P104	13/05/2013	597692	6353563	97	Cross Gradient			9080	235	122	2380	64	4580	<1	24
P139	P13939814	1/01/2009	598039	6354188	108	Cross Gradient	7.11	30200	23600	478	1180	6120	36	10200	100.04	3350
P139	P13940179	1/01/2010	598039	6354188	108	Cross Gradient	6.81	27100	23400	418	1010	5550	36	8400	93.94	3590
P139	P139	10/02/2012	598039	6354188	108	Cross Gradient			21100	478	1140	6360	43	10800	80	3070
P139	P139	14/05/2013	598039	6354188	108	Cross Gradient			22300	612	1370	6050	50	2960	74	2960
P145	P14539814	1/01/2009	598196	6353888	120	Cross Gradient	7.23	9460	5910	109	138	1080	39	2870	329.4	530
P145	P14540179	1/01/2010	598196	6353888	120	Cross Gradient	7.56	8540	5050	162	242	1570	40	3150	150.06	575
P145	P145	10/02/2012	598196	6353888	120	Cross Gradient			15300	358	690	4330	40	7630	257	1880
P145	P145	13/05/2013	598196	6353888	120	Cross Gradient			12200	268	498	2630	49	4980	244	1230
P149	P14940179	1/01/2010	597410	6355150	90	Cross Gradient	6.65	26600								
P149	P149	2/05/2012	597410	6355150	90	Cross Gradient			23500	1130	976	6480	26	11500	246	3100
P149	P149	15/08/2012	597410	6355150	90	Cross Gradient			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P149	P149	14/05/2013	597410	6355150	90	Cross Gradient			24000	1420	1140	6090		11300	240	3440
P71	P7139814	1/01/2009	598154	6354079	130	Cross Gradient	7.1	15100	9450	122	305	3020	28	4450	1976.4	250
P71	P7140179	1/01/2010	598154	6354079	130	Cross Gradient	6.98	18600								
P71	P071	10/02/2012	598154	6354079	130	Cross Gradient			5610	66	162	1960	21	3200	1090	22
P71	P071	13/05/2013	598154	6354079	130	Cross Gradient			11700	182	476	4010	34	6300	1300	292
RP19	RP19	10/02/2012	599609	6357824		Cross Gradient			10900	356	300	2800	21	4840	603	
RP19	RP19	13/02/2012	599609	6357824		Cross Gradient			3760	595	107	528	40	412	49	2130
RP20	RP20	6/02/2012	600503	6358626		Cross Gradient			4090	350	135	713	76	594	160	2280
RP20	RP20	9/02/2012	600503	6358626		Cross Gradient			8220	265	239	2440	84	4200	767	
RP20	RP20	20/05/2013	600503	6358626		Cross Gradient			5700	545	206	937	134	840	230	2820
W14	W1439814	1/01/2009	598561	6358433	150	Cross Gradient	6.99	20200	15500	573	866	2880	10	6850	583.16	1250
W14	W1440179	1/01/2010	598561	6358433	150	Cross Gradient	7.15	16400	13100	605	886	2730	11	6650	550.22	1670
W14	W14	7/02/2012	598561	6358433	150	Cross Gradient			14500	553	903	2660	10	6930	402	1630
W14	W14	15/05/2013	598561	6358433	150	Cross Gradient			12800	557	853	2750	10	5930	400	1370
W15	W1539814	1/01/2009	597337	6358523	150	Cross Gradient	7.19	2930	1830	131	104	354	4	448	889.38	232
W15	W1540179	1/01/2010	597337	6358523	150	Cross Gradient	7.12	2730	2200	158	134	401	5	686	810.08	159
W16	W1639814	1/01/2009	598094	6357979	100	Cross Gradient	6.81	11800	11400	1330	120	1120	10	4100	78.08	593
W16		1/01/2010	598094	6357979	100	Cross Gradient	6.18	9890								
W17	W1739814	1/01/2009	598094	6357972	60	Cross Gradient	7.35	3940	2750	216	134	496	4	569	799.1	676

SampleID		Sample_Date	Y	X	Completed Bore Depth	Location	pH_lab	Cond	TDS	Ca	Mg	Na	K	Cl	HCO3	SO4
W17		1/01/2010	598094	6357972	60	Cross Gradient	6.74	3570								
W18	W1839814	1/01/2009	598123	6358299	100	Cross Gradient	7.29	360	264	26	8	28	4	40	124.44	18
W18		1/01/2010	598123	6358299	100	Cross Gradient	7.01	678								
W18	W18	7/02/2012	598123	6358299	100	Cross Gradient			172	11	7	37	4	36	41	45
MB10	MB1039814	1/01/2009	597434	6359586	44.6	Down Gradient	7.06	9680	5990	149	233	1820	8	2480	1122.4	1120
MB10	MB1040179	1/01/2010	597434	6359586	44.6	Down Gradient	6.88	9840	7940	271	381	2090	8	3890	885.72	1230
MB10	MB10	8/02/2012	597434	6359586	44.6	Down Gradient			10100	344	502	2400	10	4840	682	1300
MB10	MB10	14/05/2013	597434	6359586	44.6	Down Gradient			11500	321	423	2820	10	4630	602	1370
MB11	MB1140179	1/01/2010	596862	6359066	57	Down Gradient	7.81	2040	2240	88	126	546	7	1070	433.1	201
MB11	MB11	9/05/2012	596862	6359066	57	Down Gradient			302	17	17	68	5	147	39	28
Far Hillier	Far Hillier39814	1/01/2009	601656	6353541		Up Gradient	6.91	401	310	22	5	35		111		
Far Hillier	Far Hillier40179	1/01/2010	601656	6353541		Up Gradient	8.23	875	268	16	2	20		67	1.22	
Far Hillier	FAR HILLERS	7/02/2012	601656	6353541		Up Gradient			240	13	2	22	<1	110	<1	<1
Far Hillier	FAR HILLERS	13/05/2013	601656	6353541		Up Gradient			263	18	2	48	<1	103	7	<1
Long Pad	Long Pad39814	1/01/2009	600370	6352695		Up Gradient	7.69	901	486	36	47	81	1		445.3	
Long Pad	Long Pad40179	1/01/2010	600370	6352695		Up Gradient	8.25	784	582	25	45	77	2	57	391.62	6
Long Pad	LONG PADDOCK	13/05/2013	600370	6352695		Up Gradient			677	8	65	129	3	114	294	8
South Hillier	South Hillier39814	1/01/2009	601315	6352587		Up Gradient	8.57	1270	762	32	56	168	3	153	534.36	9
South Hillier	South Hillier40179	1/01/2010	601315	6352587		Up Gradient	6.61	328	666	12	22	164	5	128	322.08	7
Wright	Wright39814	1/01/2009	602600	6353946		Up Gradient	6.45	985	688	42	18	46	11	261	70.76	2
Wright	Wright40179	1/01/2010	601315	6352587		Up Gradient	7.2	1040	169	21	10	6	4	6	117.12	8
Wright	WRIGHT	9/02/2012	601315	6352587		Up Gradient			218	30	11	18	5	38	119	2
Wright	WRIGHT	14/05/2013	601315	6352587		Up Gradient			250	31	13	23	5	86	72	<1
P101	P10139814	1/01/2009	597683	6352566	24	Up Gradient	7.1	11700	10300	561	565	1960	20	1960	630.74	4670
P101	P10140179	1/01/2010	597683	6352566	24	Up Gradient	7.18	10500	10100	562	563	1830	18	1330	472.14	4610
P101	P101	7/02/2012	597683	6352566	24	Up Gradient			8470	462	498	1550	39	1530	509	3840
P101	P101	13/05/2013	597683	6352566	24	Up Gradient			10300	536	568	1730	30	1660	687	4070
RP01	RP01	9/02/2012	590611	6359701		Regional monitoring bore			194	20	5	15	4	9	27	67
RP02	RP02	9/02/2012	584768	6360697		Regional monitoring bore			930	78	35	168	7	74	85	456
RP03	RP03	13/02/2012	593763	6363558		Regional monitoring bore			1010	134	37	148	13	97	42	580
RP03	RP03	15/05/2013	593763	6363558		Regional monitoring bore			1470	116	40	311	31	240	61	726
RP04	RP04	2/05/2012	593750	6364540		Regional monitoring bore			704	108	30	80	7	79	31	368
RP05	RP05	13/02/2012	594757	6368829		Regional monitoring bore			250	36	9	43	7	47	69	82
RP05	RP05	14/05/2013	594757	6368829		Regional monitoring bore			482	35	19	111	13	131	62	172
RP06	RP06	13/02/2012	594796	6368753		Regional monitoring bore			648	81	23	111	13	90	114	252
RP07	RP07	13/02/2012	594645	6368869		Regional monitoring bore			566	67	27	103	8	94	149	204
RP08	RP08	13/02/2012	594588	6368890		Regional monitoring bore			1460	257	41	149	12	130	33	858
RP08	RP08	7/01/2013	594588	6368890		Regional monitoring bore			7310	1480	188	800	42	769	69	3750
RP09	RP09	6/02/2012	581993	6354813		Regional monitoring bore			1200	85	46	219	7	165	63	519
RP10	RP10	13/02/2012				Regional monitoring bore			404	71	13	32	9	27	85	172
RP13	RP13	2/05/2012	601192	6363455		Regional monitoring bore			612	82	28	73	6	112	79	250
RP15	RP15	15/05/2013	581150	6354979		Regional monitoring bore			526	30	14	144	11	132	144	116

SampleID	Sample_Date	F	Al_tot	As_tot	Ba	Be	Cd_tot	Cr_diss	Co	Cu_tot	Pb_total	Fe_tot	Hg_tot	Mn_tot	Mo_tot	Ni_tot	Zn_tot	Sb_tot	Se_diss	Sr	Tl_tot	Th	U_tot	Ionic Balance
		mg/l	mg/l	mg/l	mg/l	mg/L	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/L	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	%
MB1	1/01/2009				0.239				0.028			1		4.21	0.027	0.002				1.9			0.01	**-0.9**
MB1	1/01/2010	0.6			0.198			0.001	0.046			0.64		2.5	0.025	0.001	0.015			2.14			0.011	**-0.2**
MB1	6/02/2012	1	<0.01	<0.001	0.1777	<0.001	<0.0001	<0.001	0.056	0.002	<0.001	0.12	<0.0001	1.61	0.022	<0.001	<0.005	<0.001	<0.01	3.09	<0.001	<0.001	0.013	
MB1	13/05/2013	0.6	0.1	<0.001	0.31	<0.001	<0.0001	<0.001	0.188	0.006	0.002	0.24	<0.0001	0.782	0.005	0.002	0.022	<0.001	0.01	4.26	<0.001	<0.001	0.014	3.11
MB13	1/01/2009	0.5			0.083			0.001	0.008	0.008				0.485	0.016	0.006	0.026			29.7		0.002	0.052	**-1.6**
MB13	1/01/2010	0.1		0.001	0.208		0.0002	0.001		0.013				0.951	0.004	0.003	0.198			0.923			0.003	**4.3**
MB13	8/02/2012	0.3	<0.01	<0.001	0.188	<0.001	0.0002	0.002	<0.001	0.008	<0.001	<0.05	<0.0001	0.392	0.003	0.001	0.092	<0.001	<0.01	2.08	<0.001	<0.001	0.004	
MB13	13/05/2013	0.4	1.02	0.001	0.183	<0.001	0.0008	0.006	0.003	0.052	0.015	4.66	<0.0001	1.24	0.007	0.004	0.416	<0.001	<0.01	12.4	<0.001	0.004	0.021	0.39
MB14	1/01/2009	1.2			0.058					0.004	0.002			0.018	0.008		0.036			2.31			0.005	**0.3**
MB14	1/01/2010	1.2			0.055		0.0001			0.002				0.003	0.007		0.012			2.18			0.007	**4.6**
MB14	13/02/2012	1.3	0.4	0.001	0.073	<0.001	<0.0001	0.001	0.001	0.018	0.01	0.64	<0.0001	0.072	0.008	<0.001	0.04	<0.001	<0.01	2.11	<0.001	<0.001	0.008	
MB14	15/05/2013	1.4	0.23	<0.001	0.055	<0.001	<0.0001	0.004	<0.001	0.014	0.006	0.62	<0.0001	0.038	0.009	0.002	0.022	<0.001	<0.01	1.96	NA	<0.001	NA	1.6
MB17	1/01/2009				0.039					0.001	0.02	0.54		0.243	0.024		0.013			2.32			0.002	**-0.7**
MB17	1/01/2010	2.3			0.085				0.001	0.002		0.31		0.931	0.019		0.027			2.38				**2.8**
MB17	13/02/2012	3	<0.01	0.001	0.091	<0.001	<0.0001	<0.001	<0.001	0.001	0.002	0.47	<0.0001	0.868	0.029	<0.001	0.008	<0.001	<0.01	2.26	<0.001	<0.001	<0.001	
MB17	15/05/2013	3.3	0.2	0.003	0.076	<0.001	<0.0001	<0.001	<0.001	0.02	0.036	1.56	<0.0001	0.824	0.035	<0.001	0.022	<0.001	<0.01	2.31	N/A	0.001	N/A	0.26
MB18	1/01/2009		0.01		0.15		0.0003	0.014	0.002	0.007	0.141			1.4	0.031		0.03	0.004		30.6		0.001	0.025	**2.5**
MB18	1/01/2010	0.4	0.04	0.002	0.046					0.01				0.716	0.005		0.01			18.2			0.002	**0.4**
MB18	13/02/2012	0.2	<0.01	<0.001	0.036	<0.001	<0.0001	<0.001	<0.001	0.002	<0.001	<0.05	<0.0001	0.346	0.005	<0.001	<0.005	<0.001	<0.01	17.3	<0.001	<0.001	0.001	
MB18	15/05/2013	0.4	0.68	0.002	0.056	<0.001	0.0002	0.003	<0.001	0.052	0.062	4.35	<0.0001	0.707	0.008	0.001	0.075	<0.001	<0.01	16.2	<0.001	<0.001	N/A	0.44
MB19	1/01/2009				0.101				0.012	0.003	0.004			1.24	0.02	0.018	0.016			9.32			0.01	**1.1**
MB19	1/01/2010	0.8	0.01	0.001	0.087		0.0005			0.015	0.002			0.01	0.016	0.007	0.236			8.49			0.011	**5.0**
MB19	9/02/2012	1.4	<0.01	<0.001	0.096	<0.001	0.0002	<0.001	0.004	0.008	0.006	<0.05	<0.0001	1.05	0.014	0.009	0.116	<0.001	<0.01	11.1	<0.001	<0.001	0.01	
MB19	13/05/2013	1.2	0.16	0.001	0.107	<0.001	0.0002	<0.001	0.004	0.025	0.026	0.93	<0.0001	0.646	0.018	0.008	0.142	<0.001	<0.01	10.5	<0.001	0.008	0.012	0.37
MB2	1/01/2009	0.4			0.048		0.0001			0.004				0.205	0.002		0.019			2.41			0.037	**0.7**
MB2	1/01/2010	0.3		0.002	0.05		0.0001			0.005				0.171	0.001		0.024			2.6			0.044	**-3.6**
MB2	8/02/2012	0.4	<0.01	<0.001	0.044	<0.001	0.0001	<0.001	<0.001	0.002	<0.001	<0.05	<0.0001	0.004	0.001	<0.001	0.009	<0.001	<0.01	3.22	<0.001	<0.001	0.047	
MB2	13/05/2013	0.4	0.05	<0.001	0.045	<0.001	0.0002	<0.001	<0.001	0.005	<0.001	0.12	<0.0001	0.01	0.001	<0.001	0.015	<0.001	0.01	3.59	<0.001	<0.001	0.052	0.4
MB20	1/01/2009				0.047		0.0007		0.003	0.025	0.186			0.238	0.017	0.004	0.061			6.63	0.001		0.016	**0.7**
MB20	1/01/2010	0.9		0.002	0.051		0.0008			0.029	0.082			0.01	0.015	0.006	0.194			6.14			0.016	**-3.8**
MB20	9/02/2012	1.6	<0.01	<0.001	0.047	<0.001	0.0006	0.005	<0.001	0.022	0.015	<0.05	<0.0001	0.017	0.012	0.003	0.118	<0.001	<0.01	8.16	<0.001	<0.001	0.015	
MB20	13/05/2013	1.5	0.04	<0.001	0.038	<0.001	0.0005	0.002	<0.001	0.033	0.01	0.13	<0.0001	0.01	0.014	<0.001	0.099	<0.001	<0.01	7.4	<0.001	0.003	0.018	0.56
MB3	1/01/2009	0.5	0.04		0.029		0.0003		0.008	0.012	0.003		0.0002	0.039	0.004	0.007	0.017			13.2			0.019	**4.9**
MB3	1/01/2010	0.4	0.06		0.03		0.0003	0.006	0.014	0.02	0.004		0.0002	0.051	0.004	0.01	0.111			11.4			0.017	**-3.0**
MB3	6/02/2012	0.7	0.03	<0.001	0.029	<0.001	0.0003	<0.001	0.012	0.012	0.001	<0.05	<0.0001	0.051	0.004	0.008	0.016	<0.001	<0.01	16.6	<0.001	<0.001	0.014	
MB3	13/05/2013	0.5	2.82	0.001	0.043	0.001	0.0004	<0.001	0.012	0.031	0.008	2.3	0.0003	0.069	0.003	0.009	0.022	<0.001	0.02	14.9	<0.001	<0.001	0.014	4.86
MB4	1/01/2009	0.7			0.037		0.0004		0.115	0.006	0.003			0.008	0.004		0.018		0.01	17.2			0.069	**4.6**
MB4	1/01/2010	0.6			0.031		0.0003	0.005	0.099	0.009			0.0002	0.002	0.004		0.05		0.02	13			0.068	**-3.7**
MB4	6/02/2012	0.7	<0.01	<0.001	0.029	<0.001	0.0002	<0.001	0.103	0.002	0.005	<0.05	0.0002	0.003	0.004	<0.001	0.01	<0.001	0.01	17.8	<0.001	<0.001	0.059	
MB4	20/05/2013	0.8	0.19	<0.001	0.033	<0.001	0.0002	<0.001	0.113	0.01	0.003	0.24	0.0003	0.013	0.004	<0.001	0.02	<0.001	0.02	16.6	<0.001	<0.001	0.071	4.14
MB5	1/01/2009	0.5			0.071		0.0003		0.002	0.007	0.001			0.221	0.009		0.012			29.3			0.05	**4.2**
MB5	1/01/2010	0.4			0.05		0.0004	0.001	0.002	0.01				0.124	0.009		0.036			24.2			0.049	**-2.8**
MB5	6/02/2012	0.6	<0.01	<0.001	0.055	<0.001	0.0005	<0.001	0.002	0.006	0.001	<0.05	<0.0001	0.08	0.009	0.003	0.018	<0.001	0.01	33.7	<0.001	<0.001	0.04	
MB5	20/05/2013	0.5	0.93	0.002	0.074	<0.001	0.0008	<0.001	0.004	0.054	0.018	3.7	0.0002	0.13	0.011	0.003	0.086	<0.001	0.02	31.8	<0.001	<0.001	0.046	4.98
MB6	1/01/2009	0.2			0.018					0.01				0.002	0.003		0.007			8.65			0.01	**-1.8**
MB6	1/01/2010	0.3		0.002	0.026			0.002		0.005	0.001			0.024		0.018	0.028			14.8			0.001	**-2.5**
MB6	6/02/2012	0.5	<0.01	0.001	0.024	<0.001	0.0001	<0.001	<0.001	0.004	0.001	<0.05	<0.0001	0.03	<0.001	0.019	0.013	<0.001	<0.01	21.2	<0.001	<0.001	0.002	
MB6	8/05/2012	0.2	6.12	0.006	0.527	<0.001	<0.0001	0.02	0.01	0.035	0.044	20.2	<0.0001	0.622	0.001	0.014	0.047	<0.001	<0.01	5.26	<0.001	0.003	0.004	

SampleID	Sample_Date	F	Al_tot	As_tot	Ba	Be	Cd_tot	Cr_diss	Co	Cu_tot	Pb_total	Fe_tot	Hg_tot	Mn_tot	Mo_tot	Ni_tot	Zn_tot	Sb_tot	Se_diss	Sr	Tl_tot	Th	U_tot	Ionic Balance
MB6B	20/05/2013	0.2	5.36	0.006	0.369	<0.001	0.0002	0.015	0.019	0.053	0.076	17.7	<0.0001	1.18	<0.001	0.018	0.067	0.001	0.01	5.67	<0.001	0.008	0.009	3.77
MB8	1/01/2009	1.6		0.001	0.037				0.01	0.006				0.005	0.005		0.012			1.68		0.004	0.009	**1.8**
MB8	1/01/2010	0.4			0.01			0.001		0.017				0.001	0.003		0.024			1.22			0.028	**2.3**
P100	1/01/2009				0.086			0.002	0.001	0.004				0.307			0.007			15.4		0.001		**1.8**
P100	1/01/2010	0.8			0.113									0.916						13.2				**4.6**
P100	7/02/2012	0.3	0.1	<0.001	0.044	<0.001	<0.0001	0.002	<0.001	0.026	0.011	1.5	<0.0001	0.222	<0.001	0.002	0.086	<0.001	<0.01	0.092	<0.001	<0.001	<0.001	
P102	1/01/2009				0.125		0.0004		0.004	0.031				2.94	0.007	0.007	0.404			34.8				**4.4**
P102	1/01/2010	0.1			0.142		0.0015			0.077				3.29			0.756			31.2				**3.6**
P102	7/02/2012	0.3	1.56	0.003	0.186	<0.003	0.0008	0.068	0.009	0.347	0.158	15.5	<0.0001	5.02	0.001	0.009	0.624	<0.001	0.01	43.4	<0.001	<0.001	0.002	
P102	12/05/2013	0.2	0.19	<0.010	0.109	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	1.56	<0.0001	3.78	<0.010	<0.010	<0.052	<0.01	<0.01	42.5	<0.01	<0.01	<0.01	4.68
P103	1/01/2009				0.003					0.001				0.67	0.002					0.045				**5.6**
P103	1/01/2010	0.1			0.011					0.004				0.185	0.05	0.002	0.006			0.137	0.002			**4.2**
P103	7/02/2012	<0.1	<0.01	<0.001	0.004	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.0001	0.133	0.003	<0.001	<0.005	<0.001	<0.01	0.146	<0.001	<0.001	<0.001	
P104	1/01/2009				0.013							0.17		0.544	0.002					8.28				**-4.7**
P104	1/01/2010				0.013									0.32	0.002	0.002				5.57				**4.7**
P104	7/02/2012	0.3	<0.01	<0.001	0.026	<0.001	<0.0001	0.001	<0.001	<0.001	<0.001	<0.05	<0.0001	0.256	0.006	<0.001	<0.005	<0.001	<0.01	37.6	<0.001	<0.001	<0.001	
P104	13/05/2013	<0.1	0.05	0.005	0.02	0.006	0.0005	0.004	0.004	0.004	0.006	0.75	<0.0001	0.06	0.002	0.004	0.019	<0.001	<0.01	7.23	0.005	0.008	0.009	1.98
P139	1/01/2009				0.042		0.0002		0.019	0.007		5.41		2.67	0.001	0.011	0.043			6.89				**3.9**
P139	1/01/2010	0.4		0.005	0.041		0.0003		0.015	0.01		2.94		2.07	0.001	0.011	0.043			6.18				**5.0**
P139	10/02/2012	0.6	<0.01	0.002	0.039	<0.001	0.0002	<0.001	0.024	0.001	<0.001	6.59	<0.0001	6.4	0.001	0.01	0.027	<0.001	0.01	8.05	<0.001	<0.001	<0.001	
P139	14/05/2013	0.5	0.76	0.004	0.071	<0.001	0.0007	0.002	0.012	0.07	0.014	14	<0.0001	1.87	0.002	0.009	0.209	<0.001	<0.01	7.5	<0.001	0.001	<0.001	4.76
P145	1/01/2009			0.002	0.096			0.001	0.003	0.01				1.35	0.002	0.006	0.778			1.43				**-20.0**
P145	1/01/2010	0.1		0.002	0.093			0.002		0.011				0.321	0.008	0.002	0.305			2.38				**-2.9**
P145	10/02/2012	0.5	<0.01	0.002	0.122	<0.001	<0.0001	0.002	<0.001	0.009	<0.001	0.12	<0.0001	0.951	0.016	0.003	0.177	<0.001	<0.01	4.95	<0.001	0.001	<0.001	
P145	13/05/2013	0.3	0.03	0.002	0.128	<0.001	0.0001	<0.001	<0.001	0.006	<0.001	0.34	<0.0001	1.05	0.025	<0.001	0.213	<0.001	<0.01	5.75	<0.001	0.008	<0.001	0.29
P149	1/01/2010																							
P149	2/05/2012	2.4	7	0.019	0.19	0.001	0.0029	0.012	0.009	0.257	0.194	39	<0.0001	12	0.043	0.003	0.972	<0.001	<0.01		<0.001	0.001	0.005	
P149	15/08/2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P149	14/05/2013	1.2	4.71	0.017	0.105	0.002	0.0027	0.007	0.011	0.234	0.197	32.6	<0.0001	12.6	0.034	0.003	1.1	<0.001	<0.01	23	<0.001	0.002	0.005	4.26
P71	1/01/2009				0.205		0.0001		0.002	0.009		3.82		7.88	0.018	0.004	0.02			2.14			0.001	**0.1**
P71	1/01/2010																							
P71	10/02/2012	1.5	<0.01	<0.001	0.121	<0.001	<0.0001	<0.001	0.001	0.004	<0.001	2.38	<0.0001	6.4	0.004	0.001	0.01	<0.001	<0.01	1.72	<0.001	<0.001	<0.001	
P71	13/05/2013	1.4	1.87	0.003	0.255	<0.001	<0.0001	0.006	0.005	0.111	0.018	11.4	<0.0001	8.75	0.012	0.002	0.094	<0.001	<0.01	3.35	<0.001	0.002	<0.001	3.06
RP19	10/02/2012	1.4	<0.01	<0.001	0.096	<0.001	0.0002	<0.001	0.004	0.008	0.006	<0.05	<0.0001	1.05	0.014	0.009	0.116	<0.001	<0.01	11.1	<0.001	<0.001	0.01	
RP19	13/02/2012		0.15	0.002	0.039	<0.001	0.0005	0.002	<0.001	0.066	<0.001				0.343	0.003	0.038		<0.01			<0.001	0.002	
RP20	6/02/2012		0.21	0.001	0.061	<0.001	<0.0001	<0.001	<0.001	0.045	<0.001				0.095	0.001	0.008		0.03			<0.001	0.006	
RP20	9/02/2012	1.6	<0.01	<0.001	0.047	<0.001	0.0006	0.005	<0.001	0.022	0.015	<0.05	<0.0001	0.0017	0.012	0.003	0.118	<0.001	<0.01	8.16	<0.001	<0.001	0.015	
RP20	20/05/2013	N/A	0.03	<0.001	0.018	<0.001	0.0003	<0.001	<0.001	0.06	<0.001	N/A	N/A	N/A	0.115	0.002	0.012	N/A	0.06	N/A	N/A	<0.001	0.009	1.07
W14	1/01/2009	0.8			0.047		0.001		0.09	0.025	0.018			0.071	0.006		0.098		0.02	17.8			0.025	**-0.7**
W14	1/01/2010	0.7			0.081		0.0015	0.004	0.069	0.158	0.021	0.41		0.354	0.008	0.01	0.437		0.01	14.3			0.026	**-2.0**
W14	7/02/2012	0.9	<0.01	0.001	0.044	<0.001	0.0012	<0.001	0.066	0.247	0.047	<0.05	<0.0001	0.129	0.007	0.003	0.171	<0.001	0.02	20.3	<0.001	<0.001	0.021	
W14	15/05/2013	0.9	0.64	0.001	0.045	<0.001	0.0011	0.003	0.009	0.106	0.028	1.39	0.0007	0.048	0.008	0.002	0.046	<0.001	0.02	15.1	N/A	<0.001	N/A	3.33
W15	1/01/2009	0.5			0.034					0.011				0.004	0.005		0.014			2.57			0.01	**-2.3**
W15	1/01/2010	0.5			0.045					0.004				0.025	0.003		0.006			2.92			0.01	**0.8**
W16	1/01/2009	1			0.124		0.0001		0.001	0.003				0.463			0.018			35.3				**-1.3**
W16	1/01/2010									0.019														
W17	1/01/2009	2	0.01		0.046		0.0003			0.016				0.009	0.009	0.002	0.209	0.002	0.02	4.01			0.012	**0.3**
W17	1/01/2010									0.025														
W18	1/01/2009	0.4			0.12		0.001			0.002		0.38		0.087			0.006			0.458		0.004		**-4.0**

TABLE A2 DURING-MINING WATER QUALITY DATA

SampleID	Sample_Date	F	Al_tot	As_tot	Ba	Be	Cd_tot	Cr_diss	Co	Cu_tot	Pb_total	Fe_tot	Hg_tot	Mn_tot	Mo_tot	Ni_tot	Zn_tot	Sb_tot	Se_diss	Sr	Tl_tot	Th	U_tot	Ionic Balance
W18	1/01/2010									0.066														
W18	7/02/2012	0.4	0.02	0.001	0.031	<0.001	0.0004	0.001	<0.001	0.035	<0.001	<0.05	<0.0001	0.057	0.008	<0.001	0.073	<0.001	<0.01	0.265	<0.001	<0.001	<0.001	
MB10	1/01/2009	1			0.029					0.003				0.002	0.006		0.01		0.02	4.64		0.002	0.024	**-2.6**
MB10	1/01/2010	0.8		0.002	0.038		0.0002		0.002	0.005				0.063	0.005	0.002	0.033		0.02	6.53			0.029	**-4.8**
MB10	8/02/2012	1.3	<0.01	0.003	0.05	<0.001	<0.0001	<0.001	0.009	0.002	<0.001	<0.05	<0.0001	0.483	0.005	0.004	0.031	<0.001	0.02	9.71	<0.001		0.027	
MB10	14/05/2013	0.9	5.84	0.005	0.115	<0.001	0.0004	0.008	0.015	0.088	0.035	7.41	0.0004	0.64	0.002	0.006	0.143	<0.001	0.03	11.9	<0.001	0.002	0.034	0.74
MB11	1/01/2010	0.6		0.001	0.122		0.0004			0.015				0.986	0.006	0.005	0.221			3.26			0.004	**-3.3**
MB11	9/05/2012	0.1	6.32	0.002	0.076	<0.001	0.0002	0.018	0.004	0.103	0.049	7.95	<0.0001	0.545	0.001	0.008	0.224	<0.001	<0.01	0.339	<0.001	<0.001	<0.001	
Far Hillier	1/01/2009				0.032							2.45		0.752			0.005			0.527				**-1.0**
Far Hillier	1/01/2010				0.011		0.0001			0.003		34.6		0.665		0.002	0.074			0.083				**-1.3**
Far Hillier	7/02/2012	<0.1	<0.01	<0.001	0.01	<0.001	<0.0001	<0.001	<0.001	0.001	<0.001	56.3	<0.0001	0.817	<0.001	<0.001	0.018	<0.001	<0.01	0.081	<0.001	<0.001	<0.001	
Far Hillier	13/05/2013	<0.1	0.06	<0.001	0.016	<0.001	<0.0001	<0.001	<0.001	0.001	0.003	37.4	<0.0001	0.869	<0.001	<0.001	0.014	<0.001	<0.01	0.385	<0.001	0.001	<0.001	1.71
Long Pad	1/01/2009	0.15			0.003					0.004		1.4		0.002			0.011			0.405				**11.6**
Long Pad	1/01/2010	0.2			0.003					0.007				0.001			0.014			0.324			0.001	**1.2**
Long Pad	13/05/2013	0.3	<0.01	<0.001	0.002	<0.001	<0.0001	<0.001	<0.001	0.004	<0.001	1.53	<0.0001	0.042	<0.001	<0.001	<0.005	<0.001	<0.01	0.084	<0.001	0.002	0.001	1.12
South Hillier	1/01/2009	0.3		0.002	0.017					0.002				0.016						0.527			0.003	**1.2**
South Hillier	1/01/2010	0.3	0.02	0.004	0.004					0.004				0.014		0.002	0.006			0.19				**3.4**
Wright	1/01/2009				0.037							2.45		0.555		0.02	0.446			0.805				**-18.3**
Wright	1/01/2010	0.2			0.011		0.0003		0.002	0.001		3.09		0.717		0.007	1.07			0.268				**0.7**
Wright	9/02/2012	0.2	<0.01	<0.001	0.022	<0.001	0.0006	<0.001	0.001	<0.001	<0.001	4.56	<0.0001	0.524	0.001	0.003	0.657	<0.001	<0.01	0.497	<0.001	<0.001	<0.001	
Wright	14/05/2013	0.1	0.53	<0.001	0.028	<0.001	0.0023	<0.001	<0.001	0.024	0.016	15.3	<0.0001	0.337	<0.001	0.003	2.18	<0.001	<0.01	0.501	<0.001	<0.001	<0.001	1.55
P101	1/01/2009				0.019		0.0001	0.001		0.007		0.88		4			0.005			2.51		0.002	0.001	**-0.8**
P101	1/01/2010	1.6			0.02					0.013		0.95		3.5			0.031			2.28			0.001	**4.5**
P101	7/02/2012	2	<0.01	<0.001	0.034	<0.001	<0.0001	0.002	<0.001	<0.001	<0.001	0.07	<0.0001	4.64	<0.001	<0.001	<0.005	<0.001	<0.01	2.96	<0.001	<0.001	<0.001	
P101	13/05/2013	1.9	7.8	0.008	0.202	<0.001	0.0009	0.029	0.008	0.279	0.079	47.3	<0.0001	4.88	0.004	0.007	0.5	<0.001	<0.01	2.9	<0.001	0.002	0.001	1.42
RP01	9/02/2012		2.15	0.009	0.1	<0.001	0.0002	0.002	<0.001	0.68	0.004				0.006	0.002	0.047		<0.01			<0.001	<0.001	
RP02	9/02/2012		0.15	0.004	0.044	<0.001	<0.0001	<0.001	<0.001	0.165	<0.001				0.043	<0.001	0.006		0.03			<0.001	<0.001	
RP03	13/02/2012		0.06	0.01	0.062	<0.001	<0.0001	<0.001	<0.001	0.072	<0.001				0.036	<0.001	<0.005		0.02			<0.001		
RP03	15/05/2013	N/A	0.1	0.014	0.068	<0.001	<0.0001	<0.001	<0.001	0.165	<0.001	N/A	N/A	N/A	0.097	<0.001	0.006	N/A	0.02	N/A	N/A	N/A	N/A	0.63
RP04	2/05/2012		1.3	0.012	0.05	<0.001	0.0008	0.002	0.005	2.31	0.007				0.013	0.003	0.151		<0.01			<0.001	<0.001	
RP05	13/02/2012		0.45	0.004	0.079	<0.001	<0.0001	<0.001	<0.001	0.044	<0.001				0.009	0.001	0.007		<0.01			<0.001		
RP05	14/05/2013	N/A	0.04	0.002	0.098	<0.001	<0.001	<0.001	<0.001	0.018	<0.001	N/A	N/A	N/A	0.009	0.002	<0.005	N/A	<0.01	N/A	N/A	<0.001	<0.001	0.85
RP06	13/02/2012		0.24	0.003	0.109	<0.001	<0.0001	<0.001	<0.001	0.012	<0.001				0.011	0.002	<0.005		<0.01			<0.001	0.001	
RP07	13/02/2012		0.08	<0.001	0.153	<0.001	<0.0001	<0.001	<0.001	0.01	<0.001				0.007	<0.001	<0.005		<0.01			<0.001	0.002	
RP08	13/02/2012		2.51	0.004	0.103	<0.001	<0.0001	0.005	0.002	0.131	0.002				0.093	0.002	0.012		<0.01			<0.001	0.002	
RP08	7/01/2013	2.5	1.18	0.013	0.116	<0.001	0.0001	<0.001	0.001	0.136	0.003	1.08	<0.0001	0.209	0.395	0.004	0.014	0.004	0.02	30.8	<0.001	<0.001	0.004	
RP09	6/02/2012		0.9	0.001	0.092	<0.001	<0.0001	0.001	<0.001	0.039	<0.001				0.079	<0.001	<0.005		0.05			<0.001	0.002	
RP10	13/02/2012		0.03	0.004	0.051	<0.001	<0.0001	<0.001	<0.001	0.125	<0.001				0.021	<0.001	<0.005		<0.01			<0.001	<0.001	
RP13	2/05/2012		0.12	0.004	0.062	<0.001	<0.0001	<0.001	<0.001	0.112	<0.001				0.004	<0.001	<0.005		<0.01			<0.001	0.001	
RP15	15/05/2013	N/A	0.54	0.025	0.096	<0.001	<0.0001	<0.001	<0.001	0.162	0.002	N/A	N/A	N/A	0.058	<0.001	0.007	N/A	<0.01	N/A	N/A	N/A	N/A	0.96

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Attachment B - Limitations

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APPENDIX 2

Water Quality Charts

Appendix 2 – Water Quality Charts

1.0 Water Quality Charts

The following sections include the amended water quality analysis charts from Section 3.4 of the Surface Water Assessment (Umwelt 2013). The charts have been amended to include site specific water quality triggers based on water quality observations from 2009 to 2011. The ANZECC Guidelines allow for the identification of site specific water quality triggers where two years or more of monthly water quality data is available.

The location of the water quality sampling locations is included in Figure 3.3 of the Surface Water Assessment (Umwelt 2013).

1.1 Clean Water System

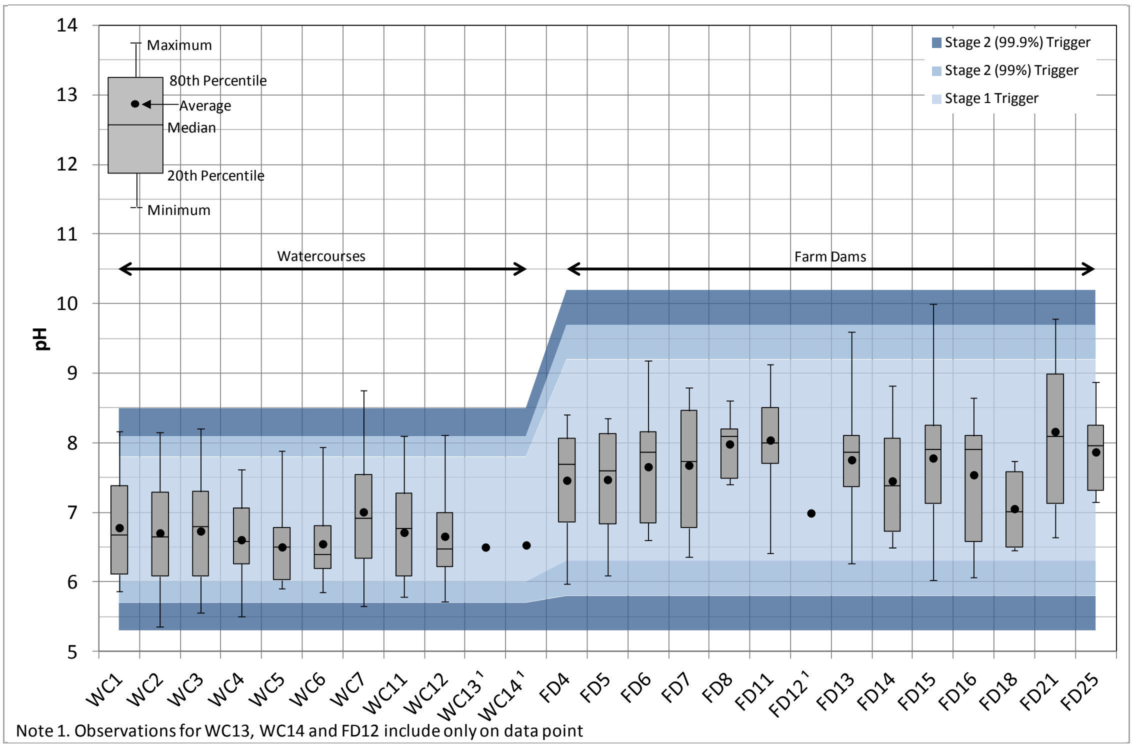

Chart 1.1 – Clean Water System – pH

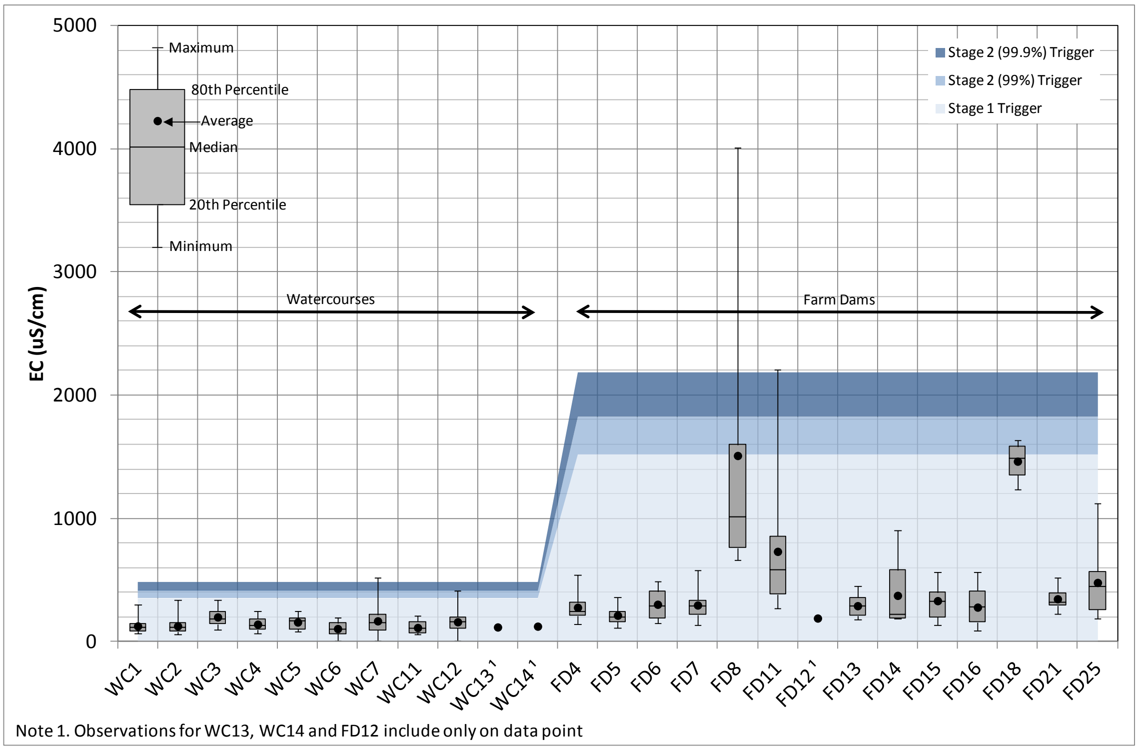

Chart 1.2 – Clean Water System – Electrical Conductivity

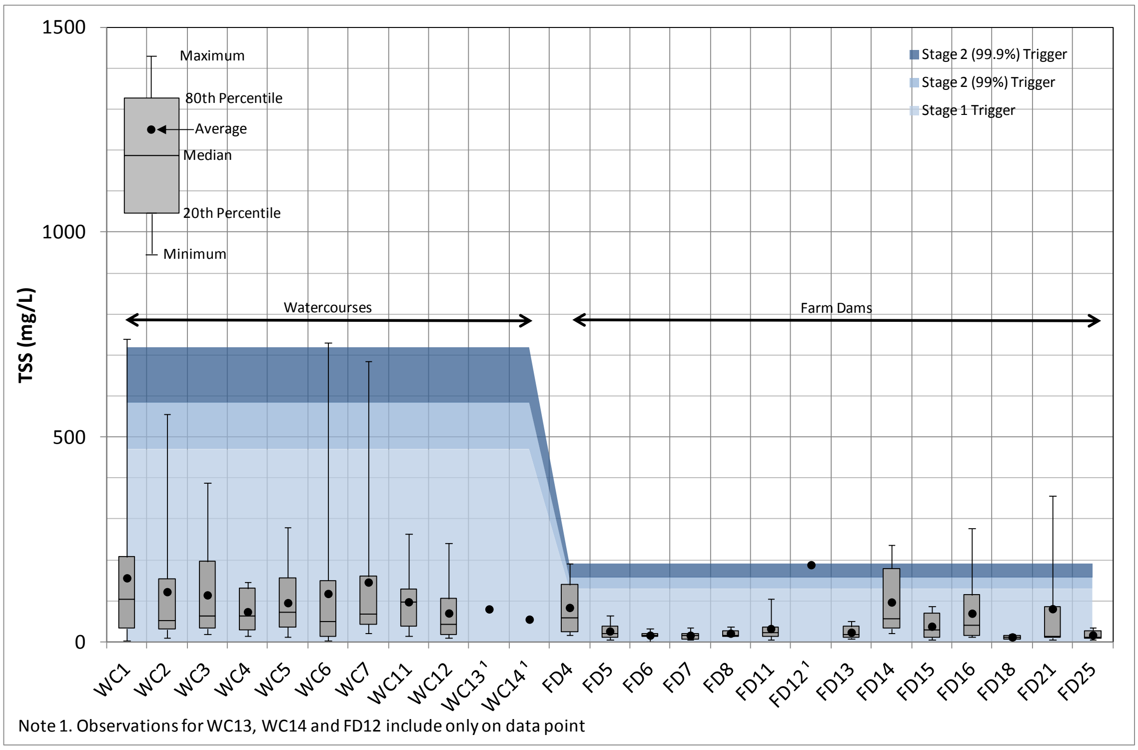

Chart 1.3 – Clean Water System – Total Suspended Solids

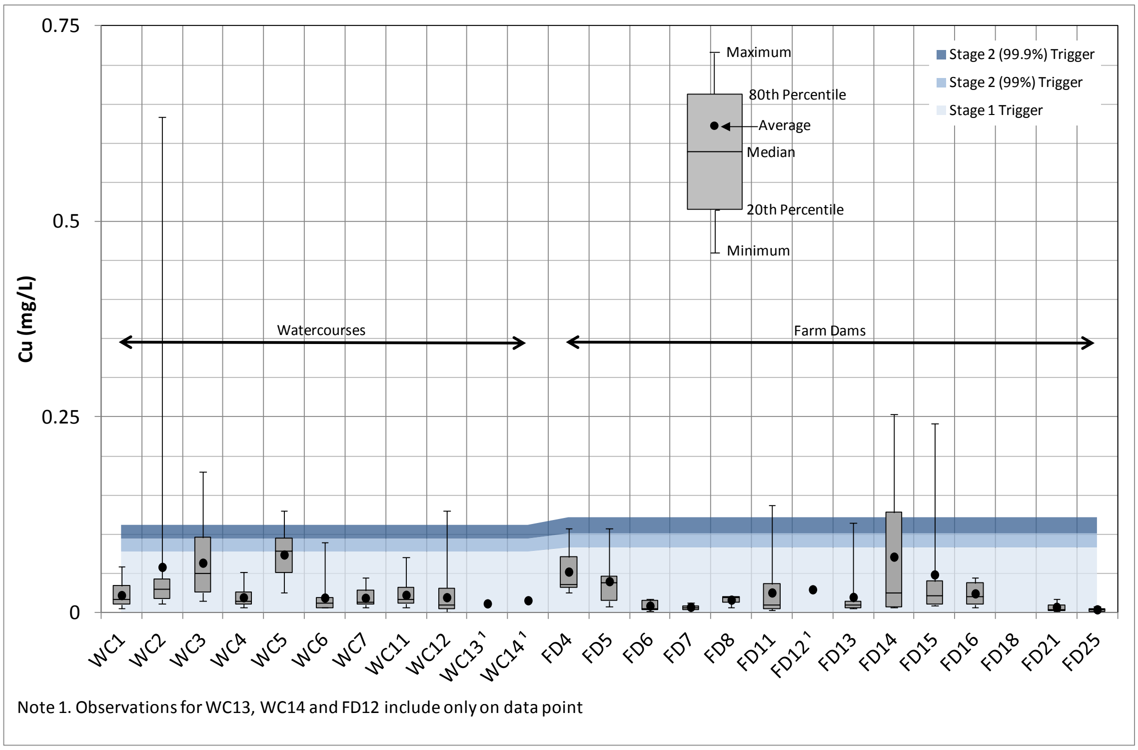

Chart 1.4 – Clean Water System – Copper

1.2 Dirty Water System

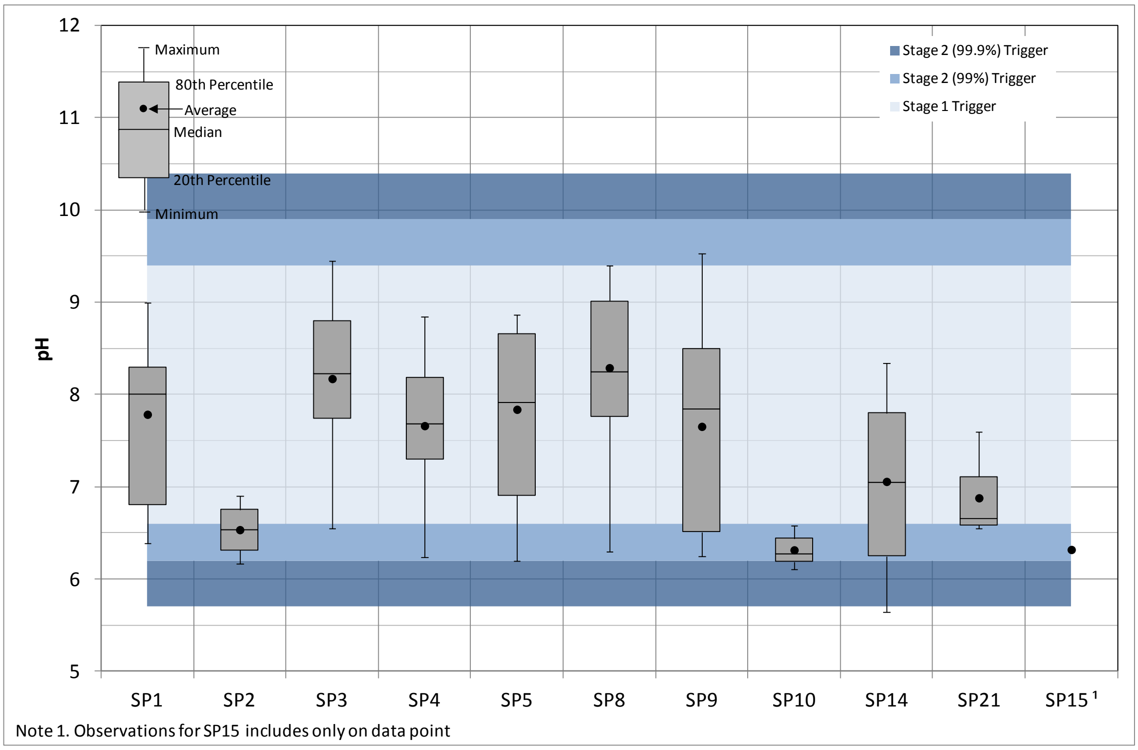

Chart 1.5 – Dirty Water System – pH

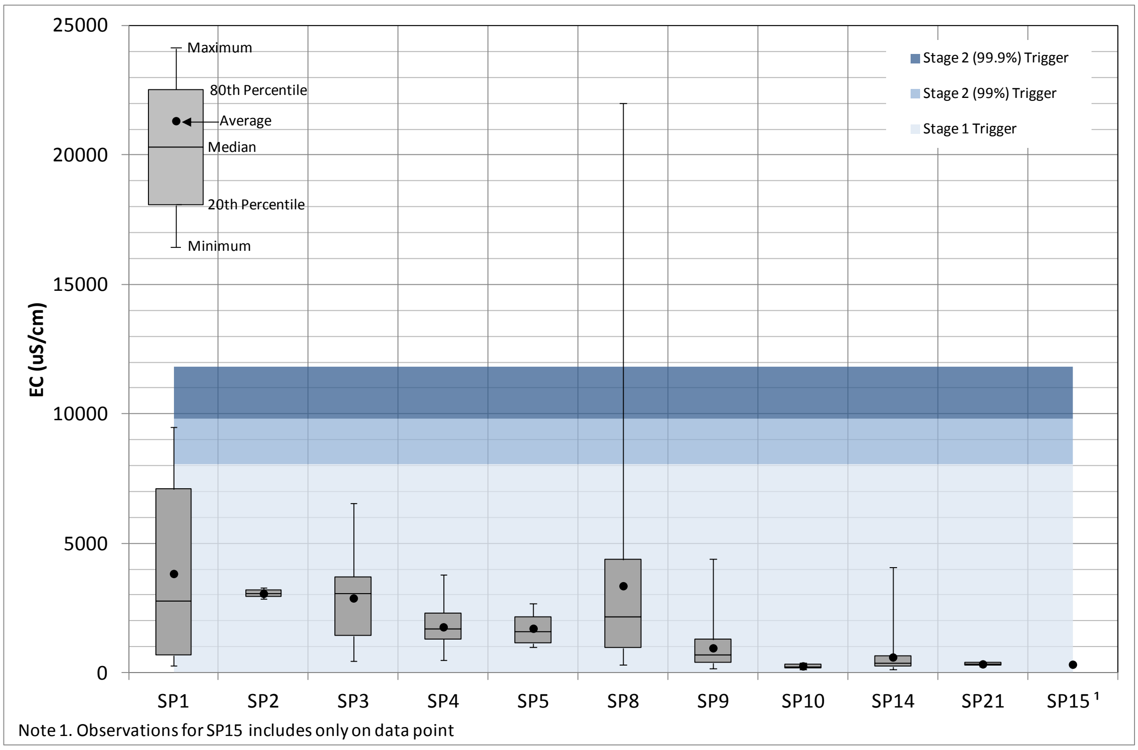

Chart 1.6 – Dirty Water System – Electrical Conductivity

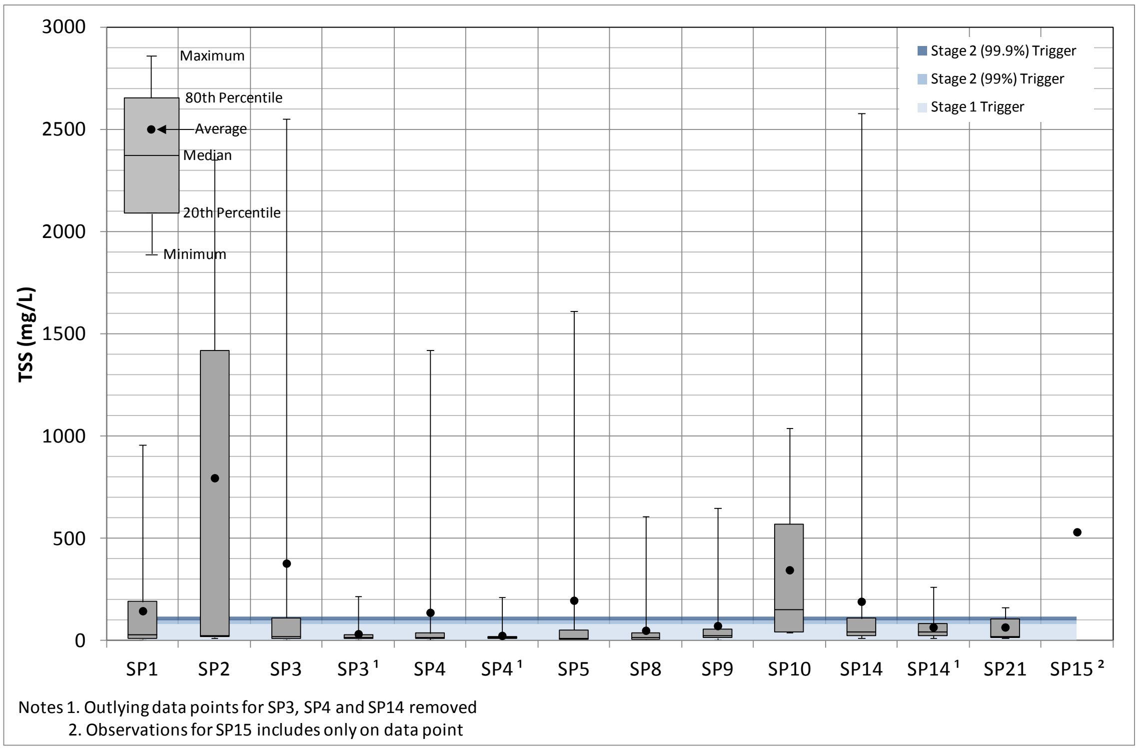

Chart 1.7 – Dirty Water System – Total Suspended Solids

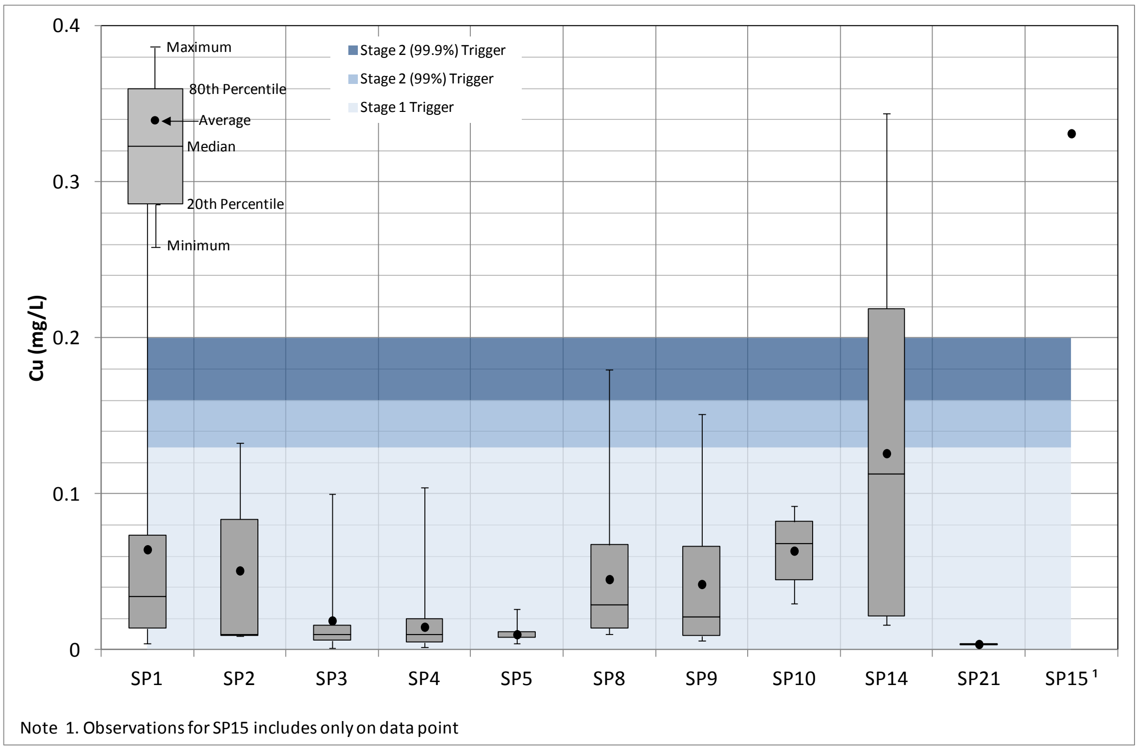

Chart 1.8 – Dirty Water System – Copper

1.3 Contaminated Water System

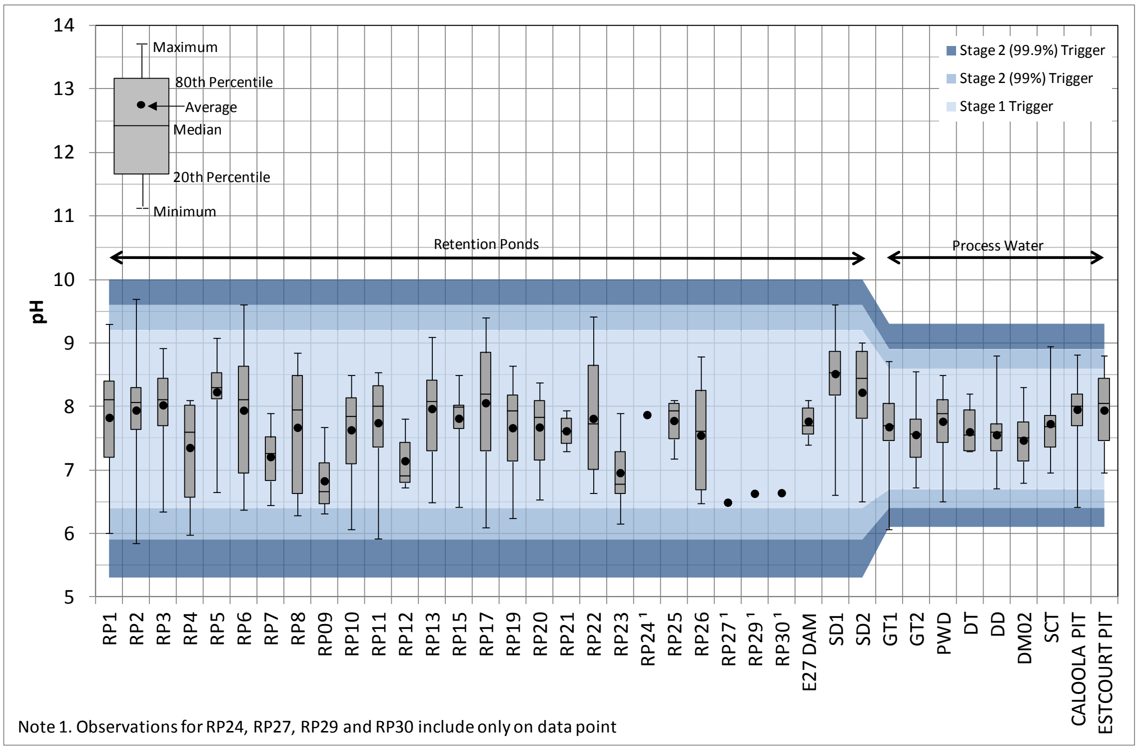

Chart 1.9 – Contaminated Water System – pH

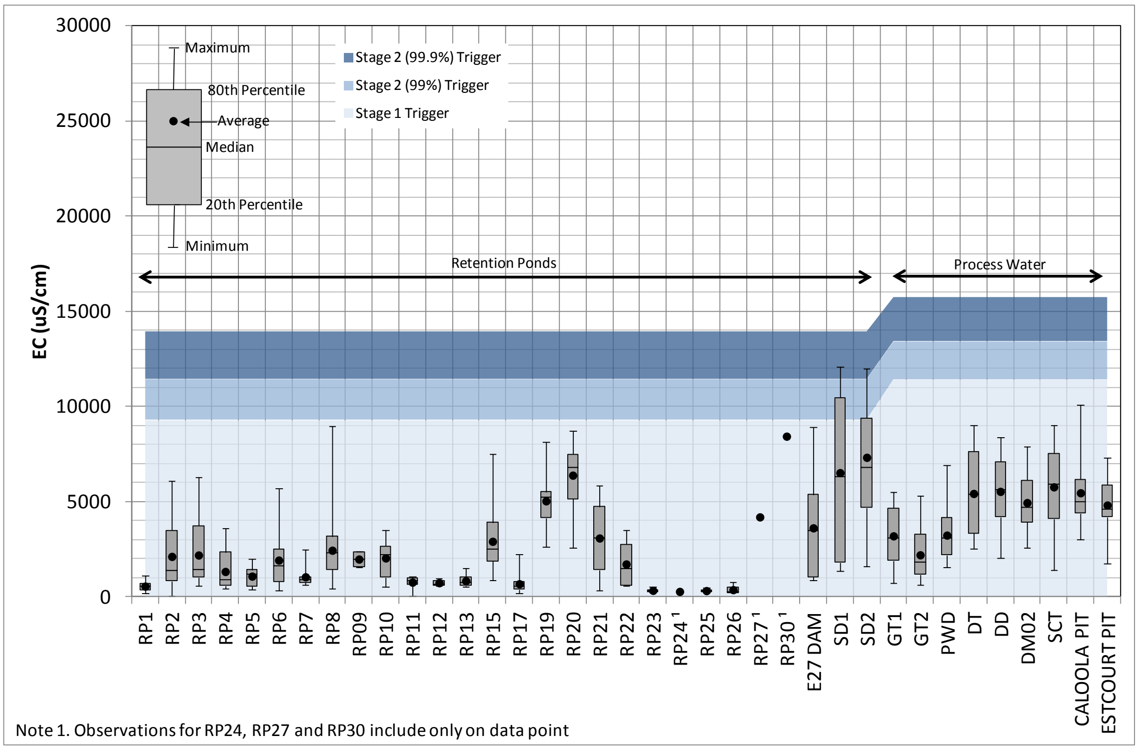

Chart 1.10 – Contaminated Water System – Electrical Conductivity

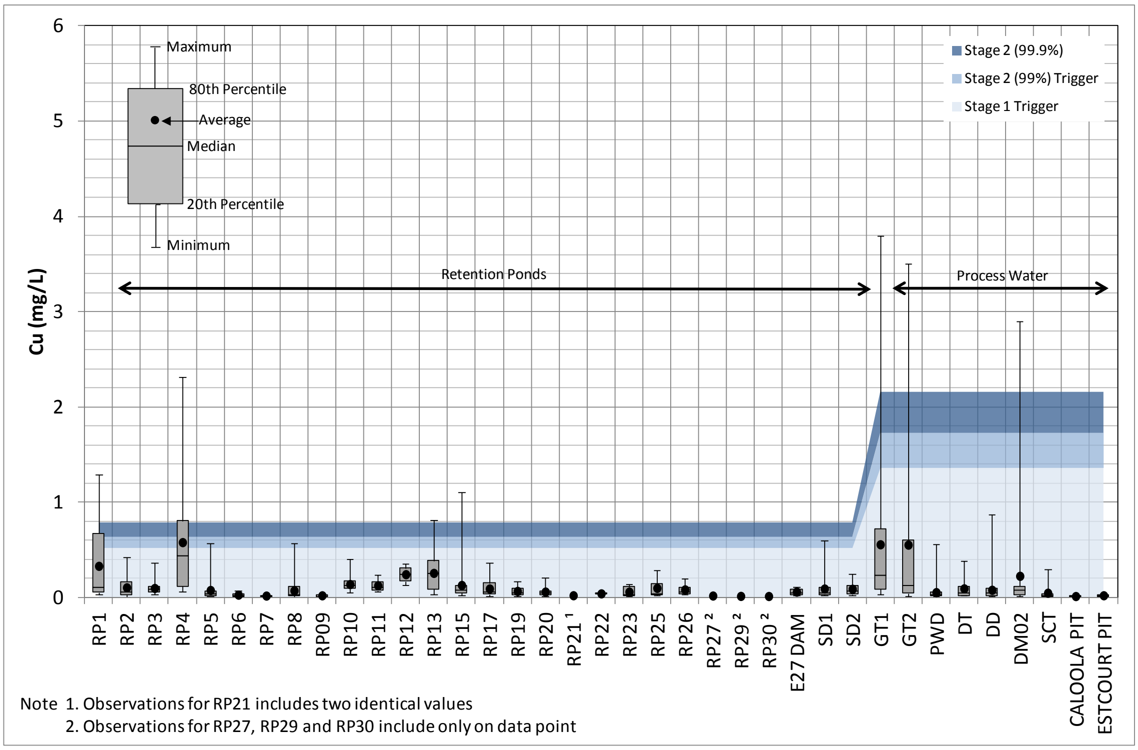

Chart 1.11 – Contaminated Water System – Copper

APPENDIX 3

Water Quality Tables

Appendix 3 – Water Quality Tables

1.0 Water Quality Tables

NPM has collected water quality information for 45 analytes since 2009, on a quarterly basis (or following rainfall events) at the monitoring locations shown on Figure 3.3 of the Surface Water Assessment (Umwelt, 2013). The sections below include summary tables of the range of observed values for each of the analytes measured at the monitoring locations for the clean water system (refer to **Section 1.1**); dirty water system (refer to **Section 1.2**); and contaminated water system (refer to **Section 1.3**).

The observed quarterly water quality data includes up to seven water quality observations. Given the limited number of samples, the summary tables below include a range of observed values. The tables also include the site specific water quality triggers developed by NPM for the site following the methods outlined in the ANZECC Guidelines (ANZECC/ ARMCANZ 2000).

1.1 Clean Water System

Table 1.1 – Historical Water Quality Ranges (2009 – 2011) – Watercourses

Analyte	Triggers			WC1	WC2	WC3	WC4	WC5	WC6	WC7	WC11	WC12	WC13	WC14
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
EC (µS) (in field)	350	415	485	80 to 460	96 to 162	220 to 220	120 to 150	110 to 241	109 to 164	106 to 380	89 to 185	122 to 197	104 to 289	141 to 257
pH (in field)	6 to 7.8	5.7 to 8.1	5.3 to 8.5	5.7 to 7.3	5.9 to 6.9	5.8 to 5.8	5.9 to 6.8	6.0 to 7.5	5.8 to 7.0	5.9 to 6.8	6.0 to 6.9	5.8 to 7.6	6.0 to 6.8	5.9 to 6.9
Total Dissolved Solids TDS (mg/L)	-	-	-	414 to 738	331 to 625	441 to 441	236 to 310	678 to 1220	250 to 269	268 to 739	186 to 444	151 to 520	228 to 1860	987 to 1370
Suspended Solids SS (mg/L)	470	585	720	70.0 to 192.0	73.0 to 174.0	38.0 to 38.0	11.0 to 165.0	65.0 to 376.0	39.0 to 178.0	8.0 to 388.0	24.0 to 52.0	8.0 to 261.0	58.0 to 767.0	108.0 to 668.0
Turbidity (NTU)	-	-	-	406.0 to 770.0	210.0 to 484.0	295.0 to 295.0	113.0 to 236.0	97.3 to 1320.0	180.0 to 627.0	177.0 to 622.0	149.0 to 250.0	53.1 to 337.0	556.0 to 2790.0	941.0 to 957.0
Hydroxide Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-	22 to 32	20 to 28	30 to 30	20 to 42	16 to 30	12 to 32	12 to 79	11 to 39	16 to 43	16 to 72	17 to 26
Total Alkalinity a CaCO3 (mg/L)	175	204	238	25 to 32	28 to 28	30 to 30	34 to 42	24 to 30	30 to 32	28 to 79	39 to 39	16 to 28	16 to 72	26 to 26
Sulfate as SO4 - Turbidimetric	-	-	-	7 to 21	8 to 17	50 to 50	8 to 14	21 to 54	10 to 12	4 to 31	2 to 28	6 to 28	9 to 51	24 to 46
Chloride (mg/L)	-	-	-	5 to 13	7 to 11	9 to 9	6 to 8	5 to 10	5 to 16	6 to 18	7 to 11	8 to 13	4 to 7	4 to 8
Calcium (mg/L)	27	31	37	2 to 3	2 to 3	9 to 9	3 to 4	2 to 6	3 to 5	3 to 11	1 to 3	2 to 5	2 to 10	4 to 5

Table 1.1 – Historical Water Quality Ranges (2009 – 2011) – Watercourses (cont)

Analyte	Triggers			WC1	WC2	WC3	WC4	WC5	WC6	WC7	WC11	WC12	WC13	WC14
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Magnesium Mg (mg/L)	12	14	17	2 to 2	2 to 2	4 to 4	2 to 3	2 to 3	2 to 3	2 to 6	1 to 3	2 to 3	1 to 5	2 to 3
Sodium Na (mg/L)	40	46	53	13 to 16	11 to 15	25 to 25	10 to 16	11 to 27	8 to 17	13 to 25	10 to 19	11 to 19	15 to 29	19 to 25
Potassium K (mg/L)	23	26	30	4 to 6	6 to 12	8 to 8	9 to 9	6 to 7	5 to 11	7 to 12	4 to 8	6 to 10	4 to 5	4 to 6
Dissolved metal Cu (mg/L)	0.078	0.094	0.112	-	-	-	7.63 to 7.63	-	-	14.60 to 14.60	-	16.60 to 16.60	11.30 to 11.30	-
Total Cyanide (mg/L)	27	31	37	-	-	-	0.002 to 0.002	-	-	0.002 to 0.002	-	0.002 to 0.002	0.001 to 0.001	-
Nitrite as N (mg/L)	-	-	-	-	-	-	0.093 to 0.093	-	-	0.084 to 0.084	-	0.140 to 0.140	0.069 to 0.069	-
Nitrate as N (mg/L)	-	-	-	-	-	-	0.084 to 0.084	-	-	0.119 to 0.119	-	0.131 to 0.131	0.670 to 0.670	-
Nitrite + Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium (mg/L)	24	29	36	21.50 to 38.30	13.90 to 32.60	18.10 to 18.10	7.63 to 13.90	9.74 to 41.90	9.96 to 25.60	5.83 to 30.50	6.86 to 19.20	2.91 to 22.20	18.20 to 84.50	49.60 to 74.70
Arsenic (mg/L)	0.0074	0.0086	0.0101	0.003 to 0.012	0.002 to 0.003	0.002 to 0.002	0.002 to 0.003	0.002 to 0.006	0.002 to 0.005	0.002 to 0.004	0.002 to 0.003	0.001 to 0.100	0.004 to 0.008	0.006 to 0.006
Strontium(mg/L)	-	-	-	0.06 to 0.08	0.05 to 0.07	0.18 to 0.18	0.07 to 0.09	0.09 to 0.14	0.05 to 0.14	0.08 to 0.20	0.02 to 0.05	0.05 to 0.07	0.23 to 0.27	0.22 to 0.24

Table 1.1 – Historical Water Quality Ranges (2009 – 2011) – Watercourses (cont)

Analyte	Triggers			WC1	WC2	WC3	WC4	WC5	WC6	WC7	WC11	WC12	WC13	WC14
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Barium (mg/L)	0.62	0.75	0.9	0.11 to 0.18	0.07 to 0.15	0.13 to 0.13	0.08 to 0.11	0.12 to 0.29	0.07 to 0.30	0.11 to 0.26	0.05 to 0.12	0.04 to 0.67	0.28 to 0.71	0.40 to 0.43
Beryllium (mg/L)	-	-	-	0.001 to 0.001	-	-	-	0.001 to 0.002	-	-	-	-	0.002 to 0.003	0.002 to 0.002
Cadmium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt (mg/L)	0.012	0.015	0.018	0.007 to 0.011	0.002 to 0.007	0.002 to 0.002	0.002 to 0.004	0.002 to 0.008	0.003 to 0.011	0.001 to 0.007	0.001 to 0.003	0.001 to 0.004	0.008 to 0.019	0.009 to 0.009
Uranium (mg/L)	0.0036	0.0044	0.0053	-	-	-	-	-	-	-	-	-	0.001 to 0.001	-
Chromium (mg/L)	-	-	-	0.020 to 0.032	0.010 to 0.022	0.013 to 0.013	0.005 to 0.011	0.007 to 0.030	0.007 to 0.017	0.004 to 0.017	0.008 to 0.016	0.004 to 0.020	0.025 to 0.065	0.037 to 0.054
Copper (mg/L)	0.078	0.094	0.112	0.02 to 0.04	0.03 to 0.05	0.14 to 0.14	0.01 to 0.06	0.08 to 0.24	0.01 to 0.08	0.02 to 0.03	0.01 to 0.02	0.01 to 0.02	0.06 to 0.12	0.05 to 0.07
Thorium (mg/L)	0.0046	0.0055	0.0066	0.003 to 0.007	0.002 to 0.005	0.003 to 0.003	0.002 to 0.004	0.001 to 0.006	0.002 to 0.003	0.001 to 0.004	0.002 to 0.004	0.001 to 0.004	0.003 to 0.014	0.008 to 0.011
Manganese (mg/L)	-	-	-	0.42 to 0.72	0.13 to 0.49	0.13 to 0.13	0.10 to 0.24	0.20 to 0.51	0.17 to 0.81	0.08 to 0.40	0.06 to 0.19	0.04 to 0.19	0.48 to 1.61	0.47 to 0.49
Molybdenum (mg/L)	0.0049	0.0059	0.0071	-	-	-	-	-	-	-	-	-	0.001 to 0.001	-

Table 1.1 – Historical Water Quality Ranges (2009 – 2011) – Watercourses (cont)

Analyte	Triggers			WC1	WC2	WC3	WC4	WC5	WC6	WC7	WC11	WC12	WC13	WC14
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Nickel (mg/L)	-	-	-	0.012 to 0.018	0.006 to 0.014	0.008 to 0.008	0.004 to 0.006	0.005 to 0.140	0.005 to 0.010	0.004 to 0.014	0.004 to 0.010	0.004 to 0.012	0.015 to 0.038	0.020 to 0.028
Lead (mg/L)	-	-	-	0.008 to 0.011	0.004 to 0.008	0.006 to 0.006	0.002 to 0.006	0.003 to 0.016	0.004 to 0.008	0.002 to 0.010	0.002 to 0.006	0.002 to 0.008	0.007 to 0.029	0.015 to 0.016
Antimony (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium(mg/L)	0.011	0.011	0.011	-	-	-	-	-	-	-	-	-	-	-
Tin (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc (mg/L)	-	-	-	0.036 to 0.056	0.024 to 0.060	0.033 to 0.033	0.014 to 0.027	0.055 to 0.160	0.021 to 0.042	0.008 to 0.044	0.023 to 0.032	0.015 to 0.032	0.044 to 0.110	0.065 to 0.094
Iron (mg/L)	22	27	31	19.80 to 29.50	11.10 to 26.00	15.20 to 15.20	6.78 to 11.70	7.70 to 36.60	9.09 to 24.20	6.07 to 25.40	5.87 to 14.40	5.91 to 17.70	19.90 to 70.80	36.30 to 60.60
Mercury (mg/L)	12	14	17	-	-	-	-	-	-	-	-	-	-	-
Flouride (mg/L)	-	-	-	-	-	0.1 to 0.1	-	0.1 to 0.1	0.1 to 0.1	0.2 to 0.2	-	-	0.1 to 0.2	0.2 to 0.2
Total Anions (meq/L)	-	-	-	1.0 to 1.1	1.0 to 1.1	-	0.8 to 1.3	0.9 to 2.0	0.9 to 1.3	1.0 to 2.2	0.5 to 1.3	0.8 to 1.2	1.1 to 2.4	1.1 to 1.1
Total Cations (meq/L)	-	-	-	1.0 to 1.2	0.9 to 1.2	1.9 to 1.9	1.0 to 1.4	0.9 to 1.9	0.9 to 1.4	1.1 to 2.4	0.7 to 1.3	0.9 to 1.4	1.0 to 2.0	1.3 to 1.6

Table 1.2 – Historical Water Quality Ranges (2009 – 2011) – Farm Dams

Analyte	Triggers			FD04	FD05	FD06	FD07	FD11	FD12	FD13	FD14	FD15	FD16	FD18	FD21	FD25
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
EC (μS) (in field)	1520	1825	2185	196 to 3400	133 to 310	159 to 373	136 to 2800	372 to 627	-	225 to 660	207 to 456	196 to 3400	164 to 358	1430 to 3600	-	227 to 395
pH (in field)	6.3 to 9.2	5.8 to 9.7	5.3 to 10.2	5.7 to 8.5	6.1 to 7.9	6.6 to 8.0	6.4 to 7.4	6.4 to 8.3	-	6.3 to 8.8	6.5 to 8.7	6.3 to 8.7	6.1 to 7.8	6.5 to 7.7	-	6.7 to 7.5
Total Dissolved Solids TDS (mg/L)	-	-	-	369 to 736	172 to 198	181 to 241	174 to 375	352 to 1540	-	220 to 384	284 to 2740	215 to 284	1220 to 2230	2380 to 2740	-	122 to 286
Suspended Solids SS (mg/L)	129	158	192	82.0 to 266.0	10.0 to 16.0	8.0 to 16.0	22.0 to 98.0	11.0 to 47.0	-	6.0 to 18.0	10.0 to 42.0	10.0 to 36.0	34.0 to 275.0	9.0 to 10.0	-	5.0 to 16.0
Turbidity (NTU)	-	-	-	156.0 to 472.0	-	-	24.2 to 357.0	55.2 to 5302.0	-	-	-	-	-	-	-	2.3 to 6.7
Hydroxide Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	26.0 to 26.0	-	-	-	12.0 to 12.0	5.0 to 5.0	2.0 to 2.0	-	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-	47 to 87	71 to 100	88 to 110	50 to 101	64 to 122	-	102 to 148	100 to 170	125 to 162	45 to 78	75 to 93	-	103 to 180

Table 1.2 – Historical Water Quality Ranges (2009 – 2011) – Farm Dams (cont)

Analyte	Triggers			FD04	FD05	FD06	FD07	FD11	FD12	FD13	FD14	FD15	FD16	FD18	FD21	FD25
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Total Alkalinity a CaCO3 (mg/L)	254	297	346	76 to 87	98 to 100	110 to 120	97 to 101	110 to 122	-	123 to 160	159 to 175	130 to 164	77 to 78	75 to 93	-	180 to 180
Sulfate as SO4 - Turbidimetric	-	-	-	20 to 55	-	2 to 5	1 to 7	85 to 120	-	13 to 20	1 to 5	4 to 42	10 to 31	1390 to 1810	-	8 to 22
Chloride (mg/L)	-	-	-	14 to 30	15 to 22	21 to 35	8 to 24	13 to 31	-	14 to 26	12 to 24	10 to 11	9 to 12	96 to 122	-	8 to 19
Calcium (mg/L)	149	186	228	7 to 13	4 to 5	9 to 14	3 to 9	21 to 269	-	17 to 23	14 to 19	13 to 33	5 to 8	359 to 414	-	22 to 33
Magnesium Mg (mg/L)	83	104	128	4 to 7	5 to 6	7 to 8	4 to 7	6 to 61	-	6 to 9	6 to 10	9 to 10	3 to 5	101 to 120	-	6 to 12
Sodium Na (mg/L)	285	355	435	21 to 50	22 to 40	17 to 40	15 to 40	28 to 116	-	20 to 44	25 to 51	22 to 44	14 to 32	206 to 253	-	12 to 26
Potassium K (mg/L)	27	31	36	8 to 13	8 to 12	14 to 21	8 to 12	9 to 15	-	10 to 17	8 to 13	10 to 15	10 to 12	17 to 20	-	20 to 32
Dissolved metal Cu (mg/L)	0.083	0.101	0.122	-	0.00 to 0.01	0.00 to 0.02	-	0.02 to 0.02	-	0.00 to 0.01	0.00 to 0.01	0.00 to 0.01	0.01 to 0.02	0.00 to 0.01	-	-
Total Cyanide (mg/L)	149	186	228	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.2 – Historical Water Quality Ranges (2009 – 2011) – Farm Dams (cont)

Analyte	Triggers			FD04	FD05	FD06	FD07	FD11	FD12	FD13	FD14	FD15	FD16	FD18	FD21	FD25
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Nitrite + Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium (mg/L)	36	45	55	6.51 to 22.30	-	-	1.80 to 29.20	2.06 to 5.38	-	-	-	-	-	-	-	0.19 to 0.54
Arsenic (mg/L)	0.0061	0.007	0.0081	0.004 to 0.008	-	-	0.002 to 0.005	0.002 to 0.004	-	-	-	-	-	-	-	0.002 to 0.003
Strontium(mg/L)	-	-	-	0.11 to 0.28	-	-	0.07 to 0.17	0.34 to 0.53	-	-	-	-	-	-	-	0.33 to 0.60
Barium (mg/L)	0.27	0.31	0.36	0.11 to 0.34	-	-	0.15 to 0.47	0.12 to 0.17	-	-	-	-	-	-	-	0.10 to 0.27
Beryllium (mg/L)	-	-	-	0.001 to 0.001	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (mg/L)	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt (mg/L)	0.012	0.015	0.018	0.003 to 0.010	-	-	0.002 to 0.007	0.001 to 0.004	-	-	-	-	-	-	-	0.001 to 0.001
Uranium (mg/L)	0.0035	0.0042	0.0049	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium (mg/L)	0.053	0.065	0.08	0.006 to 0.200	-	-	0.006 to 0.019	0.002 to 0.004	-	-	-	-	-	-	-	-

Table 1.2 – Historical Water Quality Ranges (2009 – 2011) – Farm Dams (cont)

Analyte	Triggers			FD04	FD05	FD06	FD07	FD11	FD12	FD13	FD14	FD15	FD16	FD18	FD21	FD25
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Copper™(mg/L)	0.083	0.101	0.122	0.02 to 0.48	0.01 to 0.01	0.01 to 0.01	0.01 to 0.03	0.01 to 0.05	-	0.01 to 0.01	-	-	0.01 to 0.14	0.00 to 0.00	-	0.00 to 0.00
Thorium (mg/L)	0.005	0.006	0.0072	0.001 to 0.005	-	-	0.003 to 0.004	-	-	-	-	-	-	-	-	0.001 to 0.001
Manganese (mg/L)	2.2	2.7	0	0.36 to 0.77	-	-	0.14 to 0.32	0.32 to 0.76	-	-	-	-	-	-	-	0.08 to 0.34
Molybdenum (mg/L)	-	-	-	0.000 to 0.003	-	-	-	0.004 to 0.005	-	-	-	-	-	-	-	0.002 to 0.003
Nickel (mg/L)	0.024	0.029	0.035	0.007 to 0.018	-	-	0.003 to 0.014	0.003 to 0.005	-	-	-	-	-	-	-	0.001 to 0.001
Lead (mg/L)	0.022	0.027	0.032	0.003 to 0.012	-	-	0.003 to 0.010	0.001 to 0.002	-	-	-	-	-	-	-	-
Antimony(mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium(mg/L)	0.02	0.02	0.02	0.01 to 0.01	-	-	-	-	-	-	-	-	-	-	-	-
Tin (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.2 – Historical Water Quality Ranges (2009 – 2011) – Farm Dams (cont)

Analyte	Triggers			FD04	FD05	FD06	FD07	FD11	FD12	FD13	FD14	FD15	FD16	FD18	FD21	FD25
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Zinc (mg/L)	0.1	0.12	0.15	0.012 to 0.040	-	-	0.012 to 0.032	0.006 to 0.009	-	-	-	-	-	-	-	0.007 to 0.009
Iron (mg/L)	51	63	0	6.64 to 19.60	-	-	1.97 to 21.60	2.63 to 4.73	-	-	-	-	-	-	-	0.32 to 0.53
Mercury (mg/L)	83	104	128	-	-	-	-	-	-	-	-	-	-	-	-	-
Flouride (mg/L)	-	-	-	0.2 to 0.3	-	-	0.2 to 0.4	0.2 to 0.5	-	-	-	-	-	-	-	0.2 to 0.4
Total Anions (meq/L)	-	-	-	3.4 to 3.6	2.6 to 2.6	3.0 to 3.5	2.5 to 2.7	4.0 to 5.8	-	3.6 to 4.2	3.9 to 4.1	3.7 to 3.8	2.1 to 2.5	33.5 to 42.6	-	4.4 to 4.4
Total Cations (meq/L)	-	-	-	3.4 to 3.7	2.3 to 2.8	2.8 to 3.5	2.8 to 2.9	4.1 to 5.8	-	3.5 to 4.2	4.0 to 4.3	3.8 to 3.9	1.8 to 2.5	35.6 to 42.0	-	4.6 to 4.6

1.2 Dirty Water System

Table 1.3 – Historical Water Quality Ranges (2009 – 2011) – Sediment Ponds

Analyte	Triggers			SP01	SP03	SP04	SP05	SP08	SP09	SP10	SP14	SP14	SP21	SP15
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
EC (µS) (in field)	8070	9810	11825	451 to 451	1865 to 3060	1660 to 4880	1800 to 1850	522 to 3630	230 to 3890	123 to 2120	421 to 4091	421 to 4091	300 to 379	714 to 714
pH (in field)	6.6 to 9.4	6.2 to 9.9	5.7 to 10.4	6.8 to 6.8	6.6 to 9.5	6.4 to 8.8	6.6 to 7.9	6.6 to 8.3	6.3 to 7.8	5.8 to 8.8	5.6 to 8.1	5.6 to 8.1	6.6 to 7.0	8.8 to 8.8
Total Dissolved Solids TDS (mg/L)	-	-	-	518 to 518	1660 to 2630	1380 to 2540	1610 to 1810	418 to 916	538 to 824	282 to 1080	388 to 2580	388 to 2580	162 to 210	531 to 531
Suspended Solids SS (mg/L)	80	97	116	71.0 to 71.0	6.0 to 54.0	6.0 to 55.0	8.0 to 10.0	18.0 to 93.0	27.0 to 140.0	44.0 to 256.0	8.0 to 182.0	8.0 to 182.0	15.0 to 20.0	151.0 to 151.0
Turbidity (NTU)	-	-	-	164.0 to 164.0	1.4 to 14.3	2.1 to 42.6	6.7 to 8.9	28.4 to 218.0	69.1 to 382.0	23.8 to 777.0	3.8 to 221.0	3.8 to 221.0	7.6 to 13.9	264.0 to 264.0
Hydroxide Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	12.0 to 12.0	-	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-	57 to 57	46 to 88	65 to 89	66 to 67	92 to 153	37 to 125	24 to 169	26 to 133	26 to 133	105 to 132	65 to 65

Table 1.3 – Historical Water Quality Ranges (2009 – 2011) – Sediment Ponds (cont)

Analyte	Triggers			SP01	SP03	SP04	SP05	SP08	SP09	SP10	SP14	SP14	SP21	SP15
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Total Alkalinity a CaCO3 (mg/L)	194	225	261	-	-	-	-	-	-	24 to 169	71 to 71	71 to 71	-	-
Sulfate as SO4 - Turbidimetric	-	-	-	136 to 136	797 to 1290	515 to 1150	252 to 794	112 to 479	54 to 207	24 to 145	84 to 958	84 to 958	4 to 10	34 to 34
Chloride (mg/L)	-	-	-	34 to 34	196 to 359	269 to 487	252 to 269	11 to 23	13 to 22	7 to 36	18 to 605	18 to 605	10 to 12	25 to 25
Calcium (mg/L)	490	605	735	22 to 22	183 to 245	78 to 150	113 to 137	13 to 31	13 to 21	4 to 45	14 to 202	14 to 202	20 to 24	20 to 20
Magnesium Mg (mg/L)	555	695	860	10 to 10	68 to 124	52 to 98	66 to 68	8 to 27	5 to 13	2 to 16	9 to 118	9 to 118	10 to 12	9 to 9
Sodium Na (mg/L)	4835	6125	7620	74 to 74	255 to 390	283 to 525	297 to 345	54 to 236	25 to 120	17 to 74	41 to 516	41 to 516	16 to 19	21 to 21
Potassium K (mg/L)	41	49	59	6 to 6	7 to 15	7 to 13	8 to 8	4 to 12	8 to 11	6 to 17	6 to 16	6 to 16	8 to 9	6 to 6
Dissolved metal Cu (mg/L)	0.13	0.16	0.2	0.05 to 0.05	0.01 to 0.01	0.01 to 0.01	0.00 to 0.00	0.01 to 0.10	0.02 to 0.08	0.01 to 0.09	0.01 to 0.07	0.01 to 0.07	0.00 to 0.00	0.23 to 0.23
Total Cyanide (mg/L)	490	605	735	-	-	-	-	-	-	-	-	-	-	-
Nitrite as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite + Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium (mg/L)	8.86	11	13.4	10.50 to 10.50	0.04 to 1.61	0.24 to 3.25	0.24 to 0.28	2.39 to 14.40	4.16 to 24.60	1.68 to 65.60	0.08 to 18.70	0.08 to 18.70	0.32 to 0.82	12.40 to 12.40

Table 1.3 – Historical Water Quality Ranges (2009 – 2011) – Sediment Ponds (cont)

Analyte	Triggers			SP01	SP03	SP04	SP05	SP08	SP09	SP10	SP14	SP14	SP21	SP15
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Arsenic (mg/L)	0.0075	0.0089	0.011	0.003 to 0.003	0.001 to 0.001	0.002 to 0.002	-	0.002 to 0.003	0.002 to 0.004	0.002 to 0.010	0.001 to 0.003	0.001 to 0.003	0.001 to 0.002	0.004 to 0.004
Strontium(mg/L)	-	-	-	-	7.40 to 9.84	4.67 to 6.06	-	0.20 to 0.31	0.18 to 0.30	0.14 to 0.72	0.50 to 4.13	0.50 to 4.13	0.30 to 0.44	0.38 to 0.38
Barium (mg/L)	0.17	0.2	0.23	0.11 to 0.11	0.02 to 0.05	0.08 to 0.34	0.08 to 0.09	0.05 to 0.17	0.12 to 0.18	0.13 to 0.58	0.07 to 0.15	0.07 to 0.15	0.28 to 0.34	0.12 to 0.12
Beryllium (mg/L)	-	-	-	-	-	-	-	-	-	0.001 to 0.002	-	-	-	-
Cadmium (mg/L)	0.00075	0.00091	0.0011	-	-	0.0002 to 0.0002	-	-	-	0.0001 to 0.0002	0.0001 to 0.0001	0.0001 to 0.0001	-	0.0001 to 0.0001
Cobalt (mg/L)	0.0029	0.0034	0.004	0.003 to 0.003	-	-	-	0.002 to 0.004	0.003 to 0.006	0.002 to 0.010	0.001 to 0.003	0.001 to 0.003	-	0.002 to 0.002
Uranium (mg/L)	0.0052	0.0063	0.0075	0.001 to 0.001	0.001 to 0.001	0.002 to 0.004	0.002 to 0.003	0.001 to 0.001	-	-	0.001 to 0.006	0.001 to 0.006	-	-
Chromium (mg/L)	0.019	0.024	0.029	0.007 to 0.007	-	0.001 to 0.003	-	0.001 to 0.013	0.003 to 0.020	0.006 to 0.044	0.005 to 0.013	0.005 to 0.013	-	0.007 to 0.007
Copper (mg/L)	0.13	0.16	0.2	0.15 to 0.15	0.01 to 0.36	0.01 to 0.02	0.01 to 0.01	0.01 to 0.07	0.03 to 0.10	0.04 to 0.66	0.02 to 0.21	0.02 to 0.21	0.00 to 0.01	0.33 to 0.33

Table 1.3 – Historical Water Quality Ranges (2009 – 2011) – Sediment Ponds (cont)

Analyte	Triggers			SP01	SP03	SP04	SP05	SP08	SP09	SP10	SP14	SP14	SP21	SP15
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Thorium (mg/L)	0.0016	0.002	0.0023	0.001 to 0.001	-	0.006 to 0.006	-	0.001 to 0.001	0.001 to 0.003	0.001 to 0.006	0.001 to 0.004	0.001 to 0.004	-	0.001 to 0.001
Manganese (mg/L)	0.47	0.58	0.7	0.11 to 0.11	0.02 to 0.43	0.01 to 0.06	0.01 to 0.01	0.09 to 0.30	0.16 to 0.44	0.23 to 0.71	0.04 to 0.38	0.04 to 0.38	0.07 to 0.40	0.11 to 0.11
Molybdenum (mg/L)	-	-	-	0.006 to 0.006	0.042 to 0.082	0.075 to 0.191	0.078 to 0.083	0.009 to 0.051	0.001 to 0.020	0.002 to 0.014	0.001 to 0.015	0.001 to 0.015	0.002 to 0.002	0.001 to 0.001
Nickel (mg/L)	0.0063	0.0075	0.0089	0.004 to 0.004	0.001 to 0.001	0.002 to 0.003	0.002 to 0.002	0.001 to 0.010	0.007 to 0.014	0.003 to 0.022	0.001 to 0.007	0.001 to 0.007	0.002 to 0.002	0.004 to 0.004
Lead (mg/L)	0.0034	0.004	0.0047	0.004 to 0.004	0.002 to 0.002	0.001 to 0.001	-	0.002 to 0.010	0.002 to 0.012	0.003 to 0.024	0.001 to 0.005	0.001 to 0.005	-	0.007 to 0.007
Antimony(mg/L)	-	-	-	-	0.001 to 0.001	0.001 to 0.003	0.001 to 0.002	-	-	-	-	-	-	-
Selenium(mg/L)	0.071	0.086	0.1	-	0.02 to 0.07	0.01 to 0.01	0.07 to 0.07	0.01 to 0.01	0.01 to 0.01	0.01 to 0.01	-	-	-	-
Tin (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc (mg/L)	0.017	0.02	0.024	0.028 to 0.028	0.008 to 0.036	0.008 to 0.024	-	0.008 to 0.026	0.021 to 0.039	0.006 to 0.097	0.006 to 0.030	0.006 to 0.030	0.005 to 0.006	0.030 to 0.030

Table 1.3 – Historical Water Quality Ranges (2009 – 2011) – Sediment Ponds (cont)

Analyte	Triggers			SP01	SP03	SP04	SP05	SP08	SP09	SP10	SP14	SP14	SP21	SP15
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)											
Iron (mg/L)	7.4	9.2	11.2	10.10 to 10.10	0.07 to 1.42	0.24 to 2.68	0.21 to 0.51	1.74 to 13.40	3.88 to 20.20	1.46 to 55.20	0.22 to 13.40	0.22 to 13.40	0.39 to 0.69	12.60 to 12.60
Mercury (mg/L)	555	695	860	-	-	-	-	-	-	-	-	-	-	-
Flouride (mg/L)	-	-	-	0.5 to 0.5	1.2 to 1.8	0.9 to 2.0	1.0 to 1.2	0.4 to 1.3	0.1 to 0.7	0.1 to 0.6	0.1 to 0.8	0.1 to 0.8	0.2 to 0.3	0.2 to 0.2
Total Anions (meq/L)	-	-	-	-	30.3 to 38.6	25.9 to 25.9	-	4.8 to 6.5	4.6 to 6.1	1.9 to 6.9	5.6 to 39.4	5.6 to 39.4	2.7 to 3.1	2.7 to 2.7
Total Cations (meq/L)	-	-	-	-	32.4 to 39.8	27.4 to 27.4	-	1.9 to 6.8	4.7 to 6.3	1.2 to 7.2	5.4 to 42.6	5.4 to 42.6	2.8 to 3.2	2.8 to 2.8

1.3 Contaminated Water System

Table 1.4 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 1

Analyte	Triggers			RP01	RP02	RP03	RP04	RP05	RP06	RP07	RP08	RP09	RP10	RP12	RP13	RP15	RP19
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)														
EC (µS) (in field)	9280	11430	13930	243 to 552	259 to 4710	243 to 1230	421 to 953	396 to 4420	100 to 1241	760 to 1230	1169 to 8963	1561 to 2690	502 to 817	578 to 578	605 to 1171	1008 to 1789	2600 to 16100
pH (in field)	6.4 to 9.2	5.9 to 9.6	5.3 to 10	6.0 to 6.3	6.1 to 8.5	6.3 to 8.4	6.0 to 60.2	7.1 to 9.1	6.4 to 8.4	6.4 to 7.5	6.3 to 8.6	6.6 to 8.7	6.1 to 6.6	6.7 to 6.7	6.5 to 8.3	6.9 to 8.1	6.2 to 7.6
Total Dissolved Solids TDS (mg/L)	-	-	-	194 to 194	930 to 930	1010 to 1470	704 to 704	250 to 482	648 to 648	566 to 566	1460 to 7310	1200 to 1200	404 to 404	-	612 to 612	526 to 526	3760 to 10900
Suspended Solids SS (mg/L)	64	77	92	46.0 to 46.0	6.0 to 6.0	6.0 to 6.0	46.0 to 46.0	9.0 to 15.0	13.0 to 13.0	-	98.0 to 136.0	38.0 to 38.0	8.0 to 8.0	-	8.0 to 8.0	24.0 to 24.0	9.0 to 9.0
Turbidity (NTU)	-	-	-	-	-	-	-	-	-	-	75.1 to 75.1	-	-	-	-	-	44.9 to 44.9
Hydroxide Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.4 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 1 (cont)

Analyte	Triggers			RP01	RP02	RP03	RP04	RP05	RP06	RP07	RP08	RP09	RP10	RP12	RP13	RP15	RP19
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)														
Carbonate Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	5.0 to 5.0	-	-	-	-	-	-	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-	27 to 27	85 to 85	42 to 61	31 to 31	62 to 69	114 to 114	149 to 149	33 to 69	63 to 63	85 to 85	-	79 to 79	144 to 144	49 to 603
Total Alkalinity a CaCO3 (mg/L)	169	198	231	-	-	61 to 61	-	67 to 67	-	-	-	-	-	-	-	144 to 144	-
Sulfate as SO4 - Turbidimetric	-	-	-	67 to 67	456 to 456	580 to 726	368 to 368	82 to 172	252 to 252	204 to 204	858 to 3750	519 to 519	172 to 172	-	250 to 250	116 to 116	2130 to 2130
Chloride (mg/L)	-	-	-	9 to 9	74 to 74	97 to 240	79 to 79	47 to 131	90 to 90	94 to 94	130 to 769	165 to 165	27 to 27	-	112 to 112	132 to 132	412 to 4840
Calcium (mg/L)	680	830	1000	20 to 20	78 to 78	116 to 134	108 to 108	35 to 36	81 to 81	67 to 67	257 to 1480	85 to 85	71 to 71	-	82 to 82	30 to 30	356 to 595
Magnesium Mg (mg/L)	155	185	225	5 to 5	35 to 35	37 to 40	30 to 30	9 to 19	23 to 23	27 to 27	41 to 188	46 to 46	13 to 13	-	28 to 28	14 to 14	107 to 300
Sodium Na (mg/L)	790	960	1160	15 to 15	168 to 168	148 to 311	80 to 80	43 to 111	111 to 111	103 to 103	149 to 800	219 to 219	32 to 32	-	73 to 73	144 to 144	528 to 2800
Potassium K (mg/L)	96	118	144	4 to 4	7 to 7	13 to 31	7 to 7	7 to 13	13 to 13	8 to 8	12 to 42	7 to 7	9 to 9	-	6 to 6	11 to 11	21 to 40

Table 1.4 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 1 (cont)

Analyte	Triggers			RP01	RP02	RP03	RP04	RP05	RP06	RP07	RP08	RP09	RP10	RP12	RP13	RP15	RP19
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)														
Dissolved metal Cu (mg/L)	0.52	0.64	0.79	0.04 to 0.07	0.03 to 0.56	0.04 to 0.06	0.56 to 0.56	0.01 to 0.05	0.01 to 0.14	0.01 to 0.02	0.01 to 0.01	0.00 to 0.01	0.17 to 0.19	0.13 to 0.13	0.09 to 0.11	0.02 to 0.05	0.05 to 0.17
Total Cyanide (mg/L)	680	830	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite + Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium (mg/L)	3.32	4.1	5	2.15 to 2.15	0.15 to 0.15	0.06 to 0.10	1.30 to 1.30	0.04 to 0.45	0.10 to 0.24	0.08 to 0.08	1.18 to 2.51	0.90 to 0.90	0.03 to 0.03	-	0.12 to 0.12	0.54 to 0.54	0.15 to 0.15
Arsenic (mg/L)	0.0084	0.01	0.012	0.009 to 0.009	0.004 to 0.004	0.010 to 0.014	0.012 to 0.025	0.002 to 0.004	0.001 to 0.003	-	0.004 to 0.013	0.001 to 0.001	0.004 to 0.004	-	0.004 to 0.004	0.025 to 0.025	0.002 to 0.002
Strontium (mg/L)	-	-	-	-	-	-	-	-	-	-	30.80 to 30.80	-	-	-	-	-	11.10 to 11.10
Barium (mg/L)	0.19	0.22	0.26	0.10 to 0.10	0.04 to 0.04	0.06 to 0.07	0.05 to 0.05	0.08 to 0.10	0.10 to 0.11	0.15 to 0.15	0.10 to 0.12	0.09 to 0.09	0.05 to 0.05	-	0.06 to 0.06	0.10 to 0.10	0.04 to 0.10
Beryllium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.4 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 1 (cont)

Analyte	Triggers			RP01	RP02	RP03	RP04	RP05	RP06	RP07	RP08	RP09	RP10	RP12	RP13	RP15	RP19
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)														
Cadmium (mg/L)	0.002	0.0026	0.0032	0.0002 to 0.0002	-	-	0.0008 to 0.0008	-	-	-	0.0001 to 0.0001	-	-	-	-	-	0.0002 to 0.0005
Cobalt (mg/L)	0.0023	0.0027	0.0032	-	-	-	0.005 to 0.005	-	-	-	0.001 to 0.002	-	-	-	-	-	0.004 to 0.004
Uranium (mg/L)	0.0054	0.0065	0.0079	-	-	-	-	-	0.001 to 0.001	0.002 to 0.002	0.002 to 0.004	0.002 to 0.002	-	-	0.001 to 0.001	-	0.002 to 0.010
Chromium (mg/L)	0.0037	0.0044	0.0053	0.002 to 0.002	-	-	0.002 to 0.002	-	-	-	0.005 to 0.005	0.001 to 0.001	-	-	-	-	0.002 to 0.002
Copper™(mg/L)	0.52	0.64	0.79	0.68 to 0.68	0.03 to 0.17	0.07 to 0.17	2.31 to 2.31	0.02 to 0.04	0.01 to 0.01	0.01 to 0.01	0.13 to 0.14	0.01 to 0.04	0.13 to 0.13	-	0.11 to 0.11	0.16 to 0.16	0.01 to 0.07
Thorium (mg/L)	0.0081	0.01	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (mg/L)	0.19	0.23	0	-	-	-	-	-	-	-	0.21 to 0.21	-	-	-	-	-	1.05 to 1.05
Molybdenum (mg/L)	-	-	-	0.006 to 0.006	0.043 to 0.043	0.036 to 0.097	0.013 to 0.013	0.009 to 0.009	0.011 to 0.018	0.007 to 0.007	0.093 to 0.395	0.079 to 0.079	0.021 to 0.021	-	0.004 to 0.004	0.058 to 0.058	0.014 to 0.343

Table 1.4 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 1 (cont)

Analyte	Triggers			RP01	RP02	RP03	RP04	RP05	RP06	RP07	RP08	RP09	RP10	RP12	RP13	RP15	RP19
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)														
Nickel (mg/L)	0.0033	0.0039	0.0046	0.002 to 0.002	-	-	0.003 to 0.003	0.001 to 0.002	0.001 to 0.002	-	0.002 to 0.004	-	-	-	-	-	0.003 to 0.009
Lead (mg/L)	0.047	0.06	0.075	0.004 to 0.004	-	-	0.007 to 0.007	-	-	-	0.002 to 0.003	-	-	-	-	0.002 to 0.002	0.006 to 0.006
Antimony(mg/L)	-	-	-	-	-	-	-	-	-	-	0.004 to 0.004	-	-	-	-	-	-
Selenium(mg/L)	0.13	0.16	0.2	-	0.03 to 0.03	0.02 to 0.02	-	-	-	-	0.02 to 0.02	0.05 to 0.05	-	-	-	-	-
Tin (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc (mg/L)	0.056	0.069	0.084	0.047 to 0.047	0.006 to 0.006	0.006 to 0.006	0.151 to 0.151	0.007 to 0.007	-	-	0.012 to 0.014	-	-	-	-	0.007 to 0.007	0.038 to 0.116
Iron (mg/L)	5	6	7	-	-	-	-	-	-	-	1.08 to 1.08	-	-	-	-	-	-
Mercury (mg/L)	155	185	225	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.4 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 1 (cont)

Analyte	Triggers			RP01	RP02	RP03	RP04	RP05	RP06	RP07	RP08	RP09	RP10	RP12	RP13	RP15	RP19
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)														
Flouride (mg/L)	-	-	-	-	-	-	-	-	-	-	2.5 to 2.5	-	-	-	-	-	1.4 to 1.4
Total Anions (meq/L)	-	-	-	-	-	23.1 to 23.1	-	8.6 to 8.6	-	-	-	-	-	-	-	9.0 to 9.0	-
Total Cations (meq/L)	-	-	-	-	-	23.4 to 23.4	-	8.5 to 8.5	-	-	-	-	-	-	-	9.2 to 9.2	-

Table 1.5 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 2

Analyte	Triggers			RP20	RP21	RP22	RP23	RP24	RP25	RP26	RP27	RP29	RP30	E27 DAM	SD1	SD2
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
EC (µS) (in field)	9280	11430	13930	2560 to 14200	-	605 to 633	240 to 343	-	267 to 2760	218 to 2720	6800 to 7811	-	-	-	1602 to 11400	5640 to 9898
pH (in field)	6.4 to 9.2	5.9 to 9.6	5.3 to 10	6.8 to 7.8	-	6.9 to 9.4	6.2 to 7.3	-	7.2 to 8.1	6.5 to 8.3	7.7 to 7.8	-	-	-	8.4 to 9.6	7.0 to 8.9
Total Dissolved Solids TDS (mg/L)	-	-	-	4090 to 8220	-	428 to 428	176 to 176	-	180 to 180	200 to 200	5120 to 5120	-	-	-	1000 to 1000	3730 to 3730
Suspended Solids SS (mg/L)	64	77	92	7.0 to 20.0	-	113.0 to 113.0	23.0 to 23.0	-	8.0 to 8.0	18.0 to 18.0	8.0 to 8.0	-	-	-	34.0 to 34.0	63.0 to 63.0
Turbidity (NTU)	-	-	-	19.9 to 19.9	-	-	-	-	-	-	-	-	-	-	-	-
Hydroxide Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-	160 to 767	-	52 to 52	83 to 83	-	111 to 111	80 to 80	89 to 89	-	-	-	77 to 77	130 to 130
Total Alkalinity a CaCO3 (mg/L)	169	198	231	203 to 203	-	-	-	-	-	-	89 to 89	-	-	-	-	-

Table 1.5 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 2 (cont)

Analyte	Triggers			RP20	RP21	RP22	RP23	RP24	RP25	RP26	RP27	RP29	RP30	E27 DAM	SD1	SD2
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Sulfate as SO4 - Turbidimetric	-	-	-	2280 to 2820	-	182 to 182	30 to 30	-	14 to 14	9 to 9	3220 to 3220	-	-	-	187 to 187	737 to 737
Chloride (mg/L)	-	-	-	594 to 4200	-	43 to 43	17 to 17	-	12 to 12	9 to 9	700 to 700	-	-	-	427 to 427	1580 to 1580
Calcium (mg/L)	680	830	1000	265 to 545	-	61 to 61	22 to 22	-	13 to 13	15 to 15	528 to 528	-	-	-	65 to 65	179 to 179
Magnesium Mg (mg/L)	155	185	225	135 to 239	-	8 to 8	6 to 6	-	6 to 6	5 to 5	218 to 218	-	-	-	29 to 29	126 to 126
Sodium Na (mg/L)	790	960	1160	713 to 2440	-	51 to 51	28 to 28	-	44 to 44	22 to 22	868 to 868	-	-	-	269 to 269	996 to 996
Potassium K (mg/L)	96	118	144	76 to 134	-	16 to 16	5 to 5	-	2 to 2	4 to 4	86 to 86	-	-	-	11 to 11	16 to 16
Dissolved metal Cu (mg/L)	0.52	0.64	0.79	0.02 to 0.04	-	0.04 to 0.05	0.01 to 0.03	-	0.02 to 0.03	0.03 to 0.05	-	0.01 to 0.01	0.01 to 0.01	-	0.03 to 0.05	0.02 to 0.07
Total Cyanide (mg/L)	680	830	1000	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite + Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.5 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 2 (cont)

Analyte	Triggers			RP20	RP21	RP22	RP23	RP24	RP25	RP26	RP27	RP29	RP30	E27 DAM	SD1	SD2
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Aluminium (mg/L)	3.32	4.1	5	0.03 to 0.21	-	0.31 to 0.31	1.03 to 1.03	-	0.42 to 0.42	0.33 to 0.33	0.02 to 0.02	-	-	-	0.16 to 0.16	0.79 to 0.79
Arsenic (mg/L)	0.0084	0.01	0.012	0.001 to 0.001	-	0.006 to 0.006	0.021 to 0.021	-	0.013 to 0.013	0.006 to 0.006	0.001 to 0.001	-	-	-	0.025 to 0.025	0.034 to 0.034
Strontium(mg/L)	-	-	-	8.16 to 8.16	-	-	-	-	-	-	-	-	-	-	-	-
Barium (mg/L)	0.19	0.22	0.26	0.02 to 0.06	-	0.10 to 0.10	0.15 to 0.15	-	0.11 to 0.11	0.11 to 0.11	0.04 to 0.04	-	-	-	0.13 to 0.13	0.25 to 0.25
Beryllium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (mg/L)	0.002	0.0026	0.0032	0.0003 to 0.0006	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt (mg/L)	0.0023	0.0027	0.0032	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium (mg/L)	0.0054	0.0065	0.0079	0.006 to 0.015	-	-	-	-	0.001 to 0.001	-	0.006 to 0.006	-	-	-	-	-
Chromium (mg/L)	0.0037	0.0044	0.0053	0.005 to 0.005	-	-	-	-	-	-	-	-	-	-	-	0.004 to 0.004
Copper™(mg/L)	0.52	0.64	0.79	0.02 to 0.06	-	0.07 to 0.07	0.14 to 0.14	-	0.05 to 0.05	0.06 to 0.06	0.01 to 0.02	-	-	-	0.11 to 0.11	0.25 to 0.25

Table 1.5 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 2 (cont)

Analyte	Triggers			RP20	RP21	RP22	RP23	RP24	RP25	RP26	RP27	RP29	RP30	E27 DAM	SD1	SD2
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Thorium (mg/L)	0.0081	0.01	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (mg/L)	0.19	0.23	0	0.00 to 0.00	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum (mg/L)	-	-	-	0.012 to 0.115	-	0.033 to 0.033	0.009 to 0.009	-	0.006 to 0.006	0.003 to 0.003	0.120 to 0.120	-	-	-	0.031 to 0.031	0.131 to 0.131
Nickel (mg/L)	0.0033	0.0039	0.0046	0.001 to 0.003	-	-	-	-	-	-	-	-	-	-	0.001 to 0.001	-
Lead (mg/L)	0.047	0.06	0.075	0.015 to 0.015	-	0.001 to 0.001	0.001 to 0.001	-	-	0.003 to 0.003	-	-	-	-	0.001 to 0.001	0.003 to 0.003
Antimony (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium (mg/L)	0.13	0.16	0.2	0.03 to 0.06	-	-	-	-	-	-	0.04 to 0.04	-	-	-	-	0.01 to 0.01
Tin (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc (mg/L)	0.056	0.069	0.084	0.008 to 0.118	-	0.012 to 0.012	0.006 to 0.006	-	-	0.013 to 0.013	-	-	-	-	0.009 to 0.009	0.012 to 0.012
Iron (mg/L)	5	6	7	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury (mg/L)	155	185	225	-	-	-	-	-	-	-	-	-	-	-	-	-
Flouride (mg/L)	-	-	-	1.6 to 1.6	-	-	-	-	-	-	-	-	-	-	-	-

Table 1.5 – Historical Water Quality Ranges (2009 – 2011) – Retention Ponds – Part 2 (cont)

Analyte	Triggers			RP20	RP21	RP22	RP23	RP24	RP25	RP26	RP27	RP29	RP30	E27 DAM	SD1	SD2
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)													
Total Anions (meq/L)	-	-	-	86.5 to 86.5	-	-	-	-	-	-	88.6 to 88.6	-	-	-	-	-
Total Cations (meq/L)	-	-	-	88.3 to 88.3	-	-	-	-	-	-	84.2 to 84.2	-	-	-	-	-

Table 1.6 – Historical Water Quality Ranges (2009 – 2011) – Process Water

Analyte	Triggers			GT01	GT02	PWD	DT (TSF1)	DD	DM02 (TSF2)	SCT	CALOOLA PIT	ESTCORT PIT
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)									
EC (µS) (in field)	11420	13420	15740	538 to 3950	874 to 9210	2520 to 3895	-	2570 to 6960	1430 to 4320	1372 to 2300	3490 to 6415	3040 to 3310
pH (in field)	6.7 to 8.6	6.4 to 8.9	6.1 to 9.3	6.1 to 8.6	6.7 to 8.1	6.5 to 8.7	-	6.8 to 8.2	7.0 to 8.3	6.0 to 8.8	6.8 to 8.3	7.0 to 7.9
Total Dissolved Solids TDS (mg/L)	-	-	-	-	-	2130 to 2220	-	2600 to 5850	2500 to 2500	1450 to 1450	3220 to 4220	-
Suspended Solids SS (mg/L)	85	104	125	-	-	8.0 to 18.0	-	8.0 to 78.0	368.0 to 368.0	10.0 to 10.0	7.0 to 14.0	-
Turbidity (NTU)	-	-	-	-	-	-	-	-	-	-	-	-
Hydroxide Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate Alkalinity a CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-	-	-	155 to 169	-	146 to 215	150 to 150	279 to 279	79 to 88	-
Total Alkalinity a CaCO3 (mg/L)	307	366	435	-	-	169 to 169	-	215 to 215	-	-	79 to 79	-
Sulfate as SO4 - Turbidimetric	-	-	-	-	-	596 to 623	-	1200 to 2980	1030 to 1030	396 to 396	1810 to 2400	-
Chloride (mg/L)	-	-	-	-	-	634 to 733	-	603 to 875	641 to 641	328 to 328	557 to 632	-
Calcium (mg/L)	745	877	1030	-	-	76 to 87	-	75 to 543	30 to 30	124 to 124	288 to 527	-
Magnesium Mg (mg/L)	240	284	335	-	-	48 to 50	-	38 to 209	22 to 22	56 to 56	64 to 100	-
Sodium Na (mg/L)	1635	1910	2230	-	-	623 to 677	-	748 to 1010	789 to 789	265 to 265	686 to 722	-

Table 1.6 – Historical Water Quality Ranges (2009 – 2011) – Process Water (cont)

Analyte	Triggers			GT01	GT02	PWD	DT (TSF1)	DD	DM02 (TSF2)	SCT	CALOOLA PIT	ESTCORT PIT
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)									
Potassium K (mg/L)	160	188	220	-	-	45 to 62	-	69 to 125	69 to 69	34 to 34	93 to 127	-
Dissolved metal Cu (mg/L)	1.36	1.73	2.16	-	-	0.01 to 0.03	-	0.01 to 0.03	0.01 to 0.02	0.00 to 0.02	0.00 to 0.01	0.01 to 0.01
Total Cyanide (mg/L)	745	877	1030	-	-	-	-	-	-	-	-	-
Nitrite as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite + Nitrate as N (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium (mg/L)	2.46	3.04	3.71	-	-	0.10 to 0.36	-	0.02 to 3.08	7.41 to 7.41	0.13 to 0.13	0.02 to 0.07	-
Arsenic (mg/L)	0.015	0.018	0.022	-	-	0.012 to 0.016	-	0.002 to 0.016	0.021 to 0.021	0.005 to 0.005	0.002 to 0.002	-
Strontium(mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Barium (mg/L)	0.24	0.29	0.33	-	-	0.06 to 0.07	-	0.02 to 0.10	0.19 to 0.19	0.25 to 0.25	0.05 to 0.06	-
Beryllium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (mg/L)	0.00029	0.00035	0.00042	-	-	-	-	0.0002 to 0.0002	-	-	-	-
Cobalt (mg/L)	0.0036	0.0044	0.0053	-	-	-	-	-	0.003 to 0.003	0.002 to 0.002	-	-
Uranium (mg/L)	0.0054	0.0065	0.0079	-	-	-	-	0.001 to 0.008	-	0.002 to 0.002	0.002 to 0.002	-
Chromium (mg/L)	0.004	0.0048	0.0057	-	-	-	-	0.002 to 0.002	0.007 to 0.007	-	-	-
Copper (mg/L)	1.36	1.73	2.16	-	-	0.11 to 0.56	-	0.03 to 0.17	0.51 to 0.51	0.00 to 0.00	0.00 to 0.00	-

Table 1.6 – Historical Water Quality Ranges (2009 – 2011) – Process Water (cont)

Analyte	Triggers			GT01	GT02	PWD	DT (TSF1)	DD	DM02 (TSF2)	SCT	CALOOLA PIT	ESTCORT PIT
	Stage 1	Stage 2 (99%)	Stage 2 (99.9%)									
Thorium (mg/L)	0.0017	0.002	0.0024	-	-	-	-	0.001 to 0.001	-	-	-	-
Manganese (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum (mg/L)	-	-	-	-	-	0.129 to 0.148	-	0.128 to 0.255	0.249 to 0.249	0.003 to 0.003	0.064 to 0.136	-
Nickel (mg/L)	0.0043	0.0052	0.0062	-	-	-	-	0.001 to 0.001	0.002 to 0.002	0.002 to 0.002	0.001 to 0.001	-
Lead (mg/L)	0.0064	0.0079	0.01	-	-	-	-	0.001 to 0.001	0.005 to 0.005	-	-	-
Antimony (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Selenium (mg/L)	0.021	0.024	0.028	-	-	0.02 to 0.02	-	0.02 to 0.04	0.02 to 0.02	-	0.01 to 0.01	-
Tin (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Zinc (mg/L)	0.045	0.053	0.063	-	-	0.007 to 0.007	-	0.007 to 0.007	0.013 to 0.013	0.005 to 0.005	-	-
Iron (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Mercury (mg/L)	240	284	335	-	-	-	-	-	-	-	-	-
Flouride (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Anions (meq/L)	-	-	-	-	-	34.2 to 34.2	-	91.0 to 91.0	-	-	69.4 to 69.4	-
Total Cations (meq/L)	-	-	-	-	-	36.0 to 36.0	-	91.4 to 91.4	-	-	69.2 to 69.2	-

APPENDIX 4

Response to Submissions –
Modifying Factors

Appendix 4 – Response to Submissions – Modifying Factors

Industrial Noise Policy

Section 4 of the NSW *Industrial Noise Policy* (INP) (EPA 2000) notes that noise sources containing characteristics such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequencies can cause greater annoyance than other noise at the same noise level.

Where the noise source contains annoying characteristics, the INP (EPA 2000) outlines the correction factors that should be applied to the noise from the source measured or predicted at the receiver before comparison with the Project Specific Noise Level.

The modifying factors that are potentially relevant to the noise impact assessment of the Project are:

- Tonal noises with prominent frequency determined according to the following criteria:

  Level of one-third octave band exceeds the level of the adjacent bands on both sides by:

  - 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz;
  - 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive; and
  - 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.
- Low-frequency noise in the 20 Hz to 250 Hz range according to the following criteria:
  - Measure/assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.
- Impulsive noise characterised by a short rise time of 35 milliseconds and decay time of 1.5 seconds:
  - Measured as the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.
- Intermittent noise applied to night-time only:
  - Subjectively assessed where the noise level varies by more than 5 dB.
- Duration:
  - Measured as a single-event noise where the duration may range from 1.5 minutes to 2.5 hours over any 24-hour period.

The INP (EPA 2000) states that the modifying factors are to be applied to the noise from the source measured or predicted at the receiver and before comparison with the criteria, and where two or more modifying factors are present, the maximum correction is limited to 10 dB. However, the INP (EPA 2000) also notes that where a source emits tonal and low frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range.

Noise Modelling

The noise model for the Project was prepared on the basis that equipment generating noise in the potentially audible range of 25 to 20,000 Hz range is well maintained. Failure to replace damaged mufflers, acoustic louvres and associated attenuation equipment could result in the generation of tonal or low frequency noises in excess of those modelled. Notwithstanding this, each item of equipment used in the ENM noise model of the Project was assessed for tonal noise in accordance with the procedure outlined in the INP (EPA, 2000). While this provides guidance for the assessment of tonal noise, two important additional factors need to be considered:

- Air attenuation over distance reduces high frequency noises. The contribution air makes to the absorption of high frequency sound is a function of air temperature, humidity, and frequency. It is reasonable to conclude that if a high frequency noise is inaudible due to the distance from the source then it should not be included in the tonal noise assessment described above.

- There is a threshold to the audibility of low frequency noises. Typically this occurs at 10 dB(A) for each 1/3octave frequency. As with the high frequency noises, if low frequency noises are inaudible, it is reasonable to conclude that they should not be included in the low frequency noise assessment described above. The threshold of audibility is defined in AS ISO 389.7 2003 '*Acoustics- Reference zero for the calibration of audiometric equipment Part 7: Reference threshold of hearing under free-field and diffuse field listening conditions*'.

- Based on the above, for each predicted noise result an analysis of audibility, as defined by AS ISO 389.7-2003, is made against each one-third octave band. Where the predicted noise result for an octave band was found to be inaudible the octave band noise result is excluded from the assessment of tonality and low frequency noise.

Tonal Noise Assessment

The ENM noise model incorporated approximately 100 1/3 octave noise sources. The tonal noises that can be generated by the Project would emanate from:

- reversing beepers on mobile equipment;

- alarms and sirens;

- 50 Hz drives associated with rotating machinery (although no changes will be made to the existing processing plant, it was included in this analysis);

- mechanical gearbox gear noise on drives; and

- hydraulics systems.

While individually these noise sources may be observed to have tonal aspects when in close proximity to the equipment, the cumulative sound power attributable to the Project would not typically have tonal noises that exceed the criteria set out in the INP (EPA 2000).

The tonal assessment of the predicted noise levels at the nearest affected receiver locations under worst case source to receiver wind conditions is presented graphically in **Figures 1** to **3** for representative receiver locations 5 – Bonnie Doon, 7 – Avondale and 11 – Berra Lea.

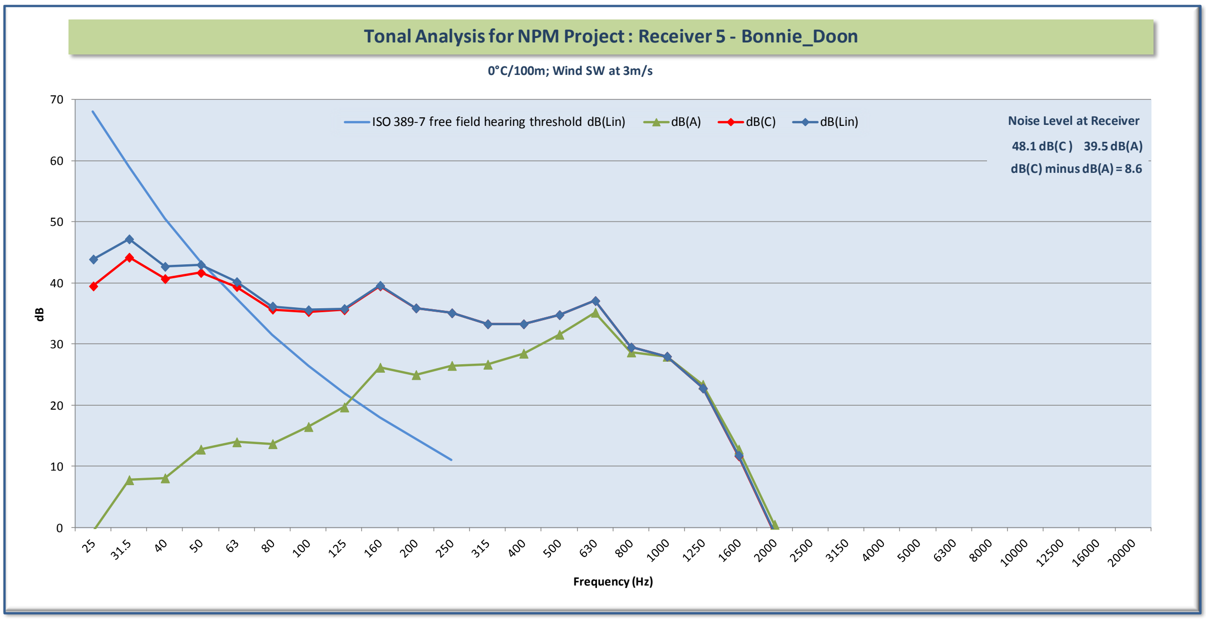

Figure 1 – Tonal and Low Frequency Analysis of at Receiver 5

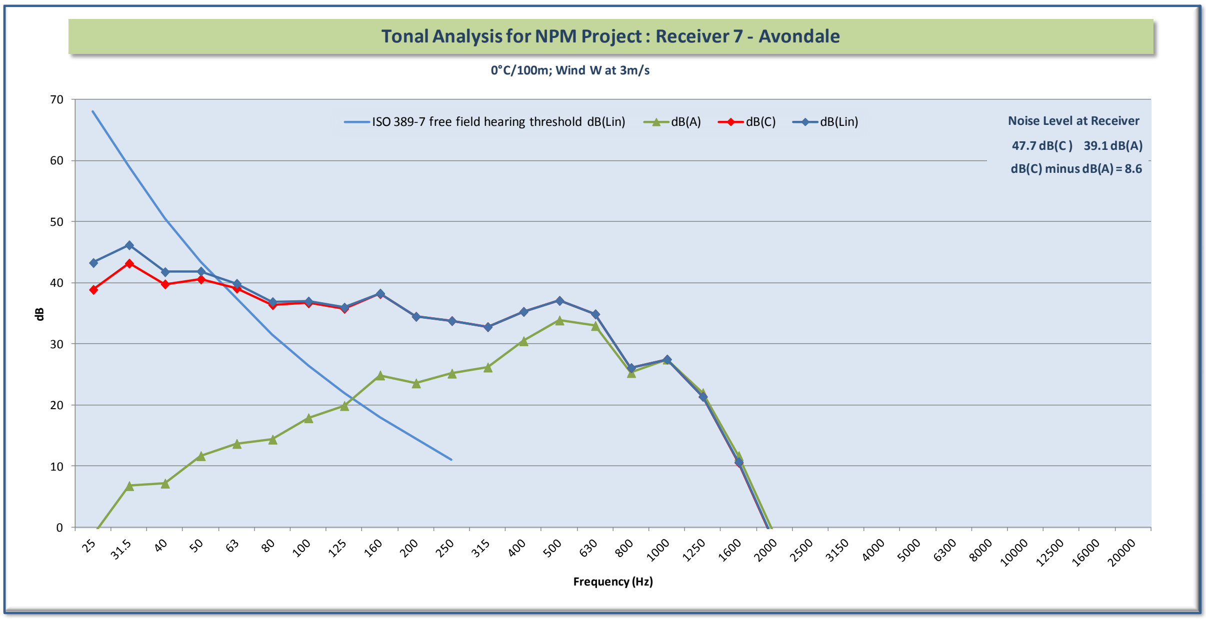

Figure 2 – Tonal and Low Frequency Analysis of at Receiver 7

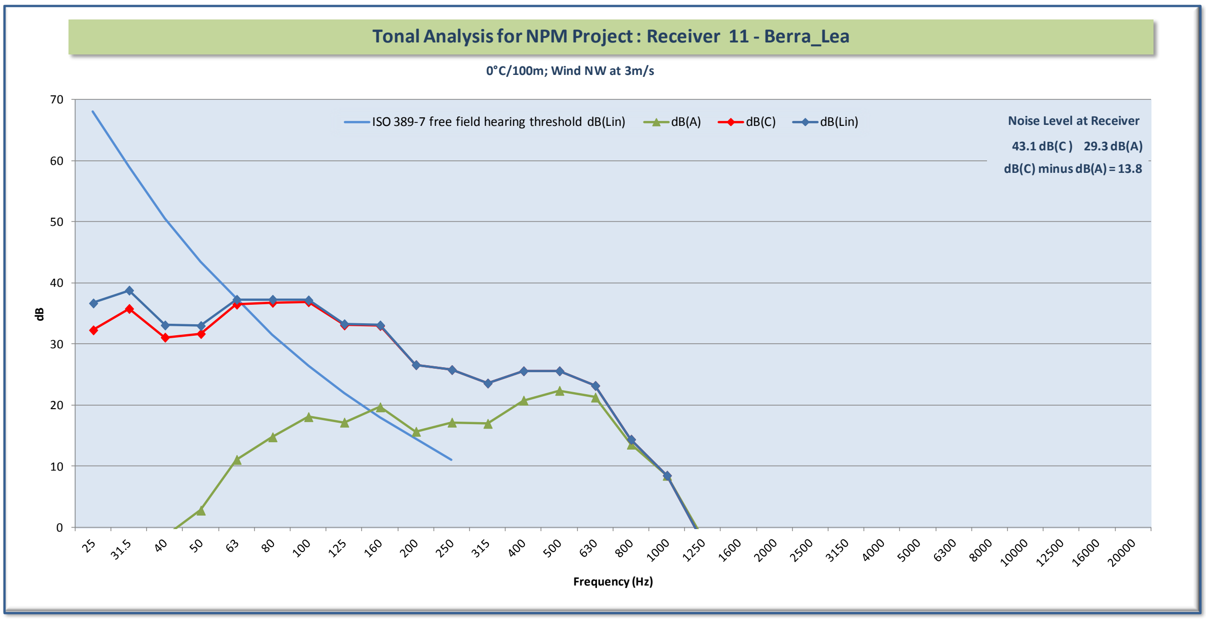

Figure 3 – Tonal and Low Frequency Analysis of at Receiver 11

The results of the analysis show that the low frequency noise generated at the source by the cumulative sound power attributable to the mining operation does not exceed the criteria set out in the INP.

Low Frequency Noise Assessment

Low frequency analysis of the noise levels at the receivers shows that the difference between C-weighted and A-weighted noise levels does not exceed the 15 dB criteria set out in the INP (EPA 2000) (refer to **Figures 1** to **3**). The difference between C-weighted and A-weighted noise levels are typically less than 15 dB due to the inaudibility of the low frequency components of the noise.

Assessment for Impulsive or Intermittent Noise and Single-event Duration

As a 24 hour per day, 7 day per week operation the Project would not normally generate noises that are impulsive or intermittent in character or give rise to short duration single-event noises.

Assessment of Predicted Noise Levels

Based on the analysis of the modifying factors that are potentially relevant to the noise impact assessment of the Project, a modifying factor correction does not need to be applied to the predicted noise levels.

References

Australian Standard ISO 389.7 2003. '*Acoustics- Reference zero for the calibration of audiometric equipment Part 7: Reference threshold of hearing under free-field and diffuse field listening conditions*'.

NSW Environment Protection Authority (EPA). *Industrial Noise Policy.*

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