APPENDIX C GROUNDWATER MODEL - SUPPLEMENTARY REPORT

The groundwater modelling report was originally submitted as Appendix I of the Draft EIS.

This document provides supplementary information that should be read in conjunction with the original report.

Grants Lithium Project Groundwater Model Addendum Report

Final Version 1.3

PREPARED FOR CORE EXPLORATION LIMITED
BY CLOUDGMS

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Table of Contents

List of Figures

List of Tables

Abbreviations and acronyms

DENR	Department of Environment and Natural Resources
GIS	geographical information system
GL	gigalitre (10^9 litres)
kL	kilolitre (10^3 litres)
km	kilometre
km^2	square kilometre
L/s	litres per second

m^2/d	metres squared per day
m^2/d	metres squared per day
m^3	cubic metre
m^3/d	cubic metres per day
m^3/s	cubic metres per second
ML	megalitre (10^6 litres)
ML/a	megalitre per year
mAHD	metres above Australian Height Datum
mBGL	metres Below Ground Level
mm	millimetre
mm/d	millimetre per day
pF	log scale for representing soil matric potential
RMS	root mean square
SRMS	scaled root mean square
SRTM	Shuttle Radar Topographic Mission
T	Transmissivity (metres squared per day)

1 Introduction

1.1. Background

Core Exploration Limited (Core) proposes to develop Grants Lithium Project (GLP), an open-cut lithium mine targeting pegmatite deposits on Mining Lease (Application) (MLA) 31726 located 24 km south of Darwin. The ore will be either crushed, screened and shipped directly or processed through a water based Dense Media Separation to produce a higher lithium concentration. The pre-strip and operation phase of the mine are planned to run for 2.5 years (29 months).

EcOz Environmental Consultants (EcOz) were engaged by Core to develop the Mining Management Plan and obtain Mining Authorisation through the Northern Territory Department of Primary Industries and Resources (DPIR). Part of the MMP process required the development of a "comprehensive groundwater model for the site, at an appropriate scale so as to identify potential impacts, including regional/off site impacts". In September 2018 CloudGMS completed the development of a numerical groundwater model to address the MMP requirements. CloudGMS (2018) details the development of conceptual and numerical groundwater models for the GLP and the use of this model to assess potential groundwater impacts from the proposed mining development as required under the MMP process.

In February 2019 Core provided an updated plan for the GLP and requested CloudGMS revise the groundwater model (GL1) to accommodate changes to the pit extents, depth and mining schedule. This document forms an addendum to the CloudGMS (2018), it presents results from the life of mine and post mine closure scenarios run with the updated model (GL2) . For detail on the site characterisation, the conceptual groundwater model, numerical model design and testing and model parameter estimation please refer to CloudGMS (2018).

1.2. Scope

The previous GLP groundwater model (GL1) will be updated (referred to herein as GL2) to accommodate the following changes:

- Revised pit design. A more detailed pit design has been provided by Core which involves as increase in the surface footprint of the pit by ~60% (126100 m^2 cf 200100 m^2) and an increase in the depth of the pit by 35 m from a depth of -150 mAHD to -185 mAHD.
- A change in scheduled mine life from 25 to 29 months.

Changes will be made to the model mesh and schedules to reflect the revised pit design and mining schedule. The two predictive scenarios - life of the mine (29 month period) and post closure (70 year period) - will be re-run with model outputs processed and analysed to update the following key results from CloudGMS (2018):

- predicted pit inflows during life of mining;
- groundwater drawdown contours at the end of the mining;
- post closure groundwater levels after 70 years;
- pit lake formation and water budget; and
- pit Lake salinity.

2 Groundwater flow model updates

2.1. Introduction

The major changes to the previous model (GL1) that have been implemented in the current groundwater flow model (GL2) are discussed in the following sections.

2.2. Mining schedule and pit development

The excavation of the pit during mining is represented in the groundwater model by seepage face boundary conditions with the elevation of the nodes assigned the elevations of the pit at monthly time steps. The pit elevations used in GL2 were determined from the planned pit excavation schedule provided at monthly intervals over the 29 month life of mine. In the previous model (GL1) the pit development was extrapolated from the extracted volume identified in the mine schedule. The difference in the final pit shells along a NNE - SSW profile through the previous (GL1) pit and the current (GL2) pit are presented below in Figure 2-1. The current pit extends approximately 100 metres further to the SSW and is 30 metres deeper than the previous pit modelled.

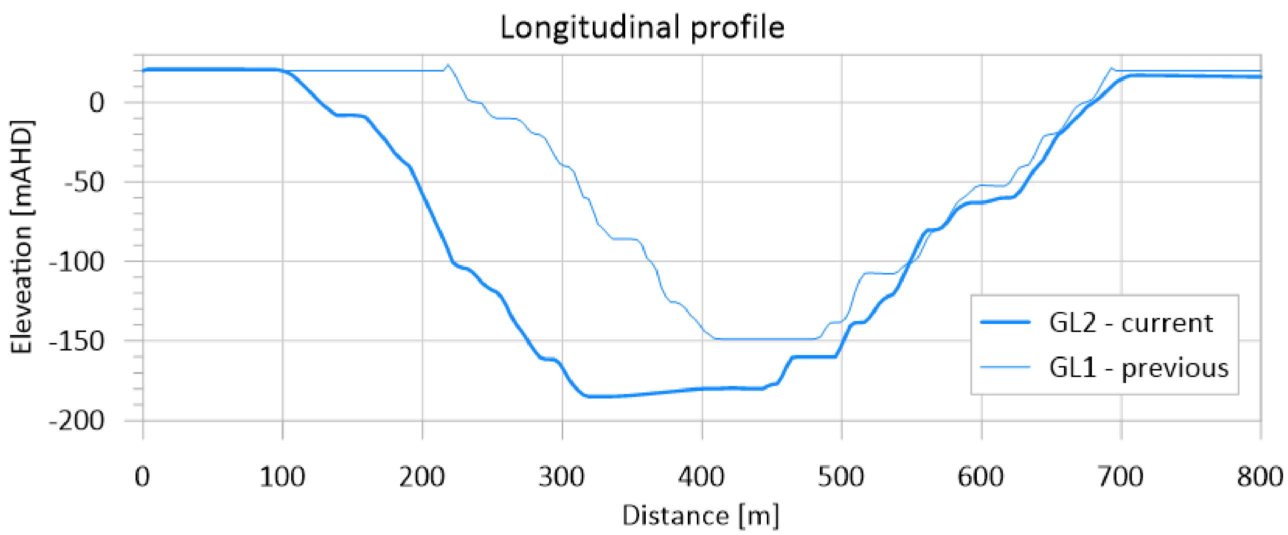

Figure 2-1 Comparison of pit shell profiles along the long axis of the pit for the previous model (GL1) and current model (GL2).

2.3. Model mesh

The updated pit design was incorporated into the supermesh as polyline features and the GL2 model mesh was generated using the same settings used to generate the mesh for GL1. The updated mesh is presented below in Figure 2-2.

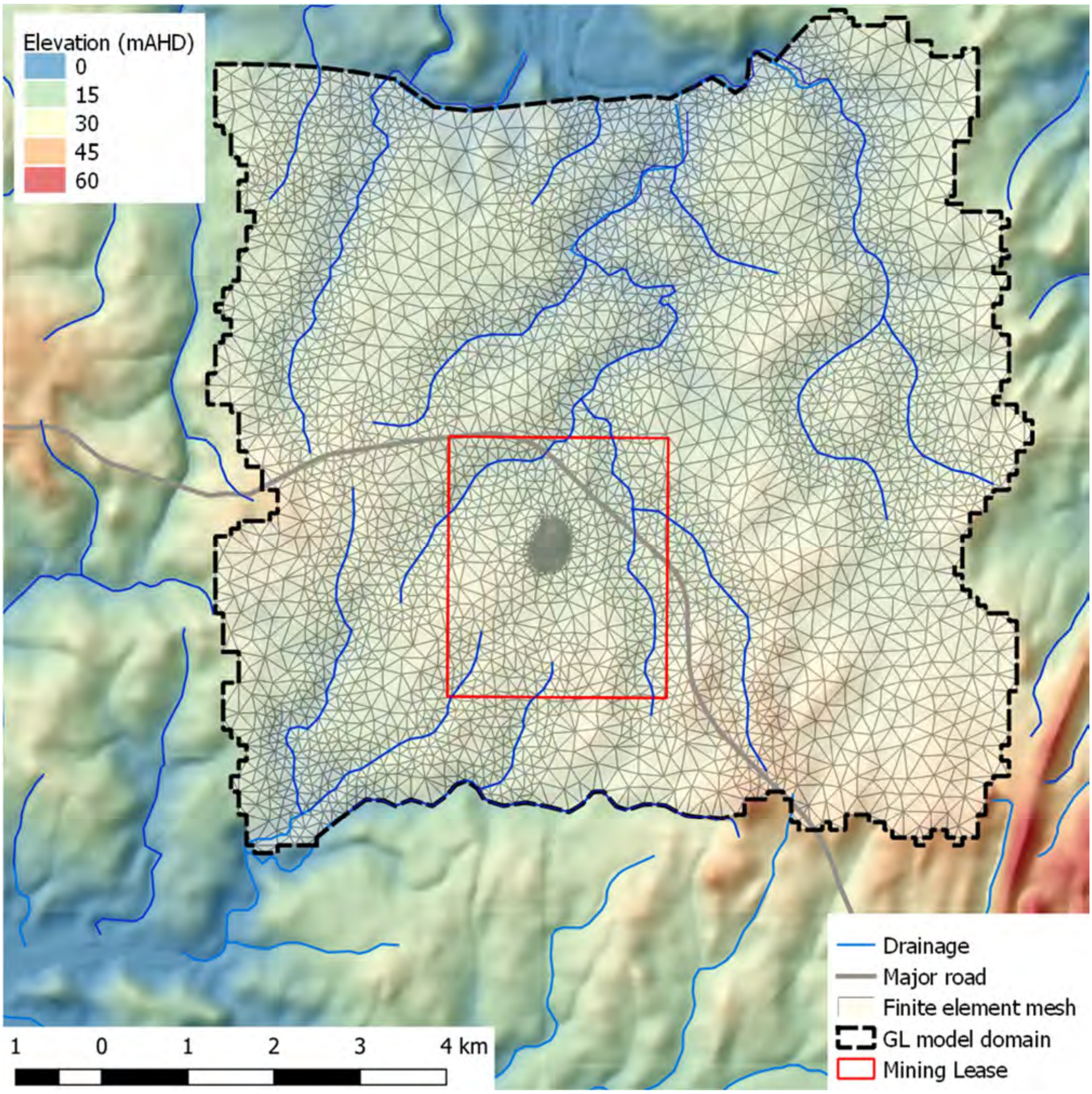

Figure 2-2 GL2 updated finite element mesh reflecting the changed pit extents.

3 Model Results

This section investigates the updated impacts of the GLP pit development over the life of the mine and post closure. The scenarios considered are summarised below:

- Life of mine (29 months - 2.4 years) June 2018 – Nov 2020
- Post closure (70 years) Nov 2020 – Nov 2090

The starting date of mining used in the previous GL1 forecast model period has been kept to enable comparison between results.

3.1. Life of mine (LoM) forecast June 2018 - Nov 2020

The life of mine (LoM) forecast scenario was designed to investigate the effect of the pit development on groundwater flow dynamics in the area. The following assumptions were made for the predictive model runs:

- All model parameters were taken from the calibrated model;
- Pit shell elevations were applied to the model as per section 2;
- Passive groundwater dewatering via sumps, with no groundwater dewatering from production bores;
- The model was run for a forecast period of 29 months from the end of the calibration period (01/06/2018) to the projected end date of the mine (01/11/2020).
- Initial conditions were taken from the final heads of the calibrated model corresponding to 43252d (01/06/2018);
- The time series climatic inputs from the period 1970 – 2018 were repeated to obtain the 70 year time series used to calculated recharge for the forecast post closure model.

3.1.1. Groundwater drawdown contours

The LoM forecast drawdown impacts at the end of the 29 month mining period are presented below in Figure 3-1.

Increases in the footprint, depth and timing have corresponded to a slight growth in the predicted drawdown cone resulting from the pit dewatering. In the west the drawdown cone extends marginally across the mining lease boundary and in the south-west the 0.1 m drawdown contour intersects the upstream end of an ephemeral drainage line. In all other respects the drawdown is similar to the original GLP model in that it is contained within the mining lease and doesn't extend beneath other ephemeral streams.

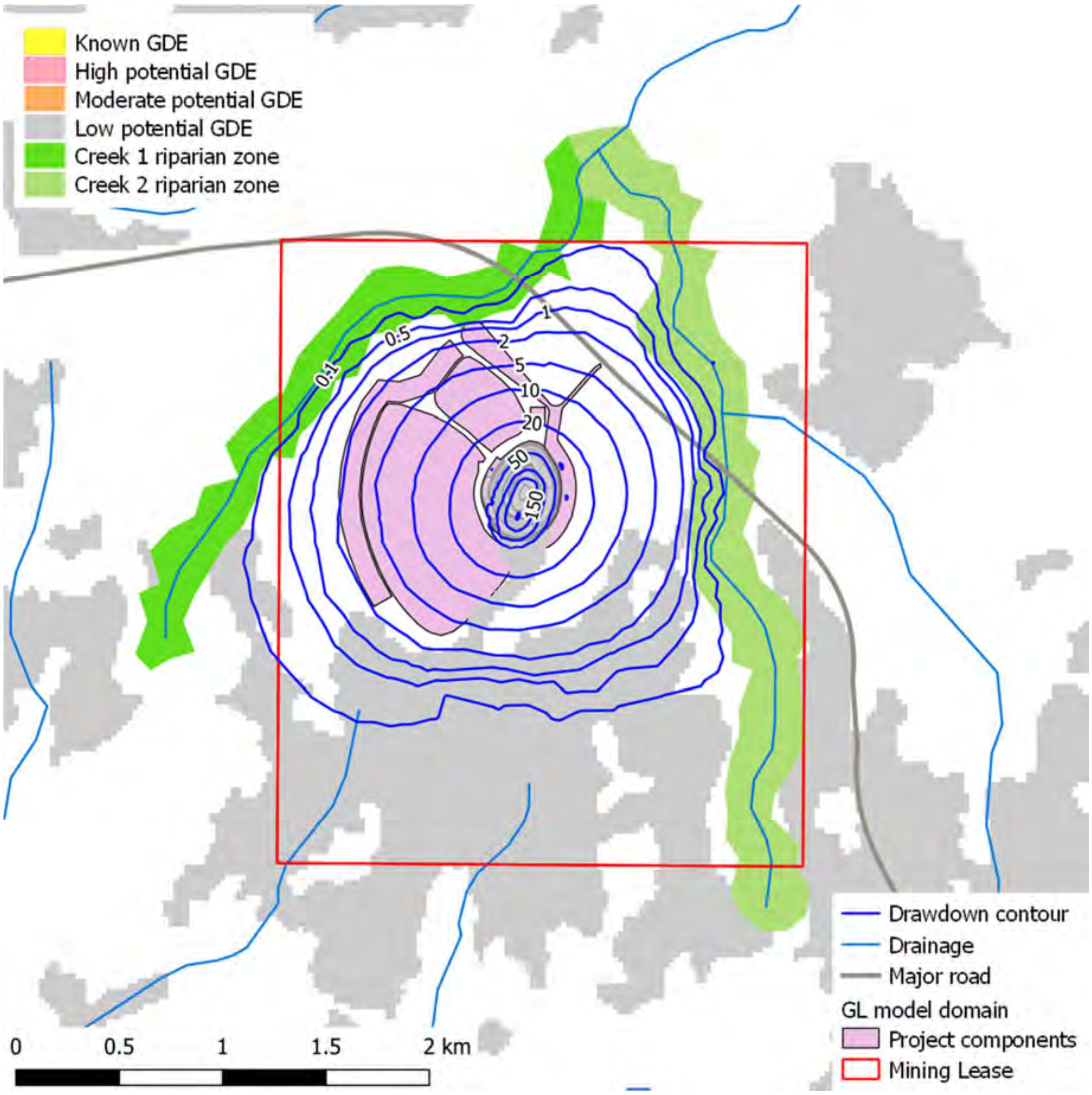

Figure 3-1 LoM final drawdown contours after 29 months of mining at year 2021.

3.1.2. LoM pit inflows

Pit inflows have been determined during the life of mine and are presented below in Table 3-1. Inflows increase from commencement of mining in June 2018 and reach a peak during the dry season of 2019 at about 2600 kL/d (23 L/s). Pit inflows steadily decline to around 1600 kL/d (18.5 L/s) for the rest of the life of mine. Pit inflows as kL/month over the LoM are presented graphically in Figure 3-2.

Table 3-1 Monthly life of mine pit inflows

Month	Inflow [kL/d]	Inflow [kL/month]	Month	Inflow [kL/d]	Inflow [kL/month]
1	561	16828	16	2595	77859
2	1223	37925	17	2399	74363
3	1436	44524	18	2387	71621
4	1543	46293	19	2172	67323
5	1555	48212	20	2137	66259
6	1642	49260	21	2207	64007
7	1607	49804	22	1869	57929
8	1757	54473	23	2062	61861
9	2301	64423	24	1899	58854
10	2137	66245	25	1994	59819
11	2546	76366	26	1804	55926
12	2362	73219	27	1832	56789
13	2617	78523	28	1843	55284
14	2439	75612	29	1682	52151
15	2482	76933			

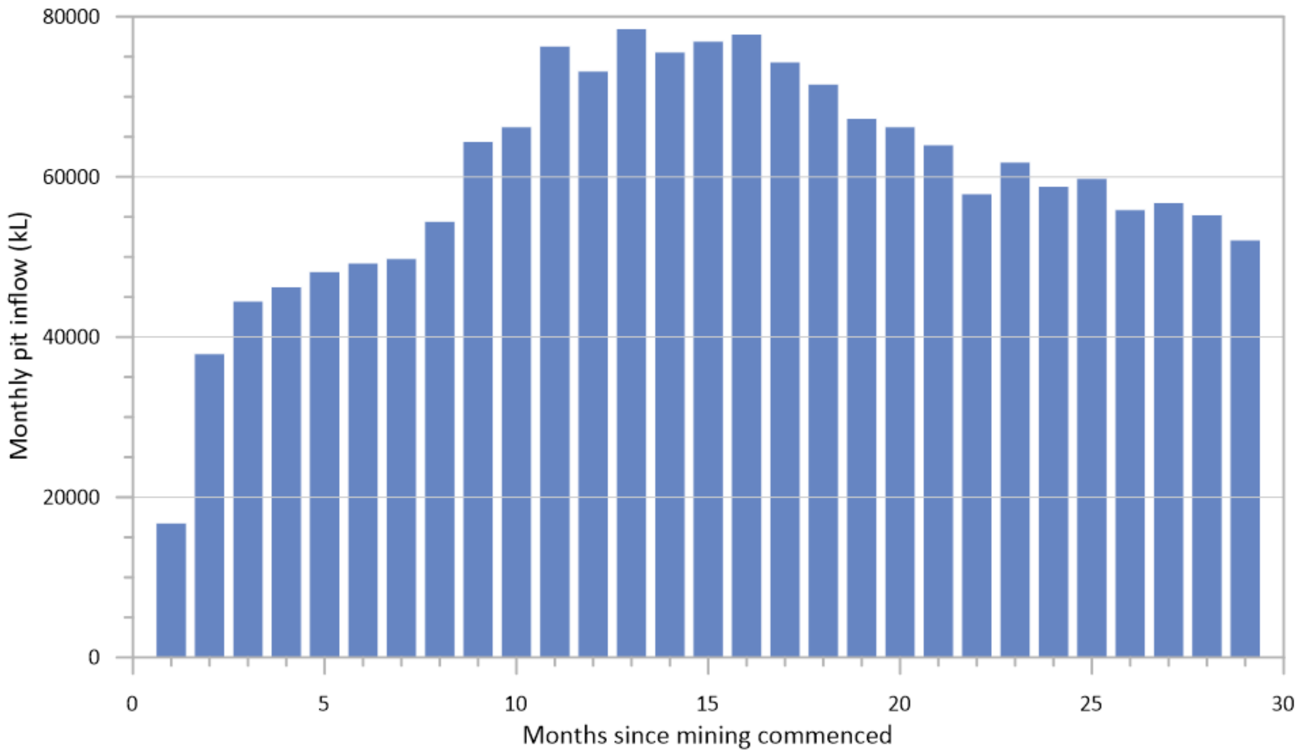

Figure 3-2 Predicted pit inflows (kL/month) during life of mine.

3.2. Post closure forecast 2020 – 2090

The post closure impacts scenario was based on the life of mine scenario with the following additional assumptions / settings:

- Initial heads were taken from the final time step of the LoM scenario 01/11/2020 (44136d);
- The post closure model runs for an additional 70 years with the final time step ending at 01/11/2090 (69580d);
- Removing the seepage face boundary conditions representing the pit; and
- Activation of the IfmLake module (CloudGMS 2018 s4.3.5) to simulate the filling of the pit void.

The post closure period of 70 years was determined by assuming pit inflows of 500 kL/d (~6 L/s) based on analytical estimates presented by CloudGMS (2018). At this rate it will take 50 years to fill the pit and an additional 5 years under dynamic equilibrium.

The seasonal nature of recharge meant that a steady state model of the system was not deemed appropriate to assess the post closure impacts. The model was run to an approximate dynamic equilibrium which is represented as a stabilisation of groundwater levels, pit-lake levels and inflows to the pit.

3.2.1. Groundwater drawdown contours

The final post closure drawdown contours are presented in Figure 3-3. This figure shows the drawdown surface after 70 years of recovery post mine closure (year 2090). The pit lake operates as a groundwater sink and will result in 0.5 m drawdown with a radial extent of approximately 750 m around the pit lake. The change in watertable surface resulting from the mining activities and the pit lake is extends marginally beyond the western boundary of the mining lease but is not predicted to change groundwater conditions beneath ephemeral drainage lines.

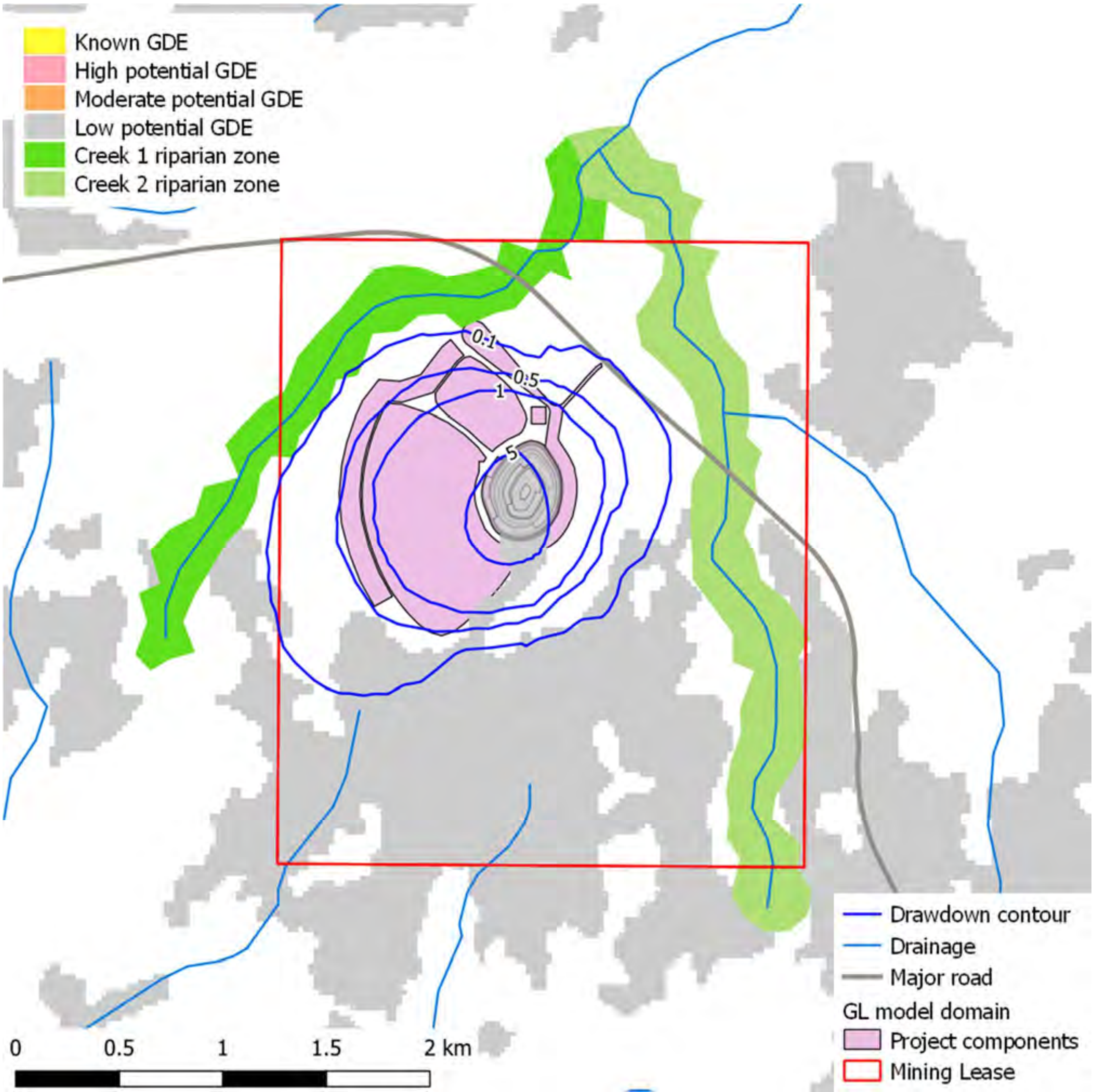

Figure 3-3 Post closure final drawdown contours after 70 years of recovery at year 2090.

3.2.2. Pit-lake formation and water budget

At the completion of mining the pit will infill over a period of approximately 50 years forming a pit-lake with a final water level of 12 – 13 mAHD reached around 2070 (see Figure 3-4). With a surface elevation around 20 mAHD this corresponds to a pit lake water level in the order of 7 – 8 m below the existing land surface and is consistent with the original modelling results.

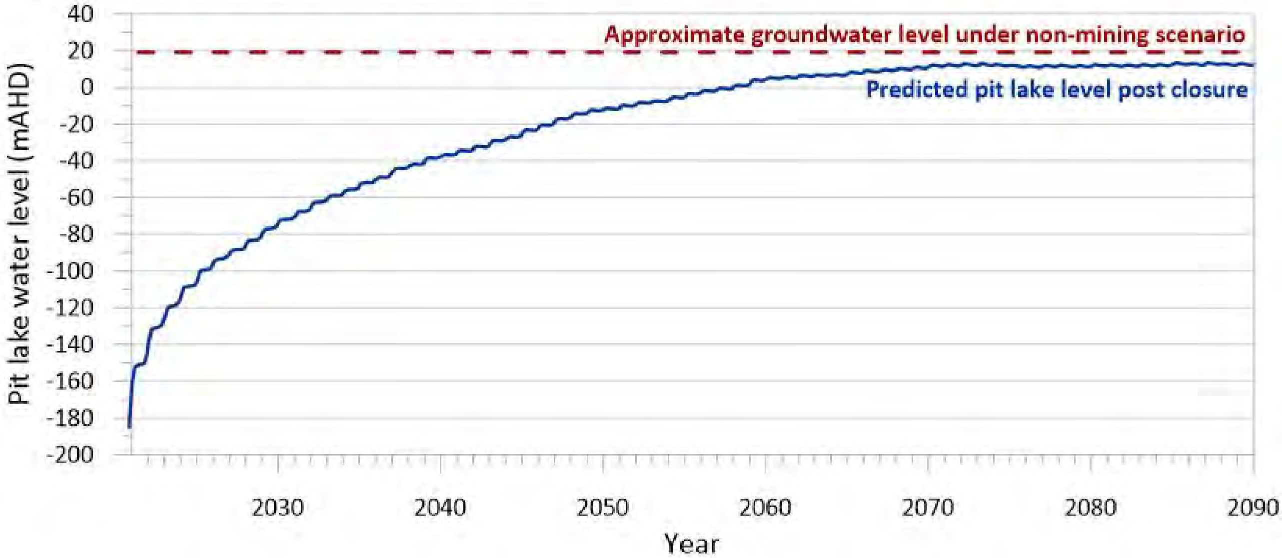

Figure 3-4 Pit lake water level after mine closure in mAHD (metres above sea level)

Once dynamic equilibrium is reached (i.e. the pit water level has stabilised) the average annual components (2070 – 2090) of the pit water budget are:

- rainfall incident on the pit area 302 000 m^3/yr
- groundwater flow into the pit 135 000 m^3/yr (equivalent to 4 L/s)
- evaporation from the surface of the pit-lake 424 000 m^3/yr

The pit-lake will only reach a level below the predicted 12 – 13 mAHD if the groundwater inflow is less than 370 m^3/d (~4 L/s) resulting in a deficit in the annual pit water budget. If groundwater inflows into the pit are greater than approximately 4 L/s the pit water lake will recover to a level approaching the pre-mining condition.

Under the modelled closure scenario the pit lake is categorised as a groundwater sink using the classifications in the Western Australian interim guidance on pit lake assessments (DMP, 2018). A pit lake operating as a groundwater sink has an average lake level that is lower than the surrounding watertable resulting in the creation of groundwater gradients toward the pit lake and groundwater discharge into the pit lake.

3.2.3. Pit-lake Salinity

The annual water balance components from the post mine forecast scenario have been used as an input into a mass balance model to estimate the water quality of the pit lake. For this model electrical conductivity (EC) has been used as the water quality indicator. The pit lake salinity has been estimated using the following equation:

$$Ps\ (n+1) = (Vp(n) \times Ps(n) + GWin \times GWs + R \times Rs - GWout \times GWs)/Vp$$

Where:

- Ps(n) = Pit lake salinity at time step (Electrical conductivity in µS/cm)
- Vp(n) = Pit Lake volume at time step (m$^{3)}$
- GWin = Groundwater inflow into pit (m$^{3)}$
- GWout = Groundwater outflow from pit (m^3)

- GWs = Groundwater salinity (Electrical conductivity in µS/cm)
- R = Rainwater inflow (m^3)
- Rs = Rainwater salinity (Electrical conductivity in µS/cm)

The inflow and outflow volumes are drawn from the model pit lake water balance from 2020 – 2090. The model assumes a groundwater input salinity of 220 µS/cm which represents the average EC from the deep monitoring bores across the site. The model assumes a rainfall salinity of 10 µS/cm which is consistent with Darwin rainfall EC from the peak wet season months (Crosbie et al, 2012).

The estimated pit lake salinity, expressed as EC, from mine closure to 2090 is shown in Figure 3-5. The model suggests that, assuming a groundwater EC of 220 µS/cm, the pit lake salinity will rise from an initial EC value of around 25 µS/cm to a final EC of 210 µS/cm in 2090.

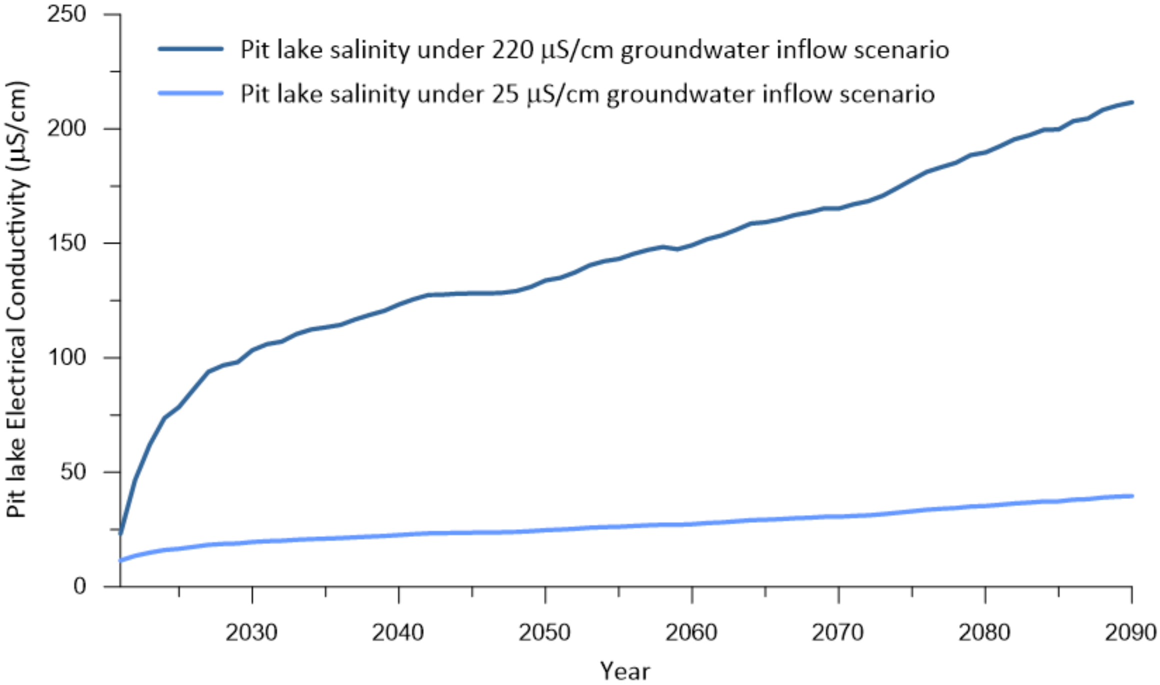

Figure 3-5 Projected pit lake EC under two groundwater EC inflow scenarios

A review of water quality sampling from other similar pit lakes/dams in the vicinity of the GLP shows Observation Hill Dam with an EC of 19 µS/cm and an abandoned historic BP mining pit 5 km south of the GLP with a salinity ranging from 17 – 26 µS/cm. These results are notably fresher than the modelled salinity for the GLP pit lake and suggest that the mass balance model is overestimating the long term EC in the GLP pit lake. A contributing cause may be the groundwater input salinity, the model assumes a groundwater inflow EC based on the deep observation bores. Once the Lake level has stabilised the majority of groundwater inflow will be drawn from the shallow groundwater system. Water quality sampling results from observation bore GBW10 indicates the shallow groundwater has an EC in the order 25 µS/cm in contrast to the deeper system with an average EC of 220 µS/cm. Re-running the mass balance model with a groundwater inflow EC of 25 µS/cm results in a final pit lake EC of 40 µS/cm, which is more consistent with EC values observed in neighbouring pit lakes/dams.

4 Conclusions

The GLP model was updated (GL2) to accommodate changes in the geometry and depth of the mine pit and also an extension in the life of the mine from 25 to 29 months. Model scenarios for life of mine (LoM) and post closure were then re-run to examine the changes to key model results from the updated information.

Results found:

- Marginal increase in the extent of the drawdown cone during mining, with the 0.1 m contour extending over the western boundary of the lease and intersecting the end of an ephemeral drainage line. Otherwise very similar to the previous modelling drawdown.
- Marginal increase in the drawdown after the post closure recovery period – cone of drawdown extends further to the southwest and slightly beyond the western boundary of the mining tenement but no changes beneath ephemeral drainage lines
- Increased predicted pit inflows (peak 60000 kL/m cf 80000 kL/m) during the life of mine due to the increased pit area and depth.
- Minimal changes in salinity balance for the pit lake post mining.

5 References

CloudGMS (2018) Development of a Groundwater Model for the Grants Lithium Project. Final Version 1.0 Unpublished

Crosbie RS, Morrow D, Cresswell RG, Leaney FW, Lamontagne S and Lefournour M (2012) New insights into the chemical and isotopic composition of rainfall across Australia. CSIRO Water for a Healthy Country Flagship, Australia.