Australasian Groundwater & Environmental Consultants

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CMOC Mining Services Pty Ltd
Northparkes
PO Box 995, Parkes NSW 2870 Australia

Attention: Chris Higgins | Environment and Farm Superintendent
via email: Chris.Higgins@au.cmoc.com

Dear Chris,

Northparkes Mine Modification 6 application – Preliminary Groundwater Assessment

1 Introduction

Umwelt (Australia) Pty Ltd (Umwelt) has been engaged to prepare and manage the assessment process for a modification to Project Approval (PA) 11_0060, which covers the approved operations at Northparkes Mine (NPM), located near Parkes in NSW.

The modification application (MOD 6) will be progressed concurrently with the Northparkes E44 Rocklands assessment processes. The proposed alterations to PA 11_0060 in Modification 6 (MOD 6) include changes to approved open cut pits E31 and E31N. A review of the mine design of E31 and E31N has identified that minor adjustments to the E31 and E31N pits are required. These changes include variation to disturbance areas and an increase in mining depths in both pits. This increase in mining depths has the potential to increase groundwater inflows, and as such, a groundwater assessment is required.

Australasian Groundwater & Environmental Consultants Pty Ltd (AGE) are currently engaged to prepare a Groundwater Impact Assessment (GIA) for the E44 Rocklands Project. Given the synergy between the GIA and MOD 6, CMOC Mining Services Pty Ltd (CMOC) (Northparkes) have requested AGE to undertake a preliminary desktop level and qualitative groundwater assessment to support the application process for MOD 6 being managed by Umwelt.

AGE have prepared this letter report using mainly client supplied information to consider the potential incremental impacts of MOD 6 on the local groundwater regime. The assessment included a review of approved mining at the E31 and E31N pits, and an evaluation of the potential impacts that may arise due to the proposed changes to mining.

1.1 Proposed Modification

The Proposed MOD 6 includes (refer to Figure 1):

- construction and use of a new underground portal access (and associated infrastructure) for E22 underground mining operations;
- TSF2 embankment buttressing (including associated amendments to the approved disturbance area);
- changes to TSF construction within the approved disturbance footprint associated with increased safety requirements for TSFs since first approved ;
- minor changes to the E31 and E31N open cut pits, including:
  - minor adjustments to disturbance areas for the approved pits and associated infrastructure (roads, safety bunds, water management etc) ; and
  - minor increases to maximum approved mining depths;
- relocation of waste rock stockpile areas for the E31 and E31N pits to avoid unnecessary material re-handling in the future due to the proposed Rocklands TSF;
- relocation of rehabilitation material stockpiling areas to facilitate future development of the proposed Rocklands TSF;
- establishment of clay and filter material borrow pits for TSF construction and lifts ;
- relocation of contractor facilities (eg. site offices, crib huts and a workshop);
- realignment of a tailings pipeline to Rosedale TSF (TSF3) ;
- realignment of the primary water supply pipeline to the western side of the Access Road to avoid conflict with the proposed E31 waste rock stockpile area and proposed Rocklands TSF; and
- clarification regarding approved disturbance boundaries and the location of ancillary infrastructure within the E31 Precinct.

A more detailed description of the modification is provided in the Modification Report.

1.2 Approved and proposed mine plan alterations and planned sequence of extraction

The E31 and E31N pits are located directly south of the Rosedale Tailings Storage Facility (TSF) as shown in Figure 1. The E31 and E31N pits are approved for disturbance areas of approximately 6.3 hectares (ha) and 5.4 ha, respectively. The E31 pit is approved to a depth of around 80 m below ground level, and the E31N pit is approved to a depth approximately 70 m below ground level. The MOD 6 application involves: increasing the approved mining depths in both E31 and E31N pits to approximately:

- 110 m below ground level in the E31 pit (an increase of approximately 30 m); and
- 95 m below ground level in the E31N pit (an increase of approximately 25 m).

It is noted that the mining of the E31 and E31N pits will occur concurrently with approved underground mining operations at Northparkes but the E26 open cut mining and E28 and E28N pits approved under the Step Change Project has not yet occurred and will not commence until after mining in the E31 and E31N pits has finished. The period of mining the E31 pits will also occur over a shorter timeframe of 2 to 4 years.

In terms of groundwater impacts, the proposed increase in mining depth in the E31 and E31N open cut pits has the potential to increase groundwater inflows, relative to previous predictions (Golder Associates, September 2013).

1.3 Objectives and scope of work

The objective of this preliminary groundwater impact assessment is to assess the potential impacts to groundwater associated with the proposed changes to mining depths for E31 and E31N. The scope of work included a qualitative desktop level assessment of groundwater impacts relating to increasing of pit depths in E31 and E31N, having regard to:

- likely changes to previous inflow predictions;
- likely impacts on groundwater levels; and
- relevant requirements of the NSW Aquifer Interference Policy.

To meet the project objective, a review of currently approved mining for E31 and E31N was undertaken. Subsequently, the proposed changes to mining were examined, which informed the assessment of potential impacts in line with changes to inflows, groundwater levels and quality, and relevant assessment considerations.

This Groundwater Assessment is limited to the proposed changes to the E31 and E31N pits.

1.4 Predicted groundwater impacts

The assessment of groundwater impacts for the Approved (PA) 11_0060 GIA Northparkes Mine is primarily based on predictions from a numerical model of the groundwater system around the Northparkes Mine developed by Golder Associates (GIA, 2013) and a subsequent Technical Memorandum for responses to review comments (Golder, 2013b). The Golder (2013) report includes an assessment of potential impacts on:

- groundwater levels and groundwater inflow during mine operation (the groundwater modelling had not assessed the groundwater take after mine closure);
- groundwater flow directions;
- groundwater quality;
- groundwater licensing; and
- registered production bores.

The sections below provide a summary of impacts predicted in the Golder 2013 GIA and assess how these impacts are likely to change based on the currently planned mine sequencing and proposed revisions to the mining depth described in Section 1.2.

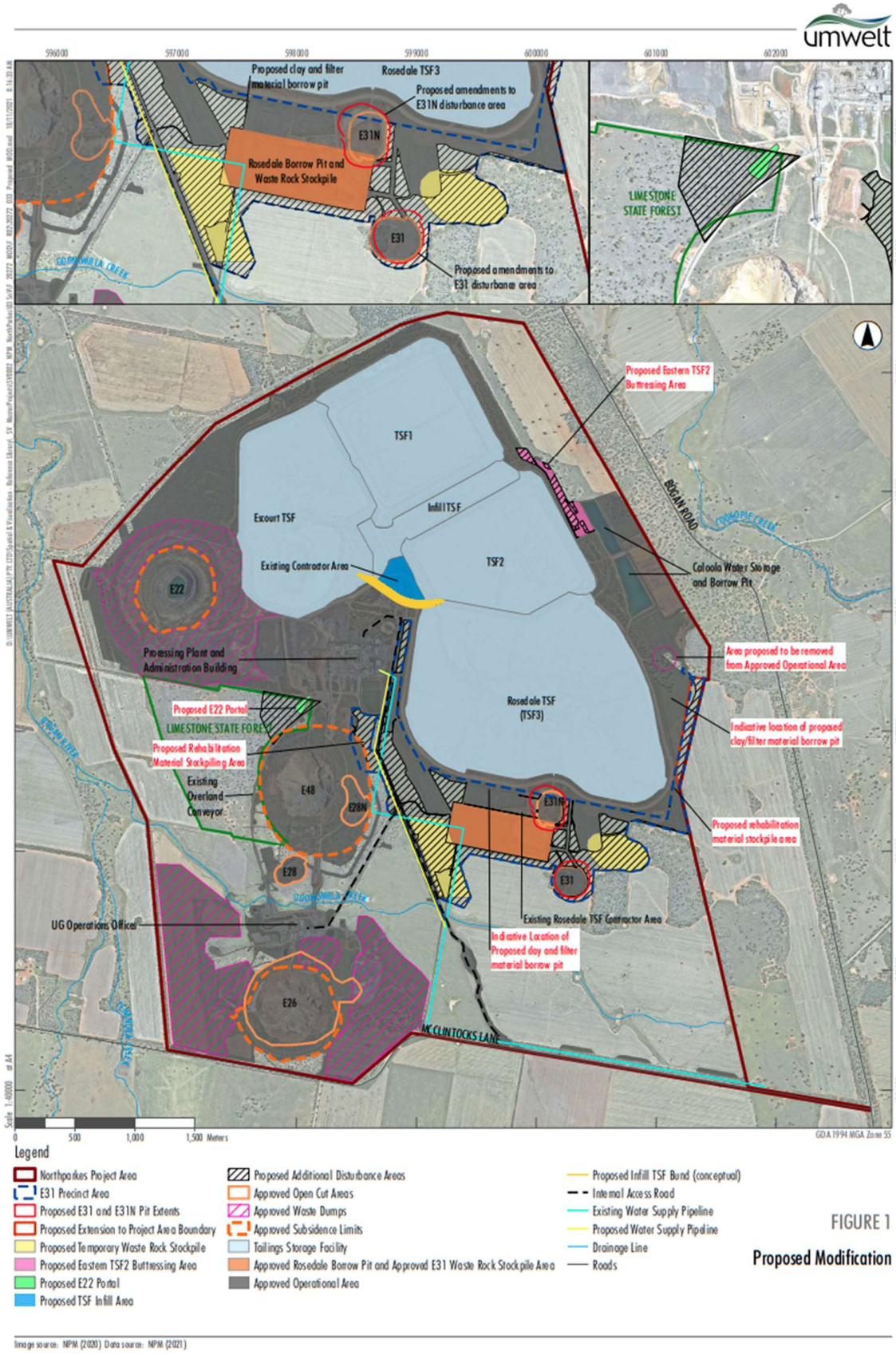


Image source: NPM (2020) Data source: NPM (2021)

Figure 1 Proposed Modification

2 Mine inflows

2.1 Approved (PA) 11_0060 GIA

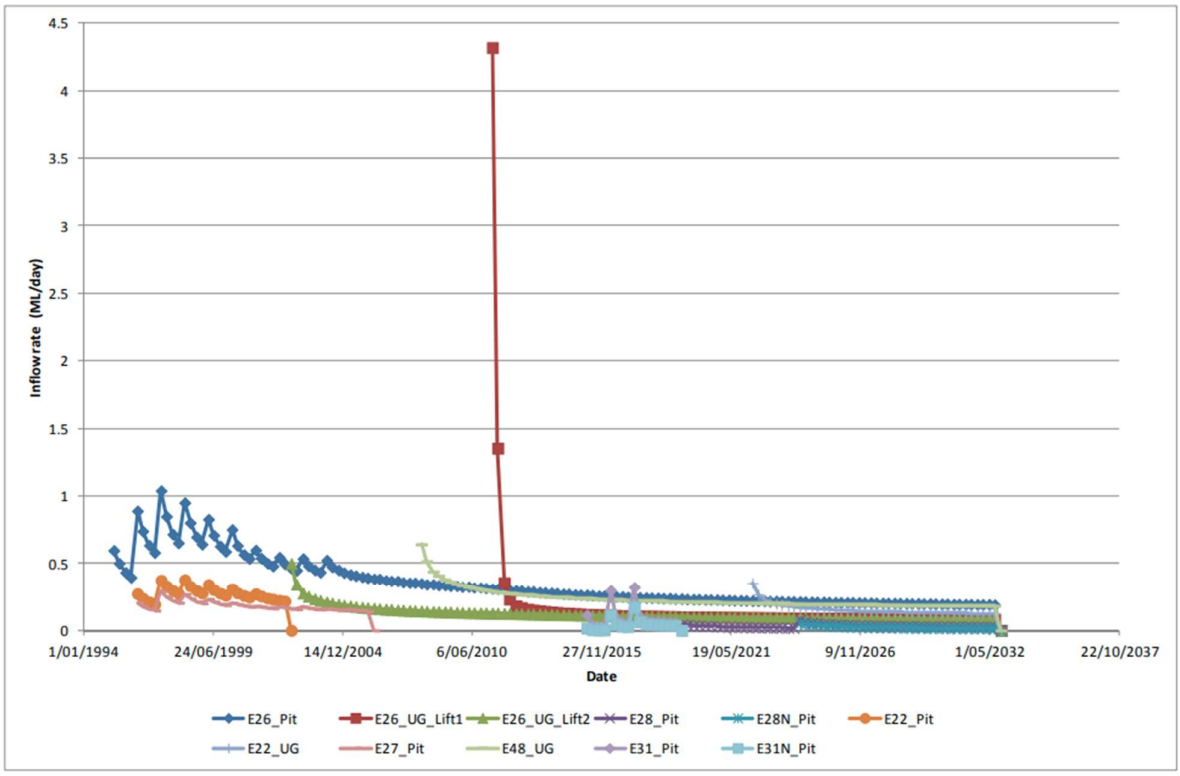
Predicted mine inflows for E31 and E31N pits based on the approved mining plan (Golder 2013b) is summarised in Table 1. The predicted range of pit inflows is between 0.03 and 0.32 ML/day. This was based on an assumed timing of mining in E31 and E31N of approximately 2018-2019 and 2014-2017 respectively. The numerical groundwater model applied maximum dewatering depths of 210 mAHD for mine pit E31 and 220 mAHD for mine pit E31N.

Table 1 Predicted N31 and N31N inflows (Golder, 2013b)

Model Time		E31	E31N
Days	Dd/mm/yy	(ML/d)	(ML/d)
7773	14/04/15	0.11	0.02
7856	6/07/15	0.04	0.00
7956	14/10/15	0.03	0.00
8039	4/01/16	0.03	0.00
8139	13/04/16	0.30	0.11
8222	5/07/16	0.09	0.04
8322	13/10/16	0.06	0.03
8404	4/01/17	0.05	0.03
8504	14/04/17	0.32	0.17
8587	5/07/17	0.10	0.06
8687	13/10/17	0.07	0.05
8770	4/01/18	0.07	0.04
8870	14/04/18	0.07	0.04
8952	6/07/18	0.06	0.04
9052	14/10/18	0.06	0.04
9135	5/01/19	0.06	0.04
9235	15/04/19	0.00	0.00

The results of hydrogeological modelling undertaken for all the mine workings as part of the Northparkes Mines Step Change Project (Golder Associates, 2013, 2013b) shows that modelled inflows peaked in 2011 at approximately 4.3 ML/day (Figure 2). Groundwater inflows are predicted to decline from 0.40 ML/day during 2019 to less than 0.3 ML/day by 2032. Actual observed inflows have been lower than predicted (Golder, 2013b).

GHD completed the 2020 water balance review, including water balance model calibration (GHD, 2020), and it indicates that the total mine inflow rate for the 2019/2020 water year is 150 ML/year (0.41 ML/day). The forecast for 2021 is 144 ML/year (0.39 ML/day).



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 2 Predicted inflow estimates to each mining area (~20%) (Golder, 2013b)

2.1.1 Incremental impacts of MOD 6

Golder (2013) indicates that increased fracturing in the mineralised zones has resulted in increased hydraulic conductivity (approximately 2x10-6 m/s to 5x10-8 m/s) in comparison to the bedrock. The hydraulic conductivity for the mineralised zones decreases notably from about 125 m depth.

MER (2006) concludes from these investigations that, of the 98 bores drilled into this area, only a handful encountered water bearing zones below 30 to 40 metres below ground level (mbgl), resulting in low potential storage in this area.

Based on the historical information and the predicted water balance figures, it is not expected that large changes in groundwater inflows will occur based on the mine pits' proposed deepening. The predicted range (Table 1) is unlikely to be exceeded.

2.1.2 Assumptions and limitations

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 (refer to the Golder 2013, GIA). The numerical groundwater model has not been validated since 2013 with updated and measured groundwater inflow rates and volumes.

As mentioned earlier, the groundwater assessment for MOD 6 is qualitative and no additional field work or numerical groundwater validation was undertaken to evaluate the 2013 model predictions against recently measured data.

Consistent with existing approvals and the mining modelled the E31 and E31N mine pits remain as final voids after mining has stopped. The proposed deepening of the voids is unlikely to have an observeable impact on post closure recovery of groundwater systems due to the relatively minor changes proposed and the nature of the local and regional geology. The underground workings in the E22, E26 and E48 will remain the primary groundwater sink.

2.2 Groundwater flow and licencing impacts

2.2.1 Approved WALs

The area within the site boundary is covered by the NSW Murray Darling Basin (MDB) Fractured Rock Groundwater Sources Water Sharing Plan (WSP), which regulates extractions from the saprock, saprolite and fractured bedrock aquifers. As defined by this WSP the site is within the Lachlan Fold Belt MDB Groundwater Source.

The Lachlan Unregulated and Alluvial Water Sources WSP regulate the extraction of alluvial groundwater within the site boundary. As defined under this WSP the site is within the Upper Lachlan Alluvial Groundwater Source. Table 2 identifies the water access licences (WALs) currently held by NPM under the WM Act, the annual extraction limit and the WSP covering the WAL.

Table 2 Existing Water Management Act 2000 Licences

Water Access Licence Number	Extraction Limit (ML/year)	Water Sharing Plan	Description
34955	232	NSW Murray Darling Basin Fractured Rock Groundwater Sources	Dewatering of E22, E26, E27and E48 underground and open cut mining areas.
31850	500	Lachlan Unregulated and Alluvial Water Sources	Aquifer
31863	634	Lachlan Unregulated and Alluvial Water Sources	Aquifer
31930	600	Lachlan Unregulated and Alluvial Water Sources	Aquifer
31963	700	Lachlan Unregulated and Alluvial Water Sources	Aquifer
31969	1 728	Lachlan Unregulated and Alluvial Water Sources	Aquifer
32004	1 600	Lachlan Unregulated and Alluvial Water Sources	High security licence (Avondale Bores 6 and 7).
32120	1 050	Lachlan Unregulated and Alluvial Water Sources	High security licence (Dawes Bore 8).
32138	1 110	Lachlan Unregulated and Alluvial Water Sources	Aquifer

Source: GWMP, GHD, 2014.

2.2.1 Incremental impacts of MOD 6

As discussed in Section 2.1.1 since the modified mine plan is not expected to result in any material increase to maximum inflows then no additional licences are likely to be required. Furthermore, recent actual inflows to the mine have been substantially less than predicted (Section 2.1) and hence the licenses currently held by NPM (refer to WAL 34955 and extraction limit of 232 ML/year in Table 2) should be more than sufficient to account for the predicted impacts.

2.3 Potential impacts on groundwater levels

2.3.1 Approved (PA) 11_0060 GIA

Open cut mining results in drawdown of groundwater levels as mining intercepts shallow aquifers that are pumped out of the open cut workings. Development of any open cut mining in E28, E28N, E31 and E31N or E26 will likely result in groundwater drawdown in the vicinity of the workings. Drawdown will continue as long as open cut areas continue to be dewatered. As dewatering ceases, it is anticipated groundwater levels will slowly re-stabilise.

The Golder 2013b technical memorandum indicates that the closest private groundwater bore to the NPM is GW002860. Based on the maximum computed groundwater drawdown extent, this bore is not within the 2 m-drawdown[1] 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 3 (Golder, 2013) 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.

2.3.1 Incremental impacts of MOD 6

As discussed in Section 2.1.1 since the modification is unlikely to materially affect either maximum inflow rates or the cumulative volume of water extracted then no additional groundwater level impacts are anticipated.

[1] The NSW Aquifer Interference Policy ((DPI-Water, 2012) minimal impact criteria of 2 metres. The proponent is required to make good any impact once it has occurred.

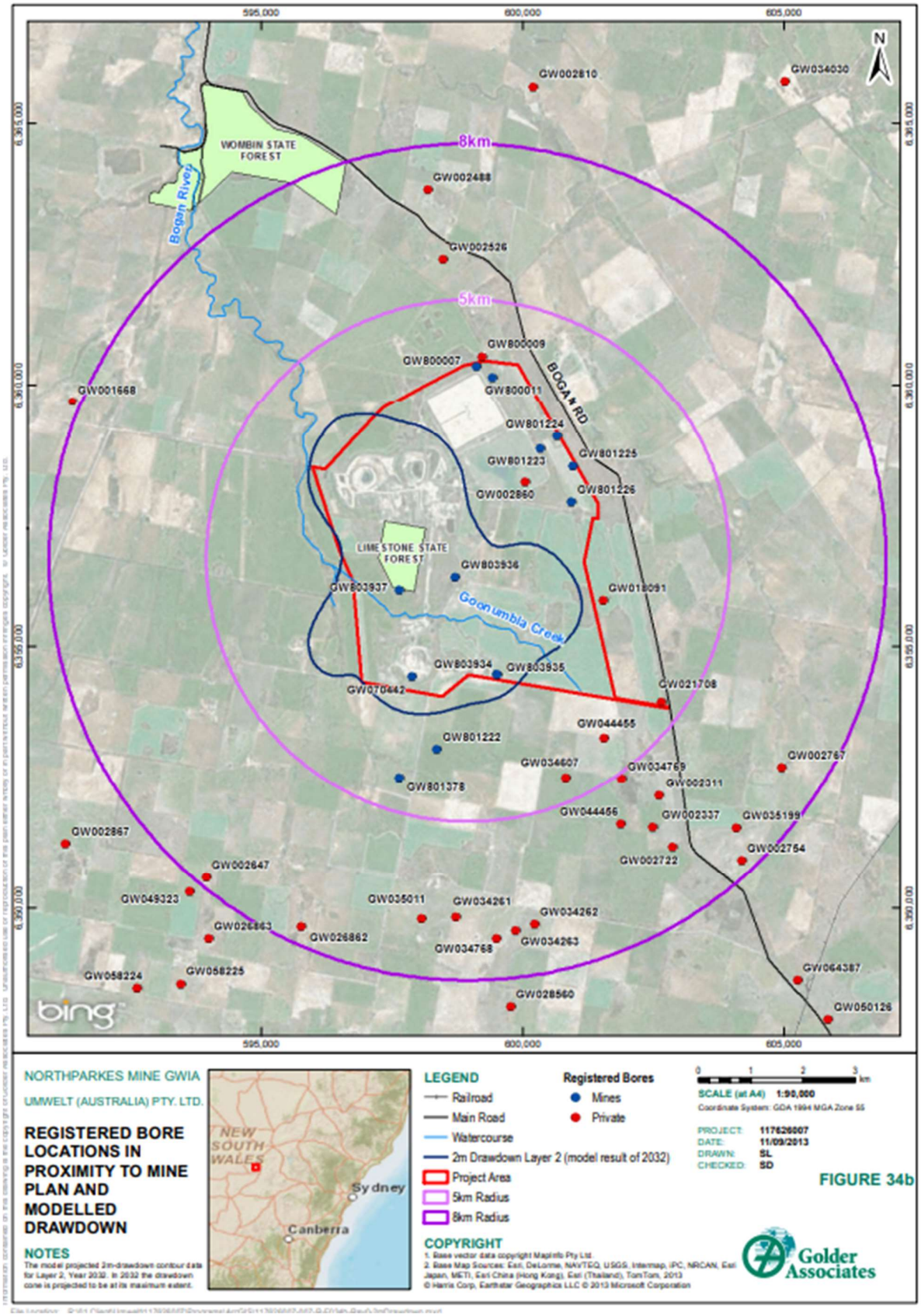


Figure 3 Registered bore location in the proximity of NPM and modelled drawdown (Golder, 2013)

3 Groundwater quality

To assess the potential for the acid rock drainage (ARD) from the mining activities on groundwater quality, a reference was made in the Golder (2013) report to the ARD prediction and control and ARD Risk Review reports prepared by Rio Tinto (Rio Tinto, 2011). The assessment provided a review of NPM operations with respect to acid rock drainage and concluded that there is no significant risk in relation to acidic drainage and the ARD is unlikely to adversely impact regional groundwater quality. The mobility of metals in the groundwater system within the NPM area is limited due to the low hydraulic conductivity and the presence of clays, which has a high capacity for adsorption and/or exchange of metals in groundwater. Hydrogeochemical modelling indicated that metal species are distributed mostly as insoluble metal carbonates, sulphates, sulphides, oxides and hydroxides. Considering the conclusion reached by previous investigations (Rio Tinto, 2011; Mackie Environmental Research, 2006), it is envisaged that leachate generated from TSF3 will unlikely adversely impact the regional groundwater quality.

The waste rocks that are from the weathered units contain lower levels of intact sulphide minerals than the waste from the underground development drives (deeper bedrock). The mine dewatering can create a zone of groundwater drawdown and exposure of mineralisation in the aquifer to oxygen. The oxidation products will enter the groundwater system 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, which can enter the groundwater system.

3.1 Incremental impacts of MOD 6

The proposed 25% increase in pit size will result in additional waste rock material, particularly in the E31N pit. The majority of this additional waste rock is likely to be unoxidized. It is likely that slight increases in TDS and sulfate will be experienced in the monitoring bores within the direct vicinity of the E31 and E31N waste rock areas during operations. Any observed changes in groundwater quality are expected to be retained within the direct vicinity of the waste rock dumps due to the low permeability of the shallow clay material. The shallow clay layers act as a buffer for seepage to the shallow weathered aquifer system.

Consistent with approved operations and practices, this material will be used for TSF construction and material not used for TSF construction will be relocated to existing approved waste rock stockpile areas. This material and proposed handling is considered to present a low groundwater contamination risk. Low grade ore will be stockpiled within existing low grade ore stockpile areas as per existing approved operations.

4 Conclusions

In summary, we do not anticipate any material changes to the predicted groundwater impacts due to the proposed mining plan alterations. Overall, since the mining footprint is largely unchanged with mining depths increasing with approximately 25% in similar rock material and anticipated similar aquifer properties, then the total volume of water extracted is not expected to be increased significantly by the Modification. If anything, long-term groundwater level and flow impacts may be slightly reduced, since the proposed mine sequence and life of mine of E31 and E31N will be slightly shorter (approximately 24 months in duration if mining of the two pits occurs concurrently).

Mining the E31 and E31N pits deeper will result in increased generation of the deeper horizons of waste rock material and potential slight changes to groundwater quality. The groundwater monitoring plan for the open cut mining areas will inform any changes in groundwater quality.

Yours faithfully,

Pieter Labuschagne
Principal Hydrogeologist
Australasian Groundwater and Environmental Consultants Pty Ltd

5 References

GHD, 2014. Northparkes Mines Groundwater Management Plan.

GHD, 2020. Northparkes Northparkes Mines Site water balance.

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

Golder, 2013b. Northparkes Mine Step Change Project – Respobces to Review Comments. Technical Memorandum, PROJECT No. 117626007-023-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.

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