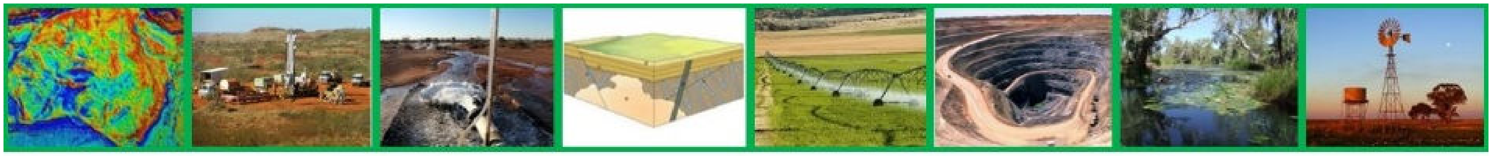
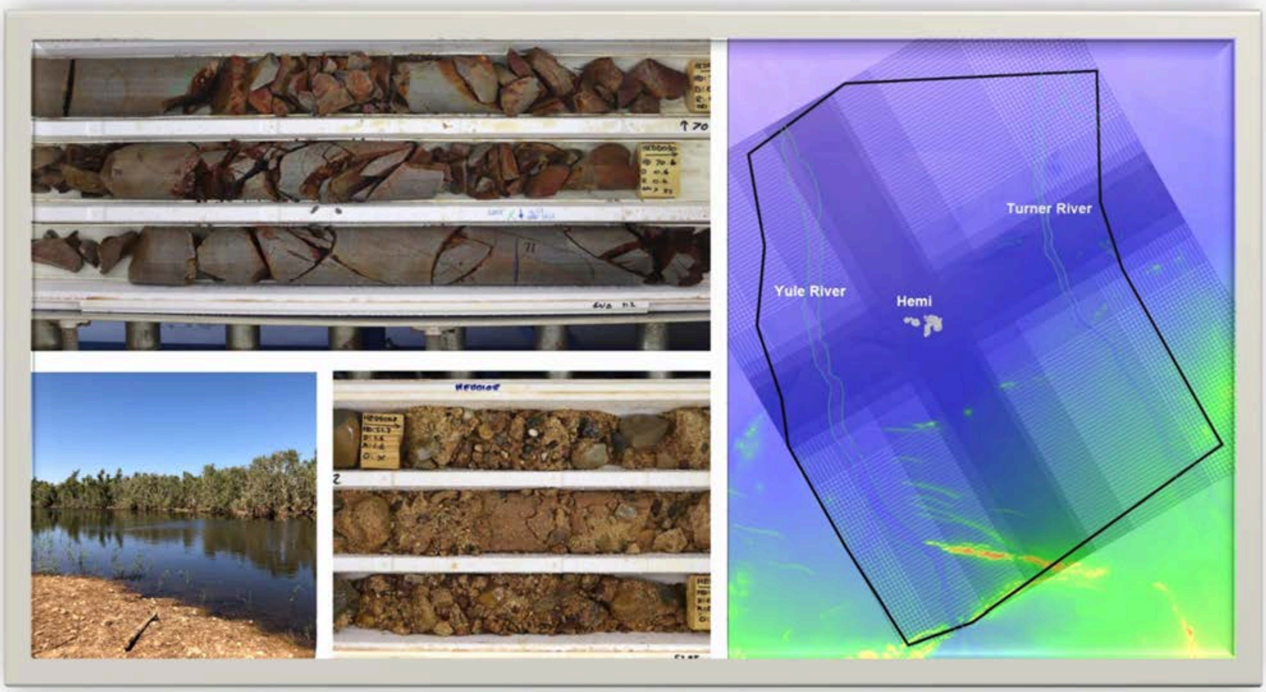


HEMI GOLD PROJECT

FEASIBILITY STUDY REPORT

GROUNDWATER AND SURFACE WATER ASSESSMENT



Report prepared for:

De Grey Mining Ltd

April 2023

Geowater CONSULTING

Document Title

Hemi Gold Project – Feasibility Study Report – Groundwater and Surface Water Assessment

Cover Photos (clockwise from top left)

Fractured Rock Aquifer zone in drillhole HEDD030, Numeric groundwater model domain, Highly permeable basal gravels in drillhole HEDD108, Jelliabidina Pool April 2021.

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Executive Summary

Comprehensive groundwater (hydrogeological) and surface (hydrological) water modelling has now been completed for the De Grey Mining Ltd (De Grey) Hemi Gold Project located in the Pilbara region of Western Australia. Hemi consists of six deposits, namely Aquila, Brolga, Crow, Diucon, Eagle and Falcon.

The groundwater and surface water modelling outcomes have provided a detailed understanding of the characteristics of the Hemi Gold Project for a multitude of scenarios. This detailed understanding has evolved from the multiple iterations of groundwater and surface water model runs that utilised an extensive dataset, including historical information sourced from regulatory authorities over time as well as project specific monitoring data accumulated over a period of more than two years.

Given the importance of this modelling to the technical, environmental and community aspects of the Hemi Gold Project, the model iterations tested variations in the following parameters during the proposed construction, operational and closure phases:

- Mine schedule;
- Mine dewatering schedule;
- Surplus water discharge options;
- Groundwater and surface water geochemistry; and
- Mine dewatering management requirements

The refinement of the above parameters in conjunction with the evolution of the groundwater and surface water models have provided appropriate technical, environmental and community outcomes for the construction, operational and closure phases. Despite this, further optimisation of the parameters that influence the groundwater and surface water models continues to be undertaken in order to ensure that the most optimal outcomes are achievable.

In summary, the project proposes a mine dewatering plan that sees groundwater extracted for a period of approximately 12 months prior to the commencement of full-scale mining operations. Approximately 50 % of this extracted groundwater would be reinjected back into the groundwater aquifer (upstream and downstream of the Hemi area) so as to minimise the overall impact of the mine dewatering process. Surplus water from the mine dewatering process is proposed to be then discharged in a controlled manner into the Turner River. This surplus water would continue to be discharged into the Turner River for a further period of 12 months after full scale mining commences, up until the time that the processing plant commences operation. From this point in time going forward, there may be an intermittent requirement to discharge minor quantities of surplus water to the Turner River, however, the project water balance demonstrates that apart from intermittent occasions when climate related events occur, the processing and mining operations water requirement would largely remove any need for surplus water discharge to the Turner River. Studies are continuing in relation to the use of any residual surplus water by on site irrigation activities beyond this point in time.

As discussed above, numerous groundwater and surface water model iterations have been assessed in order to balance the mine dewatering rate and the extent of aquifer reinjection so as to optimise potential impacts, such as groundwater mounding, the extent of wetting of the Turner River, and the management of aquifer zones with varying water quality, particular for the initial two-year period prior to the commencement of processing operations.

Environmental assessments of the impacts of the surplus water discharge to the Turner River (completed by other consultants) indicate that no adverse impacts would result from the proposed surplus water discharge.

The groundwater assessment identified some zones of the aquifer that have elevated concentrations of some metals (including dissolved arsenic). These zones are generally located in proximity to the Hemi ore. During processing operations, these aquifer zones would be identified and directed to the processing plant where the pressure oxidation stage of the processing plant would stabilise these metals and mitigate any potential environmental impacts. In the first two years of dewatering, prior to the commencement of processing operations, these aquifer zones would be identified and directed to specific reinjection bores that recirculate the water back to the Hemi pits, allowing that water to return to the mine dewatering zone during the processing operations phase, where it would then be directed to the processing operations and be stabilised via the pressure oxidation stage.

To facilitate the aforementioned requirements, a dual water management system is proposed, whereby during the first two years of dewatering, groundwater will, based on its quality, be directed to specific reinjection bores (for recirculation to the mine dewatering zone), or, where the water meets baseline quality standards, diverted to any of the other remaining reinjection bores, or for discharge to the Turner River. This dual water management system has been designed by a hydraulic engineer as part of the Pre-Feasibility Study (PFS) phase and will undergo further detailed design as part of the Definitive Feasibility Study (DFS) phase.

Utilising the hydraulic design of the dual water management system, comprehensive modelling was then completed in accordance with the mine dewatering schedule at quarterly intervals to ensure that the system was capable of achieving the required outcomes.

It should be noted that in addition to the above, De Grey have investigated alternative options for the reuse of surplus water that would otherwise be discharged to the Turner River during the first two years of dewatering (prior to processing operations commencing) in the form of third-party reuse and / or on-site irrigation. Although these options continue to be assessed and advanced, there would still be a requirement to have the base case option of discharge to the Turner River assessed on the basis that these alternative options may not be completely reliable over time.

Groundwater Model

Geowater developed conceptual and numeric groundwater models over a study area of approximately of 50km x 30km surrounding the Hemi deposits (Hemi). The models were run in predictive mode using the mine schedule from the Hemi Gold Project PFS to provide a detailed understanding of:

- The required groundwater extraction rates at quarterly intervals over the life of mine so as to enable safe and productive mining;
- The potential impacts of these groundwater extraction rates on surrounding water users and the environment.

This would then allow for the:

- Completion of a ‘H3 level’ assessment so as to support the submission of a 5C Groundwater Well Licence (GWL) application to the Department of Water and Environmental Regulation (DWER);
- Design and engineering of an appropriate life of mine dual water management system;
- Mine closure impact assessment.

The study area assessed consists of a relatively shallow alluvium that is widespread and forms a significant shallow aquifer that extends from Hemi to the Yule River but not to the Turner River. Within the alluvial cover at Hemi, there is a paleochannel river system comprised of up to 15 m of highly permeable sands and gravels, that is approximately 1,000 m wide and which drains towards the current day coast.

Executive Summary

The groundwater flow directions and hydraulic gradients are relatively uniform, with regional flow in the north to northwest direction. The depth to groundwater is typically between 5 m and 10 m and is only shallower in parts of the current Yule and Turner riverbeds, and only deeper in elevated areas of rock outcrop and subcrop.

The water quality of the shallow aquifer zones is good, being typically fresh to slightly brackish, slightly alkaline and fit for the existing pastoral and mining usage. Towards the north west of the study area along the Yule River, the groundwater is of potable quality.

The Yule River has several river pools that are likely to have a connection to the surrounding dry season water table. However, groundwater inflows to these river pools is considered to be limited. The Turner River is lacking in river pools over most of the study area as a result of the water table typically being 2 m to 4 m below the shallowest parts of the riverbed during the dry season periods.

Evaporation and evapotranspiration (ET) during dry periods are considered to be limited to sections of the main rivers where river pools, or shallow water tables and riparian vegetation occur. Recharge from river flows to the shallow aquifer systems is variable over time and location. The largest amounts of river recharge occur from the Yule River in the northwest part of the study area where large flow events spill over the main channel onto the surrounding floodplain. The least amount of recharge is considered to occur in the southern reach of the Turner River, where significant amounts of slightly weathered to fresh bedrock occur in or near the riverbed.

The weathered bedrock zones do not typically form significant aquifer zones, apart from the saprock profile of the igneous intrusives, which exhibit moderate permeability and low storativity. At the Eagle deposit, a localised zone of higher permeability has developed in the intrusive saprock.

The fresh bedrock zone permeability is restricted to localised fractured rock zones. Review of core photographs suggest fracture zones within fresh rock tend to occur close to the contact zones between (more brittle) igneous intrusives and (more ductile) sedimentary units and are potentially enhanced within and near fold hinges and later stage faulting. The amount of fracture zone development within fresh bedrock is limited such that the overall fresh rock mass is likely to have a very low permeability.

The shallower alluvium and paleochannel aquifer at Hemi are in a direct geologic and hydraulic connection with the nearest groundwater user (Atlas Iron – Mt Dove Borefield), whilst a direct connection with the more remote Water Corporation (WaterCorp) Yule River Borefield is interpreted.

Rainfall recharge to the water table in the Hemi area and surrounding alluvial plain is low but significant. A long term average of 1 % to 2 % of annual rainfall is likely in areas near and above the palaeochannel aquifer, and less than 1 % in areas of very shallow alluvial cover and bedrock outcrop. The increasing salinity trend of the shallow water table at Hemi from west to east is considered to reflect the variation in rainfall recharge.

Elevated levels of some metals, including dissolved arsenic, can occur in the weathered rock profile within and adjacent to ore zones. Elevated levels of dissolved arsenic (typically 0.020 mg/l to 0.060 mg/l) also occur in some of the basal sections of the alluvial aquifer within short down gradient distances of ore zones.

The Hemi hydrogeology is considered suitable for successful advanced dewatering of the alluvial cover and underlying weathered rock profile by a conventional borefield system. Within the more extensive fresh rock profile, relatively minor inflows would be expected and would require in-pit sumps and / or targeted dewatering bores to support dewatering.

Surface Water Model

Surface Water Solutions developed a surface water model to assess the technical requirements and potential environmental impacts for the De Grey Hemi Gold Project based on available hydrological and meteorological data relevant to the site, including precipitation gauge records and stage discharge data for the Yule River and the Turner River and the outcomes of the groundwater model in relation to the proposed mine dewatering schedule.

The Yule River catchment area adjacent to Hemi is approximately 8,337 km² and the Turner River catchment area adjacent to Hemi is approximately 2,225 km². The proposed infrastructure of the Hemi between the Yule River and the Turner River has an internal catchment area of approximately 528 km².

The baseline (existing condition) flood extents associated with 1:1,000 year (0.1 % AEP), 1:100 year (1 % AEP) and 1:20 year (0.1 % AEP) were evaluated as well as additional less frequent events for use in mine closure assessments. The maximum 1 % AEP flood depths across Hemi are generally less than 300 mm with maximum depths of 500 mm at an average flow velocity of 0.4 m/s. It is noted that this average flow velocity of 0.4 m/s is well below the Austroads 2013 guidelines recommended level of 2 m/s where infrastructure would require rock armour protection.

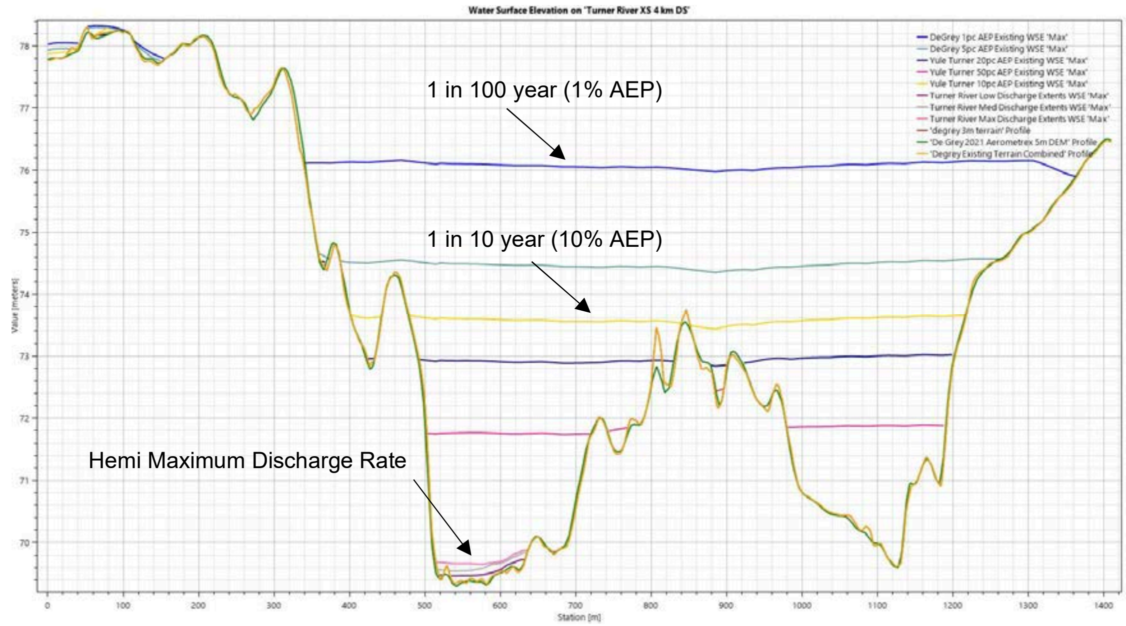
The maximum proposed surplus water discharge rate of 24.2 Ml/day corresponds to a flow rate of approximately 0.28 m³/s. Flow directions in this range of flows are highly variable, and the channel is characterised by split flow paths with substantial meandering and braiding. Aerial photography indicates some vegetation within the low flow inundation extents. The modelling indicates that the extent of inundation would be less than 50 km at the maximum discharge rate.

Figure ES- 1 shows a drone photo of the Turner River near the proposed discharge point on 3 June 2022, with an approximate flow rate of 60 Ml/day, which is around 2½ times the proposed maximum discharge rate from Hemi over the first 21 months of mine dewatering.

Figure ES- 1 - Drone photo of Turner River after rainfall event (3 June 2022) at a flow rate of 60 Ml/day

Figure ES- 2 shows a simulated cross section of the Turner River 4 km downstream of the proposed discharge point with water levels shown at the proposed maximum discharge rate, during a 1 in 10 year rain event (10 % AEP) and during a 1 in 100 year rain event (1 % AEP). The vertical scale is exaggerated to enable the proposed Hemi discharge to be seen on the diagram.

Figure ES- 2 - Cross section of Turner River 4 km downstream of the proposed discharge point



Mine Schedule

The development of the Hemi mine schedule considered the hydrogeology and hydrology of the surrounding area as well as other ‘normal’ constraints that would be applied for a project of this nature.

The detailed understanding of the palaeochannel that has been developed from the hydrogeological and hydrological assessments, both in terms of its location and the quantities of water within the aquifer zones were influential in constraining the commencement sequence of the six Hemi deposits.

Hemi would require a two year construction period for the processing plant and a nine month pre development mining phase, where material would be required to be mined at a lesser rate in order to construct the run of mine (ROM) pad and the first stage of the tailings storage facility (TSF), as well as to access the initial ore for processing. This would allow for a 15 month mine dewatering phase prior to the bulk mining phase. To ensure a level of redundancy in the mine dewatering schedule for ramp to 100 % of pumping requirement, the groundwater model targeted a 12 month period for mine dewatering, which then allowed for a three month mine dewatering ramp up period.

The mine schedule had a typical constraint of five metres of vertical descent applied through the bedrock areas and the rates of dewatering and the consequential levels of the resultant water table across the six Hemi deposits were then checked to ensure that geotechnical parameters relating to hydrogeology that were utilised in the pit design could be realised in practice. In addition to this, the lateral and vertical quality of water through the dewatering zone was reviewed to ensure that those areas where elevated metals might be present did not dominate the dewatering schedule in the first two years prior to the commencement of processing operations.

Mine Dewatering Schedule

Dewatering rates of approximately 60 Ml/day to 78 Ml/day are required in the first two years of dewatering. Approximately 50 % of this extracted water is reinjected back into the aquifer upstream and downstream of Hemi with approximately 10% of this reinjected water tracking back to the Hemi dewatering zone within the first two to ten years. In the first and second year of mine dewatering an average of approximately 24 Ml/day and 22 Ml/day respectively of surplus water would require discharge to the Turner River if there were no alternative third party reuse or on-site irrigation activities.

The mine dewatering rates decrease to approximately 34 Ml/day at the end of four years of mine dewatering and approximately 21 Ml/day after ten years of mine dewatering, with an average surplus water quantity of approximately 2 Ml/day beyond the third year of dewatering.

Surplus Water Management Strategy

Numerous iterations of the groundwater and surface water models have been completed with the aim of optimising the surplus water discharge associated with Hemi over the life of mine.

Aquifer reinjection has been maximised to an extent that minimises any impacts on the aquifer in the long term with consideration to ensuring that associated impacts, such as aquifer mounding do not present an issue. In conjunction with this, the dewatering schedule continues to be 'smoothed' wherever possible so as to provide more consistent flows over time, albeit with all surplus flows reducing significantly once the processing plant commences operation.

It has been recognised that the reuse of surplus water beyond the limitations of aquifer reinjection might present an improved outcome versus the base case of discharge to the Turner River and to that end, De Grey is continuing discussions and assessments in relation to third party reuse of water and on-site irrigation options. That said, without 100 % reliability of these alternatives, there would still be a need for a base case discharge scenario, and this is why De Grey has completed the necessary hydrological and environmental studies relating to the Turner River discharge option to ensure that the potential environmental impacts are understood and manageable.

The current surface water modelling predicts that at the maximum discharge flow rates in the first two years of dewatering the extent of inundation would be less than 50 km. The width of the Turner River is generally between 800 m and 1,000 m and the likely width of flow at those maximum proposed discharge rates would be around 30 m to 50 m with a water depth of around 150 mm to 200 mm. By comparison, a 1 in 10 year rain event (10 % AEP) spreads across more than 80 % of the river bed at a depth of approximately 3.5 m.

Groundwater and Surface Water Geochemistry

There will be a requirement to adequately manage the groundwater extraction at Hemi from a geochemistry perspective due to the presence in some zones of elevated levels of specific metals, including dissolved arsenic, which is generally in proximity to the some of the Hemi ore zones.

Soluble arsenic levels have and continue to be mapped through the Hemi aquifer zone. This mapping has been utilised in conjunction with permeability data and groundwater model drawdown so as to be able to then model the ability to separately extract water from Hemi based on its soluble arsenic level. Groundwater with baseline arsenic levels (< 0.024 mg/l) would be directed to the Turner River discharge point, whilst water with elevated arsenic levels (> 0.024 mg/l) would be directed to aquifer reinjection sites that recirculate the water back to the Hemi dewatering zone. The latter of these streams would then be directed to the processing plant after the first two years of dewatering where the pressure oxidation stage of the processing plant would stabilise any elevated arsenic, so that it does not have the potential to re-enter the aquifer zone.

Executive Summary

Mine Dewatering Management System

Anthony Elder Consulting was engaged to provide a design for a dual water management system that was capable of extracting groundwater from the Hemi aquifer zone in accordance with the mine schedule and mine dewatering schedule over the life of the mine.

As part of the design, each dewatering bore and reinjection bore would have the capability of directing the flow depending on the water quality, via two different streams, a baseline soluble arsenic stream (< 0.024 mg/l) and an elevated soluble arsenic stream (> 0.024 mg/l). This would be accomplished via a dual header pipe arrangement that would deliver the water, based on its quality characteristics to one of two water storage facilities. Transfer pumps would then deliver the water to the appropriate endpoint.

The mine dewatering management system would consist of approximately 100 dewatering bores over the life of mine, of which approximately 40 to 60 dewatering bores would be operating at any one point in time. Where applicable, each bore would be connected to two header pipes. In those zones where the soluble arsenic levels are elevated near to the Hemi ore zones, the initial stages of dewatering would generally not be impacted as the primary flow of water would be from the main aquifer. Whilst the soluble arsenic level remained at the baseline level, the dewatering bore would be directed into the baseline level header pipe. As water was removed from this zone, and where the soluble arsenic level at depth increased, the dewatering bore would be directed to the elevated level header pipe for appropriate management.

In addition to the above, approximately 40 reinjection bores would be established in the initial stages of dewatering in order to minimise short term impacts on the aquifer.

As stated earlier, De Grey has and continues to progress alternative options for third party reuse of groundwater and on-site irrigation options. To that end, the design of the mine dewatering management system can be readily adapted to allow should either of these alternatives need to be implemented.

Potential Impacts to the Environment and Third-Party Users

The groundwater and surface water models have been developed with a primary focus on ensuring that potential impacts to the environment and third-party users are either avoided or manageable.

The key environmental and third-party user criteria can be summarised as follows:

- Flora species are not adversely impacted by the proposed mine dewatering schedule;
- Fauna species (including subterranean) are not adversely impacted by the mine dewatering schedule;
- Flora and fauna species not adversely impacted by potential water mounding at aquifer reinjection sites;
- Zones of the aquifer where elevated levels of soluble metals (including arsenic) exist, that they can be identified and separately managed to those zones that have baseline levels of soluble metals;
- Sufficient aquifer reinjection sites exist where the reinjected water will recirculate back to the Hemi aquifer dewatering zone;
- Design of a tailings storage facility (TSF) including controlled seepage that ensures long term landform stability and does not adversely impact on the mine dewatering schedule or the short and long term environment of the aquifer;
- Surplus water that is required to be discharged to the Turner River (primarily in the first two years of dewatering), will not adversely impact the existing environment of the river;

- Existing pastoral bores are not adversely impacted by the mine dewatering schedule, or can be ‘made good’ by other means if there is a material impact;
- Atlas Iron Mt Dove borefield is not adversely impacted by the mine dewatering schedule, or can be ‘made good’ if there is a material impact;
- Yule River pools are not adversely impacted; and
- Port Hedland Yule River Borefield, which is a Public Drinking Water Source Area (PDWSA) is not adversely impacted by the mine dewatering schedule;

It is understood based on third party consultant feedback that the flora and fauna assessments that were completed do not impact on the mine dewatering schedule and that the discharge of surplus groundwater containing baseline levels of soluble metals would not adversely impact the Turner River. In addition to this, water mounding in reinjection areas has been limited to two metres from the surface in the relevant areas.

The collation of water sample analysis data has allowed for a detailed understanding of the soluble arsenic management requirements, whilst the groundwater modelling has confirmed that adequate aquifer reinjection bores exist for the management of those zones where elevated soluble arsenic is present during the first two years of mine dewatering. The TSF modelling shows that there would be no adverse impacts based on the design of low level controlled seepage rates determined by the consultant tailings design engineer (CMW).

With respect to the pastoral bores, there would be a requirement for De Grey to install deeper bores (or provide an alternate source of water) for three of the pastoral bores on Indee Station. The drawdown impact on the Atlas Iron Mt Dove borefield is not considered to be of a material nature, whilst one of the existing bores would be subject to transient mounding of the water table, which would not affect its production capacity.

Importantly, no adverse impacts are predicted for the Port Hedland Yule River Borefield over the life of mine. The drawdown extends some nine kilometres to the northwest, however this is still a considerable distance (> 20 km) from the WaterCorp extraction bores.

There are no predicted impacts to the river pools or riparian vegetation with the maximum drawdown extent some 2.5 km from the closest point of the Yule River to the west and northwest of Hemi.

Table of Contents

FIGURES

TABLES

APPENDICES

1 INTRODUCTION

1.1 Background

De Grey Mining Ltd (De Grey) is a Western Australian based mining company listed on the Australian Securities Exchange ("ASX:DEG") that is seeking to develop the Hemi Gold Project ("Project") in the Pilbara region of Western Australia, some 85 km south from the regional hub of Port Hedland.

The Project is of a scale that places it in a Tier 1 category for gold mine developments. The Project consists of six deposits; Aquila, Brolga, Crow, Diucon, Eagle and Falcon, collectively known as the Hemi deposits. Although the Hemi deposits will provide ore for the Project over a mine life in excess of ten years, there is also potential for additional resources from regional deposits that may, subject to the outcomes of further studies, be processed at the Hemi processing facility.

In 2020, De Grey engaged Geowater and requested they provide hydrogeological and hydrological recommendations relating to the proposed Hemi Gold Project including requirements with respect to water exploration drilling, installation of water monitoring bores and other monitoring and data collection activities so that hydrogeological (groundwater) and hydrological (surface water) assessments, including detailed modelling, could be completed initially to a Scoping Study level. De Grey approved these recommendations, which were over time executed under the supervision of Geowater. Geowater in collaboration with De Grey engaged Surface Water Solutions to complete a Scoping Study level surface water assessment to complement the groundwater assessment.

After the completion of the Scoping Study in September 2021, De Grey requested from Geowater additional advice in relation to the hydrogeological and hydrological requirements for a Pre-Feasibility Study (PFS) and ultimately a Definitive Feasibility Study (DFS), including the ability to undertake conceptual and numerical groundwater modelling for the Hemi Gold Project in accordance with a number of proposed mining and processing schedules. Surface Water Solutions were engaged to undertake the surface water assessment for the PFS phase to complement the groundwater assessment. To validate the appropriateness and robustness of the groundwater modelling, De Grey engaged Jurassic Consulting to complete a technical review of the work completed by Geowater.

During the PFS phase, De Grey engaged Anthony Elder Consulting to assess the proposed mine dewatering schedule and to design a mine dewatering management system capable of providing the necessary solutions based on the groundwater and surface water model outcomes.

1.2 Project Overview

The location of the Hemi deposits in relation to Port Hedland and the regional deposits is shown on Figure 1–1 and the proposed layout of the associated infrastructure is shown on Figure 1–2.

Figure 1–1 Hemi Gold Project Location

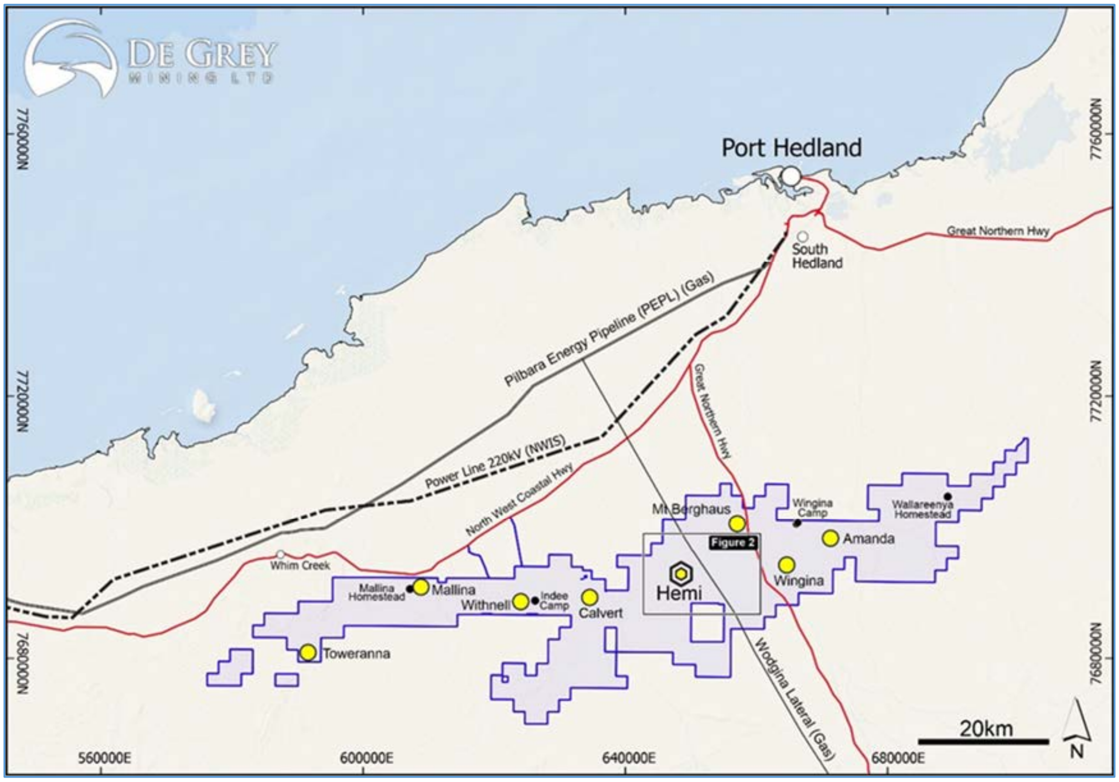
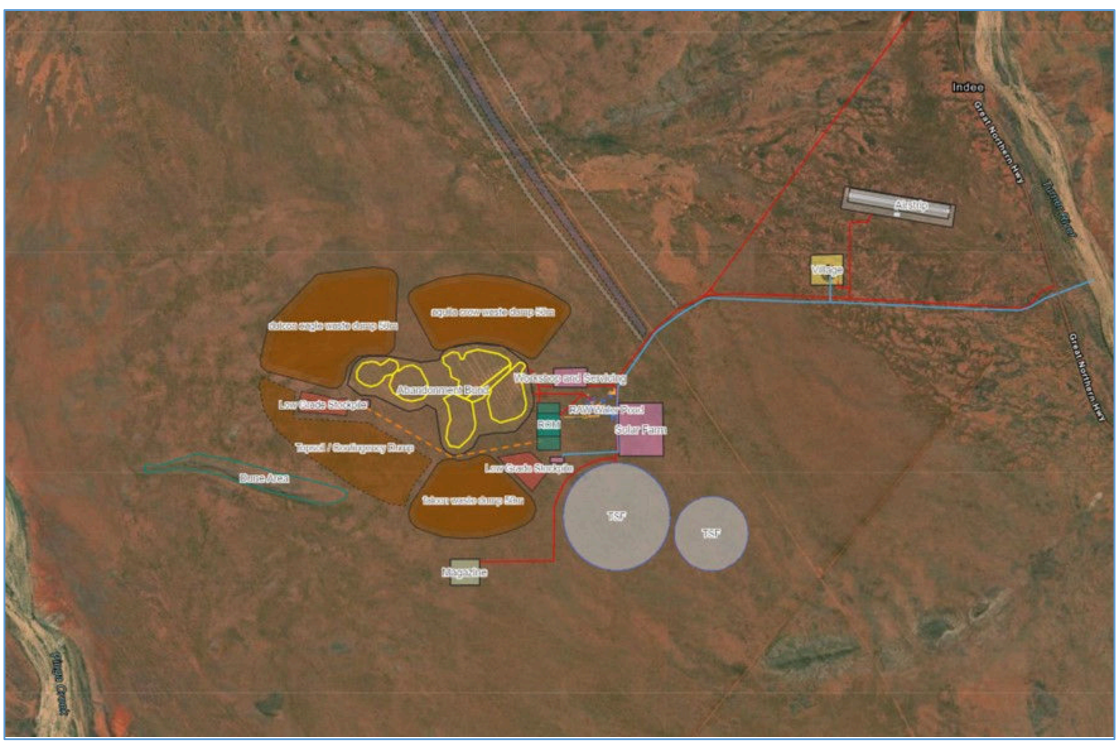


Figure 1–2 Hemi Gold Project Infrastructure



The Project comprises the following key components:

- Development of open cut pit operations at the Hemi deposits in a sequential manner over the life of mine;
- Construction and operation of a 10 Mtpa processing facility located adjacent to the Hemi deposits capable of achieving 93 % to 95 % gold recovery from free milling and semi refractory ores;
- Staged construction of tailings storage facilities ("TSF") with a planned capacity for 130 Mt of processed tailings slurry;
- A water supply from the local groundwater aquifer with accompanying groundwater and surface water management infrastructure to facilitate mine dewatering and site flooding protection;
- Accommodation village with messing and accommodation capacity for approximately 600 personnel;
- Airstrip with capacity for 100 seat jet aircraft; and,
- A 12 km sealed access road from the Great Northern Highway.

1.3 Mining and Processing

Mining at Hemi is to be undertaken via conventional open cut pit mining methods with ore trucked from the pits to a nearby run of mine (ROM) stockpile for crushing and milling prior to gold extraction by gravity, pressure oxidation and carbon in leach (CIL) methodologies. Waste rock and low-grade ore material will be placed in stockpiles as close as practically possible to the open pits.

Groundwater occurs between six to seven metres below ground at Hemi, such that dewatering of the open pits will need to commence in advance of actual mining so that safe, dry mining conditions are achieved. The groundwater system at Hemi is considered amenable to dewatering by a borefield system, with some groundwater abstraction occurring from in-pit floor sumps. Completed pits are planned to remain dewatered in case of additional mining, with two separate pit voids being formed at the end of mining, with a combined volume of approximately 366 Mm^3.

The ore processing rate of 10 Mtpa will generate saturated tailings material that will be stored within engineered storage facilities designed to control the rate of seepage of water from inside the TSF to the underlying water table. Decant and rainfall runoff from the TSF surface will be reclaimed and used in the processing circuit.

The processing circuit will include an oxidation component in the form of high pressure autoclaves. The high pressure autoclaves will have oxygen injected into them in order to oxidise the sulphide minerals thereby facilitating gold recovery.

A significant advantage of this process is that the high pressure autoclaves also oxidise a number of other metal species, including arsenic, as well as the sulphide minerals. This oxidation of these metals, including arsenic, subsequently provides protection to the environment as the modified valency of the arsenic makes it no longer soluble under the long term conditions that exist and therefore it is unable to re-enter the aquifer.

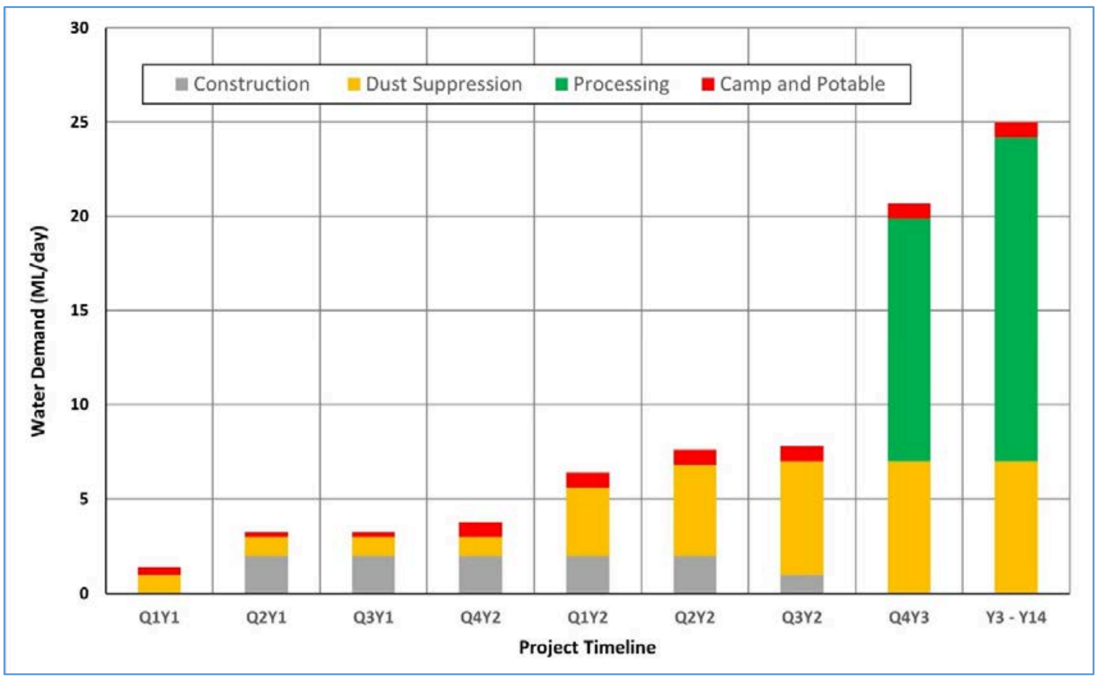
1.4 Project Water Requirements

The main water requirements of the Project comprise:

- Process plant water – 17.2 Ml/day - used in the various stages of ore processing from crushing, milling, flotation, pressure oxidation, gold recovery and tailings transfer as a slurry;
- Dust suppression water – 7.2 Ml/day - used predominantly to suppress dust created by heavy equipment and vehicles on haul roads, access roads and within other work areas;
- Village water – 0.6 Ml/day used to source and supply potable and domestic use water for the mine village.

Figure 1–3 displays the various water demand rates on a quarterly basis for Hemi based on the PFS mining schedule. Mine dewatering and construction of the processing plant (which has a duration of 24 months in total) commence simultaneously. Approximately 15 months after mine dewatering and processing plant construction commence, large scale mining commences, which in turn, increases the water demand via a requirement for dust suppression. Approximately 24 months after mine dewatering and processing plant construction commence, the processing plant commences operation, which in turn increases the overall water demand to approximately 25 Ml/day.

Figure 1–3 Project Water Demand Profile



1.5 Previous Field Investigations and Reports

In late 2020, a network of shallow local and semi-regional monitoring bores were installed using a conventional RC drill rig under the supervision of Geowater.

In April 2021, a regional census of pastoral bores and wells surrounding Hemi was completed by De Grey and Geowater. The results of these field programmes were assessed and presented in the May 2021 *Scoping Study Groundwater Report* by Geowater (Geowater 2021).

Between July 2021 and May 2022, the following field investigations were undertaken as part of the PFS:

- Drilling of 37 aircore holes in July 2021 to investigate the main paleochannel aquifer location to the north and south of Hemi, followed by the installation of four multi-piezometer bores in these areas in November 2021;
- Drilling and construction of eleven production bores and ten monitoring bores in alluvial and bedrock aquifer zones within and near proposed open pit locations at Hemi;
- A passive seismic geophysical survey to help delineate alluvium bedrock contacts along the Turner River and on two select transects near Hemi;
- Drilling and construction of six monitoring bores along three transects across the Turner River (at the proposed location where surplus water discharge to the river would occur);
- Drilling and construction of twelve monitoring bores in the region of the proposed tailings storage facility (TSF);
- Field estimation of aquifer hydraulic properties by undertaking pumping tests in production bores and falling head (slug) tests in monitoring bores;
- Bore census assessment of pastoral bores and wells in December 2021 (across an expanded area compared to the April 2021 census);
- Detailed water quality analyses of groundwater and select river pool water samples collected in April 2021, October to December 2021, and April 2022.
- Installation of surface water monitoring equipment within the Turner River by De Grey and Geowater in late 2021 ahead of the 2021/2022 wet season;

Detailed descriptions of the PFS field work and results were presented in the June 2022 *Pre-Feasibility Study Groundwater and Surface Water Investigations Report* by Geowater (Geowater 2022).

1.6 Climate

The Hemi region climate is classified by the *Koppen* system as having a *hot desert climate*. It experiences hot summers and mild winters, with most rainfall occurring during the summer months between December – March. Annual rainfall is characterised by high variability, much of which is related to the occurrence of tropical cyclones in the region. Annual pan evaporation typically exceeds annual rainfall by an order of magnitude.

1.6.1 Rainfall

Automated weather stations were installed at the Hemi Deposit, Wingina Camp and Withnell Camp by De Grey in the latter stages of 2021. These weather stations record rainfall amounts and evaporation estimates over 15 minute intervals, which will enable ongoing assessment of any significant aquifer recharge and flood events at Hemi in future years. Additional rain gauge loggers are scheduled to be installed at Hemi in 2023 to enable monitoring of local rainfall variability.

The estimation of historical rainfall and other climate data for Hemi was sourced from interpolated data from the *SILO* database (maintained by the Queensland government), which compares rainfall with the nearest Bureau of Meteorology (BoM) weather stations. Table 1–1 provides average rainfalls for the past 30 years, which for Hemi and the wider region surrounding have been approximately 350 mm to 400 mm per annum with high variability of rainfall on an annual basis. It should be noted that the annual rainfall data in Table 1–1 utilises a July to June water year (not calendar year) as this period captures individual wet seasons better than calendar year periods.

Table 1–1 Summary Rainfall Data (from *SILO*)

Site	Average Annual Rainfall 1993 – 2022 (mm)	Rainfall Year Ending				
		30 June 2018 (mm)	30 June 2019 (mm)	30 June 2020 (mm)	30 June 2021 (mm)	30 June 2022 (mm)
Hemi	379	263	616	254	419	292
Port Hedland Aero	346	240	437	216	319	385
Indee Homestead	412	301	690	314	440	298
Mallina Homestead	369	231	601	243	451	285

Figure 1–4 plots the monthly *SILO* rainfall data series for Hemi since July 1992 as well as the cumulative deviation of monthly rainfall from the 30 year average.

Figure 1–4 Hemi Monthly Rainfall July 1992 – June 2022

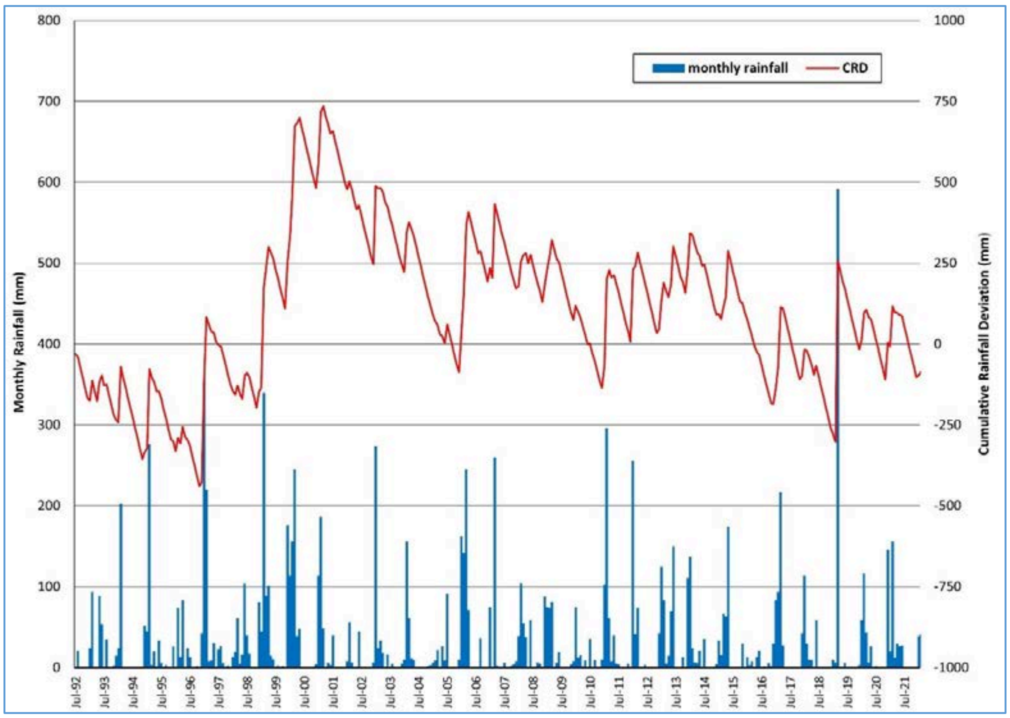


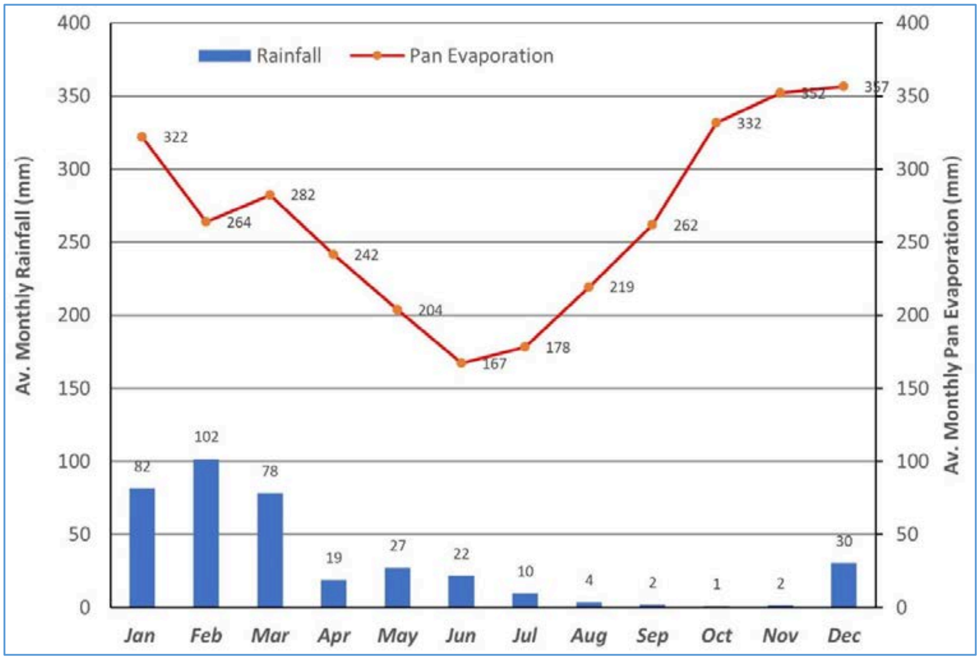
Figure 1–4 and Table 1–1 highlight the following:

- The 2018/2019 wet season rainfall was the largest on record. Almost 600 mm of rainfall occurred over three days during late March 2019 in association with Cyclone Veronica;
- A notably wetter than average period occurred between 1996 and 2001;
- Three of the past five wet seasons have been 20 % to 30 % drier than the 30 year average.

1.6.2 Evaporation and Evapotranspiration

Figure 1–5 shows the SILO 30 year average Class A Pan evaporation data for Hemi, which exceeds rainfall in all months of the year. The average annual evaporation calculated from this dataset is 3,180 mm, approximates to the 3,200 mm figure, which is shown by the BoM on their national average maps.

Figure 1–5 Hemi Average Monthly Rainfall and Pan A Evaporation



Evapotranspiration (ET) is a more important term than pan evaporation in most groundwater studies, as ET represents the overall total transfer of water, as water vapour, to the atmosphere from both vegetated and un-vegetated land surfaces. It is affected by climate, availability of water and vegetation.

> ‘**Areal actual ET**’ is defined by BoM as *the ET that actually takes place, under the condition of existing water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average. For example, this represents the evapotranspiration which would occur over a large area of land under existing (mean) rainfall conditions.*

For the Hemi region, BoM indicates that the average areal actual ET is of the order of 350 mm. This is similar to the average rainfall amount, thus inferring that virtually all of the rainfall at Hemi is lost to the atmosphere as ET, and that rainfall recharge to groundwater is limited.

> ‘**Areal potential ET**’ is defined by BoM as *the ET that would take place, under the condition of unlimited water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average. A large area is defined as an area greater than one square kilometre*.

For the Hemi region, BoM indicates that the average areal actual ET is of the order of 1,700 mm. This situation may arise in parts of the current day river channels close to river pools where the water table remains close to the ground surface month after month.

2 GROUNDWATER (HYDROGEOLOGY)

2.1 Background

Groundwater field investigations at Hemi commenced in November 2020 as part of the project *Scoping Study* phase and has continued throughout 2021 and 2022 as part of the *Pre-Feasibility Study phase*. Details of the field investigations are presented in Geowater 2021 and Geowater 2022 reports.

A summary chronology of the completed field investigations is provided below:

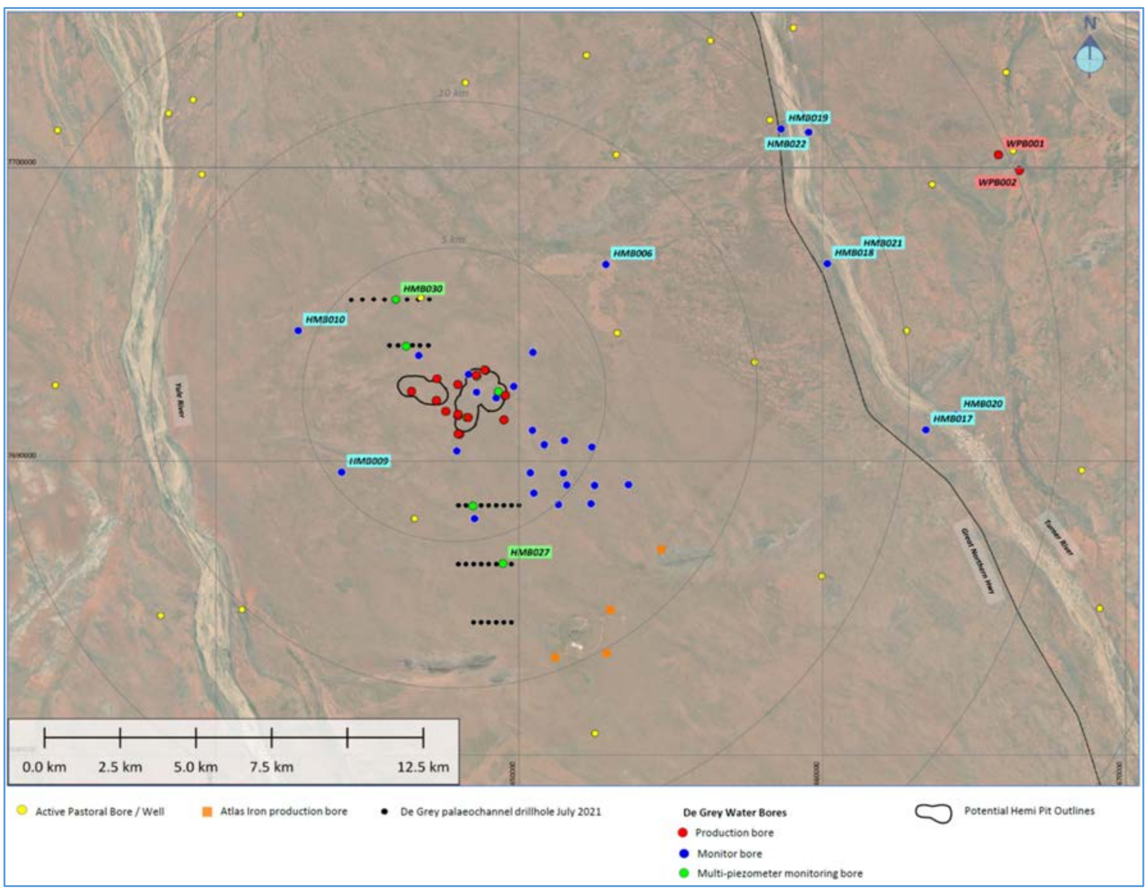
- ***November 2020*** - Drilling and construction of 11 shallow monitoring bores, followed by falling head (slug) tests and laboratory analysis of groundwater samples collected during bore development;
- ***December 2020*** - Drilling and construction of three small production bores. Commencement of a groundwater monitoring programme to record groundwater abstraction, water levels and water quality;
- ***April 2021*** - Inspection and monitoring of pastoral bores and select river pools located within 20 km of Hemi. Commencement of bi-annual detailed water quality analyses from monitoring and production bores;
- ***July 2021*** - Drilling of 37 air-core holes to investigate the main paleochannel aquifer location to the north and south of Hemi, followed by the installation of four multi-piezometer bores in these areas in November 2021;
- ***August - November 2021*** - Drilling and construction of 11 production bores and ten monitoring bores in alluvial and bedrock aquifer zones within and near proposed open cut pit locations at Hemi. Drilling and construction of four multi-piezometer bores in the main palaeochannel aquifer zone up and down gradient of Hemi;
- ***September - October 2021*** - Drilling and construction of six monitoring bores along three transects across the Turner River (at the proposed surplus water discharge point in the river). A passive seismic geophysical survey to help delineate alluvium bedrock contacts along the Turner River and on two select transects near Hemi;
- ***October 2021 - January 2022*** - Pumping tests completed in ten production bores and falling head (slug) tests completed in all monitoring bores;
- ***December 2021*** - Bore census assessment of pastoral bores and wells in December 2021 on Mundabullangana and Indee pastoral leases;
- ***March - May 2022*** - Drilling and construction of 12 monitoring bores in the region of the proposed tailings storage facility (TSF).

2.2 Drilling and Bore Construction

Figure 2–1 and Figure 2–2 show the location and type of water bores installed, as well as those bores of other groundwater users in the Hemi region. The bores drilled to date have had various objectives, which can be summarised according to the following spatial groupings:

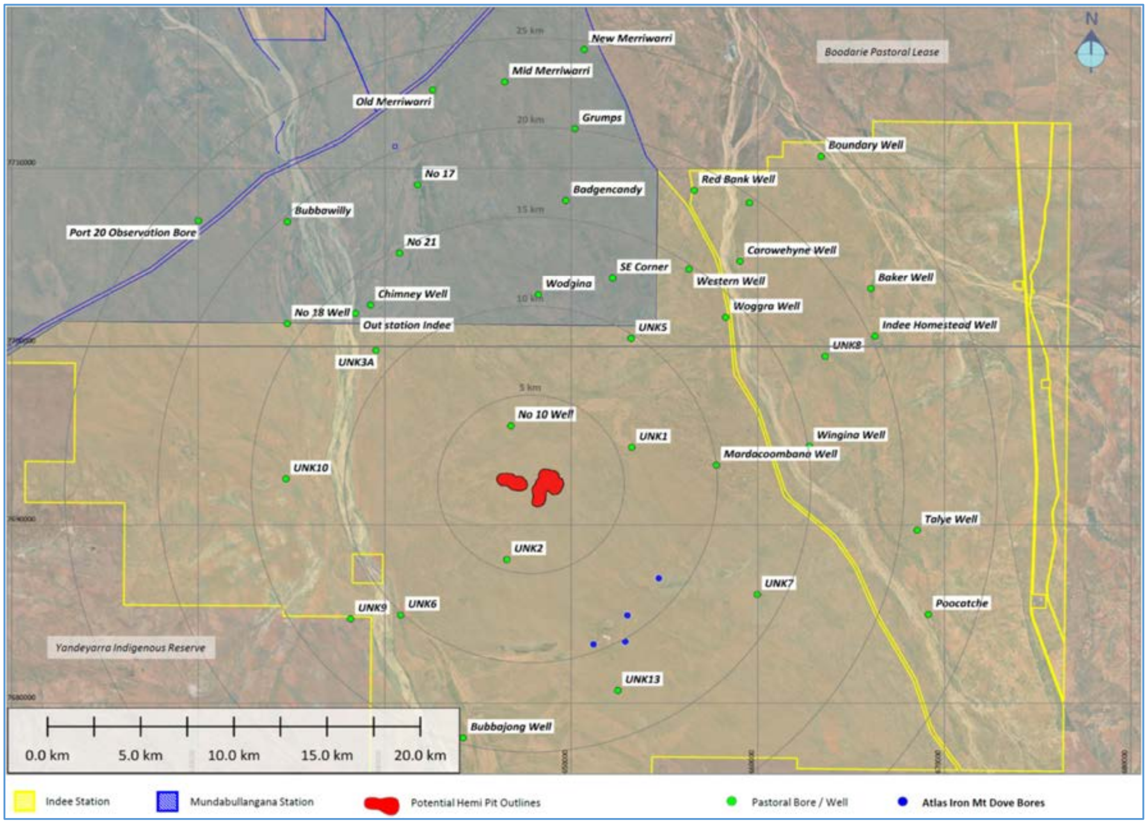
- Production and monitoring bores at Hemi – primarily to assess aquifer hydraulic properties and groundwater quality with the intent to estimate open pit dewatering requirements. The bores are focussed on the alluvial aquifer and weathered rock zones rather than deeper fresh bedrock settings;
- Monitoring bores near the proposed TSF – designed to provide baseline groundwater levels and water quality of the shallow aquifer system, and to provide input to assessment of controlled TSF seepage requirements in relation to the underlying aquifer;
- Monitoring bores near the Turner River – designed to provide baseline water quality and potential degree of connection between local groundwater and (ephemeral) surface water in the area where the proposed discharge point for surplus watering into the river is located;
- Monitoring bores within a 2 km to 7 km radius of Hemi to establish baseline groundwater conditions within the shallow aquifer system that have potential to be impacted by mine dewatering.

Figure 2–1 De Grey Bores



The majority of De Grey water bores were also used for the sampling of subterranean stygofauna, with most monitoring bores (HMB012 – HMB042) constructed with 2.0 mm slots to suit this purpose.

Figure 2–2 Active Pastoral Bores and Well



2.3 Pumping Tests and Falling Head Tests

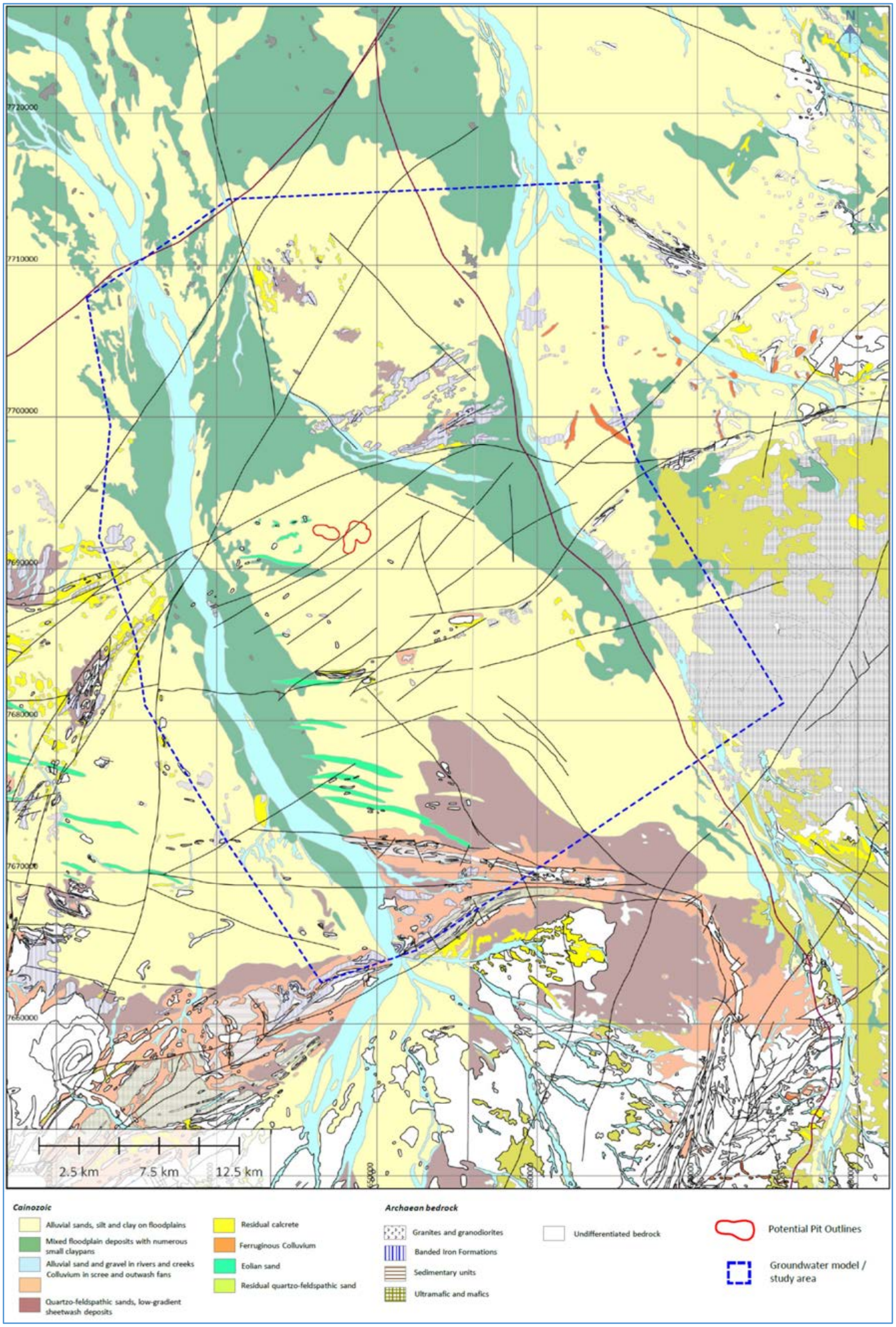
Determination of aquifer hydraulic properties was achieved by completing pumping tests in all PFS production bores (apart from HPB005). These were done by McArthur Drilling with Test Pumping (MDP) under the technical supervision of Geowater. Step drawdown tests were completed in all bores, whilst constant rate tests (CRT) of between 24 hours and 72 hours duration, with water level recovery monitoring, were completed in ten of the bores. Details of these tests, and analyses, are provided in the *Hemi PFS Field Investigation Report* by (Geowater 2022).

2.4 Conceptual Groundwater Model

2.4.1 Model Extent and Data Availability

Given the known high permeability and spatial extent of the alluvial aquifer near Hemi, a relatively large area was selected for groundwater model development to consider the potential impacts of planned groundwater use at Hemi. The model area totals 1,520 km² and is shown on Figure 2–3. It includes both the Yule River and Turner River and extends about 25 km upgradient and downgradient of Hemi.

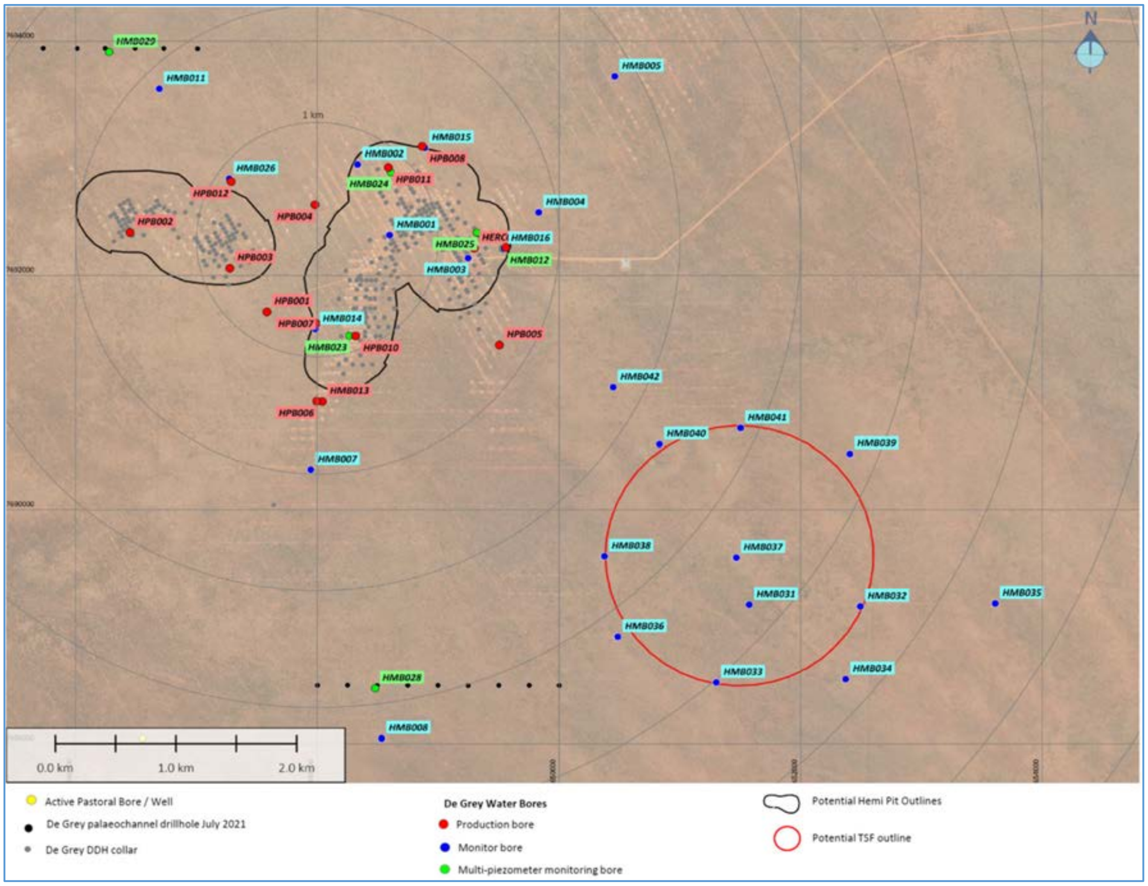
Figure 2–3 Surface Geology and Groundwater Model Area



The conceptual and numeric groundwater models have been derived using datasets and interpretations up to specific points in time, as outlined below:

- Water bore pump testing and groundwater monitoring results up to April 2022;
- Mineral resource drilling datasets up to mid December 2021. A significant number of diamond drill core holes have been completed at Hemi, including intersections of the alluvial aquifer zones. These drillholes provided excellent input to the development of conceptual groundwater models. Their collar locations are shown on Figure 2–4;
- Geological surfaces and structures modelled and interpreted by De Grey.

Figure 2–4 Drill Collar Locations



2.4.2 Regional Geology

Surficial Geology

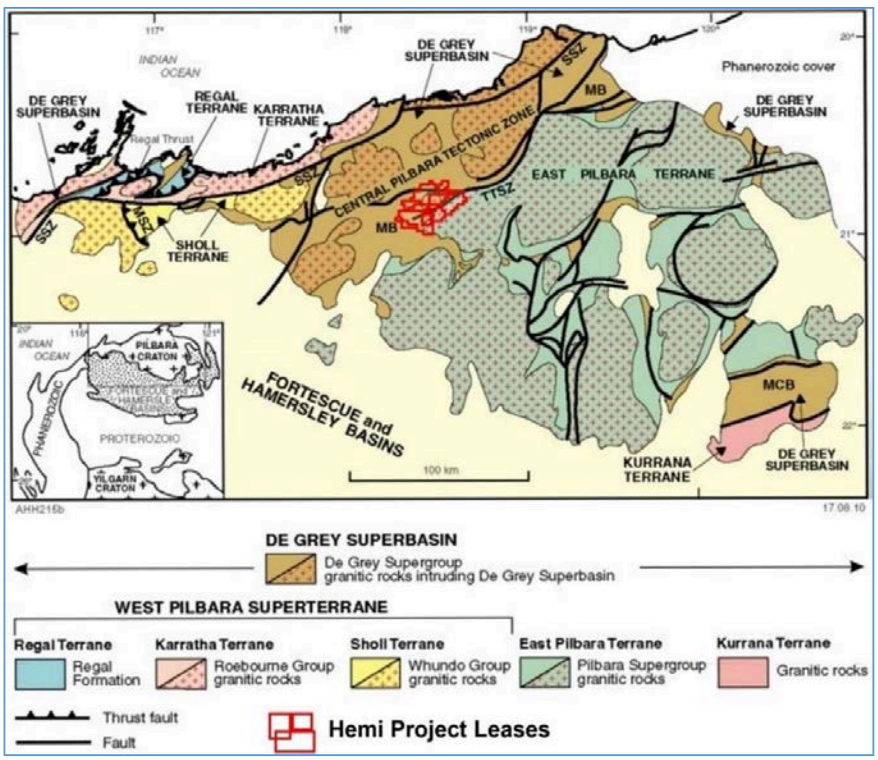
Figure 2–3 presents the surficial geology of the study area as defined by DMIRS 1:100,000 geological mapping products. The surficial geology of the region is dominated by quaternary alluvial deposits associated with current and ancient drainage lines through a relatively flat sand plain setting. Minor colluvial and sheetwash sediments occur adjacent to bedrock outcrops, which are dominant to the south and south east of the study area. In the Hemi area, De Grey has shown the alluvial sediments to be up to 45 m thick, whilst previous drilling near the Water Corporations Yule River Borefield just to the north of the study area indicates that alluvium reaches up to 80 m thickness.

Bedrock Geology

The study area occurs predominantly within the Archaean Mallina Basin, which is part of the Central Pilbara Tectonic Zone in the Pilbara Craton (Figure 2–5). Previous reporting by De Grey (2022) is reproduced here to describe the regional bedrock setting:

- The age of the Mallina Basin is poorly constrained to 3015-2931 Ma. The basin is a closed basinal structure composed of older conglomerate and arkosic sandstone overlain by turbiditic wacke siltstones and shales (derived from older Pilbara Craton crust) with minor basaltic rocks accumulated in a rift related extensional setting. The sediments have been intruded by rocks of the Sisters Supersuite which are compositionally heterogenous.
- The most prominent intrusive rocks have been assigned to the Indee Suite, and are granitic in composition, and are the most voluminous suite in the region. The second intrusive suite are the ultramafic-mafic rocks of the Millindinna Intrusion which are part of the Langenback Suite, and which are proximal to the Hemi mineralisation.
- The Tabba Tabba Shear Zone (TTSZ) is a large Northeast-Southwest trending crustal tectonic structure that forms the southern-eastern boundary between the Central Pilbara Zone and the East Pilbara Terrane and it also forms the eastern-southern boundary of the Turner River Project area. Deformation within the Mallina basin reached a maximum low to moderate greenschist facies adjacent to the major shear zones, but is less intense away from the shear zones.

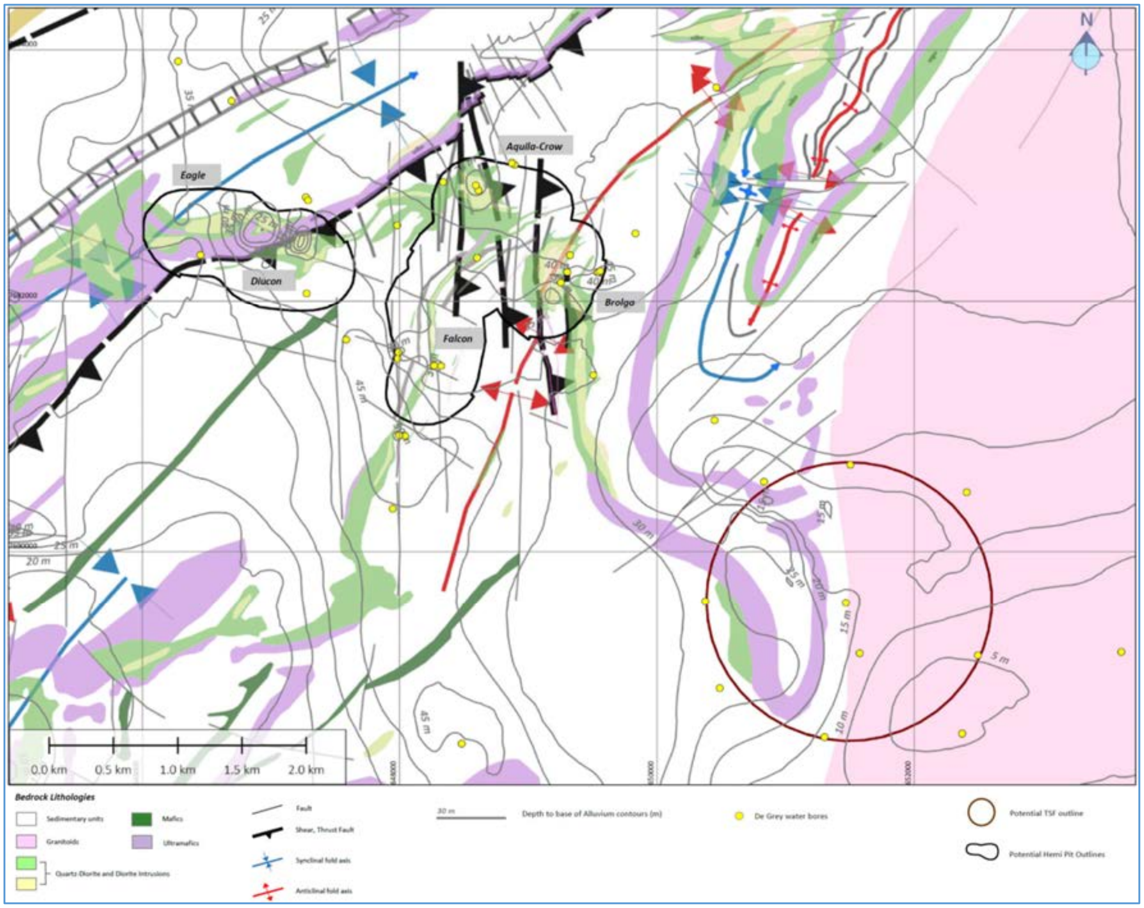
Figure 2–5 Regional Geology Plan (after De Grey [2022])



2.4.3 Hemi Geology

Figure 2–6 presents a plan of the bedrock geology of the local Hemi area as interpreted by De Grey in 2021, as well as contours of alluvium thickness interpreted by Geowater in the latter stages of 2021. The plan also highlights the location of the six different deposits that make up Hemi; Aquila, Brolga, Crow, Diucon, Eagle and Falcon.

Figure 2–6 Hemi Bedrock Geology Plan

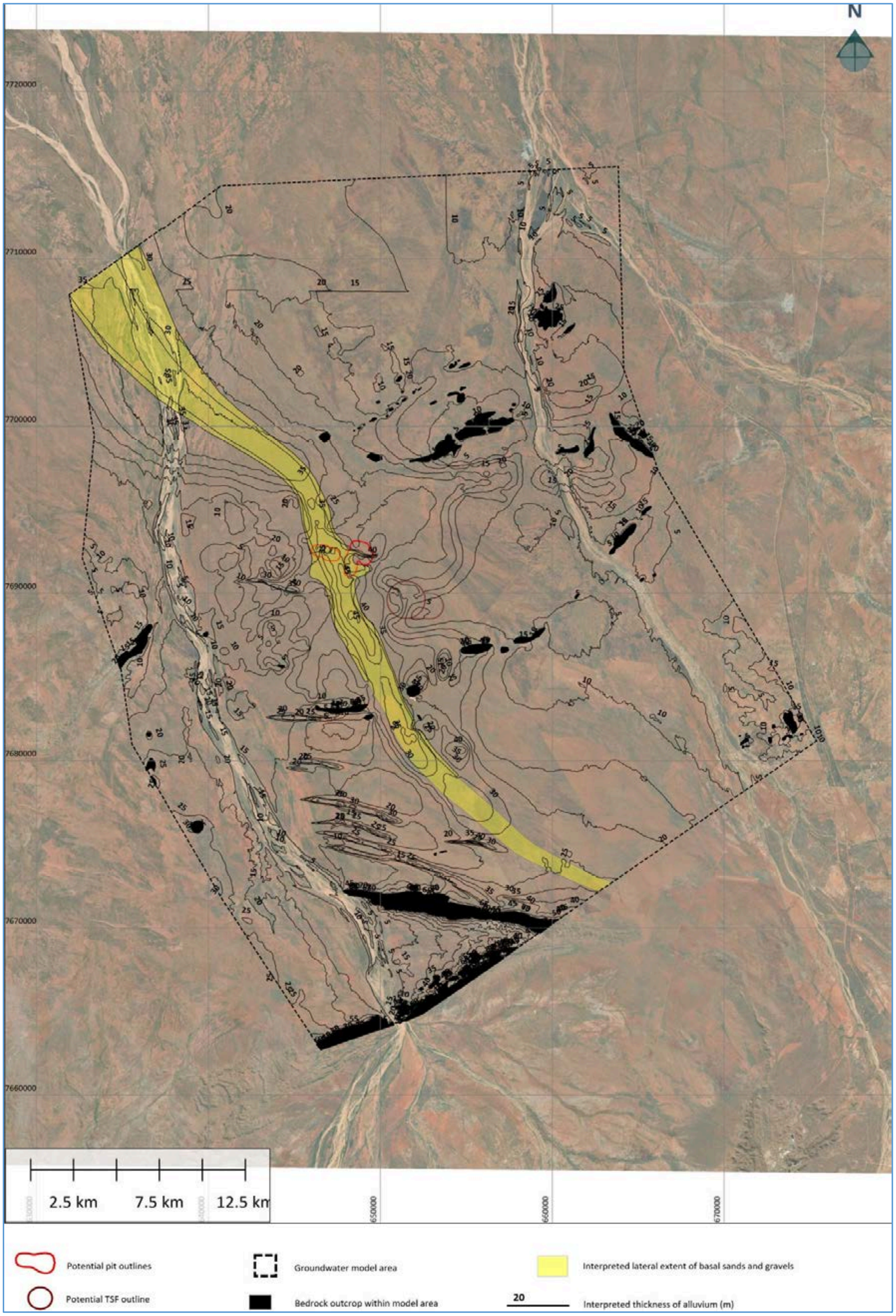


Alluvium

In the Hemi area, the thickness of alluvium is quite variable, ranging from about 5 m to the south east of the proposed TSF site, up to 45 m near the western side of the Hemi Deposit. Figure 2–7 highlights how the deepest alluvial sediments form a palaeovalley with an axis that trends to the north-northwest. Within this alignment, a coarse sand and gravel unit occurs that is up to 15 m thickness and 1,000 m wide. This basal unit often appears unconsolidated in drill core, with very little indication of consolidation or other post-diagenetic effects. Small interbeds of finer sand and silt can be present in this basal coarse grained unit. The basal unit becomes thinner at greater lateral distances, but can still be a few metres thick over a total palaeovalley width of 2.0 km to 2.5 km. The coarse basal alluvium was deposited by a large, high-energy ancient river system draining in the direction of the current day coast.

Above the coarse basal alluvium, there is a variable thickness of poorly sorted finer-grained alluvium that ranges in thickness from 5 m to 30 m. This unit is dominated by silty sands and sandy silts with minor amounts of gravel and clay variably throughout. Overall, this alluvium is very poorly sorted and typically only weakly consolidated. No distinct clay or clay rich beds are present in this alluvium, however, relatively smaller scale interbeds or lenses of sand and gravel as well silt-clay intervals do occur. The lateral extent of these sediment interbeds can be limited (< 100 m). Diagenetic overprints in this alluvium are typically weak, with only minor development of calcareous and siliceous zones, typically between 1 m to 6 m below ground. These overprints are not considered significant to the hydrogeology of the Hemi area.

Figure 2–7 Alluvium Thickness



The textural contrasts between the lower (coarse) and upper alluvium are highlighted by the diamond drill core photos presented on Figure 2–8.

Figure 2–8 Lower and Upper Alluvium Core Photos

Bedrock Lithologies

Sedimentary rocks of the Archaean Mallina Formation commonly form the footwall and hanging wall lithologies at Hemi. They are comprised of interbedded shales, siltstones and fine-medium grained wackes, and locally black shales, which have undergone low-medium greenschist facies regional metamorphism and locally contact metamorphosed immediately adjacent to the intrusive rocks (De Grey, 2022).

Intermediate igneous intrusives, as diorites and quartz-diorites, occur as the main host-rock to gold mineralisation at Hemi, with lesser amounts of more felsic and mafic intrusives. These lithologies form larger intrusive bodies as well as sills. In the Eagle and Diucon area, an ultramafic unit up to 200 m wide occurs concordantly within the sedimentary intrusive rock suite. Bedding and intrusive contacts are mainly near vertical to steeply south-easterly dipping at Hemi.

The large granitoid body to the east of Hemi is informally known as the Mount Dove Granite and is part of the sisters Supersuite. Local intersections show it is typically a coarse grained massive granodiorite.

Bedrock Structures and Weathering

Figure 2-6 highlights tight folding (with northeast trending fold axes) is present at Hemi and that some significant deformation and folding has occurred after the emplacement of the intermediate igneous intrusives. Large-scale thrusts and shear zones are also aligned to the north-east trend. Smaller, but still significant scale, north-south faults and shears are also present. Later stage north-west trending faults, with lateral displacements of at least tens of metres, have been mapped from drillhole interpretations.

The bedrock weathering profile is quite complex at Hemi and is influenced by several factors, including the primary lithology type, presence and nature of structural features and elevation within the Cainozoic landscape. The weathering profile (defined as the thickness of material from the base of alluvium to the top of fresh rock) ranges from 15 m 150 m. The thinnest profiles tend to occur in parts of Brolga, Crow and Eagle within relatively wide igneous intrusive zones that are relatively devoid of major structures. Conversely, the deepest weathering profiles tend to be associated with the finer grained sedimentary rock units and in areas associated with significant shear zones and faulting, notably at Aquila, Falcon and parts of Diucon.

Gold Mineralisation

The Hemi Deposit is a large gold system that comprises six adjacent deposits; Aquila, Brolga, Crow, Diucon, Eagle and Falcon (see Figure 2-6). De Grey (2022) report that:

- *The Hemi discovery is an intrusion related gold deposit predominately associated with diorite to quartz diorite intrusions and sills. Gold mineralisation is associated with localised to massive zones of fractured to brecciated albite, chlorite and carbonate (calcite) altered intrusion with disseminated sulphides and stringers containing pyrite and arsenopyrite with minor occurrences of pyrrhotite, overprinted in places by quartz-sulphide veins that occasionally host visible gold.*
- *Mineralisation at Hemi is characterised by consistent broad zones of low Au (gold) grade with strong continuity along strike, and steeply dipping higher Au grade ore shoots.*
- *Sulphide abundance in the mineralised intrusions typically ranges from 2.5 % to 10 % and there are strong correlations between gold, arsenic and sulphur.*
- *The gold zones and intermediate to mafic intrusions are typically magnetic as indicated by 1st Vertical Derivative TMI imagery and magnetic susceptibility.*

2.4.4 Hydrogeology

Aquifer Settings

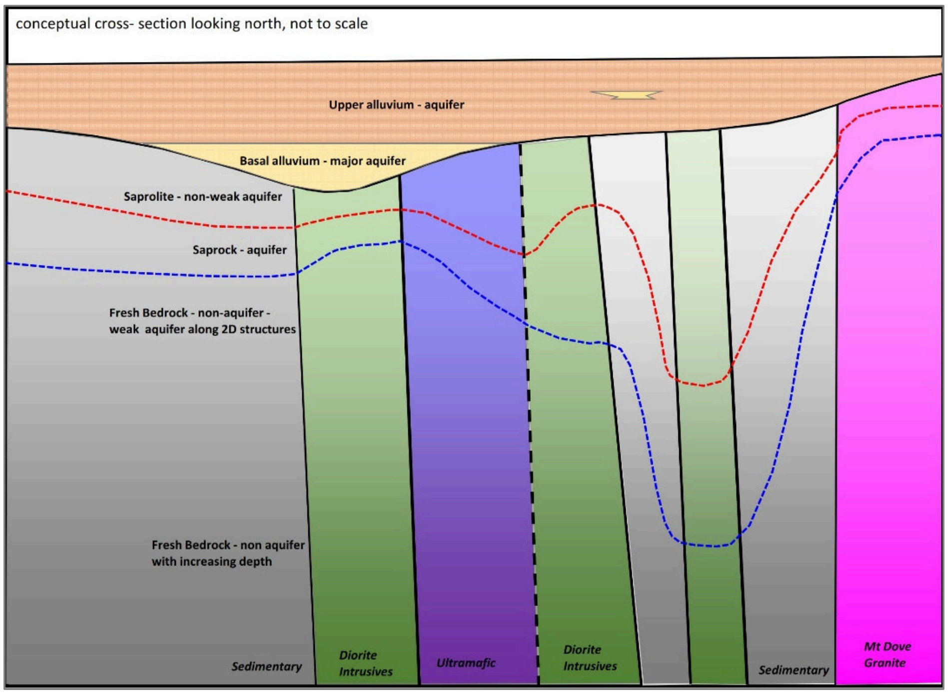
A schematic section through the Hemi Deposit is displayed as Figure 2–9 to highlight the hydrostratigraphy that has been resolved by the mineral resource drilling and groundwater bores installed to date. The different aquifer zones are based on their fundamental lithology type and comprise, from shallow to deepest:

- ***Upper alluvium*** - a laterally extensive aquifer system having low to moderate (but significant) permeability and saturated thickness.
- ***Lower alluvium*** - this comprises the basal paleochannel sands and gravels which forms a major aquifer system with high permeability and storage values, Extensive continuity in the north-south direction and of the order of 1 km to 2 km in the transverse east west direction.
- ***Saprolite zone*** - the uppermost sections of weathered bedrock that commonly weather to a clay rich assemblage with a resultant inherent limited permeability, notably within the sedimentary and ultramafic lithologies.
- ***Saprock zone*** - this covers the lower part of the weathering profile and comprises moderately to slightly weathered rock. At Hemi, it is clear that the intermediate igneous intrusives have developed a relatively higher permeability than the surrounding sedimentary and ultramafic units in the saprock profile. Diamond drill core and water bore testing indicate low to moderate fractured rock permeability in the intrusives.

- ***Fresh bedrock*** - The lithologies present at and near Hemi do not form aquifer zones when they are unweathered, including the arkosic wackes and sandstones. Extensive reviews of diamond drill core logs and photos indicates that discrete fracture zones related to the brittle ductile nature of the igneous intrusives, and possible later stage cross-cutting faults form permeable but narrow flow paths within bedrock. There is also an indication that the openness (and hence permeability) of these structures gradually declines with depth, such that permeable fractures in core were rarely observed below about 150 m (vertically) below ground.

Interpolation of these aquifer zones into the regional extent of the model area has been completed with typical levels of uncertainty as a result of the limited data availability compared to Hemi itself.

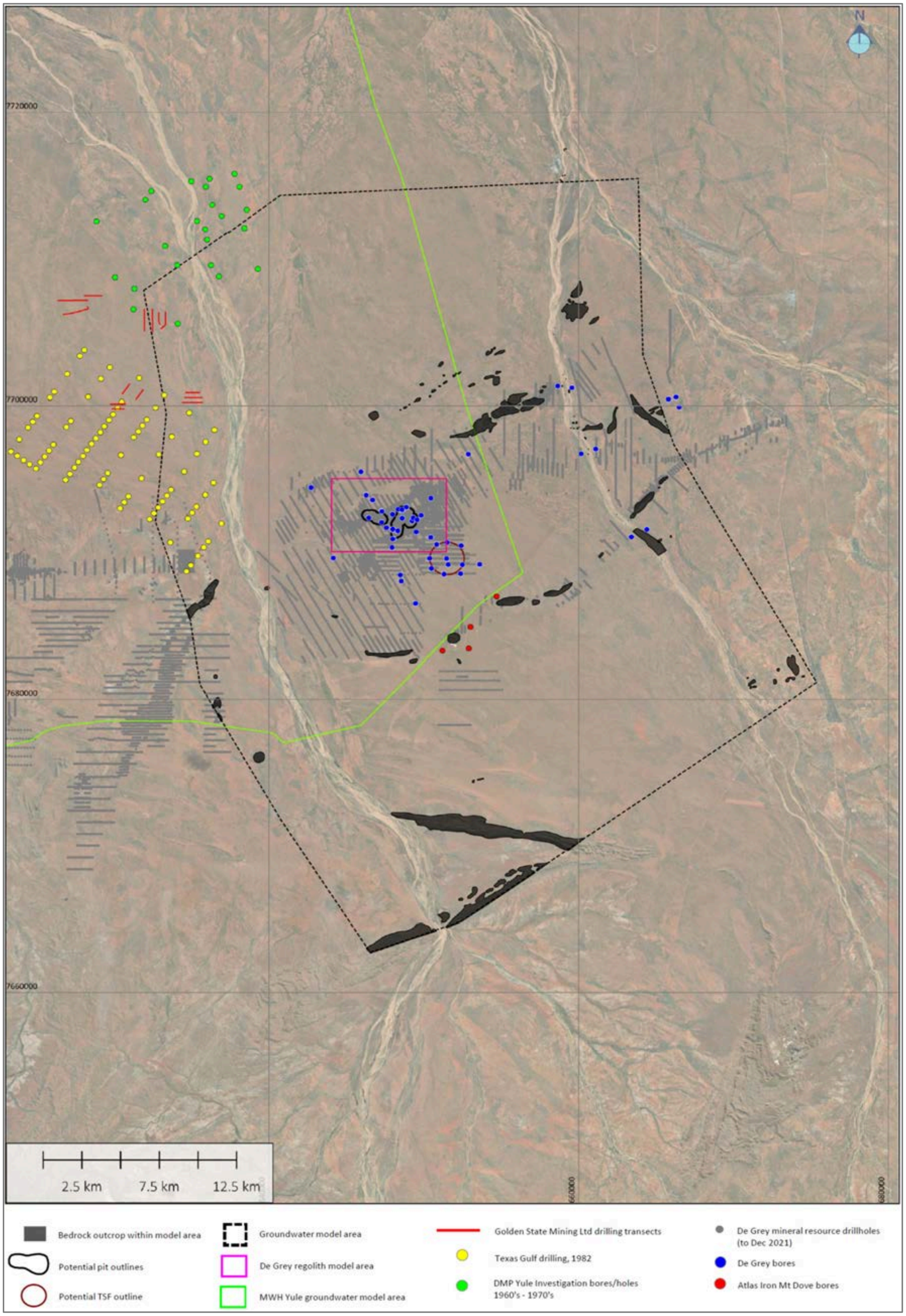
Figure 2–9 Hemi Aquifer Settings



Alluvium

Figure 2–10 highlights the various datasets that have been used to map alluvium throughout the study area. Given the extent and significance of the alluvial aquifer in the wider study region, mapping of this unit is important to the assessment of potential impacts and hence it was beneficial that the available datasets tended to be concentrated in the areas of most significance (the Water Corporation and Atlas Iron bore fields and the Yule and Turner River reaches nearest to Hemi).

Figure 2–10 Alluvium Mapping Datasets



A brief commentary on the various data sources is provided below:

- The many thousands of mineral resource drillholes (many thousands) from the De Grey database in the model area. It should be noted that despite the significant number of drillholes in this database, not all of these holes intersected the base of transported cover above bedrock;
- The DMP Yule River investigation bores and holes (from the 1960's and 1970's) closest to the study area. The results of this drilling was captured (alongside other datasets) by MWH when they undertook the groundwater modelling exercise of the Yule River Borefield on behalf of the Department of Water in 2010;
- The MWH (2010) model extent covers the Hemi area. Where more recent De Grey drilling and Geowater assessments exist, then the MWH model data has been replaced to improve the accuracy of the data;
- The north west part of the De Grey model area near the Yule River includes mineral resource drilling results accessed from the DMIRS *WAMEX* database;
  - Shallow drilling for tin deposits in alluvium by Texas Gulf in 1982;
  - Aircore drilling by Golden State Mining in 2020;
- Aerial imagery was used to identify areas of bedrock outcrop;
- The regolith modelling by De Grey incorporates geochemistry indicators (such as Sn content) in addition to lithological and textural logging to model the base of transported cover within the immediate Hemi area. This included estimation of the coarser basal sand and gravel unit.

The main palaeochannel hosting the coarse basal sands and gravels at Hemi is interpreted to extend downstream (north) of the model area. The limited available data suggests the paleochannel crosses or merges with the Yule River alignment just south of the North West Coastal Highway. Its exact geological and stratigraphic relationship to the thick sands and gravels tapped by the Water Corporation production bores further north is not confirmed. However, it is considered likely that the aquifer zones are in direct hydraulic connection with each other. Figure 2–7 shows the interpreted lateral extent of the coarse basal alluvium. The location and nature of the palaeochannel system near the southern end of the model area is less certain due to the decreased density of drilling in that area.

The elevation (mAHD) of the base of alluvium cover over the whole model area was interpreted using the available datasets and gridding into 20 m cell-sizes using *Surfer v16* software. Within and near areas with outcropping bedrock, the interpolated base of alluvium surface is not accurate as it has been constructed to show one continuous surface through the model domain. The unrealistic presence of alluvium in these areas is overcome in the numeric model by assigning bedrock hydraulic properties to the uppermost alluvial layers. Figure 2–7 shows the interpreted alluvium thickness and areas of bedrock outcrop through the study area.

Bedrock / Weathering

De Grey prepared a regolith model for the immediate Hemi area as part of the PFS phase. This model has an extent of 7 km x 5 km as shown on Figure 2-11. The modelling was completed in 2021 using *Leapfrog* software to utilise observations of drill core and percussion samples as training datasets for various drilling databases that included geochemistry, density, short-wave infrared and geotechnical logging. The modelling generated a continuous surface throughout the model domain for each of the following rock weathering zones below the transported alluvial cover; upper saprolite, lower saprolite, saprock, strongly jointed fresh rock and weakly jointed fresh rock. These surfaces were provided in digital *.dxf* format to Geowater.

The De Grey regolith model results were reconciled at a broad level against the water bore drilling and testing result, as well as the high level review by Geowater of drill core photographs from 180 drillholes. Overall, the occurrences of saprolite, saprock and fresh rock were considered similar, whilst the De Grey occurrences of 'strongly jointed weathered fresh rock' and 'weakly jointed fresh rock', which were primarily domained for metallurgical reasons, were not uniformly aligned with the Geowater singular category of 'slightly weathered'. The two De Grey categories of jointed rock were also sometimes considered as saprock or fresh rock by Geowater, however, both systems display the common trend of reducing permeability from overlying saprock to underlying tight fresh bedrock.

Outside of the De Grey regolith model, drillholes tended to be shallow aircore holes that rarely intersect the full rock weathering profile. In these areas, and where there was no drilling at all, the following assumptions were made by Geowater to enable interpretation of rock weathering profiles across the entire groundwater model domain:

- The upper and lower saprolite layers within the De Grey model are considered to exhibit similar hydraulic properties and were interpolated as single layer (corresponding to the base of saprolite);
- In regions where the ground surface is fairly flat and significant alluvial cover exists, the full rock weathering profile was assumed to have a maximum thickness of 80 m, with uniform sublayer thicknesses of 25 m for saprolite, 15 m for saprock, 20 m for slightly weathered and 20 m for a transition zone to fresh rock (equivalent to De Greys weakly jointed fresh rock);
- In rock outcrop and nearby areas, the full weathering profile was assumed to be 20 m, with equal sub-layer thicknesses of 5 m;
- The rock weathering surfaces away from Hemi were derived by projecting the base of alluvium surface downwards by the thicknesses described above, so most weathered rock layers appear parallel.

The Hemi and regional area interpretations were merged and re-gridded in Surfer to produce a 20 m sized grid over the whole study area and used for the numerical model construction. Isopach (thickness) maps of each rock weathering layer are provided as Figure 2–11 to Figure 2–14.

Figure 2–11 Thickness of Saprolite

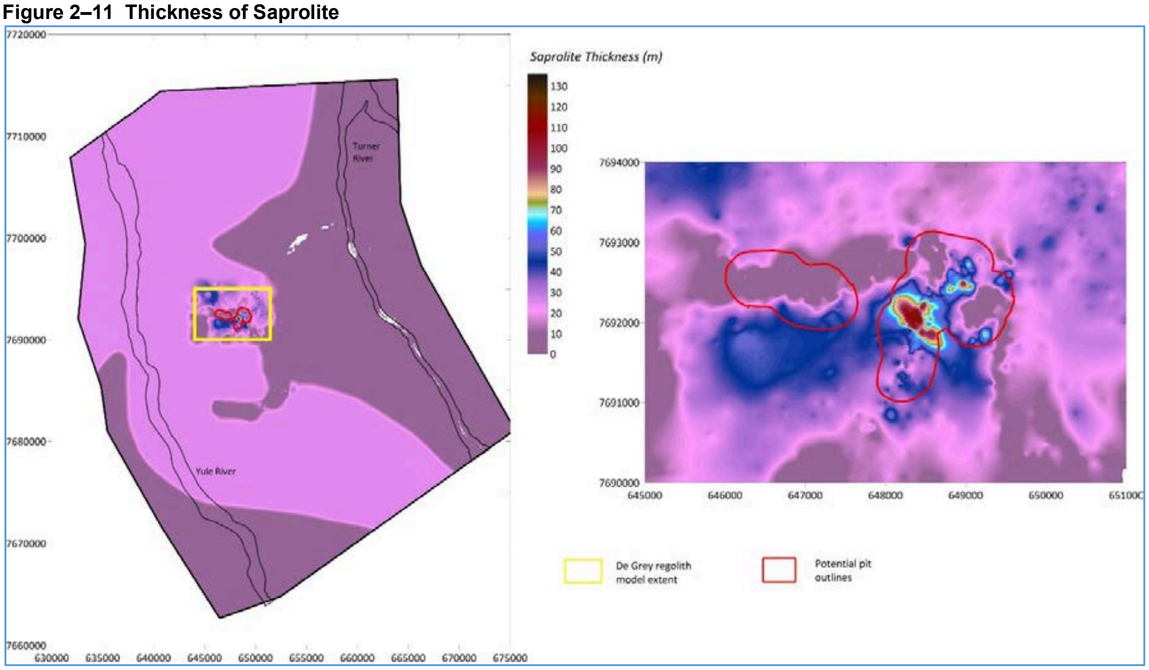


Figure 2–12 Thickness of Saprock Profile

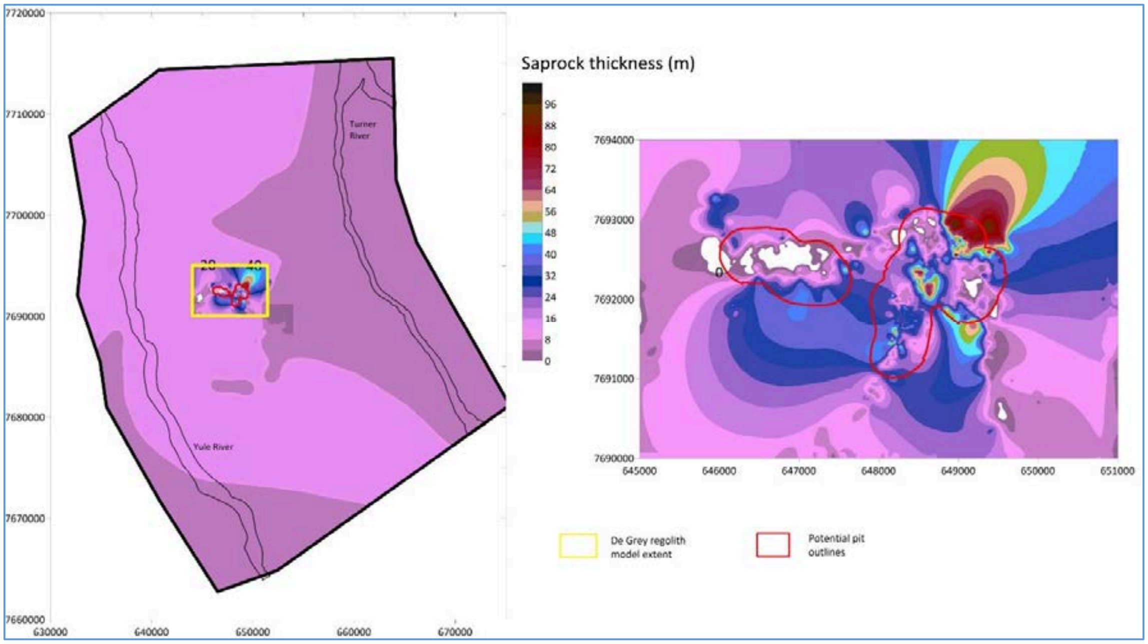


Figure 2–13 Thickness of Slightly Weathered Profile

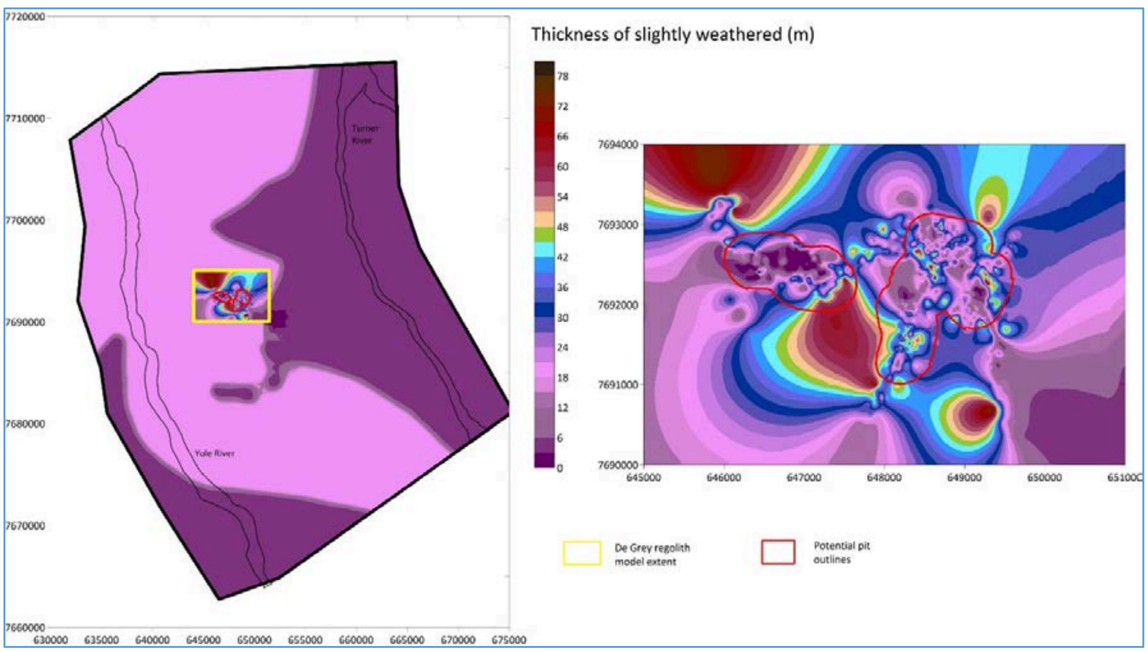
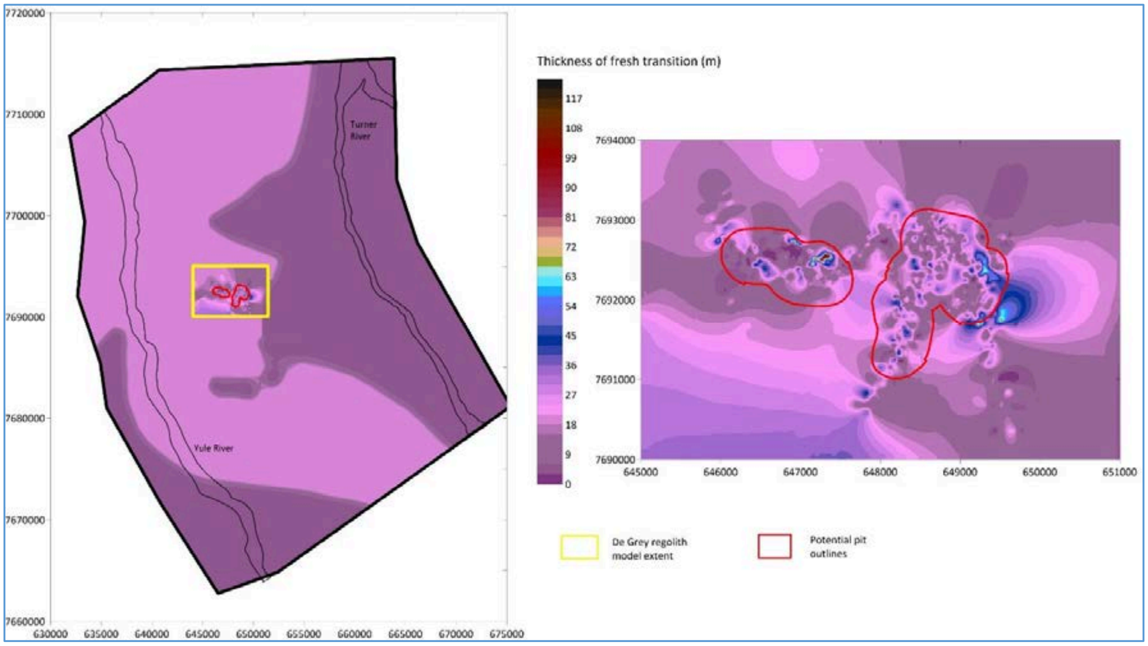


Figure 2–14 Thickness of Fresh Transition Profile



The review of drill core photographs has provided useful information about aquifer occurrences and potential properties of the different bedrock profiles at Hemi. Key observations comprise:

- The sedimentary and ultramafic bedrock within the highly to moderately weathered profiles appear less permeable than the suite of mineralised igneous intrusive rocks;
- The saprock and slightly weathered profiles within igneous intrusive rocks can exhibit high permeability in zones of strong jointing and fracturing. These zones tend to have limited vertical extent given the relatively shallow depth of weathering in many parts of the igneous intrusive suites. At the Eagle deposit, there is an area of up to 200 m x 200 m in which most of the drill core holes display significant joint and fracture sets. Figure 2–15 shows drill core exhibiting these elevated permeability zones;
- Minor occurrences of narrow (typically less than 1 m) felsic dykes, logged in the De Grey system as porphyries (AFPY), are notable for their very low permeability, both internally and along their contacts with surrounding rock;
- Increased amounts of minor to moderate fracturing within slightly weathered and fresh bedrock often appears to be associated near the boundaries between sedimentary and igneous intrusive units. Whilst not proven by this study, the increased fracturing may also be spatially linked to the occurrence of fold hinges and fault locations;
- As commonly observed at many other bedrock mines, shear zones in bedrocks at Hemi appear to be mostly impermeable owing to their foliated and intact nature;
- Within slightly weathered and fresh bedrock, there is an overall trend of decreasing permeability with depth, with very limited indications of significant fracture permeability below about 150 m. The limited occurrence below this depth is often associated with minor scale vuggy veins, however, these show no obvious indications of weathering or extensive continuity.

Figure 2–15 Drill Core Examples of Elevated Saprock Permeability within Hemi Igneous Intrusives

Groundwater Levels

Regional Water Table

The regional water table as of December 2021 has been interpolated using *Surfer v16* software to produce the contours shown on Figure 2–16 which also shows the location of water bores and wells with groundwater level data. Only minor adjustments were made to the contours, by assuming several river pool elevations to be representative of the water table and by interpreting several conceptual values near the outer limits of the study area.

The water table in the project region is a broad reflection of the overlying ground surface and shows that regional groundwater flow in the shallow aquifer system is north-north westerly under low hydraulic gradients of between 1 in 800 to 1 in 1600. These are similar to the average riverbed gradients of the nearby Yule River (1 in 900) and Turner River (1 in 650).

The depth to the water table below ground (for December 2021) was calculated in *Surfer v16* by subtracting the water table surface from a ground surface DTM generated on a 20 m grid size from finer resolution Lidar data provided by De Grey. As shown on Figure 2–17, the water table in the immediate Hemi area occurs between five to seven metres below surface, with a broad trend of slowly increasing depth to the south and slightly decreasing to the north in areas of low relief. The greatest depths to the water table (> 20 m) occur below outcropping bedrock areas, which are more prominent to the south of Hemi.

Figure 2–16 Water Table Contours – December 2021

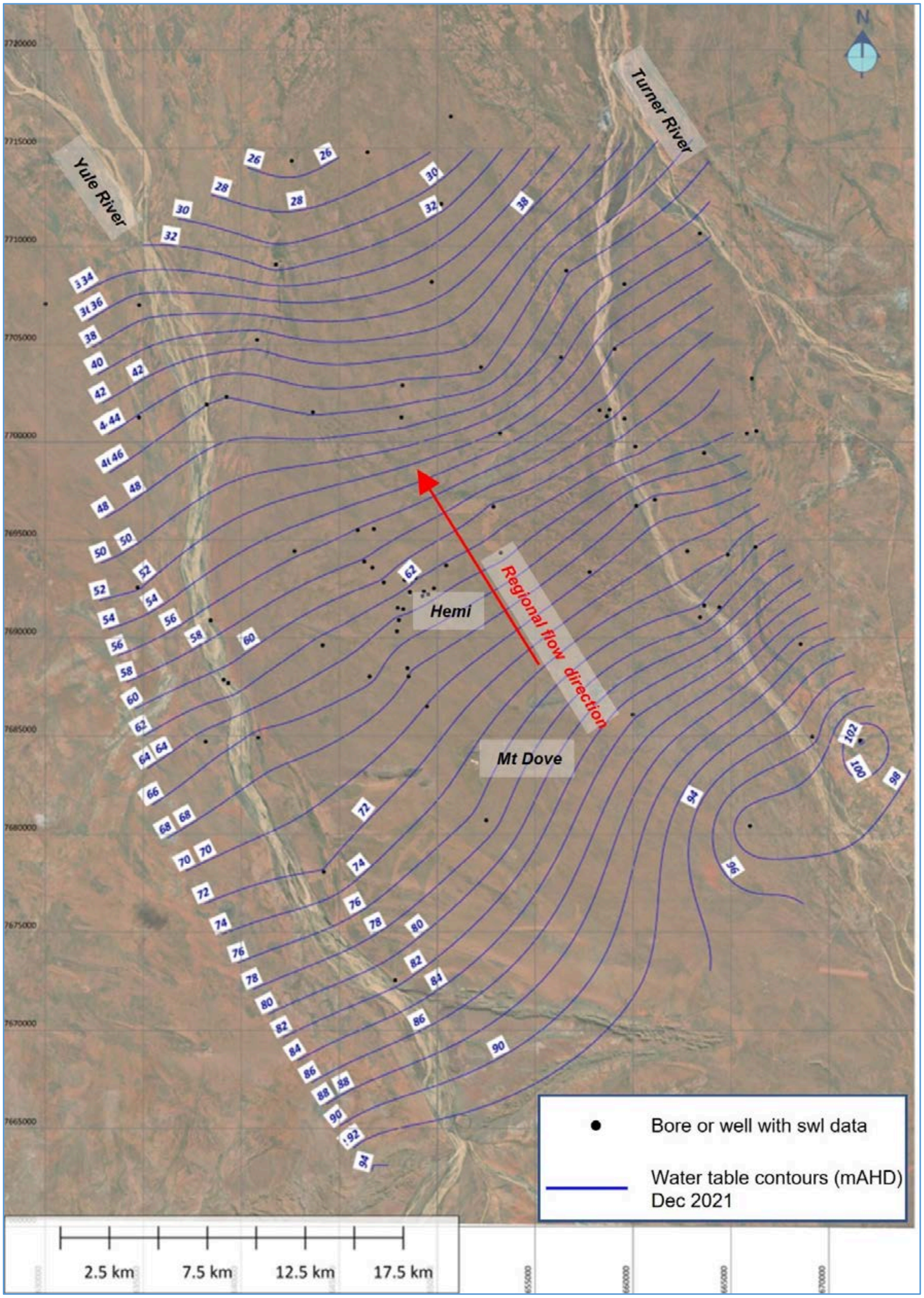
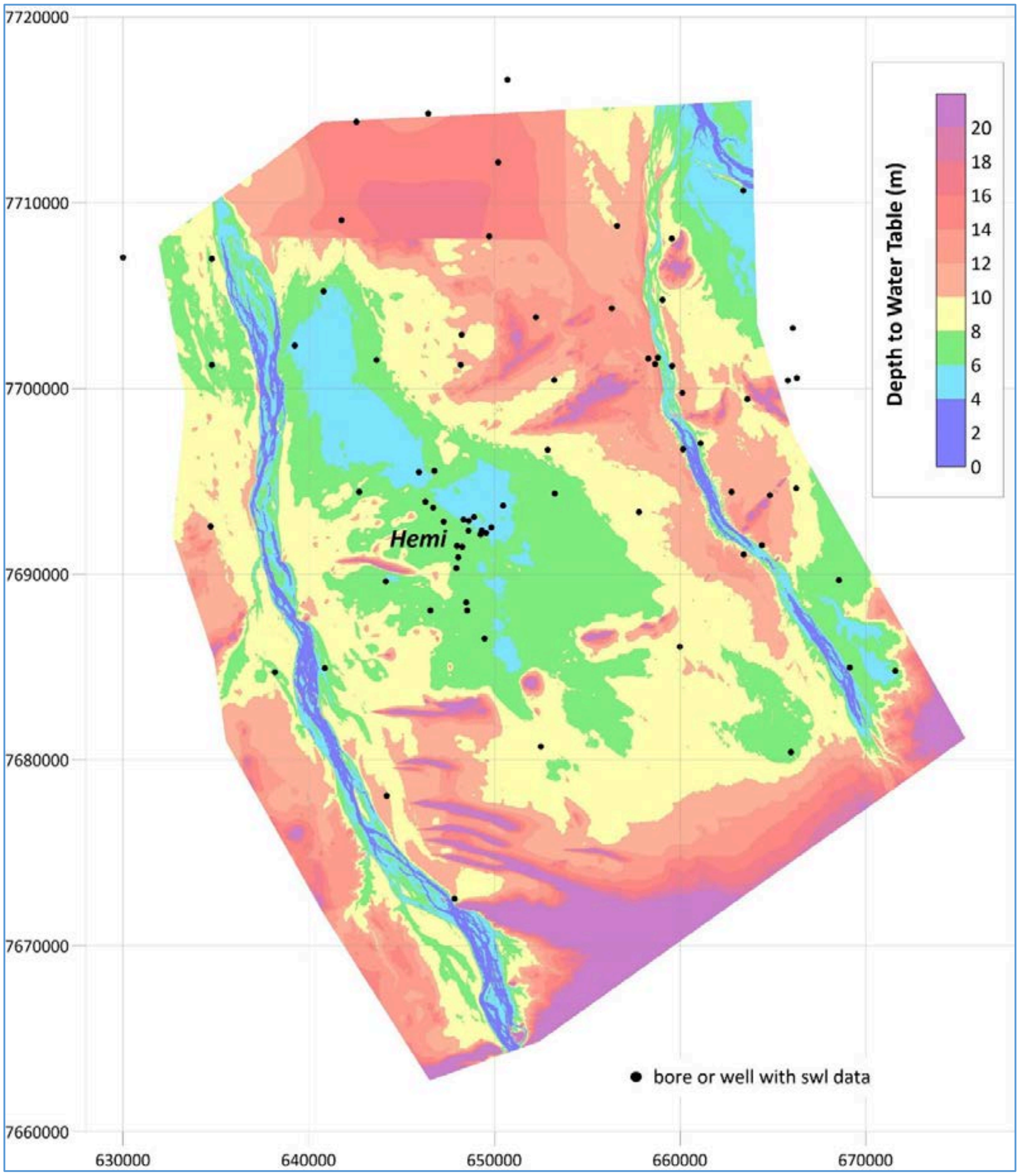


Figure 2–17 Depth to Water Table – December 2021

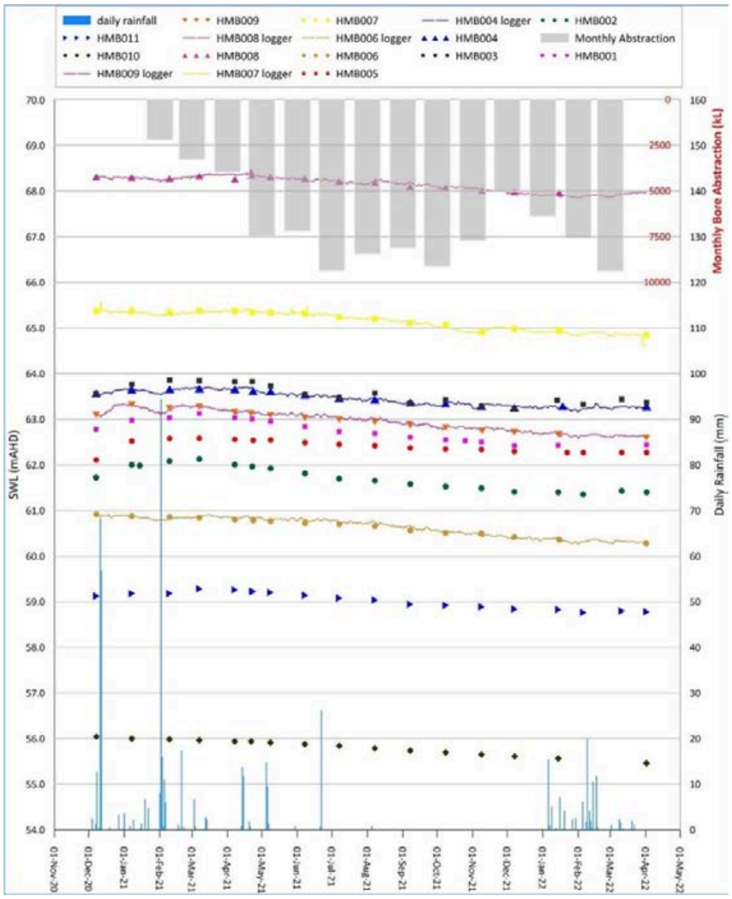


Hydrographs

Figure 2–18 displays groundwater levels for Hemi bores HMB001 to HMB011, as well as daily rainfall and monthly abstraction volumes from Hemi production bores used to supply water for drill rigs and dust suppression on the main Hemi access track. The rainfall data is sourced from interpolated values for Hemi made by the Queensland Government's *SILO* database.

Several monitoring bores show a slight increase in groundwater levels of 0.3 m to 0.5 m between December 2020 and March 2021, which is considered to reflect minor but significant recharge from the two large (> 100 mm) rain events in that period. From around April 2021, groundwater levels in most bores show a gradual declining trend throughout the regional dry season period, with a flattening or small reversal of this trend during the drier than average 2021/2022 wet season. The monitoring bores closest to abstraction sites at Hemi (HMB001 to HMB004) do not show any signs of aquifer dewatering in response to abstraction to date, and the observed groundwater levels are considered to reflect natural variations in seasonal rainfall recharge events.

Figure 2–18 Hemi Region Groundwater Hydrographs – December 2020 – April 2022

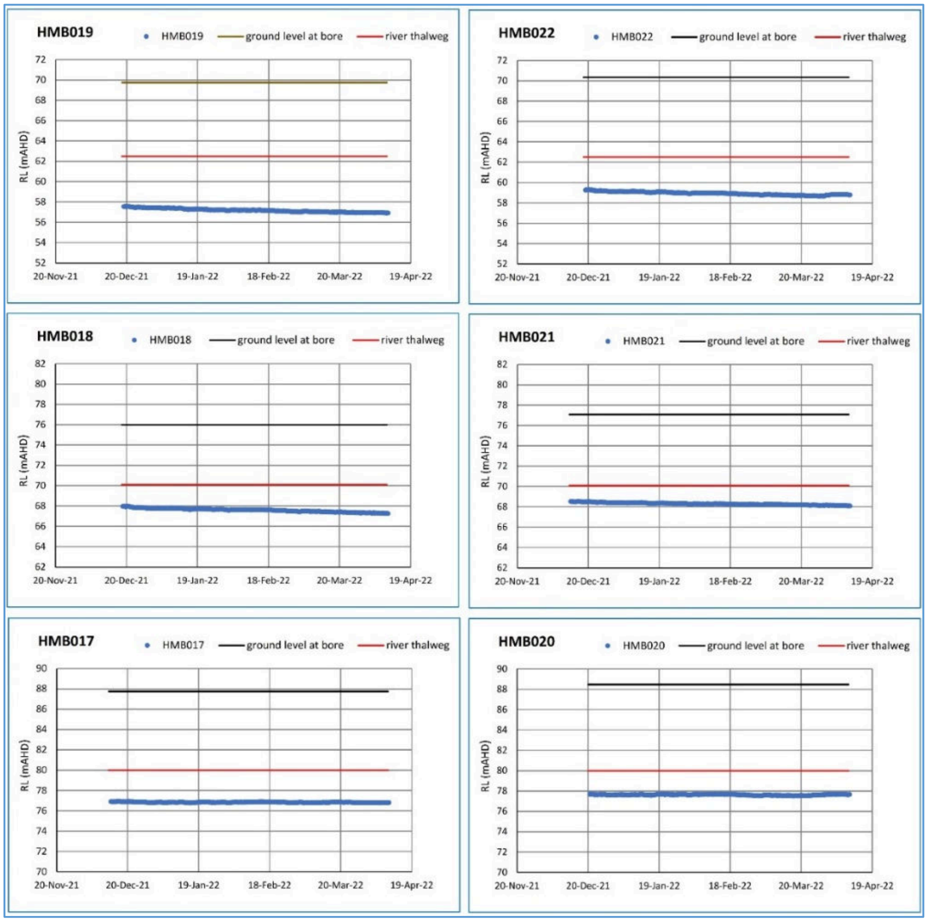


The six monitoring bores located next to the Turner River were installed to assist investigations into the option of discharging surplus groundwater to the Turner River. Monitoring of groundwater levels in these bores commenced in December 2021 utilising pressure transducers with manual readings and data downloads every two months. Hydrographs for these bores are shown on Figure 2–19, as well as the lowest elevation within the nearby section of the Turner River and ground level at the bore. No river flows occurred during the monitoring period to May 2022, and the plots show that the water table occurs between two to five metres below the lowest elevations of the riverbed.

Vertical Head Gradients

Eight multi-piezometer monitoring bores have been installed in the Hemi region with a shallow and deep standpipe constructed in the same drillhole and isolated from each other by an annular cement bentonite seal. The main purpose of these is to measure groundwater quality from different geological intervals, as well as to provide a measurement of any vertical head differences present in the groundwater system. The vertical head differences observed to date under the natural baseline regime are limited (> 0.15 m), which is as expected given the likely strong hydraulic connection present between alluvium zones and underlying weathered bedrock, as well as the lack of large hydraulic stresses during the observation period.

Figure 2–19 Turner River Hydrographs



Saturated Alluvium

Estimation of the alluvial aquifer thickness has been achieved by subtracting the base of alluvium grid from the December 2021 water table grid in *Surfer v16*. Contours of the aquifer thickness are shown on Figure 2–20 for the regional area and on Figure 2–21 for the local Hemi area. These figures highlight the following:

- The alluvial aquifer is not continuous throughout the entire model area, notably to the east of Hemi, and along much of the Turner River. Between Hemi and the Yule River there are some 'islands' where the alluvium is unsaturated, and the water table would be present within the bedrock profile;
- In the Hemi area, there are large areas of alluvial aquifer between 25 m to 40 m thickness that will require dewatering ahead of open cut pit mining. On the south east side of the proposed TSF, the water table is present just below the base of alluvium.

Groundwater Quality

Groundwater quality in the Hemi region is typically fresh to brackish (800 mg/l to 1,100 mg/l TDS), near-neutral to slightly alkaline (pH range of 7.5 – 8.5), and with elevated hardness (approximately 270 mg/l as calcium carbonate). Since December 2020, almost 120 groundwater samples from the Hemi and Turner River areas have been analysed for detailed water quality at ALS laboratory (Wangara, Perth). The ALS analytical reports are included in full as part of the field investigations report (Geowater, 2022).

Figure 2–20 Alluvial Aquifer Thickness (m) – Regional – December 2021

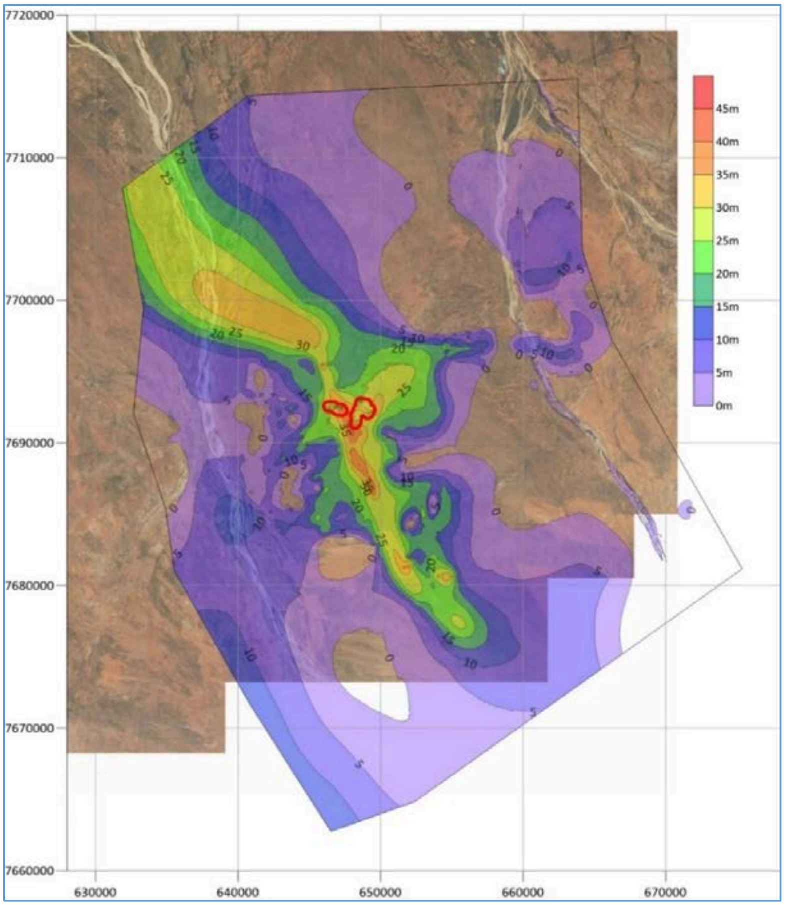
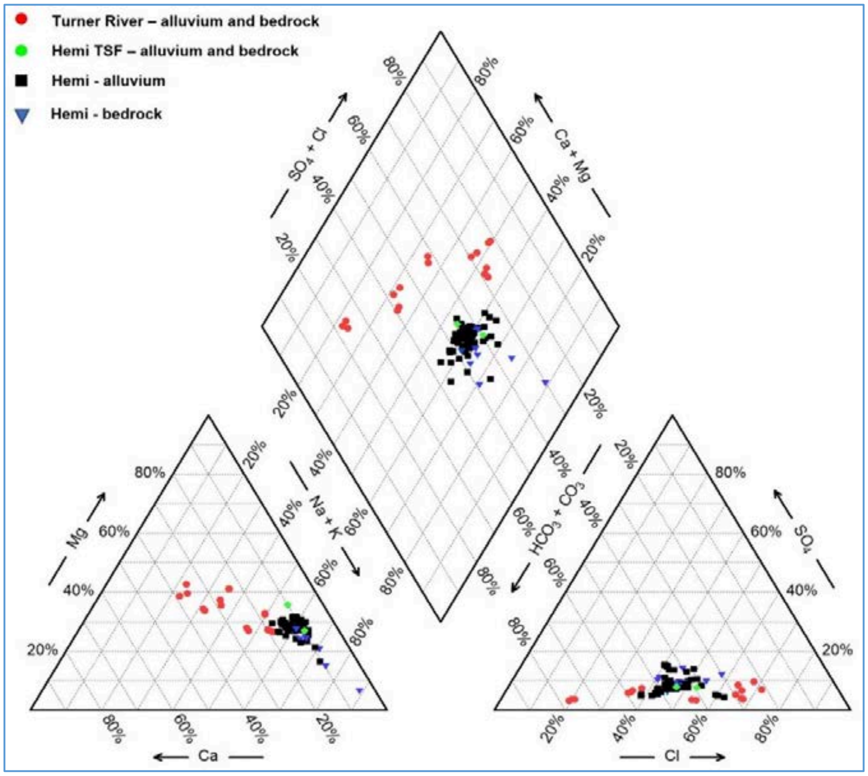


Figure 2–21 - Alluvial Aquifer Thickness (m) – Hemi – December 2021

Water Type

Figure 2–22 shows a Piper trilinear diagram to highlight the different proportions of major and minor ions between three sample groupings (Hemi alluvium, Hemi bedrock and Turner River). Groundwater in the Hemi region can be characterised as a mixed water type, with sodium and potassium the dominant cations, with lesser magnesium and only minor calcium. Chloride and bicarbonate are the dominant anions with only minor sulphate. The bedrock intervals sampled to date are relatively shallow and show a trend towards increasing sodium and potassium levels at the expense of magnesium.

Figure 2–22 Piper Plot – All Bores

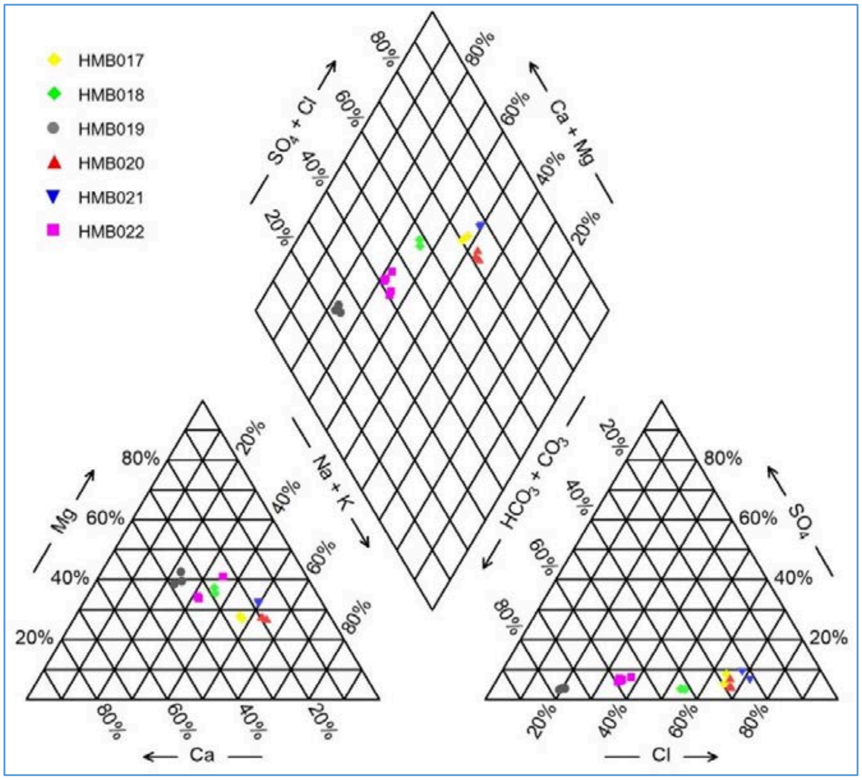


This may be a result of cation exchange within the clay mineralogies of the saprolite and saprock intervals that the bedrock bores are screened within. In a vertical context, the salinity of groundwater within alluvium and weathered bedrock at Hemi is very similar, with no obvious changes between shallow and deeper intervals (excluding the finer-scaled observation of fresher water at or very close to the water table surface in some bores). Water samples collected from multi-piezometer bores on the same dates have salinity values within 10 % of each other between shallow and deep intervals.

As shown in Figure 2–22, groundwater quality in the Turner River monitoring bores is more variable than in the Hemi area. Figure 2–23 shows another Piper diagram that identifies individual bores and shows that bores HMB017, HMB020 and HMB021 can be characterised as a sodium chloride type water, HMB018 as a mixed water type and HMB019 and HMB022 as a mixed cation bicarbonate type. The two northern bores, HMB019 and HMB022 are screened within sedimentary bedrock and have low salinity (350 mg/l to 550 mg/l) and may have a reasonable hydraulic connection to occasional recharge from river flooding events. Surficial calcrete deposits have been observed in the riverbed close to this drill transect.

The southernmost bores HMB017 and HMB020 are screened within mafic schistose bedrock of relatively low permeability. The sodium chloride nature and salinity values (1,000 mg/l to 1,350 mg/l) suggest limited or no significant groundwater recharge from river flooding events in this bedrock dominated reach of the river.

Figure 2–23 Piper Plots – Individual Bores



Salinity Trends

The alluvial aquifer in the Hemi region shows a trend of increasing salinity from west to east as shown by the late 2021 regional electrical conductivity (EC) contour plan (Figure 2–24). The major ion water chemistry of this trend is highlighted on the Durov plot (Figure 2–25) which shows that, from west to east, cation ratios remain similar whilst chloride increases notably at the expense of bicarbonate. Given the similar geochemistry of the alluvium, the increasing salinity and chloride to the east is interpreted to reflect relatively lower rates of groundwater recharge.

Review of EC:TDS relationships show that the relationship of EC * 0.71 is a good indicator of groundwater salinity in the Hemi region (Geowater, 2022).

Trace Metals

Gold mineralisation at Hemi is generally associated with pyrite and arsenopyrite. The occurrence and deportation of dissolved arsenic is therefore an important aspect of the environmental impact studies. To facilitate these studies, a comprehensive suite of trace metals has been analysed on all groundwater samples, to the lowest detection limits available at ALS. Most of the analyses are for dissolved metal levels on samples that have been filtered in the field at the time of collection using a 0.45 µm filter. Total metals analyses have also been undertaken since October 2021 on groundwater samples that exhibit a cloudy or turbid nature.

The laboratory results indicate that dissolved arsenic, chromium, uranium and vanadium levels in some bores at Hemi are higher than the levels in bores more distant from Hemi and / or in baseline surface water samples collected in the Turner River. Figure 2–26 plots these dissolved metal levels against the distance from the known main ore zones at Hemi, and highlights the different sample categories. Both distance and concentration values are plotted on a logarithmic scale given the variations present.

Figure 2–24 Regional EC Contour Plan (late 2021)

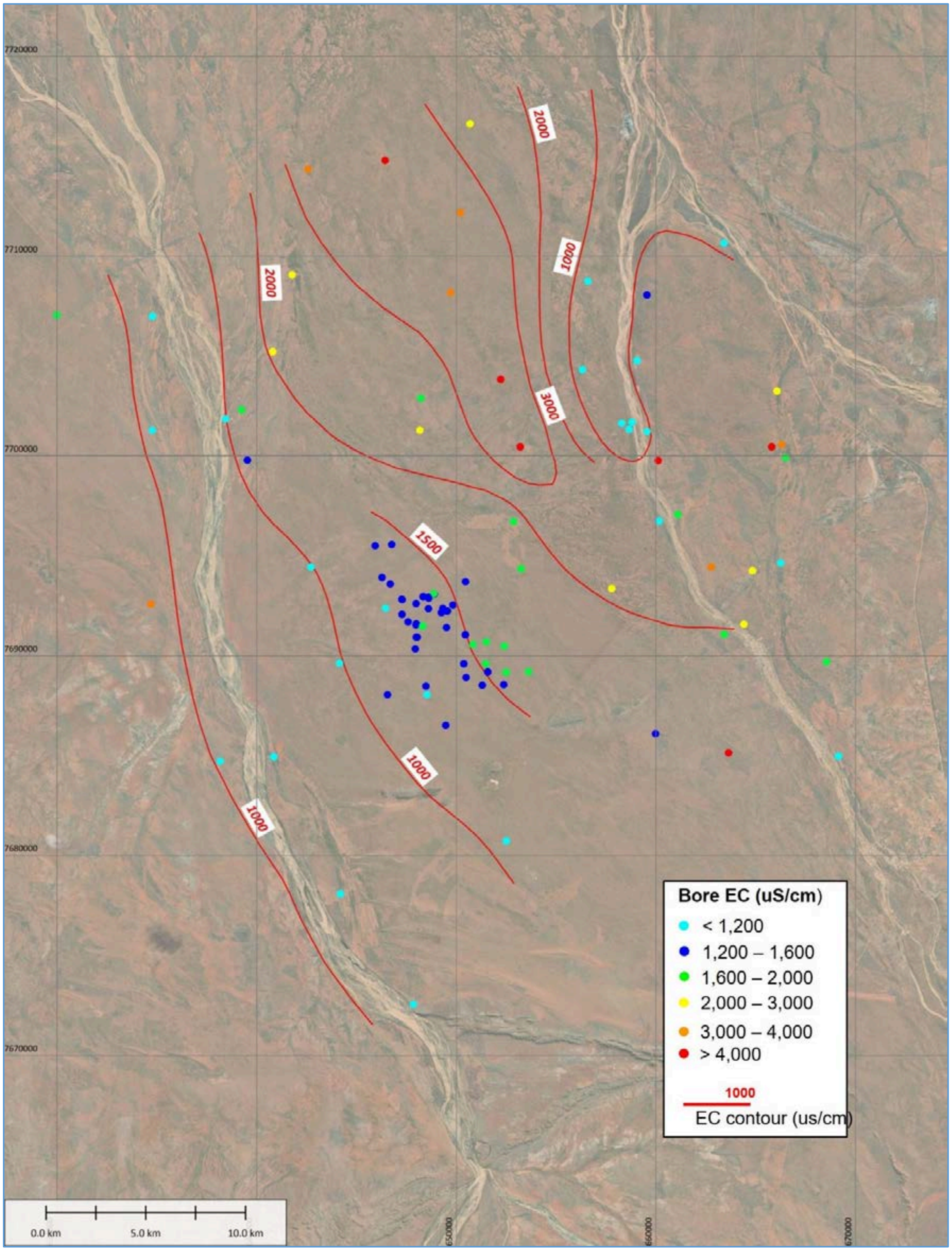
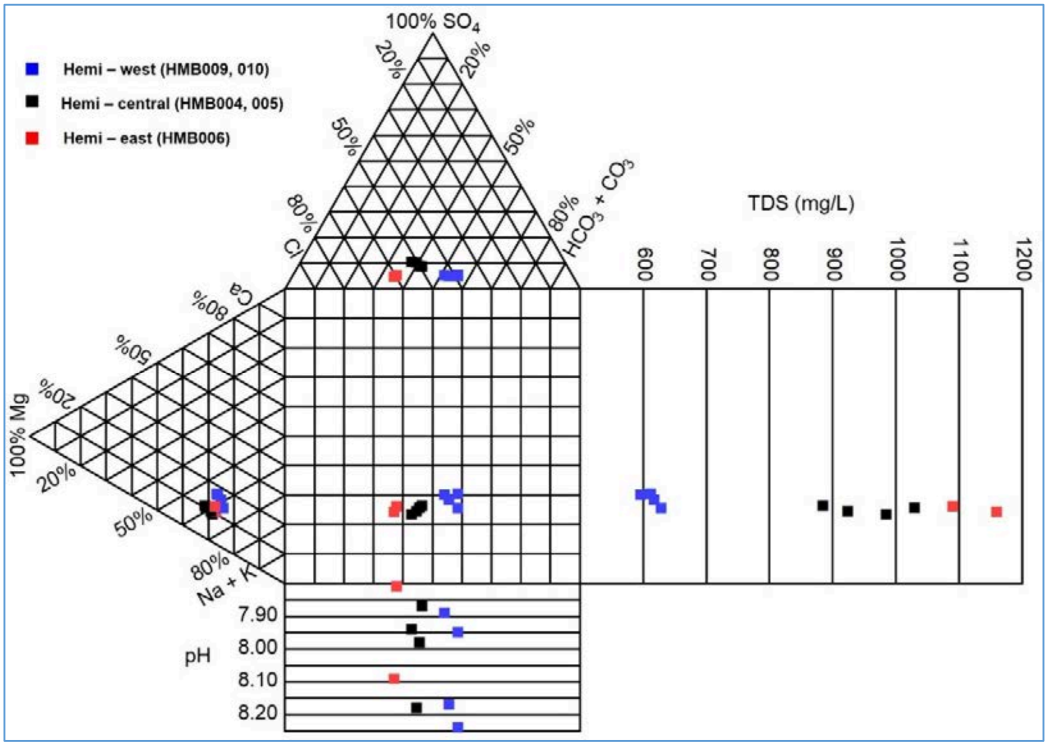


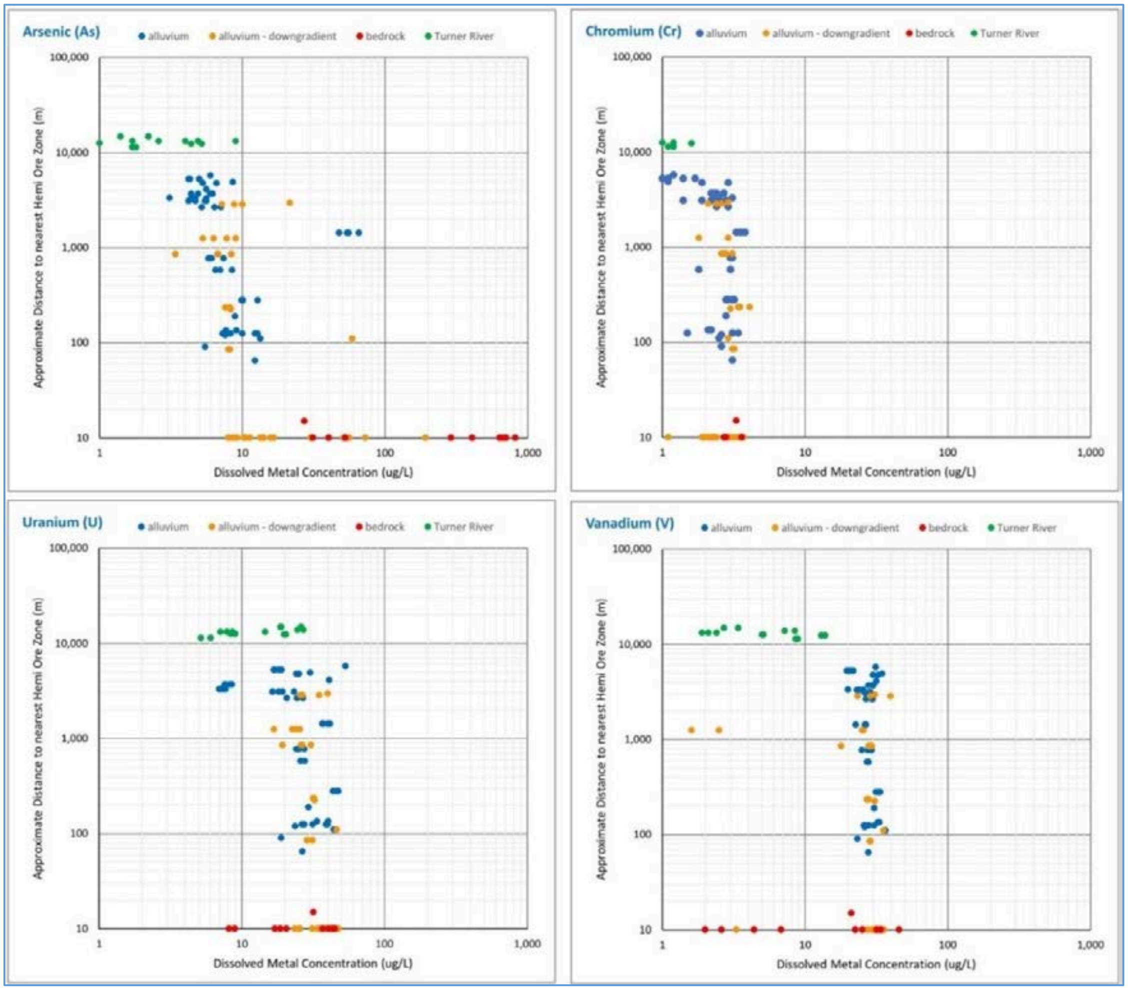
Figure 2–25 Durov Plot – Hemi Alluvial Aquifer



Comments regarding the trace metal data comprise:

- The distance of 10 m is nominal and equates to the bore location being within or very close to the Hemi ore zones;
- Groundwater samples in bedrock are only available for bores located within ore zones and display the highest arsenic levels (up to 1 mg/l);
- There is a tendency for arsenic values in alluvium bores located directly down gradient of ore zones to be higher than alluvium bores located upgradient of the Hemi ore zones. There are three outliers in the dataset that contradict this with alluvial arsenic values of around 0.050 mg/l at around 1,400 m away. That said, these results are from bore HMB005, which is located just downgradient from a mineralised deposit area (Scooby);
- Chromium values are typically higher in alluvium bores located upgradient and laterally distant from the Hemi ore zones, which suggest that elevated chromium levels are not related to the Hemi gold mineralisation system;
- Groundwater near the Turner River bores typically have lower arsenic, chromium and uranium levels relative to the Hemi region;
- Uranium and vanadium levels are similar in concentration between upgradient, downgradient and Hemi bedrock zones, which suggest their distribution in the groundwater system is not closely related to the Hemi gold system. It may be more in relation to all the Hemi sites being broadly downgradient of a large granodiorite dome present to the south east of Hemi.

Figure 2–26 Dissolved Trace Metals



Hydraulic Parameters

Ten of the De Grey production bores at Hemi underwent controlled pumping tests to estimate key hydraulic aquifer parameters, with a focus on the alluvial aquifer system compared to the fractured and weathered bedrock system. All monitoring bores had falling head (slug) tests completed. The derived hydraulic parameters of these are summarised in Table 2–1 alongside other hydraulic parameters used in groundwater studies at Mount Dove and the Yule River Borefield.

2.4.5 Conceptual Model Summary and Water Balance

Several plans have been prepared to help visualise key aspects of the local and regional hydrogeology. Figure 2–27 shows an isometric plan view of the whole model area, Figure 2–28 to Figure 2–30 are scaled regional sections (looking north) and Figure 2–31 and Figure 2–32 are local (NE looking) sections through Eagle-Diucon-Falcon and Crow-Aquila-Brolga.

Table 2–1 Hydraulic Parameters

Bore(s) / Category	Geology Unit(s) Screened	Transmissivity [T] (m²/day)	Aquifer Thickness [b] (m)	Hydraulic Conductivity [K] (m/day)	Storativity [S]	Specific Storage [Ss]	Specific Yield [Sy]
De Grey Pumping Tests							
HPB002	Basal sands and gravels	360	24	15	-	-	-
HPB003	Alluvium and basal sands/gravels	1,312	41	32	6.0E-3	1.5E-4	-
HPB004	Alluvium and basal sands/gravels	10,50	30	35	-	-	-
HPB006	Alluvium and basal sands/gravels	2,300	45	51	1.0E-4	2.2E-6	-
HPB007	Alluvium	600	20	29	2.0E-3	9.5E-5	-
HPB008	Alluvium	250	29	8.6	4.0E-4	1.4E-5	-
HPB009	Alluvium and basal sands/gravels	900	39	23	6.0E-4	1.5E-5	0.05
HPB010	Bedrock	180	30	6.0	2.6E-4	8.7E-6	-
HPB011	Bedrock	0.3	21	1.4E-2	-	-	-
HPB012	Alluvium and basal sands/gravels	2,000	30	67	2.5E-4	1.5E-5	0.10
De Grey Falling Head (Slug) Tests							
various	Turner River alluvium and/or bedrock	-	-	3.5E-3 – 0.7	-	-	-
various	Hemi Deposit alluvium	-	-	0.05 - 40	-	-	-
various	Hemi Deposit bedrock	-	-	1.5E-2 – 1.7	-	-	-
various	TSF alluvium and/or bedrock	-	-	0.15 – 9.0	-	-	-
various	Hemi regional alluvium	-	-	0.1 – 60	-	-	-
Atlas Iron Mt Dove Pumping Tests							
MDEX2	alluvium	91	20	4.5	-	-	-
MDEX3	alluvium	283	12	24	-	-	-
MDEX5	bedrock	32	51	0.6	-	-	-
MDEX6	alluvium & bedrock	2213	22	100	-	-	-
DMP Yule River Investigations, 1960's – 1970's							
23	alluvium	974	12	80	-	-	-
13	alluvium	207	9	24	-	-	-
11	bedrock	29	6	5	-	-	-
33	alluvium	16	7	2.2	-	-	-
MWH Yule River Numeric Model, 2010							
Calibrated model values	Alluvium Sand	-	-	35	-	1.0E-4	0.07
	Alluvium Clay	-	-	0.4	-	9.8E-3	0.05
	Bedrock	-	-	0.02	-	1.0E-6	0.02

Figure 2–27 Conceptual Hydrogeology Plan

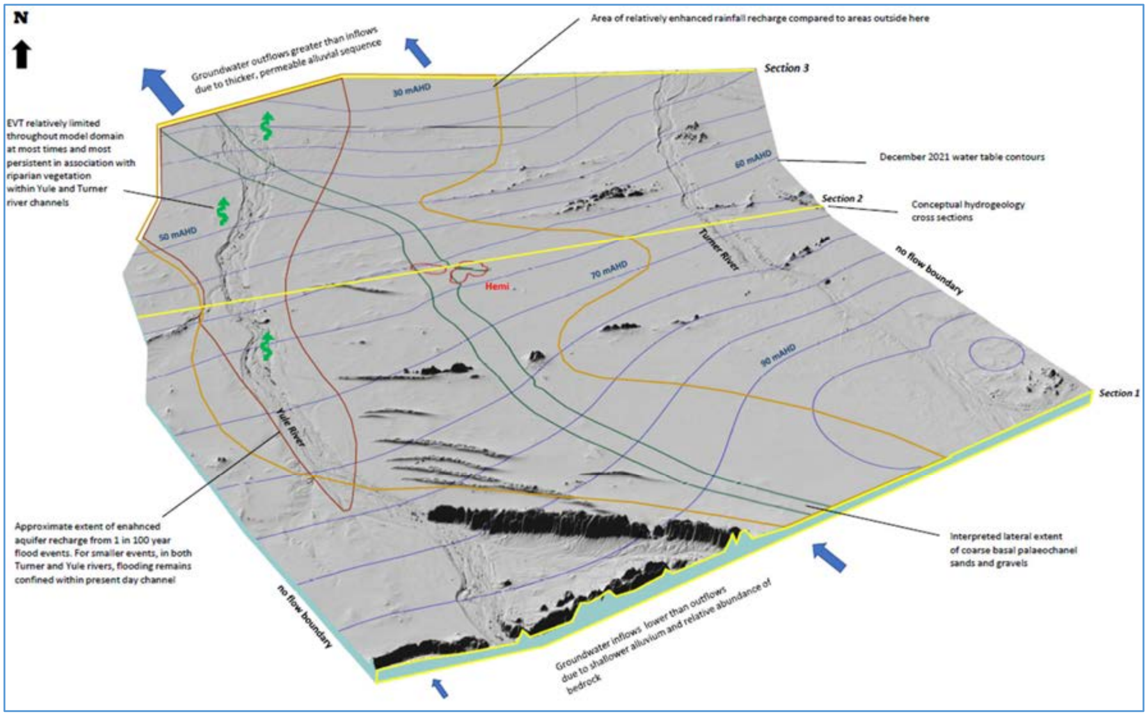


Figure 2–28 Conceptual Hydrogeology Section 1 – Southern Model Boundary

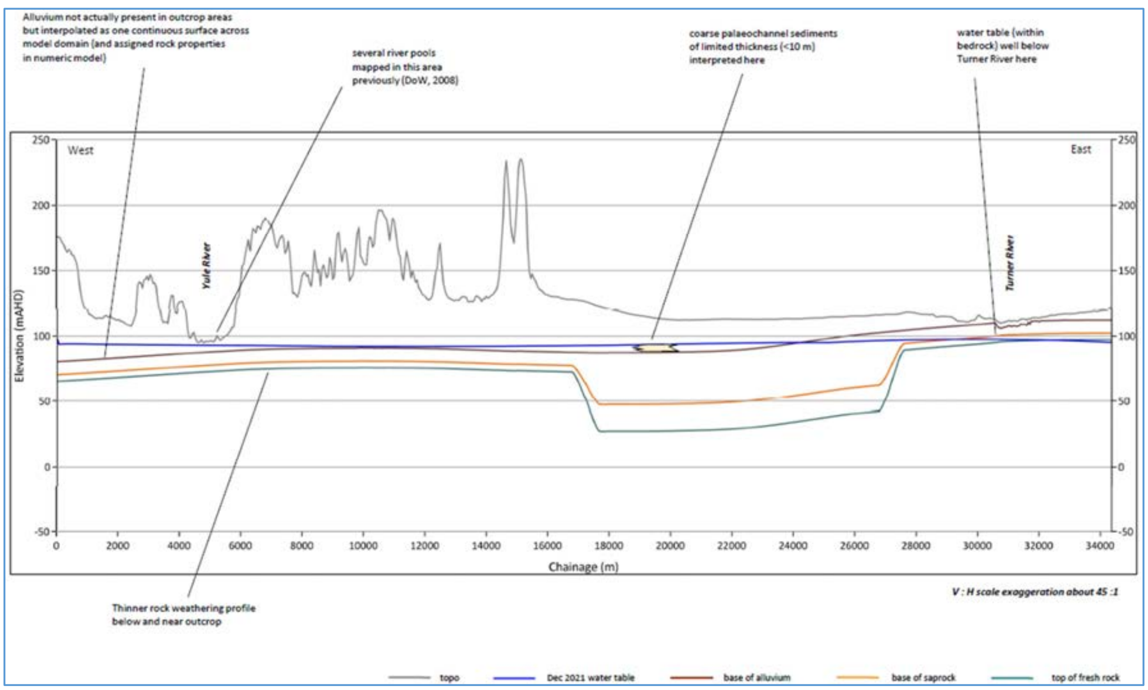


Figure 2–29 Conceptual Hydrogeology Section 2 – Regional Hemi Section

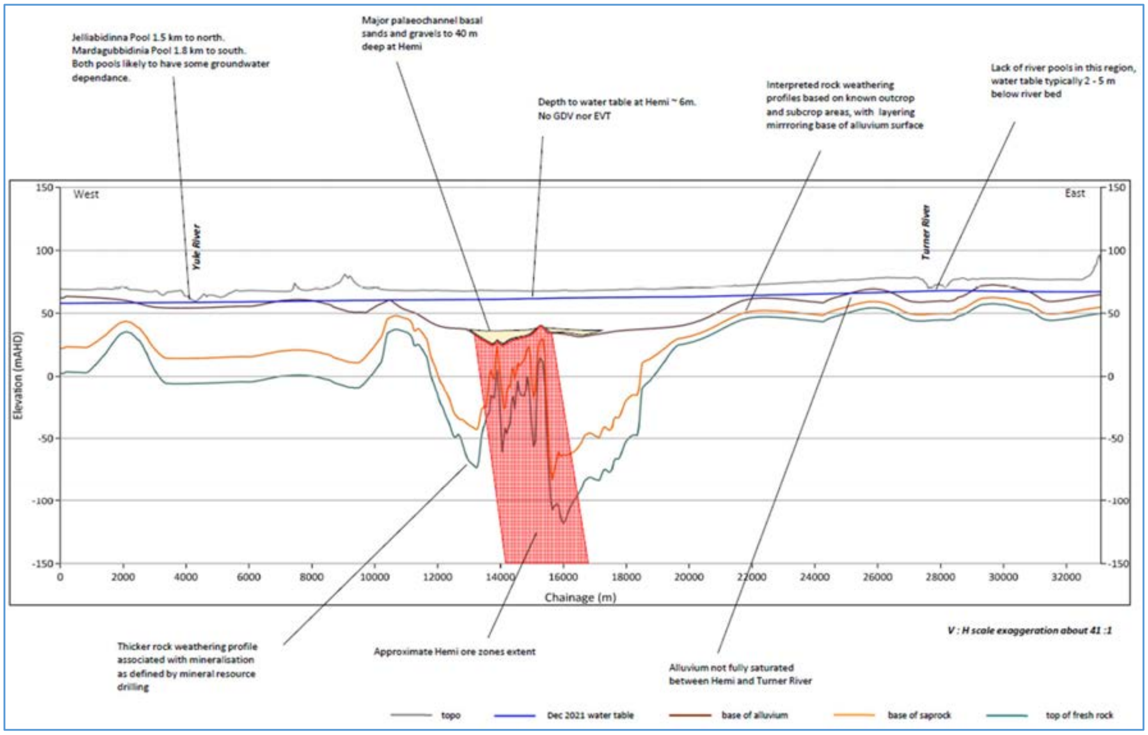


Figure 2–30 Conceptual Hydrogeology Section 3 – Northern Model Boundary

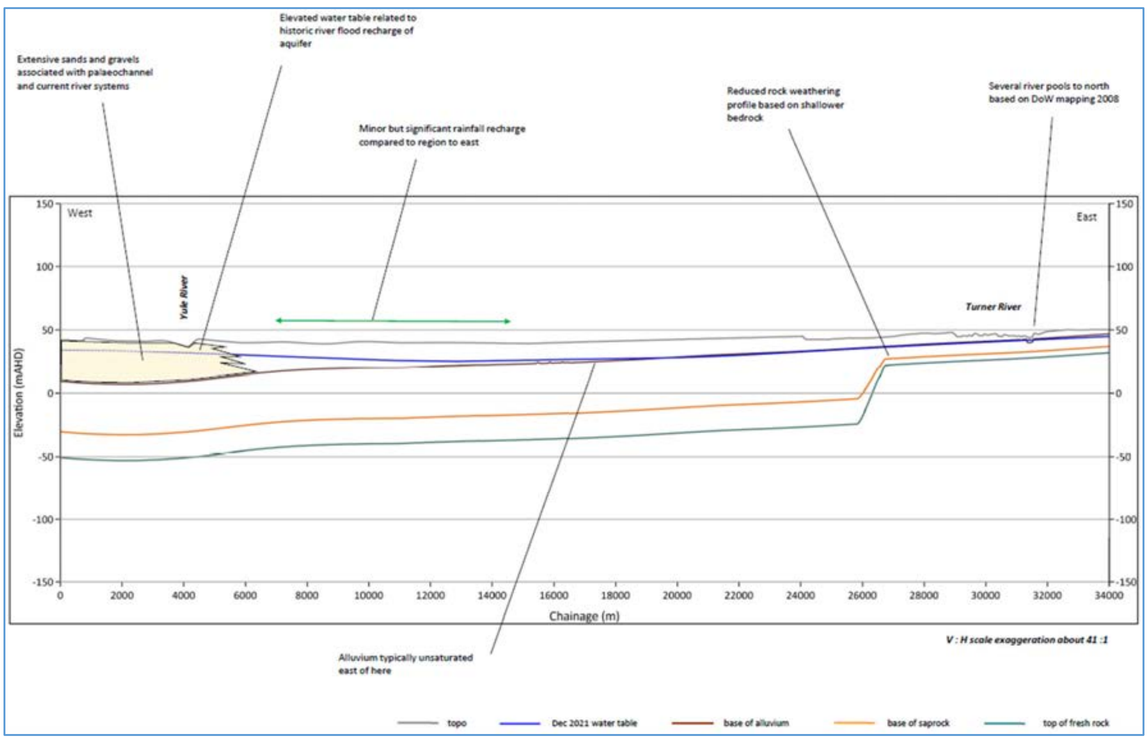


Figure 2–31 Conceptual Hydrogeology Section 4 – Eagle-Diucon-Falcon

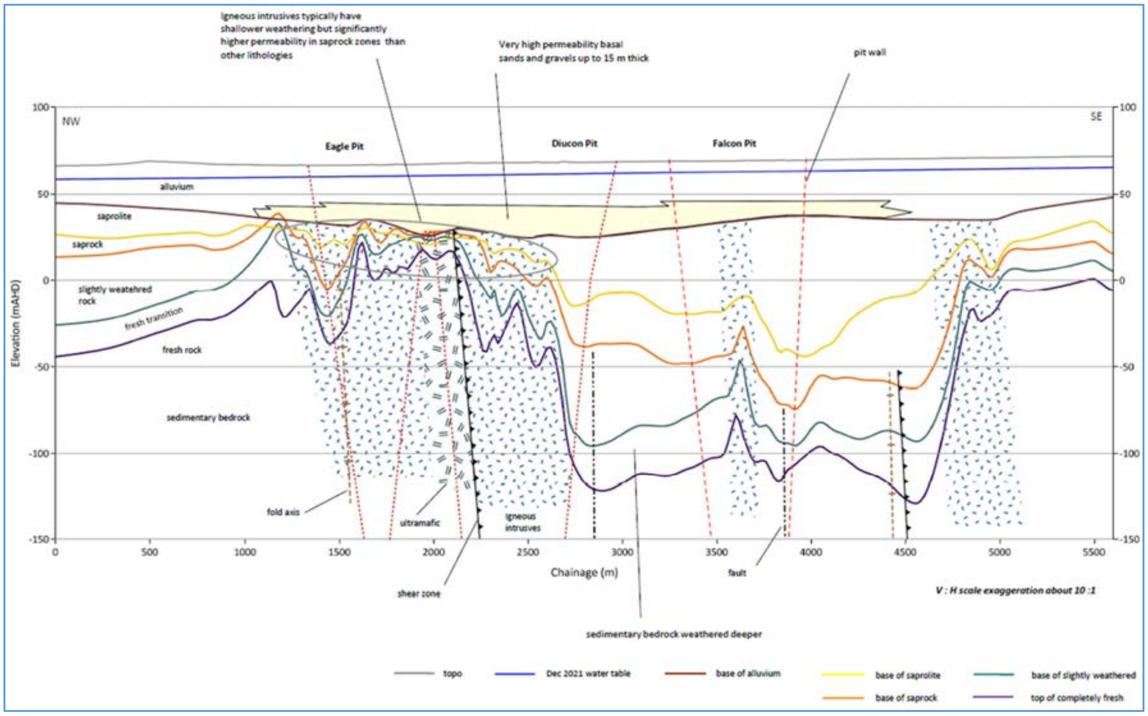
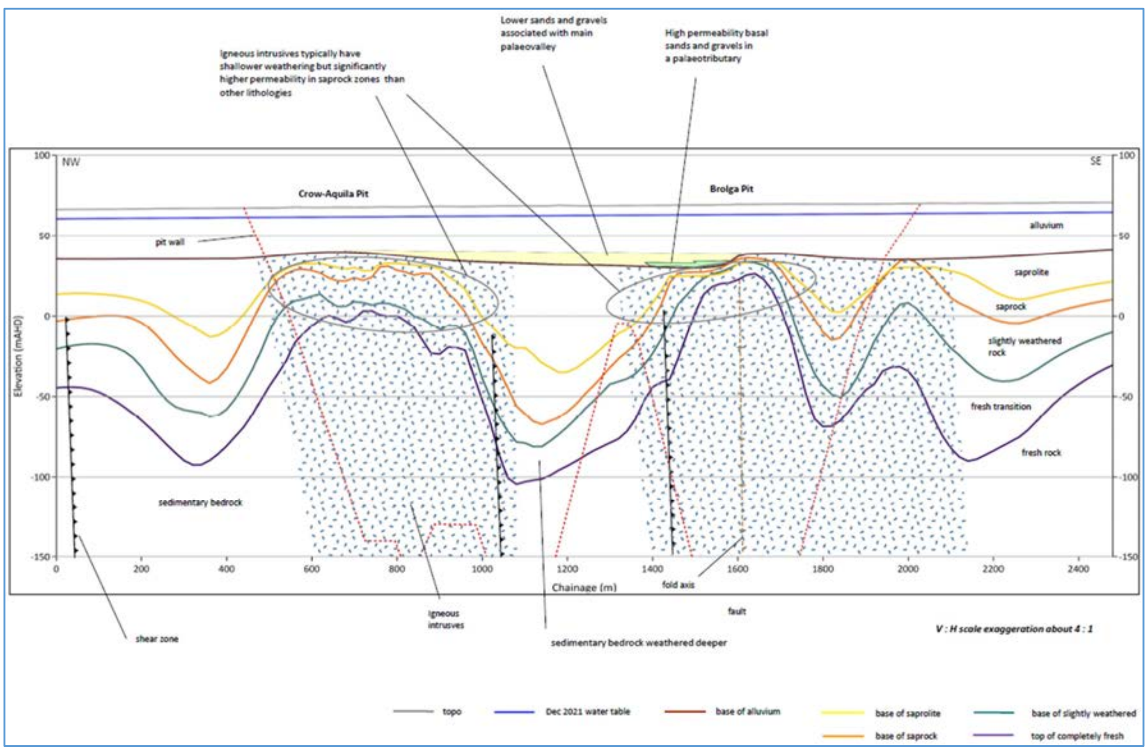


Figure 2–32 Conceptual Hydrogeology Section 5 – Crow-Aquila-Brolga



Summary aspects of the known and interpreted hydrogeology at Hemi and the wider model domain are provided below:

Regional

- The alluvial cover at Hemi is widespread and forms a significant shallow aquifer that extends to the Yule River but not the Turner River;
- Within the alluvial cover, there is a paleochannel river system comprised of up to 15 m of highly permeable sands and gravels, that is about 1,000 m wide and which drains towards the current day coast;
- The depth to groundwater is typically between 5 m to 10 m over most of the model domain, and only higher in elevated areas of rock outcrop and subcrop;
- Groundwater flow directions and hydraulic gradient are relatively uniform, with groundwater levels around 100 mAHD on the southern boundary and 25 mAHD on a section of the northern boundary;
- The Turner River lacks river pools over most of the model domain as a result of the water table typically being 2 m to 4 m below the shallowest parts of the riverbed;
- The Yule River has several river pools that are likely to have a connection to the surrounding dry season water table. Groundwater inflows to these pools are considered to be limited, based on the surrounding groundwater levels and gradients, as well as the elevated salinity of some pools compared to nearby groundwater levels;
- Evaporation and evapotranspiration (ET) during dry periods are considered to be limited to sections of the main rivers where river pools, or shallow water tables and riparian vegetation occur;
- Recharge from river flows to the shallow aquifer systems are variable over time and location. The largest amounts of river recharge occur from the Yule River in the north western part of the model area where large flow events spill over the main channel onto the surrounding floodplain. The least amount of recharge is considered to occur in the southern reach of the Turner River, where significant amounts of slightly weathered to fresh bedrock occurs in or near the riverbed;
- The model domain is a ‘net’ producer of groundwater as groundwater outflows at the northern (downgradient) boundary are significantly higher than groundwater inflows at the southern (upgradient) boundary;
- The water quality of shallow aquifer zones is good, being typically fresh to slightly brackish, slightly alkaline and fit for the existing pastoral and mining usage. In the north west of the study area along the Yule River, groundwater is of potable quality.

Hemi

- At Hemi, weathered bedrock zones do not typically form significant aquifer zones, apart from the saprock profile of igneous intrusives, which exhibit moderate permeability and low storativity. At the Eagle deposit, a localised zone of higher permeability in the intrusive saprock has developed;
- Within fresh bedrock, permeability is restricted to localised fractured rock zones. Review of core photographs suggest;
    - Fracture zones within fresh rock tend to occur close to the contact zones between (more brittle) igneous intrusives and (more ductile) sedimentary units, and potentially enhanced within and near fold hinges and later stage faulting;
    - The amount of fracture zone development within fresh bedrock is limited such that the overall fresh rock mass is likely to have a very low permeability;

- Both the shallower alluvium and paleochannel aquifer at Hemi are in a direct geologic and hydraulic connection with the nearest groundwater user (Atlas Iron – Mt Dove Borefield). A direct connection with the more remote Watercorp Yule River Borefield is interpreted;
- Rainfall recharge to the water table in the Hemi area and surrounding alluvial plain is low but significant. A long term average of 1 % to 2 % of annual rainfall is likely in areas near and above the palaeochannel aquifer, and less than 1 % in areas of very shallow alluvial cover and bedrock outcrop. The increasing salinity trend of the shallow water table at Hemi from west to east is considered to reflect variation in rainfall recharge;
- Elevated levels of dissolved arsenic occur in the weathered rock profile within and adjacent to ore zones. Elevated, but smaller levels of dissolved arsenic (typically 0.02 mg/l – 0.06 mg/l) also occur in the basal sections of the alluvial aquifer within short down-gradient distances of ore zones.

Table 2–2 provides a summary water balance for the conceptual model, derived from interpretations and simple analytical estimates.

Table 2–2 Conceptual Model Water Balance

Component	Value		Comments
	(kL/day)	(GL/year)	
Inflows			
Groundwater Inflow – Bedrock	340	0.12	Based on Darcy Equation (Q = K*i*b*L), December 2021 swls and Conceptual Section 1
Groundwater Inflow - Alluvium	950	0.35	Based on Darcy Equation (Q = K*i*b*L), December 2021 swls and Conceptual Section 1
Riverbed Recharge	9,870	3.61	Limited accuracy estimate based on assuming river flow recharge is equivalent to a rainfall recharge rate of 10 % over 103 km² riverbed areas
Direct Rainfall Recharge	12,540	4.57	Based on higher recharge area rate of 1.5 % of annual rainfall, lower recharge area rate of 0.5 % annual rainfall, in turn based on chloride levels in rainfall vs shallow aquifer, long erm rainfall average of 350 mm/year and mapping of thicker alluvial cover at 600 km² (higher recharge) and shallow alluvial cover and outcrop at 817 km² (lower recharge) area.
Total Inflows	***23,700***	***8.65***	
Outflows			
Groundwater Outflow - Bedrock	360	0.13	Based on Darcy Equation (Q = K*i*b*L), December 2021 swls and Conceptual Section 3
Groundwater Outflow - Alluvium	3,770	1.38	Based on Darcy Equation (Q = K*i*b*L) , December 2021 swls and Conceptual Section 3
Bore Pumping	450	0.16	Based on pastoral usage estimate and low level pumping in recent years by Atlas Iron at Mt Dove
ET	19,120	6.98	Not a standalone estimate, but rather the value required to balance total inflows with total outflows
Total Inflows	***23,700***	***8.65***	

The conceptual water balance is considered to have limited accuracy given that the largest components of the balance (recharge and evapotranspiration) have the highest uncertainty. River recharge is significant to the overall balance, however, the variable and ephemeral nature of river flows in the Pilbara makes the conversion to long term average rates assumed by a steady state water balance more complicated and less certain. Support for some of the recharge and ET steady state estimates are provided by:

- Chloride analyses of a limited number of rainfall samples from Wingina Camp show low chloride levels (0.5 mg/l to 1 mg/l). Coupled with the chloride levels in groundwater samples from the upper sections of the shallow alluvial aquifer in the Hemi region, a simple 1-D chloride balance approach indicates rainfall recharge rates of between 0.5 % – 1.5 %;

- River recharge in the Yule numeric model by MWH (2010) was calibrated in a transient model using a long period of river flow and groundwater level data to align groundwater recharge with rainfall and river flow patterns. This produced a probabilistic set of recharge values;
  - For a 20^{th} percentile (dry) year, total recharge was 4 Gl. This is assumed to be a zero river flow year, with the 4 Gl a result of applying values of 0 % to 2.5 % of rainfall to estimate direct rainfall recharge to parts of the aquifer away from the river;
  - For a 50^{th} percentile (mean) year, total model recharge was 20 Gl;
  - For a 90^{th} percentile (flood) year, total model recharge was 44 Gl;

The mean recharge total of 20 Gl is about 2.5 times higher than the Hemi conceptual (mean) estimate of about 8 Gl, which is considered realistic given the greater area of the Yule model and the known occurrences of significant groundwater recharge from river flooding;

- The derived ET losses of 7 Gl/annum in the Hemi conceptual model equates to a linear rate of about 1,650 mm/year if all the ET loss is constrained to areas in the model where the December 2021 water table occurs less than 2 m below ground. This area is small (4.2 km^2) and represents less than 1 % of the total model area, occurring only within some sections of the Yule and Turner riverbeds.

2.5 Numeric Groundwater Model

2.5.1 Background

The objectives of developing the numeric groundwater model were to provide:

- Robust technical assessment of the planned usage of the local groundwater resources at Hemi and the potential impacts of this usage on the environment and surrounding water users;
- Assessment to a 'H3 level' so as to adequately support the submission of a 5C Groundwater Well Licence application to the Department of Water and Environmental Regulation (DWER);
- Estimation of a mine dewatering schedule to a standard suitable for supporting a PFS level design and engineering assessment of the required mine dewatering management system.

The approach taken in developing the numeric model was consistent with other similar mining project groundwater studies and involved the conversion of the conceptual model into a numeric format for calibration and prediction simulations by:

- Using the conceptual model and field investigations to develop the layering and initial distribution of aquifer properties and boundary conditions. The boundary of the conceptual model was used for the numeric model domain as there are no large physical boundaries close to the areas of interest, and the conceptual model boundaries are considered distal enough to minimise numeric boundary effects to the areas of interest;
- Calibrating the numeric model in steady state to available datasets and concepts. The local and regional water table data and interpreted surface for December 2021 was used as the key steady state calibration dataset to modify model parameters to obtain a suitable fit to the observed values. The absence of significant hydraulic stresses limited the transient calibration of the model in the Hemi area, hence groundwater level data over a 12 month period was utilised in several monitoring bores;
- Applying predictive simulations to estimate mine dewatering requirements for the PFS mine schedule using passive dewatering (in-pit drains only) and advance dewatering (bores and in-pit drains) scenarios;

- Reconciling dewatering inflows with the project water demand schedule to develop an iterative dewatering base case scenario which incorporated simulation of aquifer reinjection of part of the dewatering surplus;
- Assessing uncertainty in the model predictions by varying model inputs for parameters considered the most significant to modelling objectives (permeability, specific yield and recharge);
- Creating a closure model using the end state of the operational phase model as the starting point and the running the model over many decades to predict the development of pit void lakes and to assess any potential long term impacts on the environmental and surrounding aquifer system.

The numeric model has been developed in a staged manner consistent with recommendations from the *Australian Groundwater Modelling Guidelines* (Barnett, et al., 2012). The guidelines define three ‘confidence levels’ (C1, C2, C3) for models as a means of providing a non-technical benchmark by which the reliability or confidence of the required model predictions can be assessed and communicated amongst stakeholders and non-modellers. Overall, the developed model for Hemi is considered by Geowater to be of the intermediary Class 2 level of confidence and fit for purpose.

2.5.2 Model software selection

The numerical model code selected was *MODFLOW SURFACT*, a finite-difference code, which is an enhanced version of the widely used U.S. Geological Survey modular three-dimensional (3D) groundwater flow modelling code, *MODFLOW*. It includes adaptive time stepping for model stability and fractured well package for better representation of multi-aquifer bores. *Visual MODFLOW FLEX* and *Surfer* software were used as the pre and post processors.

The known and interpreted sub-horizontal and sub-vertical geometries of the main aquifer zones throughout the model domain, as well as their relatively linear nature, suits the block nature of *MODFLOW* and negated the need to consider the use of unstructured grid or finite element model platforms.

2.5.3 Model Construction

As a finite-difference code, the model domain is discretised into rectangular blocks representing the hydraulic properties of the material inside each block. Finer grids were assigned to areas of interest and areas of large hydraulic gradient making a total of 2,823,088 blocks within the model. The largest model blocks have areas of 400 m x 400 m, and the smallest blocks measure 25 m x 25 m. Figure 2–33 shows the model extent and grid discretisation and highlights how the model axes are rotated from real world systems to align with the main paleochannel trend.

The model layers were based on the hydro-stratigraphic units of the conceptual model:

- Upper Alluvium;
- Lower (basal) Alluvium;
- Saprolite;
- Saprock;
- Slightly Weathered Bedrock;
- Transitional Weathered Bedrock; and
- Fresh Bedrock.

Figure 2–33 Numeric Model Extent and Grid

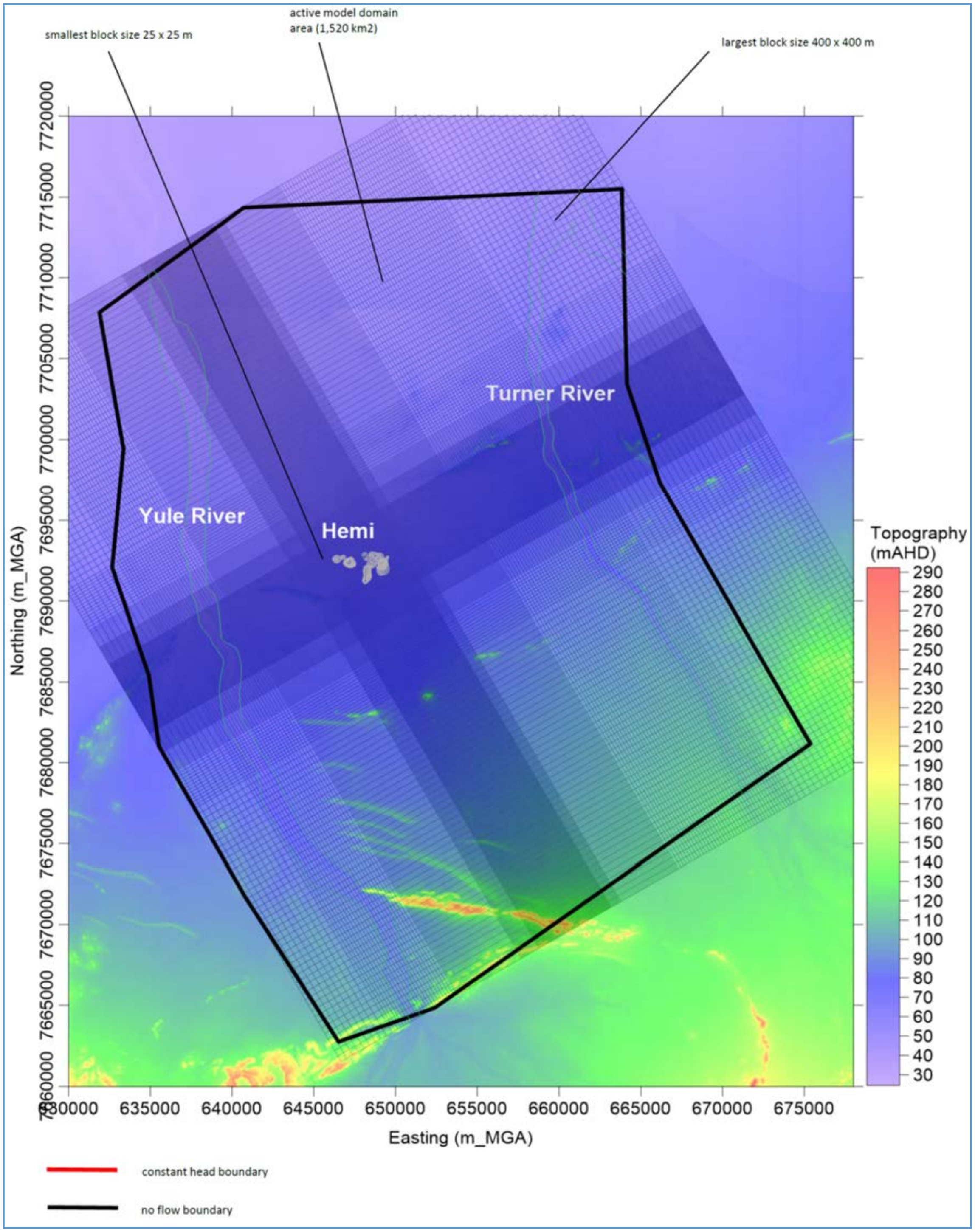


Figure 2–34 to Figure 2–39 show the interpolated elevations of the base of each hydro-stratigraphic unit adopted in the numeric model. The six uppermost hydro-stratigraphic units were each subdivided into two equal layers in the numeric model to create improved vertical discretisation. The fresh bedrock unit was subdivided into five layers which resulted in a total of 17 model layers. The base of the model (layer 17) was set at -400 mRL to be below the vertical limit of proposed open cut pit mining.

Figure 2–34 Upper Alluvium – Basal Surface and Property Zones

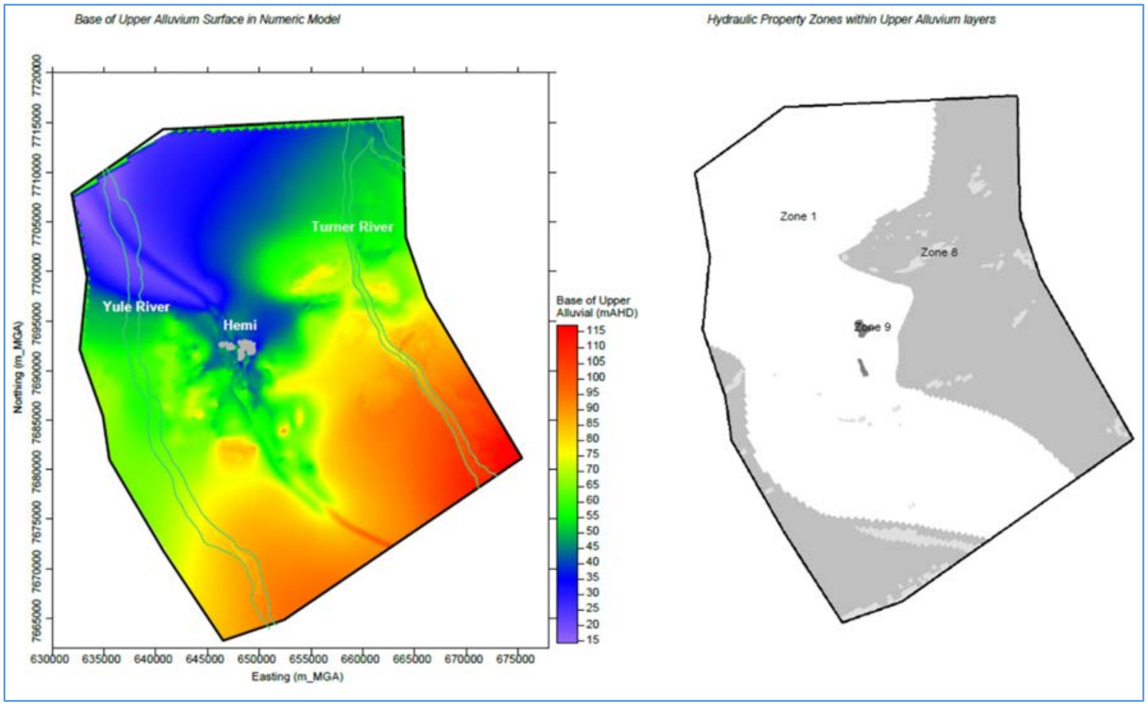


Figure 2–35 Lower Alluvium – Basal Surface and Property Zones

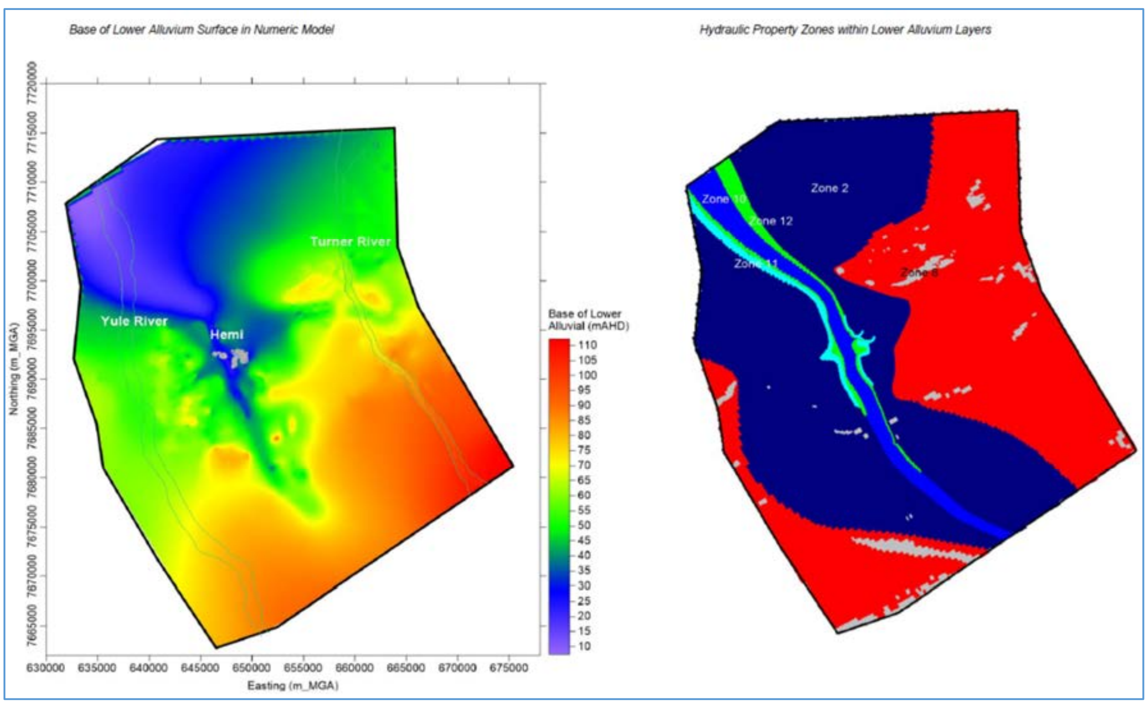


Figure 2–36 Saprolite – Basal Surface and Property Zones

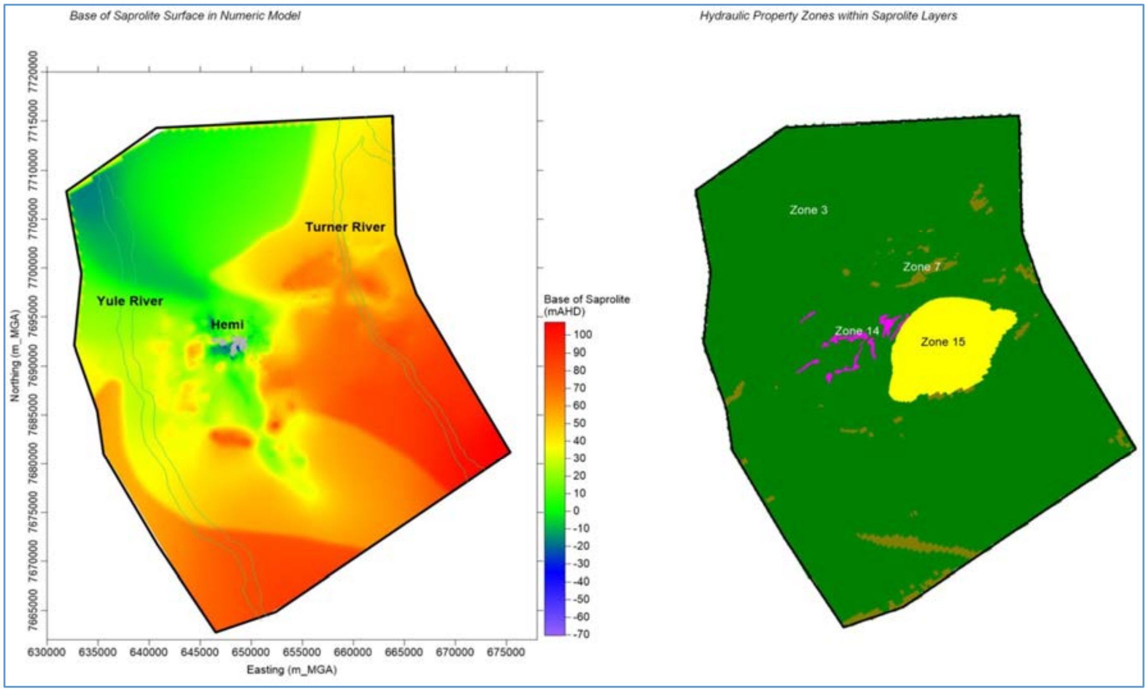


Figure 2–37 Saprock – Basal Surface and Property Zones

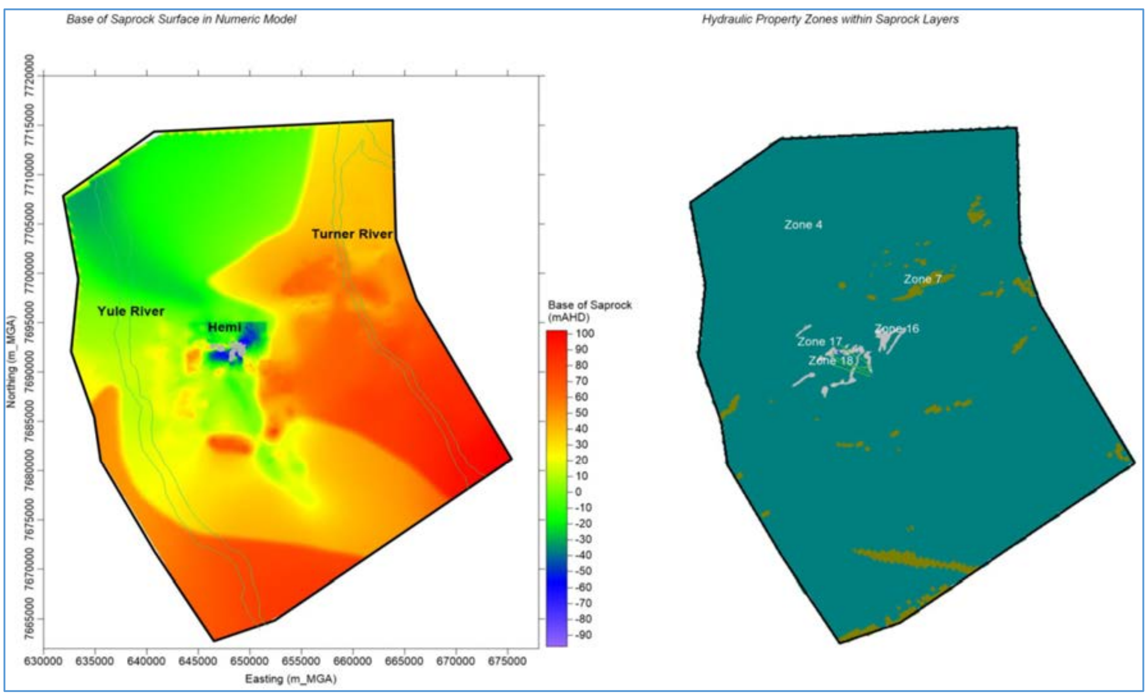


Figure 2–38 Slightly Weathered Bedrock – Basal Surface and Property Zones

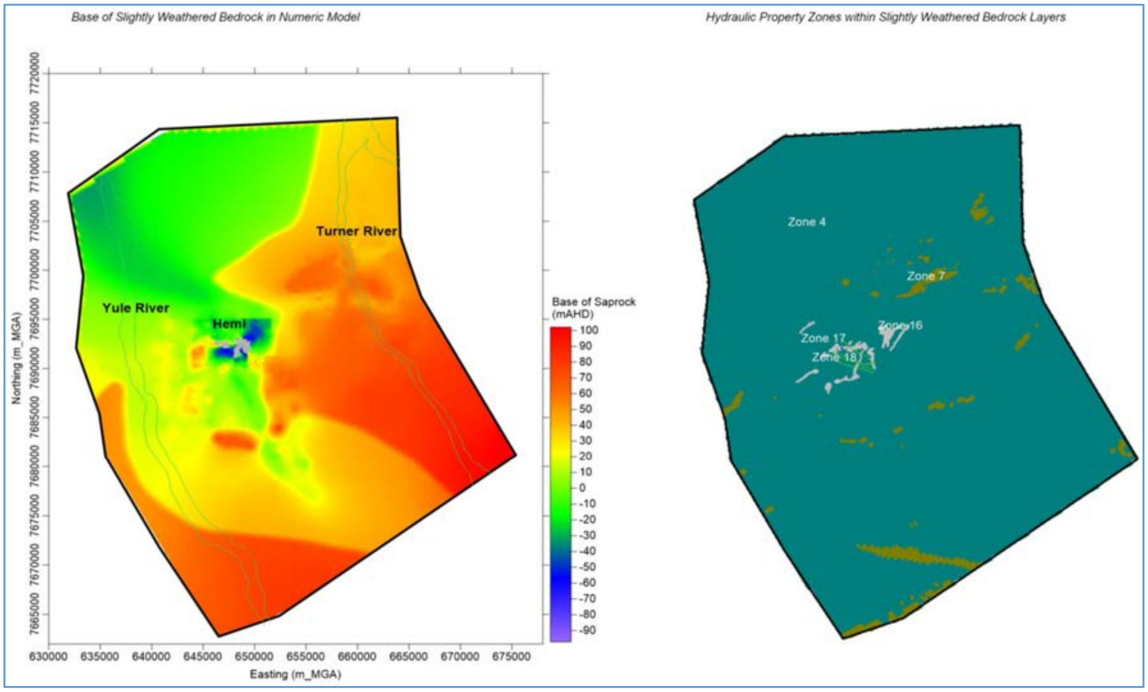
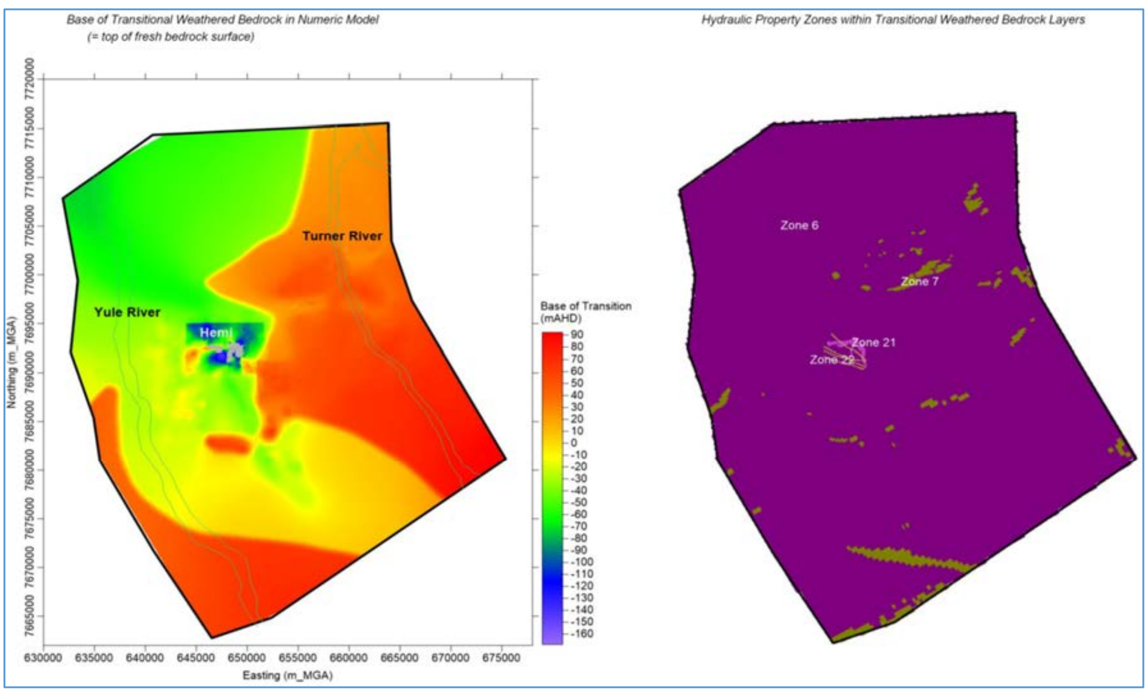


Figure 2–39 Transitional Weathered Bedrock – Basal Surface and Property Zones



Within each hydro-stratigraphic unit, variability in hydraulic parameters were defined as separate property zones based on the hydraulic testing done at Hemi and other projects (Mt Dove and Yule bore fields), as well as interpretive values from the conceptual model for areas lacking field testing. Table 2–3 provides a reconciliation of hydraulic property zones with the hydrostratigraphic units and includes the hydraulic parameters adopted at the completion of model calibration. Figure 2–34 to Figure 2–39 show the spatial extent of each property zone within the main model layers.

Table 2–3 Hydro-stratigraphic Units and Hydraulic Property Zones and Values

Hydro-stratigraphic Unit	Model Zone	Material Description	Hydraulic Conductivity		Specific Yield	Specific Storage
			Horizontal	Vertical		
			Kx,y (m/day)	Kz (m/day)	Sy	Ss
Upper Alluvium	1	Alluvium where thickest and/or distal from outcrop	3	1.5	0.075	1E-5
	8	Alluvium closest to outcrop or subcrop	1.0	0.5	0.05	1E-4
	9	Alluvium where bores show some shallow sand and gravel lenses but with uncertain extents	15	3	0.10	1E-4
Lower Alluvium	10	Basal gravels in main palaeochannel	75	45	0.20	1E-5
	11	Basal sands and gravels on shoulder of main palaeochannel	15	3	0.15	1E-5
	12	Basal sands and gravels in potential paleo-tributaries	7.5	1.5	0.10	1E-5
	13	Alluvium closest to outcrop or subcrop	0.5	0.10	0.05	1E-4
	2	All other zones in lower alluvium, equivalent to zone 1	3	1.5	0.075	1E-4
Saprolite	14	Hemi igneous intrusives (m)	0.10	0.10	0.05	1E-4
	15	Mt Dove granite dome	0.01	0.01	0.05	1E-4
	3	All other areas in saprolite layer	0.10	0.10	0.05	1E-4
Saprock	16	Hemi igneous intrusives (excluding ultramafic units)	2	2	0.03	1E-5
	17	Hemi elevated permeability zones in saprock at Eagle	15	15	0.03	1E-5
	18	NW-SE fault corridors	2	2	0.03	1E-5
	4	All other areas in saprock layer	2	2	0.03	1E-5
Slightly Weathered	19	Hemi igneous intrusives (includes ore zones and 20 m buffer into surrounding rock types)	0.10	0.10	0.04	1E-6
	20	NW-SE fault corridors	2	2	0.03	1E-6
	5	All other areas in slightly weathered layer	1E-2	1E-2	0.03	1E-6
Fresh Transition	21	Hemi igneous intrusives (includes ore zones and 20 m buffer into surrounding rock types)	1E-2	1E-2	0.03	1E-6
	22	NW-SE fault corridors	0.10	0.10	0.03	1E-6
	6	All other areas in fresh transition layer	1E-3	1E-3	0.02	1E-6
Fresh Rock	7	All	1E-4	1E-4	0.01	1E-6

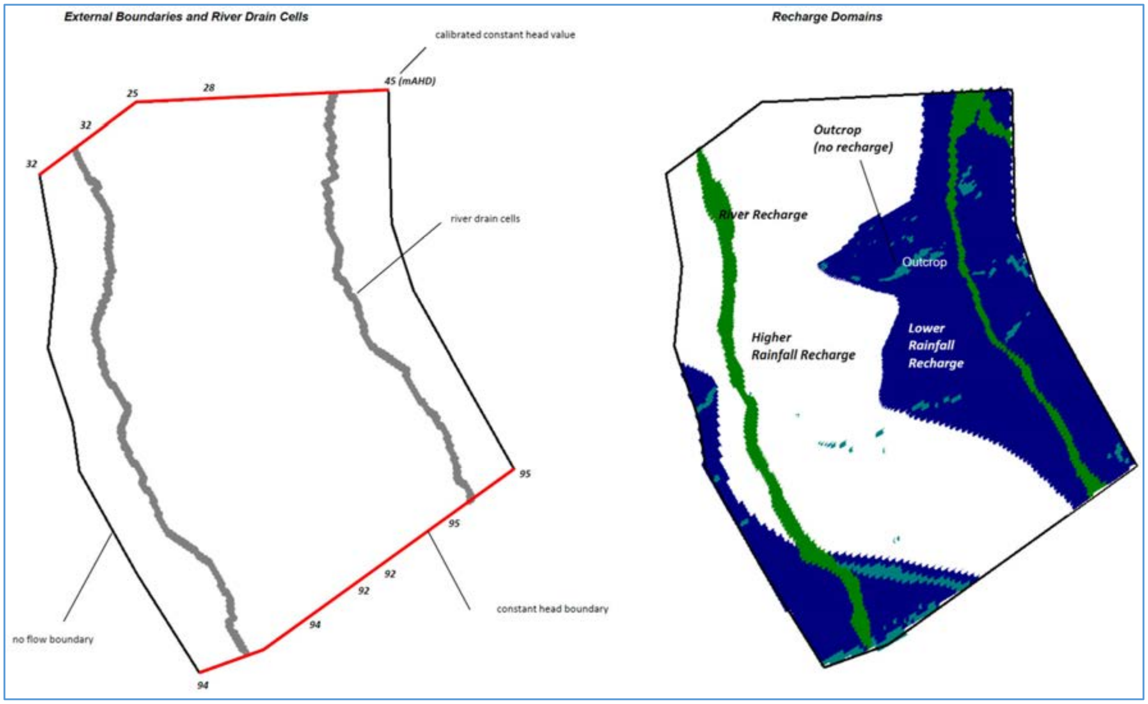
2.6 Boundary Conditions

Based on the conceptual model, the northern and southern model boundaries were assigned *MODFLOW* constant head boundary conditions to facilitate throughflow in the direction of groundwater flow. Figure 2–40 shows the calibrated constant head values along these boundaries. The eastern and western boundaries were assigned no flow boundaries as supported by the typical regional groundwater flow directions shown on Figure 2–16.

Based on the distance of Hemi from the rivers and the relatively short project life, the two rivers were simulated as simple 'gaining' streams only in the model. This was done by setting drain cells at the basal riverbed elevations along the river reaches within the model (Figure 2–40). The influence of actual river recharge to the surrounding shallow aquifer (i.e., 'losing' streams) is approximated in the steady state model by applying estimates of average recharge to the water table within the confines of the existing river channels. These areas are shown on Figure 2–40 alongside rainfall recharge zones applied over the model domain.

Evapotranspiration is set throughout the numeric model domain into two spatial zones (river and plains). Within the banks of the Yule River and Turner River, evaporation from the deeper rooted riparian vegetation that was present there was approximated using an averaged ET rate of 8 mm/day with an extinction depth of 3.0 m. In all other areas of the model the same ET rate was used but with a shallower extinction depth (2.0 m). This shallower setting is based on the dominance of grasses and small trees throughout the plains and outcrop areas. In areas of relatively shallow water tables surrounding Hemi (4 mbgl to 7 mbgl) where in-situ monitoring of groundwater salinity has been undertaken, there is no evidence of any significant ET from the water table.

Figure 2–40 Steady State Model Boundary Conditions



2.6.1 Model Calibration

Based on the available datasets, the numeric model was calibrated in a staged manner to groundwater levels only. The first stage (steady state) involved the establishment of a water level condition consistent with the existing (pre-mining) water level, and the second stage (transient state) involved the simulation of temporal changes in water level caused by applied stresses to the aquifer system.

Steady State

The steady state calibration of the numeric model was achieved using a trial and error approach (Barnett et al., 2012) by adjusting the conceptual model values of hydraulic conductivity (permeability), constant head boundary elevations, recharge rates and ET extinction depths within the model until a suitable match between simulated and measured December 2021 water table values and a low mass balance closure error was achieved.

The calibrated hydraulic conductivity values are listed in Table 2–3 whilst Figure 2–41 displays contours of the simulated December 2021 water table against the interpreted contours from the conceptual model. Figure 2–42 provides a scatter plot of simulated and measured water table data from 56 bores and wells measured in December 2021, and shows a root-mean-square error of 3.27 m. It also shows the tendency for simulated water levels to be slightly higher than measured in areas downgradient of Hemi. Near Hemi, there is a close match of simulated and measured groundwater levels (in the range from 60 mAHD to 65 mAHD).

Table 2–4 provides the water balance for the calibrated steady state model and indicates that the model domain as a whole is a net recharge environment with recharge gains exceeding ET losses with the steady state balance maintained by groundwater outflows at the northern model boundary that exceed groundwater inflows at the southern model boundary. This balance is consistent with the conceptual model.

Figure 2–41 Simulated versus Interpreted Water Table Contours – December 2021

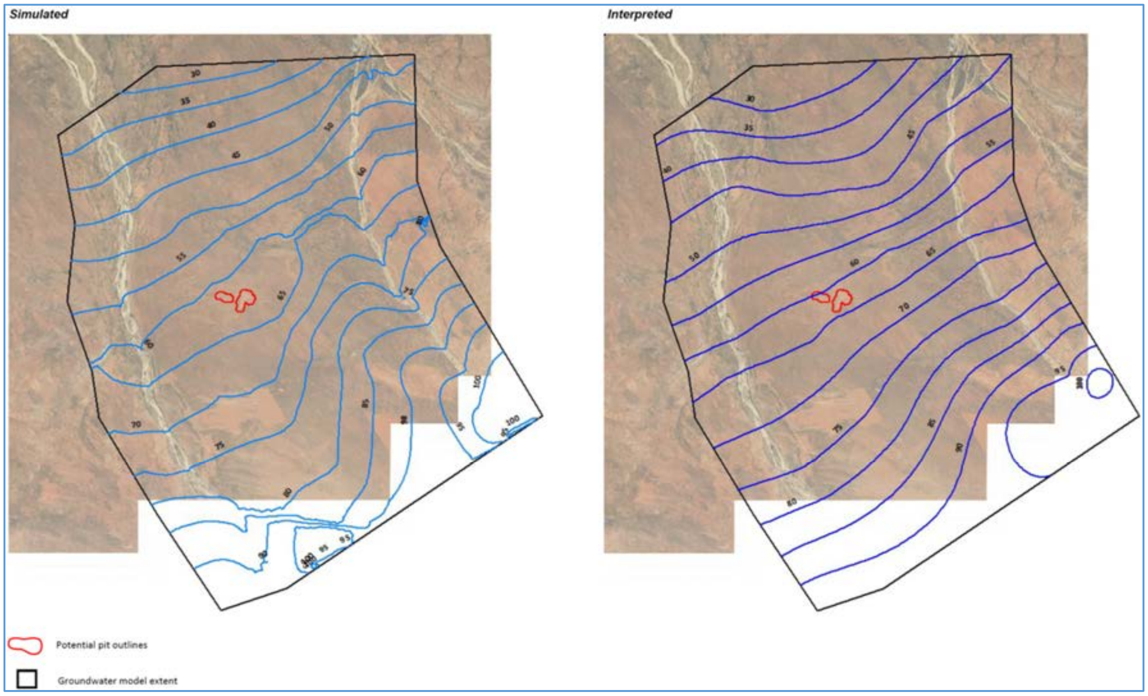


Figure 2–42 Simulated vs Measured December 2021 Groundwater Levels

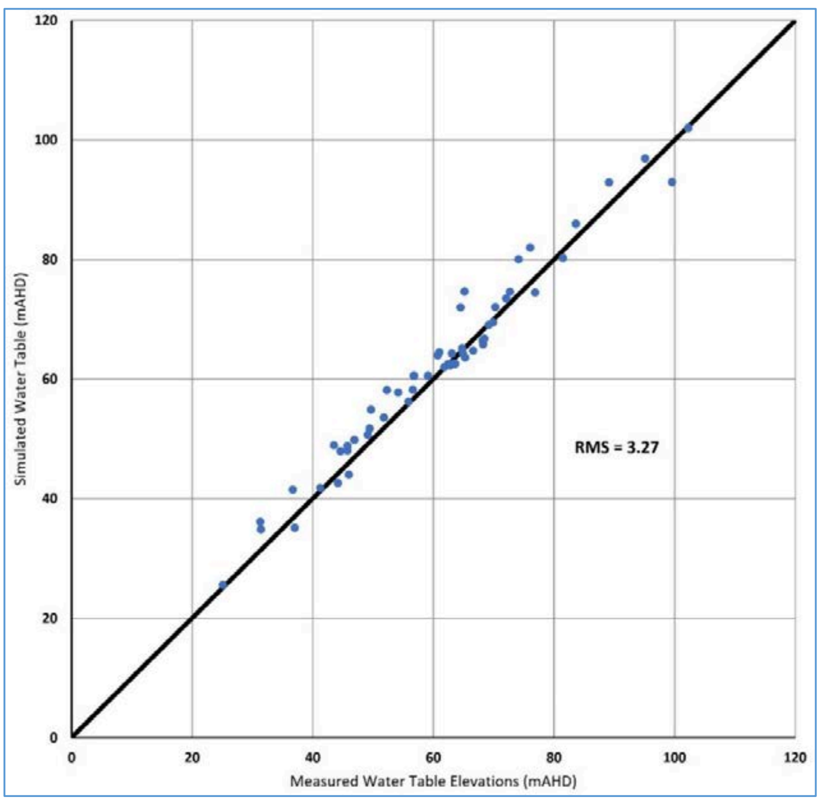


Table 2–4 Calibrated Steady State Model Values and Balance

Parameter		Value(s)	Comments
River Recharge		28 mm/year	Applied only inside river channels
Rainfall Recharge		0 (outcrop areas), 0.8 mm/year (shallower alluvial areas), 2.8 mm/year (deeper alluvial areas)	2.8 mm/year equates to 0.8 % of annual rainfall
Evapotranspiration		7.8 mm/day	3.0 m extinction depth in river channels, 2.0 m elsewhere
CHB Elevations	North boundary	32;32;24;28;45 mAHD	West to east values
	South boundary	94;94;92;92;95;95 mAHD	West to east values
CHB Inflows		1,097 kL/day (0.40 Gl/year)	Groundwater flow entering southern model boundary
Recharge		14,495 kL/day (5.29 Gl/year)	Rainfall and estimated long-term average river recharge
ET		8,674 kL/day (3.17 Gl/year)	ET predominantly from within main river channels
CHB Outflows		6,906 kL/day (2.52 Gl/year)	Groundwater flow leaving northern model boundary
Mass Balance Discrepancy		12 kL/day or 0.08 %	

Groundwater abstraction from bores and wells within the model domain was not included as part of the steady state model calibration, as no significant amounts of abstraction have occurred in recent years. Abstraction from the Mt Dove borefield in recent years has been very limited (of the order of less than 50 kL/day) to support minor camp accommodation levels (Atlas Iron, 2016). There are about 40 active pastoral bores and wells within the model domain and these tend to pump less than 400 kL/day in total given that most of them recirculate unused or overflowing water back into the bore.

Transient Calibration

Transient calibration of the model was limited by the absence of significant hydraulic stresses and available data in the Hemi area of interest. Rainfall data and groundwater level data from 11 monitoring bores (HMB001 to HMB011) over the twelve month period to December 2021 was used by applying recharge at the same ratios as the steady state model to the actual rainfall data of the calibration period and then comparing simulated and measured water levels in the monitoring bores.

Figure 2–43 and 2-44 present the simulated versus measured transient hydrographs, which show a good fit in a broad sense, but not at a finer scale, where the observed water table rises of 0.3 m to 0.5 m in some bores in response to the 2021/2022 wet season are not replicated in the simulation. In the Hemi area, the steady state model utilises a rainfall recharge rate of 0.8 % of annual rainfall. The calibration hydrographs suggest this rate may be lower than the actual recharge response observed in several bore areas. However, the recharge rates throughout the model (and other model inputs such as specific yield) were left unchanged from the steady state model for the following reasons:

- The transient dataset has limited spatial extent and hydraulic stress magnitude;
- The 0.8 % rainfall recharge rate is considered near the lower end of the likely long term average but would provide an element of conservatism when simulating drawdown amounts and extent with the predictive models.

Figure 2–43 Transient Calibration Hydrographs HMB001 – HMB006

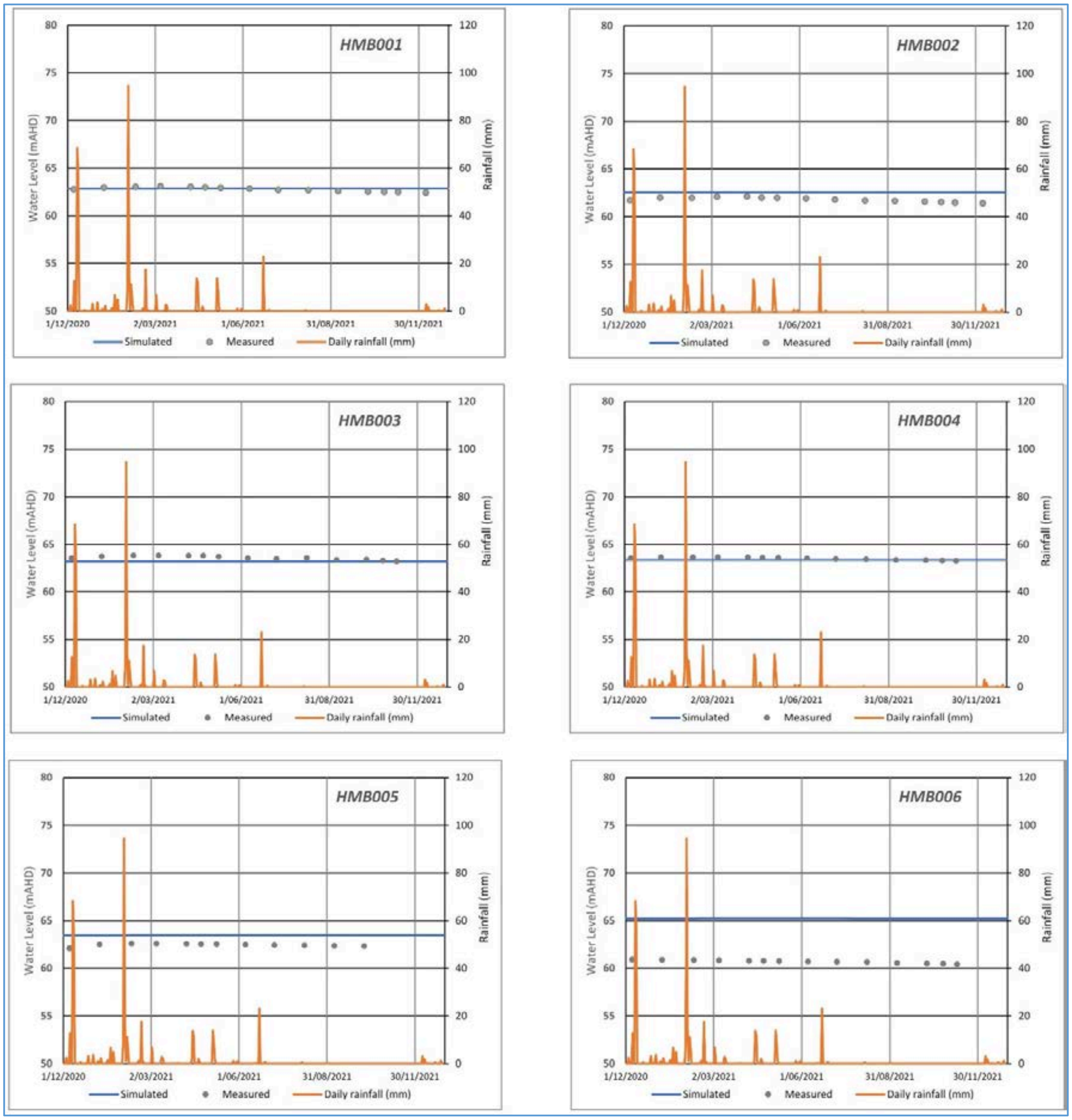
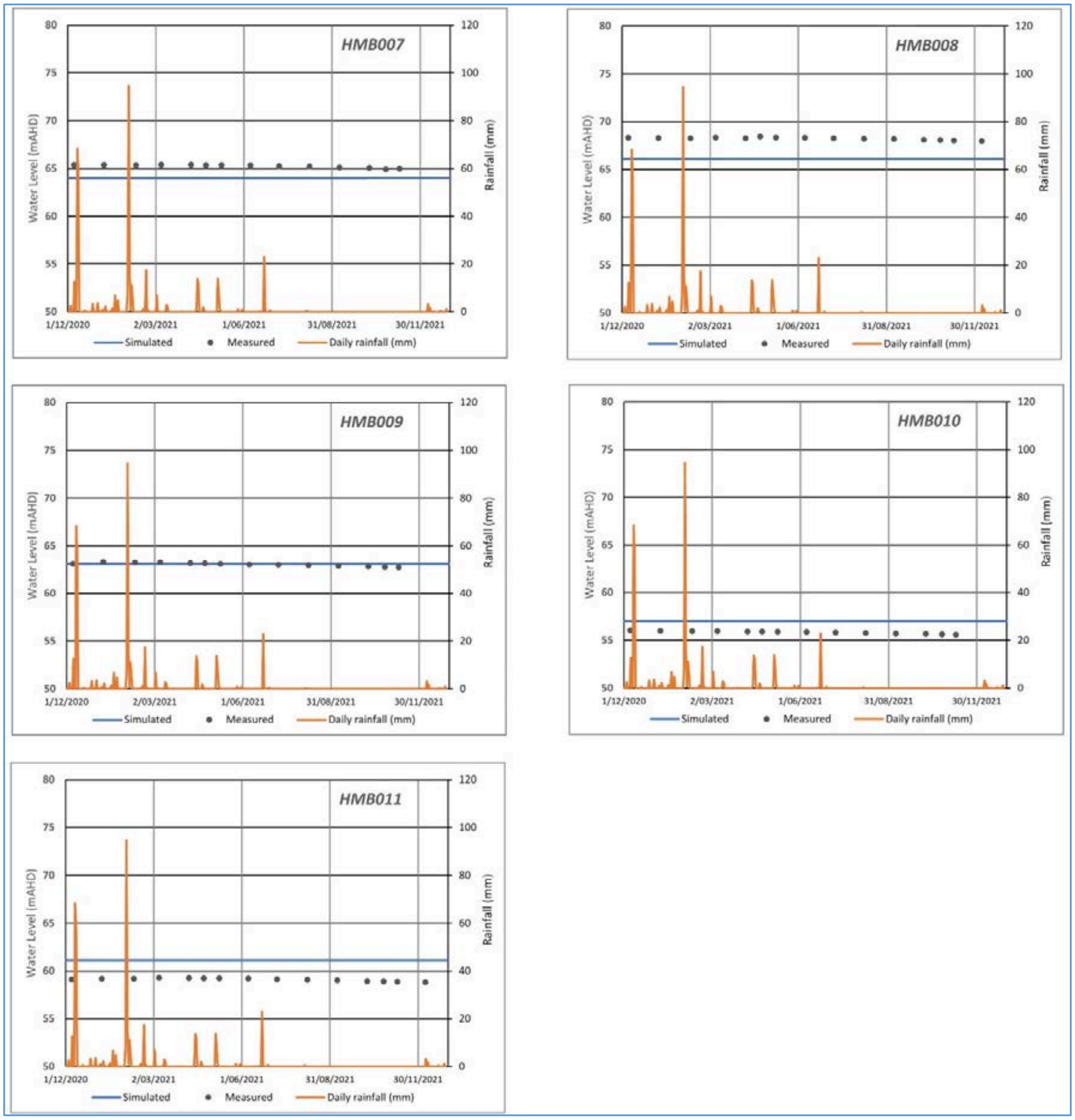


Figure 2–44 Transient Calibration Hydrographs HMB007 – HMB011



2.6.2 Predictive Scenarios

Key project assumptions for the predictive simulations comprised:

- No backfilling of pits occurs, and each completed pit is kept dewatered until the end of the project;
- Supply bores, if required, would be established in the main alluvial paleochannel aquifer to the north and south of the mine;
- The developed ‘base case’ scenario includes:
  - Advance dewatering utilising some bores that start operating up to 12 months prior to commencement of mining;
  - A portion of surplus dewatering discharge is reinjected into the palaeochannel aquifer to the north and south of the mine;

- In the first two years of dewatering, prior to commissioning of the ore processing circuit, any dewatering discharge with elevated soluble arsenic levels would be directed to reinjection bores where the water is recirculated back to the mine dewatering system in later years.

The dewatering simulations were conducted in two ways:

- Estimation of inflows using only in-pit dewatering cells was completed first. This method is the simplest and fastest way to simulate dewatering inflows in the numeric model. Although a drain-only system is not recommended in reality for the Hemi pits, its simulation in numeric models provides a lower bound estimate for likely dewatering inflows, and also a worst case type prediction of groundwater levels and pore pressures near the pits that can aid geotechnical assessments and designs regarding pit wall stability and slope angles. The drain-only scenario was also used as the basis for the quantitative component of model uncertainty analyses, given the significant efficiency benefits of this scenario approach;
- Simulation of dewatering inflows using bores and drains in the numeric model. This represents the recommended actual (base case) dewatering strategy for Hemi; with dewatering bores considered to be suitably effective for advanced dewatering of the alluvial aquifer, and suitable for a significant portion of the weathered rock aquifer zones. In-pit drain cells are still simulated in the numeric model in these aquifer zones to estimate water not captured by bores, as well as the deeper slightly weathered to fresh bedrock areas where in-pit drains are commonly the only practical option to capture some groundwater inflows.

The average rainfall and river recharge rates from the steady state model were applied to the prediction scenarios by repeating the same schedule year after year, with the majority of the recharge applied in wet season months in proportion to the average monthly rainfall patterns.

It should be noted that the numeric model only simulates groundwater inflows to the pit and does not include the rainfall runoff generated within the confines of the open pit crests. These runoff volumes can be significant in large pits during cyclonic rain events and are addressed as separate parts of the pit dewatering system design.

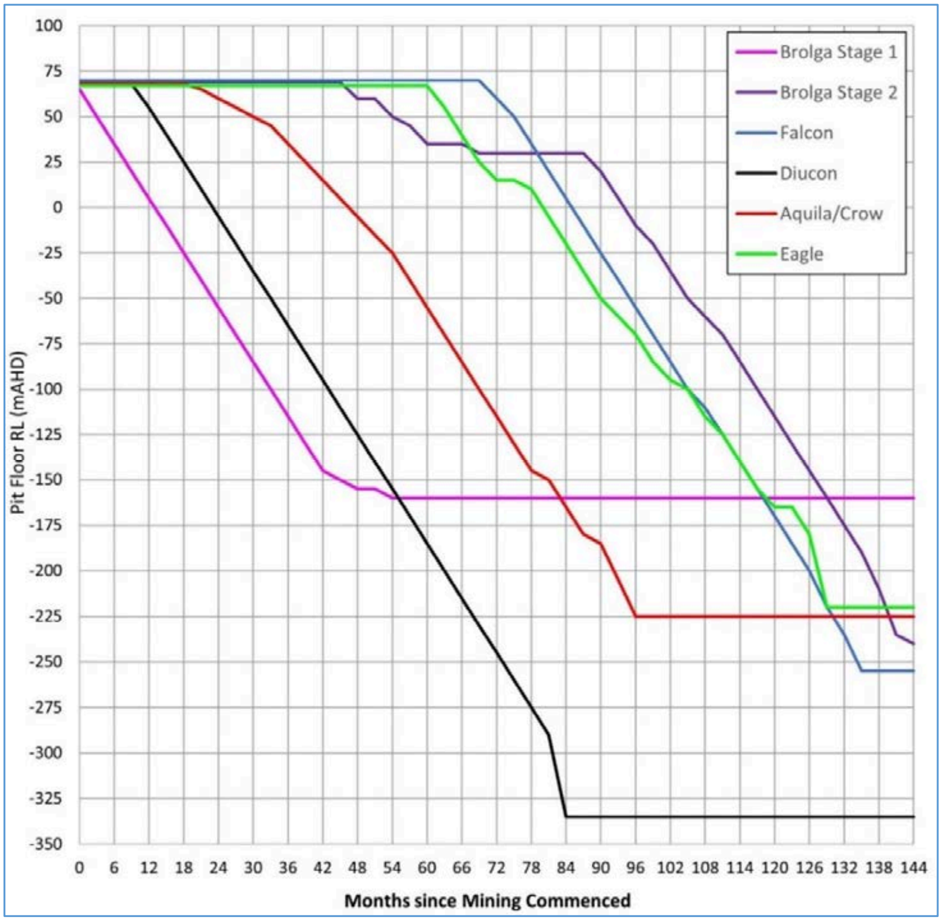
Mine Schedule

Preliminary modelling of dewatering requirements was initially done for a mine schedule that was developed as part of the Scoping Study 2021. The mining schedule was revised for the PFS and provided to Geowater in early June 2022 as *Version 19, Run 06*. Summary aspects of the PFS mine schedule relevant to dewatering and water supply requirements are:

- Mining commences as a starter (staged) pit at Brolga, then follows the sequence of Diucon, Aquila-Crow, Brolga Stage 2, Eagle and finally Falcon;
- Pit depths range from 230 m at Brolga Stage 1 to 400 m at Diucon.
- Ore processing commences nine months after mining starts;
- Mining is completed over a 12 year duration and ore processing over 11.5 years;
- The vertical advance rate of mining is typically 60 m/annum (5 m/month).

Figure 2–45 shows the vertical advance schedule of each open cut pit relative to the number of elapsed months after mining commences.

Figure 2–45 PFS Mine Schedule – Pit Vertical Advance



Drains Only

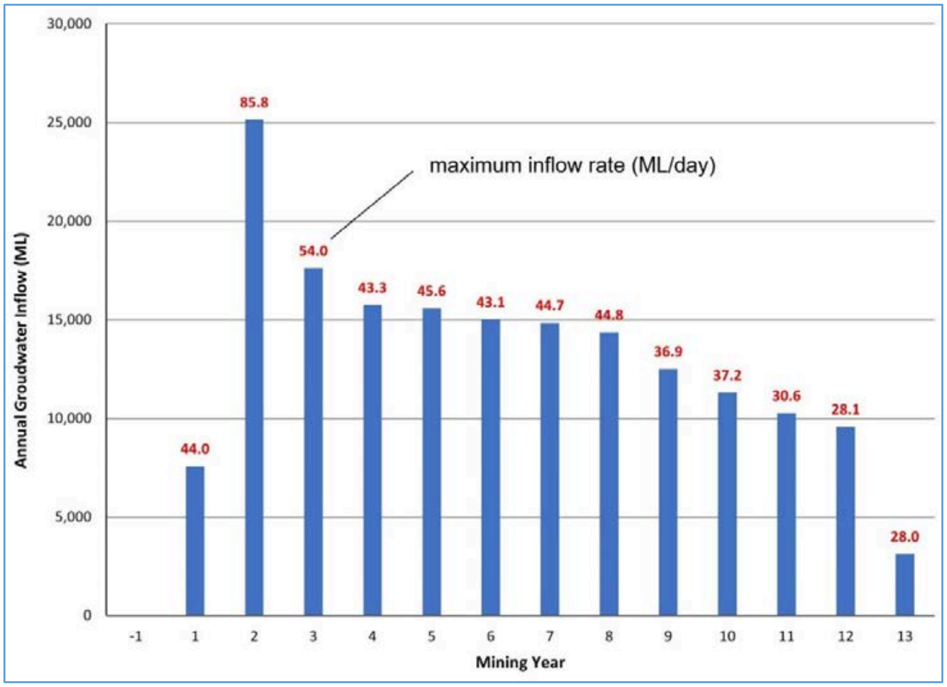
Drain cells were set in the model on a monthly schedule by assuming a drain cell elevation five metres below the interpolated pit floor elevation from the quarterly mining schedule. The drain cells were applied to the full pit area at each floor elevation based on the assumption that the entire pit floor was mined and exposed at each time step in the model.

The drain cell only simulation was run assuming the first day of mining commenced 12 months after the groundwater model starts. This helps make comparisons later in this report section with the dewatering bore models, which commence simulated pumping 12 months before mining starts.

Figure 2–46 shows the annual groundwater inflows and maximum daily flow rates (as averaged over the monthly time steps in the model). A total of 173 Gigalitres (Gl) dewatering discharge occurs across the project life. This amount is partly academic, as the Hemi dewatering system will be based on bores and drains, which involve the abstraction of greater volumes of groundwater to facilitate advance dewatering for mining and reduced groundwater levels in pit wall areas that should benefit slope stability through the alluvium and weathered bedrock profile.

Model instability was experienced with some drain cells set in the deeper, low permeability bedrock layers, resulting in convergence issues and artificial inflow spikes at several time step junctions. These elevated flows are artificial and were reduced to surrounding trend values, which are adopted within the totals shown on Figure 2–46.

Figure 2–46 Drain Only Dewatering Scenario – Groundwater Inflows



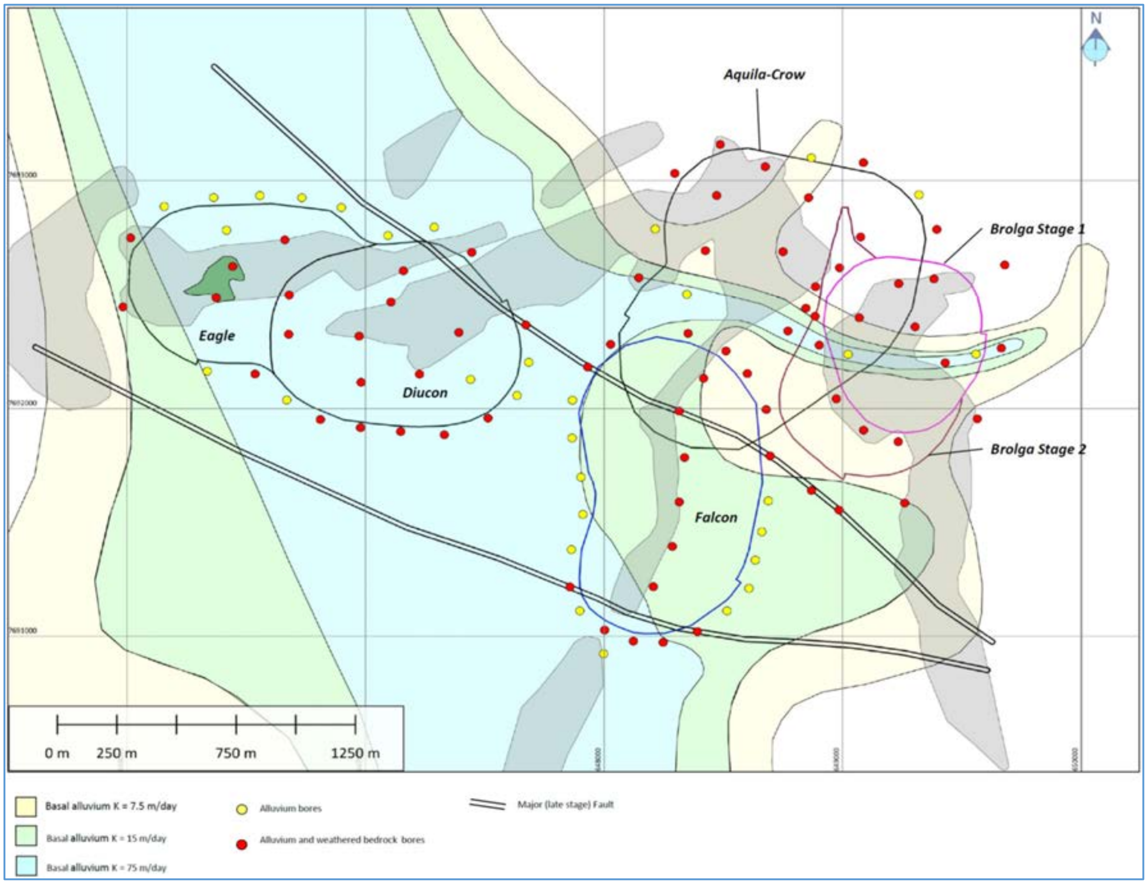
Bores and Drains

A conceptual dewatering borefield was developed for the numeric model that has internal dewatering bores located inside pit crests and external bores beyond the perimeter of pit crests. Figure 2–47 shows the location of the 101 dewatering bores simulated across the mine life; four of these simulated bores correspond to existing investigation bores (HPB006, 008, 009 and 012). The borefield layout was initially established in the numeric model for the Scoping Study 2021 mine schedule and was then adapted for the PFS mine schedule by adjusting flow rates and commencement dates.

The internal bores were set to operate over shorter time periods in the early years of dewatering to provide sufficient advance dewatering through the upper pit levels. These internal bores were made inactive at the time that mining first starts in the relevant pit, that is, in-pit dewatering bores active during mining were not simulated. Drain cells across the pit floors were maintained in the model to capture inflows not reporting to bores in the model. External dewatering bores were placed typically within 30 m to 70 m of interim and final pit crest positions.

A total of 31 dewatering bores were set as shallow bores with screens only set within the alluvial aquifer. The remaining 70 bores were simulated with screens set in both the alluvial aquifer and underlying saprolite and saprock intervals. These deeper bores were not screened in the transitional weathering zone or fresh bedrock, as given the low permeability of these zones, model instability is promoted, and only insignificant flows are expected. The bore locations and initial pumping rates were optimised according to their location relative to the alluvial palaeochannel aquifer and bedrock geology, with bores preferably located within the deeper more permeable profiles (subject to mine schedule and pit location positions). Initial flow rates assigned to bores in the model also depended on the timing of bore pumping commencement. Bores in the early years of dewatering within the most transmissive aquifer zones were assigned rates of between 2,160 kl/day to 2,592 kL/day (25 l/s to 30 l/s) whilst bores in less transmissive zones in later years were assigned initial rates of between 500 kl/day to 864 kl/day (5.8 l/s – 10 l/s).

Figure 2–47 Dewatering Bore Locations



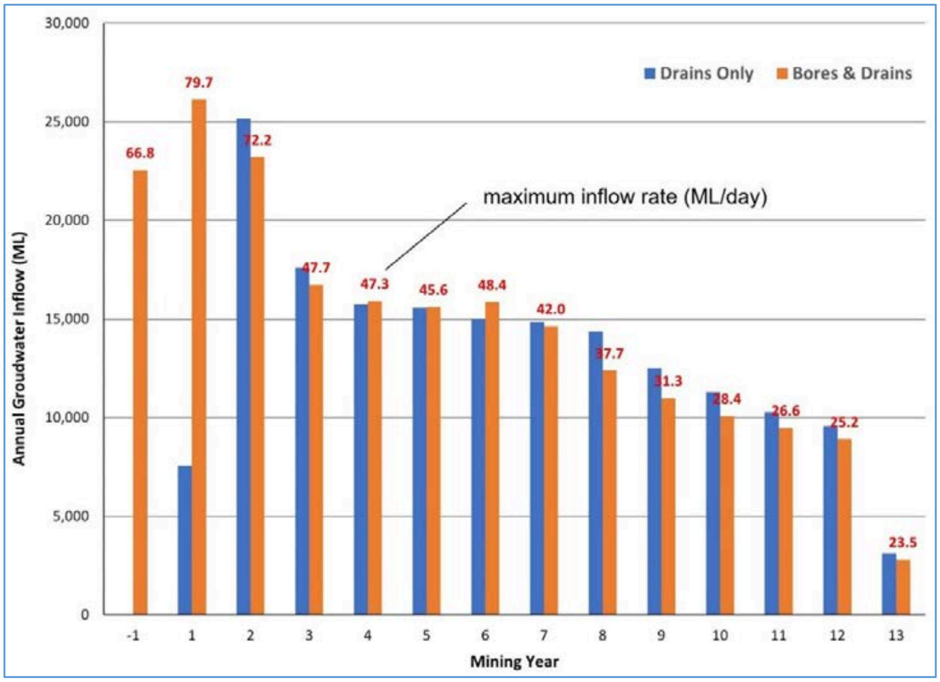
It should be noted that:

- Modelled flow rates represent bores that pump continuously, that is, without allowance for pumping downtime;
- Field investigations show that higher pumping rates can be achieved in the main palaeochannel aquifer zone (up to about 4,320 kl/day), however, these would not be sustained for long periods and the lower initial flows are used to represent a more realistic input to cost effective design of pumping and piping infrastructure.

Once each bore commences in the model at the assigned rate, the model determines the available rate in subsequent time steps based on the reducing groundwater levels from the combined effects of all bores and drains at each bore position. Once dewatering of aquifer zones occurs, the inflow rates to each bore start to decline (as happens in reality).

Bore abstraction commenced 12 months before the start of mining in the Brolga Stage 1 Pit. Several iterations of the model were run to adjust flow rates and check the progressive dewatering results were adequate for the mine schedule. Figure 2–48 presents the annual groundwater discharges and includes the drain-only scenario flows for comparison.

Figure 2–48 Bores and Drains Dewatering Scenario – Groundwater Inflows



The bores and drains scenario totals 205 Gl of abstraction over the life of mine. Much of the increased abstraction is derived from aquifer storage in the first two years of dewatering in comparison to the drains-only inflow results. As expected, inflow rates are greatest in the first three years of dewatering, with a maximum rate of almost 80 Ml/day simulated in Year 2 Month 7 of the model. In later years, inflow rates are slightly lower than the drain only scenario, which reflects the greater extent of dewatering and lower hydraulic gradients around the pits.

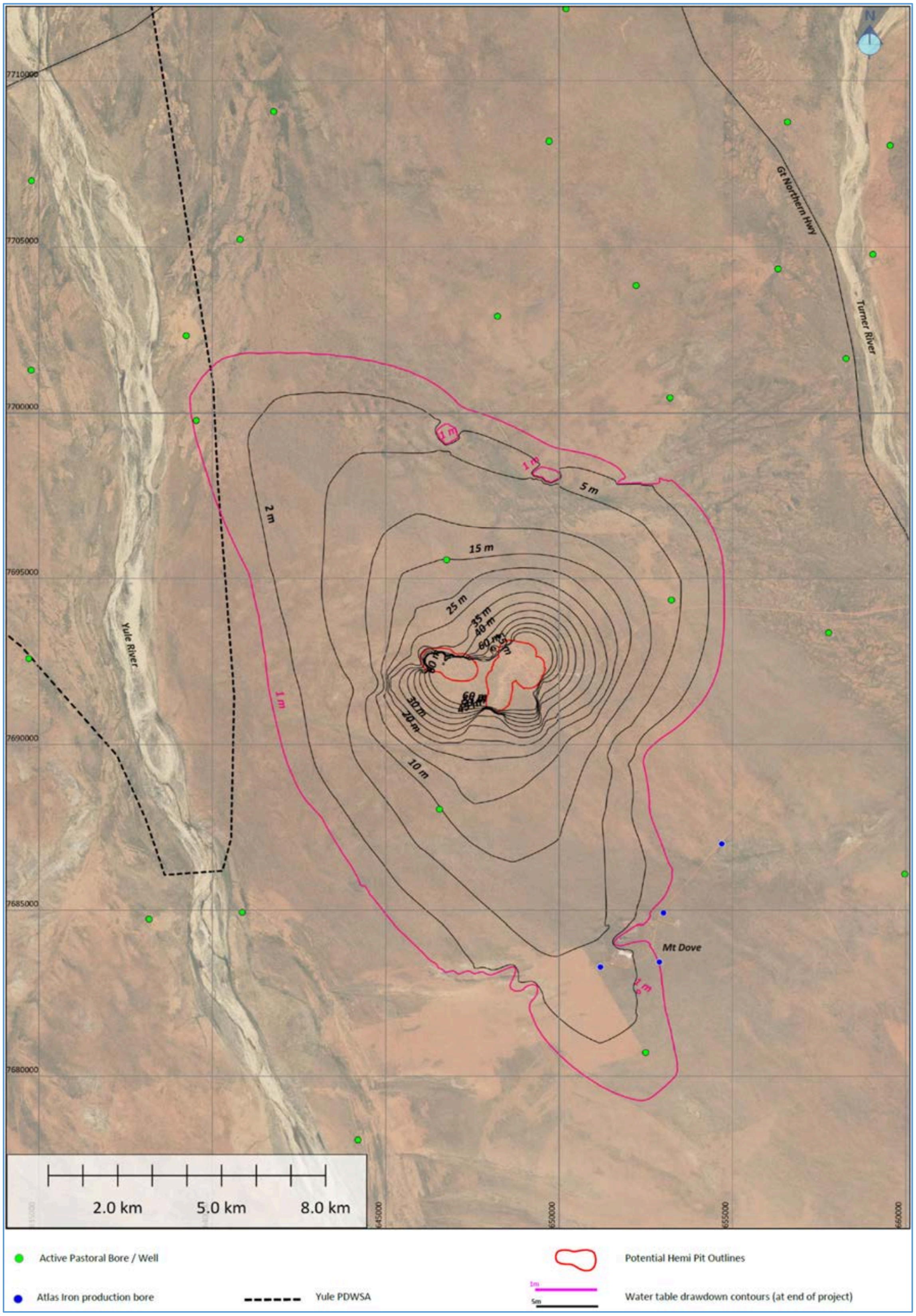
Figure 2–49 shows the maximum drawdown contours, which occur at the very end of the project (which equates to 13 years and 4 months after the start of dewatering. Drawdown contours above 60 m are not shown on Figure 2–49 as the focus of the figure is to compare the regional extent of dewatering drawdown for environmental impact purposes.

Water Balance

The results of the drain and bore simulation were compared to the project water demand schedule, which indicates:

- A significant portion of the dewatering discharge is surplus to project requirements in the first two years of dewatering up until the ore processing circuit is commissioned when total project water demand increases to 25 Ml/day;
- In the last few years of the project, dewatering inflows are the same or slightly higher than project demand, which means no supply bore fields are required by the project. Water supply for the site camp may be sourced from a separate aquifer source in preference to using dewatering discharge, however, the camp demand is low (0.6 Ml/day).

Figure 2–49 Maximum Drawdown – No Aquifer Reinjection Scenario



Aquifer Reinjection

In order to mitigate potential environmental impacts surrounding the mine dewatering at Hemi, Geowater recommended that aquifer reinjection be modelled to identify the improvements that could be realised, albeit at a significant cost in terms of additional water bore construction and water management infrastructure.

The aquifer reinjection in effect 'banks' the extracted water so that a significant portion of the water can recirculate for reuse in the operations.

Initially a level of 30 % aquifer reinjection was modelled with a focus on the following outcomes:

- That water mounding at the reinjection sites was not excessive whereby it might impact on flora or surface conditions;
- That the degree of aquifer reinjection reduced or mitigated any potential impacts of the proposed surplus water discharge to the Turner River;
- That zones of groundwater containing elevated metals concentrations (e.g. arsenic) would be manageable via reinjection to those bore sites that recirculated back to the mine dewatering zone.

The 30 % reinjection scenario required approximately 20 reinjection bores in the palaeochannel upstream and downstream of Hemi and provided successful outcomes of each of the aforementioned points.

Based on this, it was proposed that a 50 % aquifer reinjection scenario be modelled to identify if further improvements could be made to those outcomes.

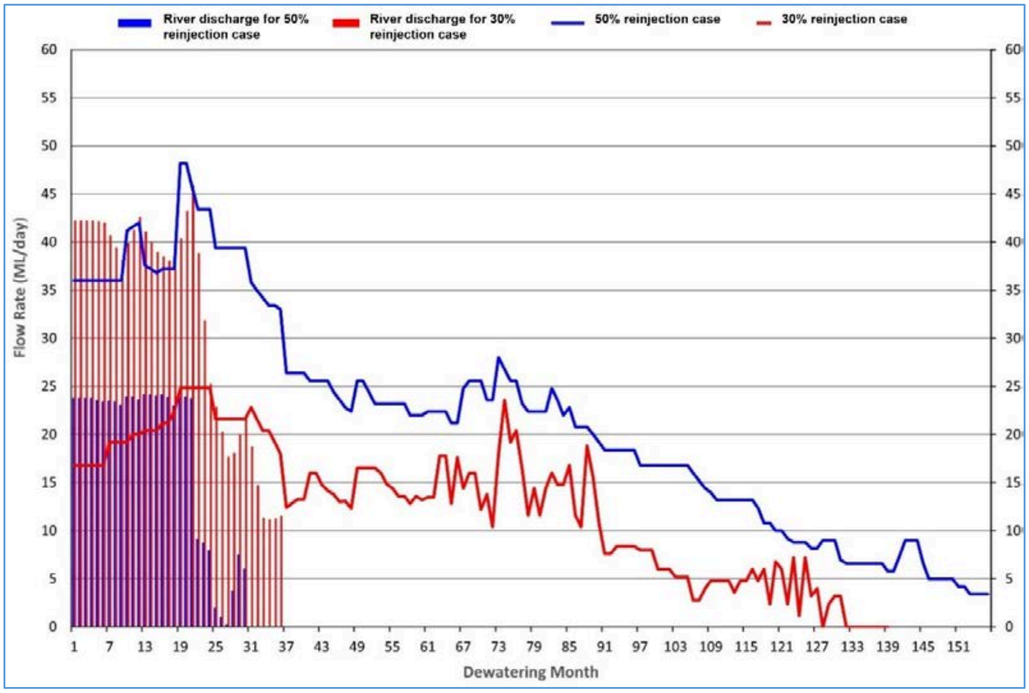
This scenario required an additional 20 aquifer reinjection bores in the palaeochannel upstream and downstream of Hemi and with respect to water mounding, a maximum level of two metres below the surface was set as a constraint in the model. The outcomes were improved with a significant lessening of surplus water discharge flows to the Turner River, mounding did not exceed the two metre constraint, and, the management of zones of groundwater containing elevated metals was readily achievable.

Reinjection rates were assigned based on the proximity to the open-pits and the associated drawdown and recirculation effects expected in areas closer to the pits, as well as the depth to the existing baseline water table (6 m to 9 m to the south and 4.5 m to 6 m to the north).

Figure 2–50 shows the results of the 30 % and 50 % aquifer reinjection modelling. It can be seen that the quantity of surplus discharge water has decreased significantly in terms of overall quantum (35.1 Gl to 16.6 Gl), in daily flow (~45Ml/day to ~23Ml/day) and in terms of the time frame of those flows.

Prior to the modelling of the 50 % aquifer reinjection scenario, the 30 % aquifer reinjection scenario was adopted as a base case, so that comparisons could be made to establish whether any updated parameters were an improvement or otherwise. It should be noted that the increase in aquifer reinjection rate had only a minor impact on the mine dewatering outcomes (due to slightly elevated groundwater recirculation to the mine dewatering zone), hence the comments in the following section remain valid in principle for both the 30 % aquifer reinjection and 50 % aquifer reinjection cases.

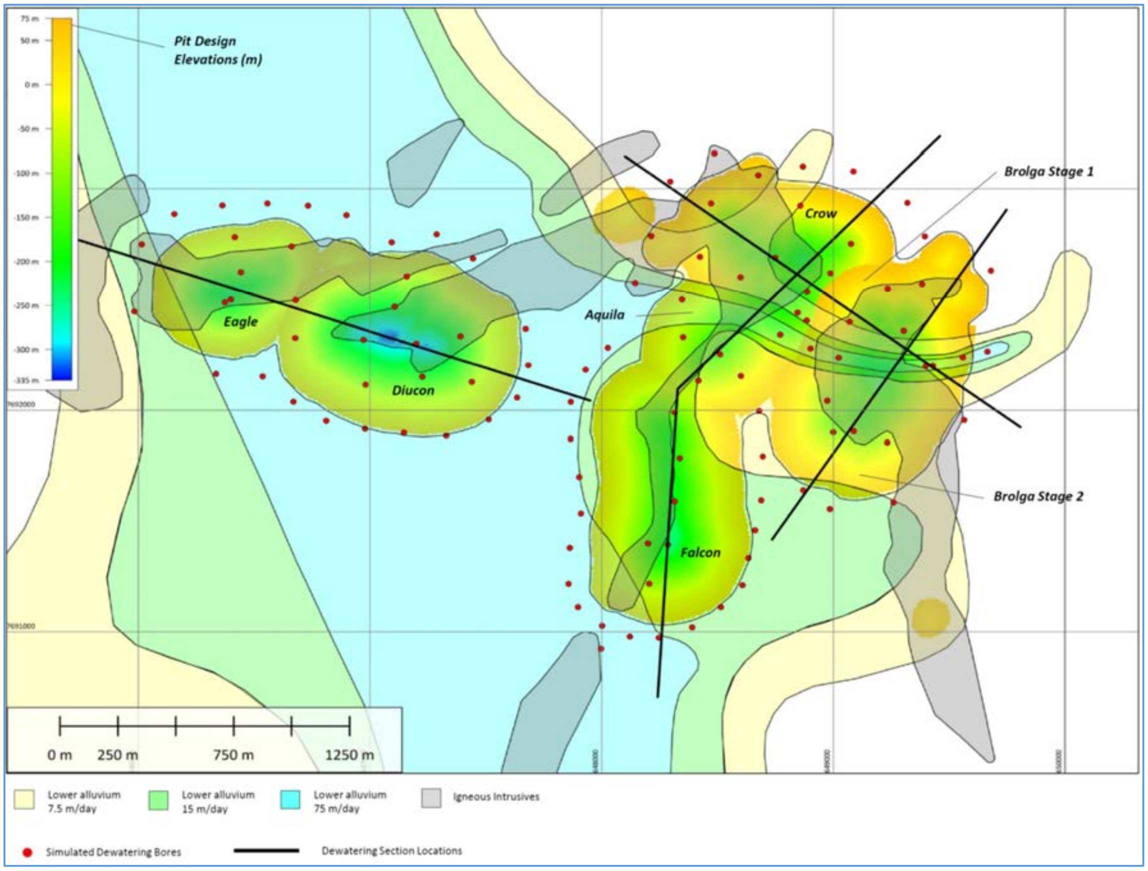
Figure 2–50 Reinjection and River Discharge Schedule (ML/day)



The effectiveness of the simulated dewatering was then assessed by comparing predicted groundwater levels against required target levels for each model iteration completed. Figure 2–51 presents the trace of four dewatering cross-sections used to show dewatering progress as groundwater levels across the various pit outlines at progressive points in time. Twenty-two transient sections were produced in total to show groundwater levels against pit progress and the main hydro-stratigraphic layers. These sections highlight the following regarding dewatering progress and effectiveness:

- Dewatering of alluvium and upper weathered rock profiles at Brolga Stage 1 pit is achieved in advance of mining progress. Once mining advances into fresh bedrock it is predicted that groundwater levels within the lower rock weathering and fresh rock profiles only decline very slowly and remain elevated relative to the advancing pit floor. This effect is repeated at all the other pits and is considered both expected and commonplace in low to very low permeability bedrock open-pit settings. Elevated groundwater levels (pore pressures) near and behind pit wall positions can have a significant influence on pit stability, but only typically within unconsolidated or highly weathered rock masses. Elevated pore pressures within high strength and competent bedrock rarely becomes a key factor in pit wall slope designs.
- Nearby sections of the Crow and Brolga Stage 2 pit benefit from dewatering achieved in the earlier years of Brolga Stage 1 dewatering.
- Dewatering of the alluvial aquifer at Diucon is achieved in advance of pit progress, although only just in time on the northern side. Dewatering on the south-eastern side is more advanced due to the closer proximity to the effects of Brolga and Crow dewatering.
- As elsewhere, once the saprolite and saprock bedrock profiles become dewatered near the pit boundaries, groundwater levels within the slightly weathered and fresh bedrock profiles do not drain readily, which will result in elevated pore pressures behind bedrock walls during mining.
- The early stages of dewatering at Falcon are well advanced in relation to pit progress given the cumulative effects of six years of dewatering at the other nearby pits.

Figure 2–51 Dewatering Section Locations



3 SURFACE WATER (Hydrology)

The Hemi area occurs as part of a flat spinifex plain that slopes gradually to the north northwest with only local minor relief caused by bedrock outcrop or sand-dunes. The Yule River and Turner River occur about nine km to the west and 14 km to the east of Hemi.

Figure 3–1 shows the catchment areas of the Turner and Yule Rivers used by Surface Water Solutions (SWS) to estimate river flows near Hemi. The Yule River at this location has a catchment area of 8,337 km², which is much larger than the equivalent Turner River catchment area of 2,225 km². Three government river flow gauging stations on the Yule River and Turner River occur in the region (Figure 3–1). The Kangan gauge on the Yule River upstream of Hemi is no longer in service and only has flow data for the period between 1966 to 1979, whilst the Pincunah gauge has daily flow records since 1985 and Jelliabidina gauge has daily flow records since 1972.

Flow in both rivers near Hemi is reliant on large rain fall events of the order of > 150 mm, and the biggest river flows are typically related to the occurrence of cyclones that generate large and widespread rainfall as they cross the Pilbara Coast. Daily flow data for the Jelliabidina and Pincunah sites has been collated for the past 30 years, with a water year defined as the July to June period so as to better capture the effects of individual wet seasons. Figure 3–2 plots these annual river flows, as well as listing the number of months in which flow occurred (noting that months with total flows less than 5 Ml were excluded from the count). The flow data highlights:

- No flow was recorded in eight of the 30 years at the Yule River gauge and in four of the 30 years at the Turner River Pincunah gauge;
- Peak monthly river flow in the Yule River at Jelliabidina occurred in February 1995 (811,831 Ml) following a large rainfall event associated with Cyclone Bobby;
- Peak monthly river flow in the Turner River at Pincunah occurred in March 2007 (90,644 Ml) following large rainfall events associated with cyclones George and Jacob;
- Flows in the Turner River at Pincunah are typically an order of magnitude lower than in the Yule River at Jelliabidina, consistent with the large difference in catchment areas of the two gauges.

Flood modelling of the study area has been completed by Surface Water Solutions (SWS, 2022). A conservative approach to the flood modelling has been taken by SWS by assuming that peak river flows in the Turner River and Yule River occur simultaneously, and are coincident in time with peak flooding in the Hemi area from local scale rainfall events. Figure 3–3 and Figure 3–4 show the maximum flood depths predicted by the SWS model for the 20 % AEP (1 in 5 year) and 1 % AEP (1 in 100 year) events.

These indicate:

- For the 1 in 5 year event, river flooding is limited to within the current day channels, and localised flooding in the immediate Hemi area is not significant;
- For the 1 in 100 year event, the Turner River overtops it main bank and generates flow in an anabranch to the east. The Yule River generates widespread flooding to the northwest of the Hemi area; this has significance to the shallow aquifer system;
- Large river flows do not cause flooding of the Hemi area, instead, widespread but shallow flooding is likely to be generated by ponding and sheet flow from incident rainfall over and near Hemi. This would tend to coalesce into low points that form a subtle drainage line over Hemi that trends to the northwest.

Figure 3–1 Surface Water Catchment Area

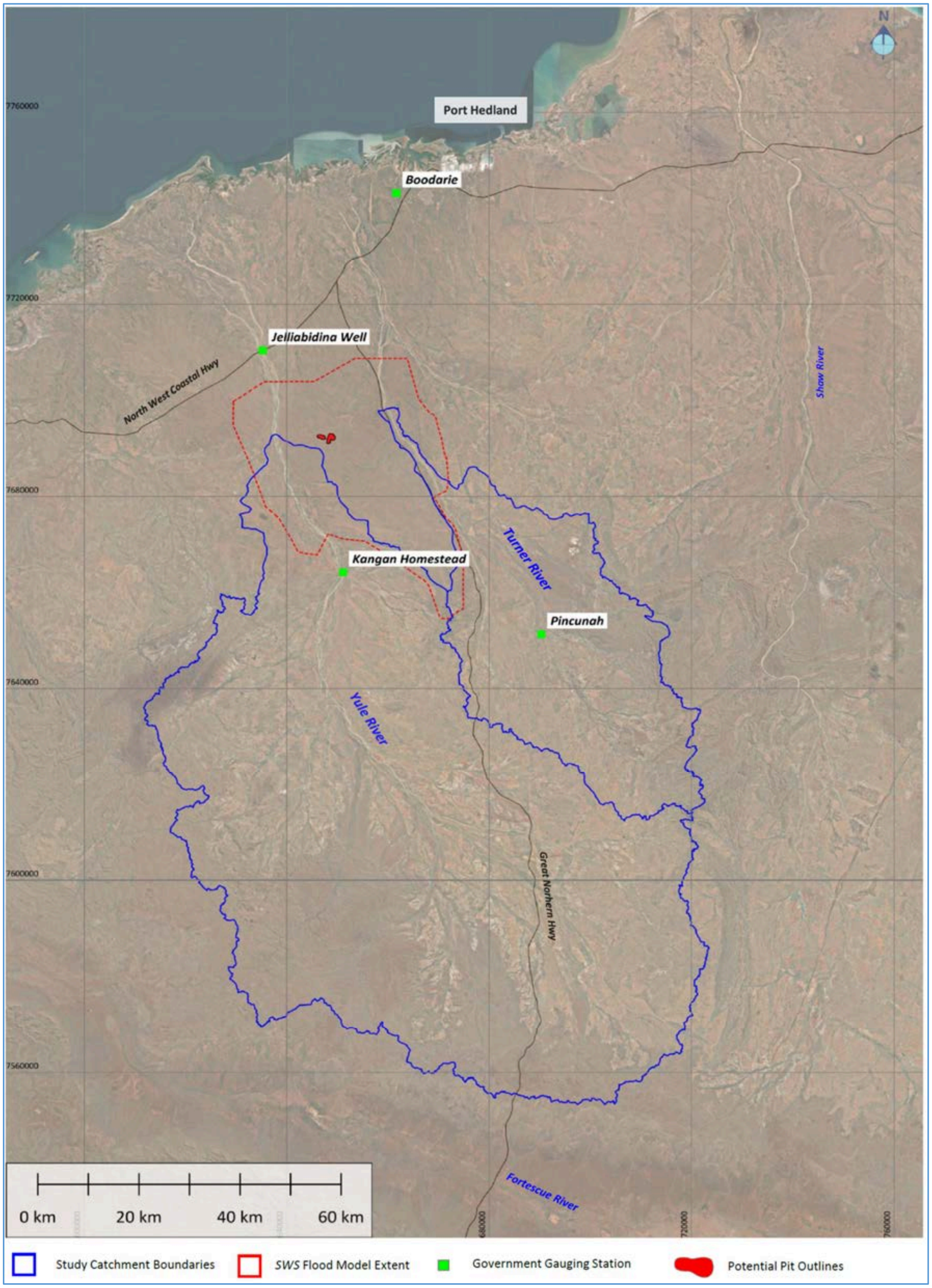
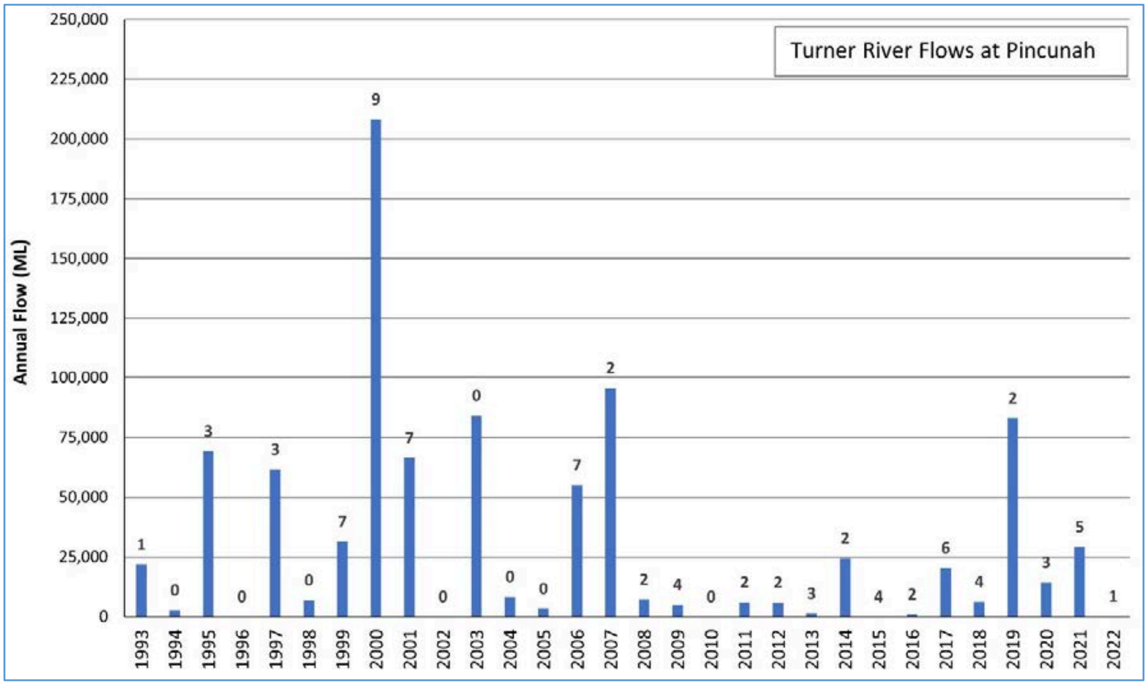


Figure 3–2 Annual River Flows at DWER Gauging Stations



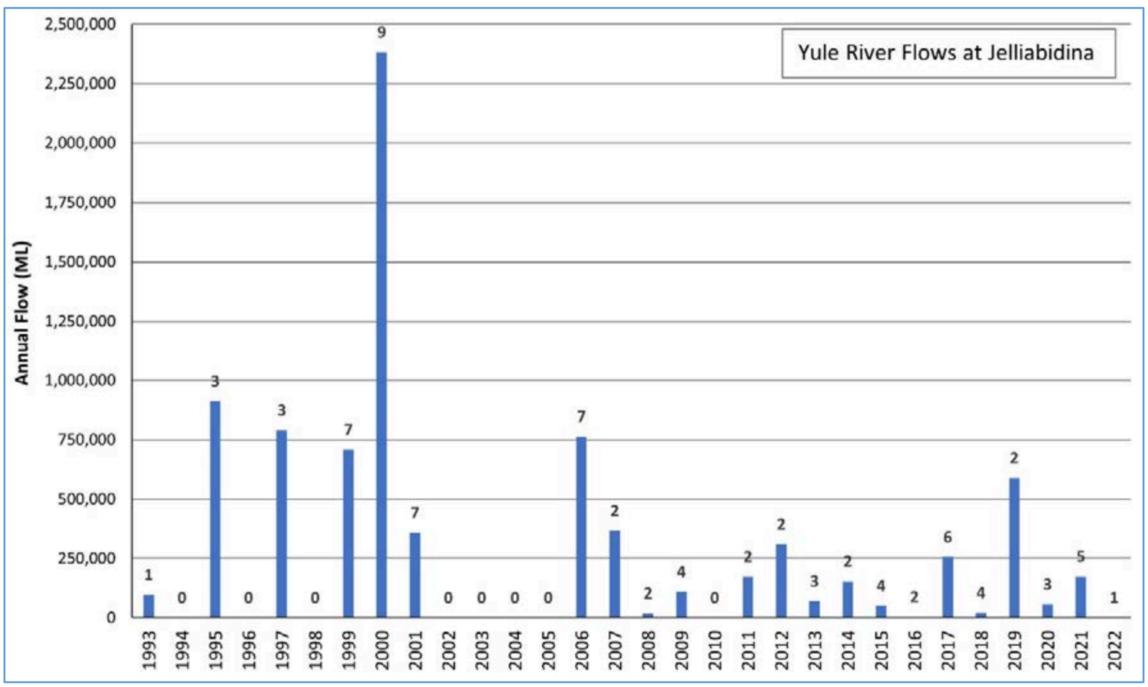


Figure 3–3 20 % AEP (1 in 5 year) Flood Event – Maximum Flood Depth

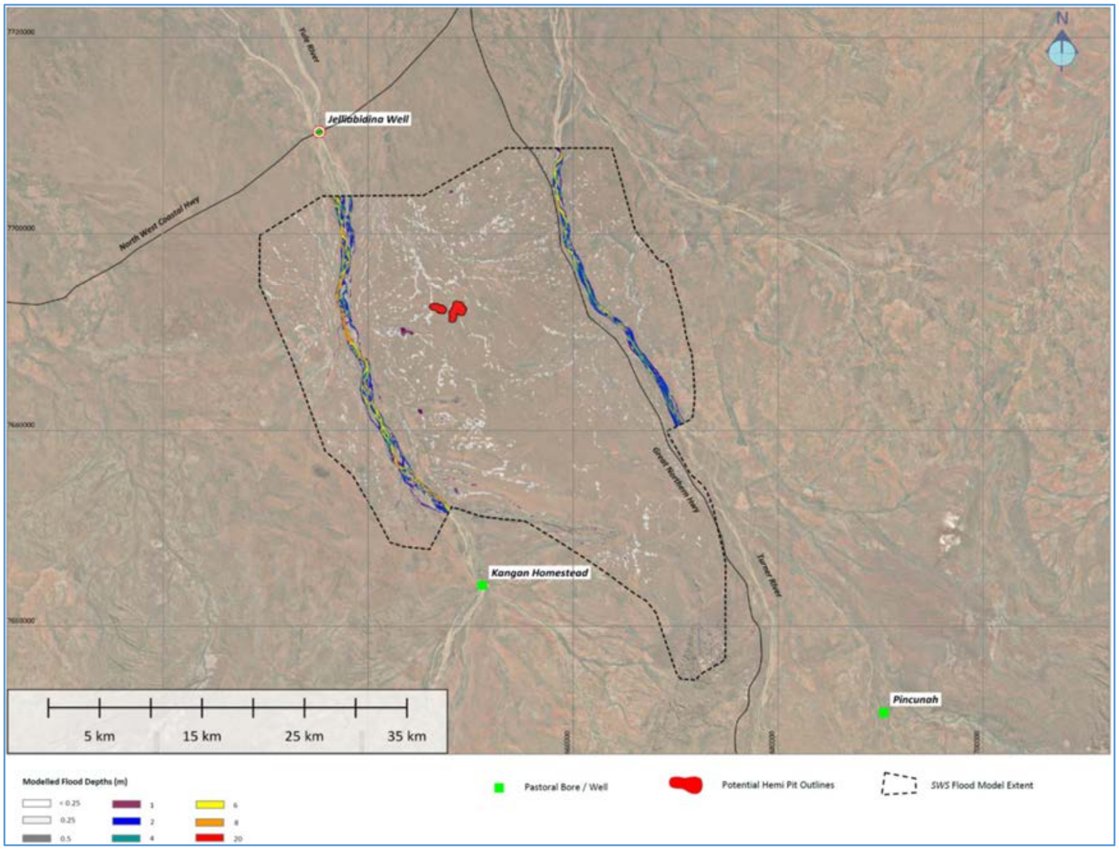
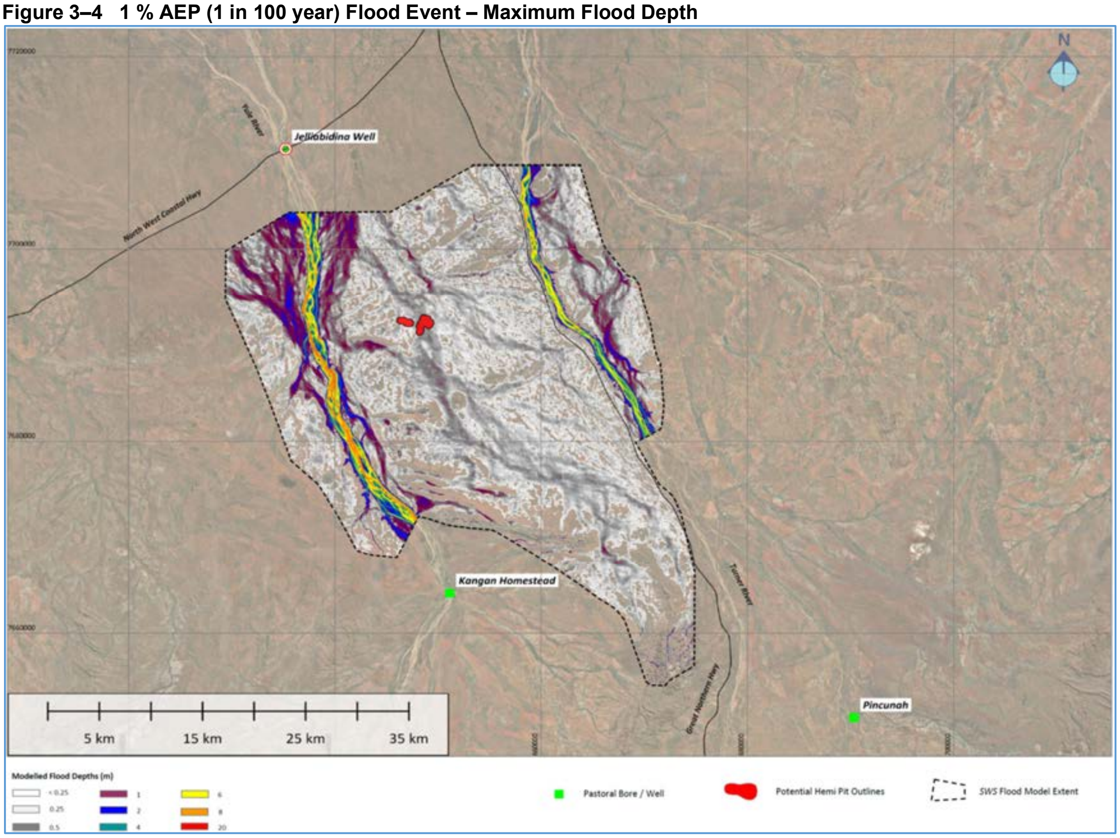


Figure 3–4 1 % AEP (1 in 100 year) Flood Event – Maximum Flood Depth



No river flows were observed or recorded in the Turner River or Yule River during the PFS investigation period after March 2021 and April 2021 respectively. Consequently, the water level logger and rising stage samplers installed in the Turner River in 2021 did not capture any data. There was an unseasonal rain event that generated small flows in both rivers in the project region on the 2 June 2022, and which occurred outside of the assessment period. As such, this data will be utilised as part of the DFS phase of work.

3.1 Hemi Area

No obvious drainage lines or creeks exist at the Hemi Deposit. Following a 24-hour rainfall event of about 90 mm at Hemi (to 9 am) on 2 February 2021, De Grey flew a drone survey on the following day (3 February 2021). The rainfall event corresponds approximately to a 1 in 2 year recurrence for that event size. Figure 3–5 is an aerial image looking north-northwest over the Crow Deposit and shows only very minor flooding on cleared tracks and pads, with little or no ponding of water in uncleared areas.

Figure 3–5 Aerial Image over Crow Deposit 3 February 2021

3.2 Surface Water Quality

Water quality sampling within the Turner River and Yule River commenced in 2021 and has included sampling of small river pools in the absence of any significant river flows. Detailed water quality analyses was completed by ALS in 2022. Table 3–1 provides a summary of these results, and includes the water samples collected from the actual river flow event; albeit as a minor flow that occurred in early June 2022.

The river pool samples show increased salinities, pH and metals content relative to the water quality from the small flow event in June 20022. This is as expected and reflects the effects of evaporation and likely increased groundwater contributions to river pools during sustained dry periods.

Table 3–1 2022 Surface Water Quality Summary

Analyte		Unit	Yule River Pools (Jan – Apr)	Turner River Pools (Jan - Apr)	Turner River Flow (3 – 6 Jun)
Number of water samples		*n/a*	*10*	*5*	*4*
EC		uS/cm	459 – 3,280	236 – 3,200	225 - 258
Total Dissolved Solids (gravimetric)		mg/L	264 – 1,880	146 – 1,800	143 - 158
Total Dissolved Solids (sum of ions)		mg/L	361 – 2,230	191 – 1,975	< 5
Total Suspended Solids		mg/L	< 5 - 27	< 5 - 147	< 5
pH (lab)		pH units	8.0 – 8.9	8.0 – 9.4	7.7 – 8.0
Hardness		mg/L as $CaCO_3$	99 - 411	87 - 312	43 - 52
Arsenic	(dissolved)	ug/L	0.4 – 5.8	1.4 – 9.8	0.6 – 0.7
	(total)	ug/L	0.7 – 6.1	1.7 – 11.1	0.9 – 1.0
Chromium	(dissolved)	ug/L	<0.2	<0.2 – 0.3	0.5 - 0.7
	(total)	ug/L	<0.2 – 1.2	0.6 - 36	2.7 – 6.1
Uranium	(dissolved)	ug/L	0.5 – 19.3	1.4 – 8.5	0.6 – 1.7
	(total)	ug/L	0.76 – 23.4	1.63 – 9.79	0.8 – 1.09
Vanadium	(dissolved)	ug/L	0.3 – 10.4	2.3 – 11.2	1.9 – 2.4
	(total)	ug/L	0.7 – 11.4	3.3 – 25.5	3.6 – 4.9

4 MINE DEWATERING SCHEDULE AND SURPLUS WATER MANAGEMENT STRATEGY

Table 4–1 shows the average annual mine dewatering and surplus water discharge quantities for the life of mine model based on 50 % aquifer reinjection.

Table 4–1 Average Dewatering and Surplus Discharge Quantities for 50 % Aquifer Reinjection Scenario

Mine Dewatering Year	Average Annual Mine Dewatering Ml/day	Average Annual Surplus Water Discharge Ml/day
Year 1	63.3	24.3
Year 2	72.6	22.0
Year 3	54.4	8.4
Year 4	35.7	4.5
Year 5	37.1	4.7
Year 6	35.4	3.6
Year 7	35.4	2.9
Year 8	29.1	0.3
Year 9	24.6	1.0
Year 10	21.9	0.2
Year 11	20.2	1.1
Year 12	18.9	0.4
Year 13	18.0	0.3

During the two year period prior to operations and based on 50 % aquifer reinjection scenario, there is a surplus discharge water requirement of approximately 16.9 Gl. Thereafter, that is, from year 3 onwards, the total surplus discharge water requirement is approximately 10 Gl in total, a quantity that on an annual basis, could be reused by third parties or applied to on site irrigation activities, if required. For the 30 % aquifer reinjection scenario, the surplus discharge water requirement over the first two years would increase to 35.1 Gl.

Importantly, modelling of the 50 % aquifer reinjection scenario demonstrates that groundwater zones where elevated levels of metals exist would be manageable if a dual water management system is implemented. This would entail directing those zones of groundwater with elevated metal levels (including arsenic) to reinjection bores that recirculate the reinjected water back to the mine dewatering zone. After the first two years, the water with elevated metals would be directed to the processing plant where the process allows them to be stabilised.

The aforementioned approach to the management of surplus water has been considered by De Grey in the context of published DWER guidelines and policies (DoW 2103b, DWER 2020a), which state that *mine dewatering volumes must first be used for:*

- mitigation of environmental impacts
- fit-for-purpose onsite activities (for example processing, dust suppression and mine camp use).

Any dewatering volumes that remain after these requirements have been met constitute mine dewatering surplus. The mining guideline states the options for disposing of this water, as follows:

- Transferring the water to meet other demands, including those of other proponents in the area and public water supply.
- Injecting back into an aquifer at sites determined by the proponent and agreed to by the former Department of Water.
- Controlled release to the environment where the dewatering surplus is allowed to flow (either through a pipe or overland) into a designated water course or wetland determined by the proponent and agreed to by the department.

Aquifer reinjection and on site irrigation have been determined by De Grey as the preferred options for surplus water management. However, these options do not provide a feasible ‘total' solution during the first two years of mine dewatering, where opportunity for high volumes of third party water reuse would likely be limited to a few years and on site irrigation would likely be limited to 5 Ml/day to 10 Ml/day.

4.1 Turner River Discharge

A controlled release strategy to the Turner River has been proposed for the surplus groundwater during the first two tears of mine dewatering, prior to the commencement of processing operations. The mine dewatering schedule has a significantly lesser amount of surplus water over the ensuing years with quantities that could readily be utilised for third party reuse or on-site irrigation options.

The Turner River has been proposed as the preferred release point rather than the Yule River for the following reasons:

- Absence of any DWER-mapped river pools for nearly 23 km downstream from the conceptual discharge location point (opposite the Mt Dove turnoff on the North West Highway);
- Greater depths to the underlying water table;
- Avoidance of the Yule River Public Drinking Water Source Area (PDWSA).

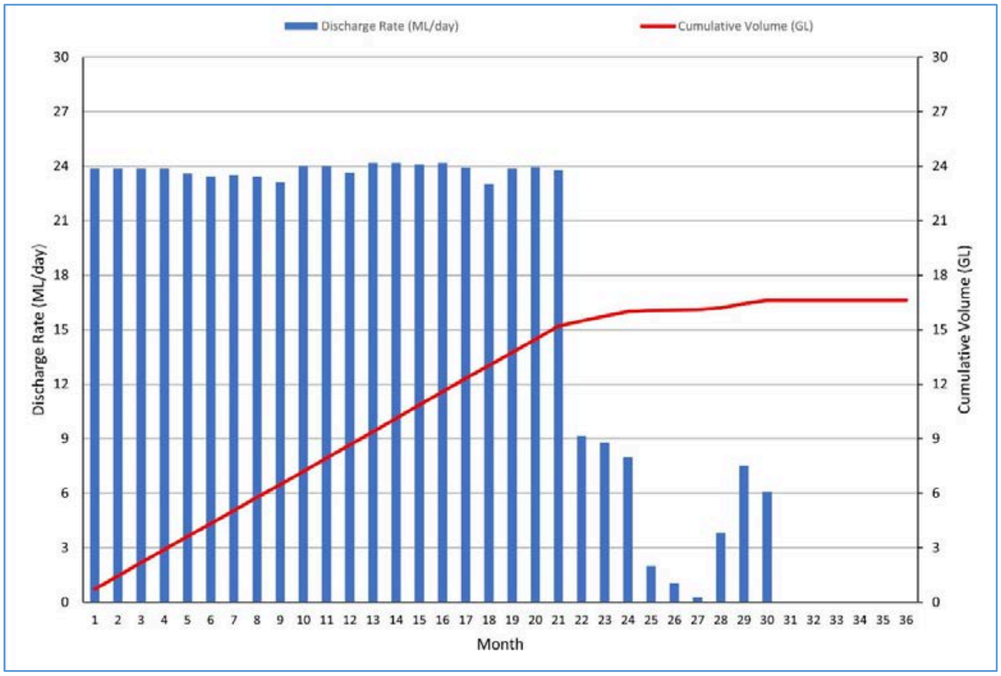
The potential impacts of surplus water discharge to the Turner River have been assessed by expert consultants, SWS (hydrological impact), Stantec (ecological impacts), MBS Environmental (aquatic impacts) and others using key inputs from Geowater, namely discharge flow rates and water quality estimates. The outputs from modelling by SWS have in turn been utilised by Geowater to assess any possible impacts of river discharge on the underlying aquifer.

Figure 4–1 shows the average proposed surplus water discharge rates and cumulative volumes.

4.2 Elevated Arsenic Water Management

Dissolved arsenic levels in groundwater above natural background levels have been measured in bores screened within bedrock ore zones and in basal alluvium up to a few hundred metres downgradient of the ore zones at Hemi. Once the processing plant is operational, elevated levels of dissolved arsenic in the groundwater from relevant in-pit sumps and dewatering bores will be directed to the processing water stream. The processing plant flowsheet allows for the stabilisation of elevated metals such as dissolved arsenic via the pressure oxidation stage in the circuit.

Figure 4–1 Proposed Turner River Discharge Schedule



Prior to the commissioning of the processing plant, robust options for the management of elevated arsenic levels in water are required. These will include a dual header pipe water management system, which is capable of directed baseline level water to areas prone to environmental impacts and water with elevated levels of metals to areas that recirculate back to the mine dewatering zone so that t can be directed to the processing plant when pumped at a future date. To that end, a detailed assessment of the dewatering bore flow and quality data has been modelled utilising a bespoke dewatering spreadsheet tool developed by De Grey to track arsenic levels over time in accordance with the PFS mining schedule and mine dewatering schedule.

Geowater provided estimates of initial arsenic levels within each simulated dewatering bore using the results of sampling to date. Transient estimates of average arsenic levels over quarterly intervals for two years for each bore were also made by Geowater by using estimates of the changing ratio between alluvial and bedrock groundwater as dewatering of aquifer zones in the numeric model progresses over time. These source estimates were then tracked by the dewatering spreadsheet tool to create separate pipeline distributions in the designs for two different water streams; the elevated arsenic stream based on bores with the potential to pump groundwater with elevated arsenic levels for significant periods during their lifespan.

During the first two years of dewatering, the elevated arsenic water stream determined above would be reinjected into the main palaeochannel aquifer at locations close enough to the open pits such that the reinjected water will be recirculated by travelling through the aquifer back to the pit and be recaptured by the mine dewatering system. After two years, all elevated arsenic water would then be directed into the processing plant circuit. Confirmation of the re-circulation of the elevated arsenic water through the aquifer has been demonstrated by undertaking particle tracking within the numeric flow model.

4.3 Water Management System

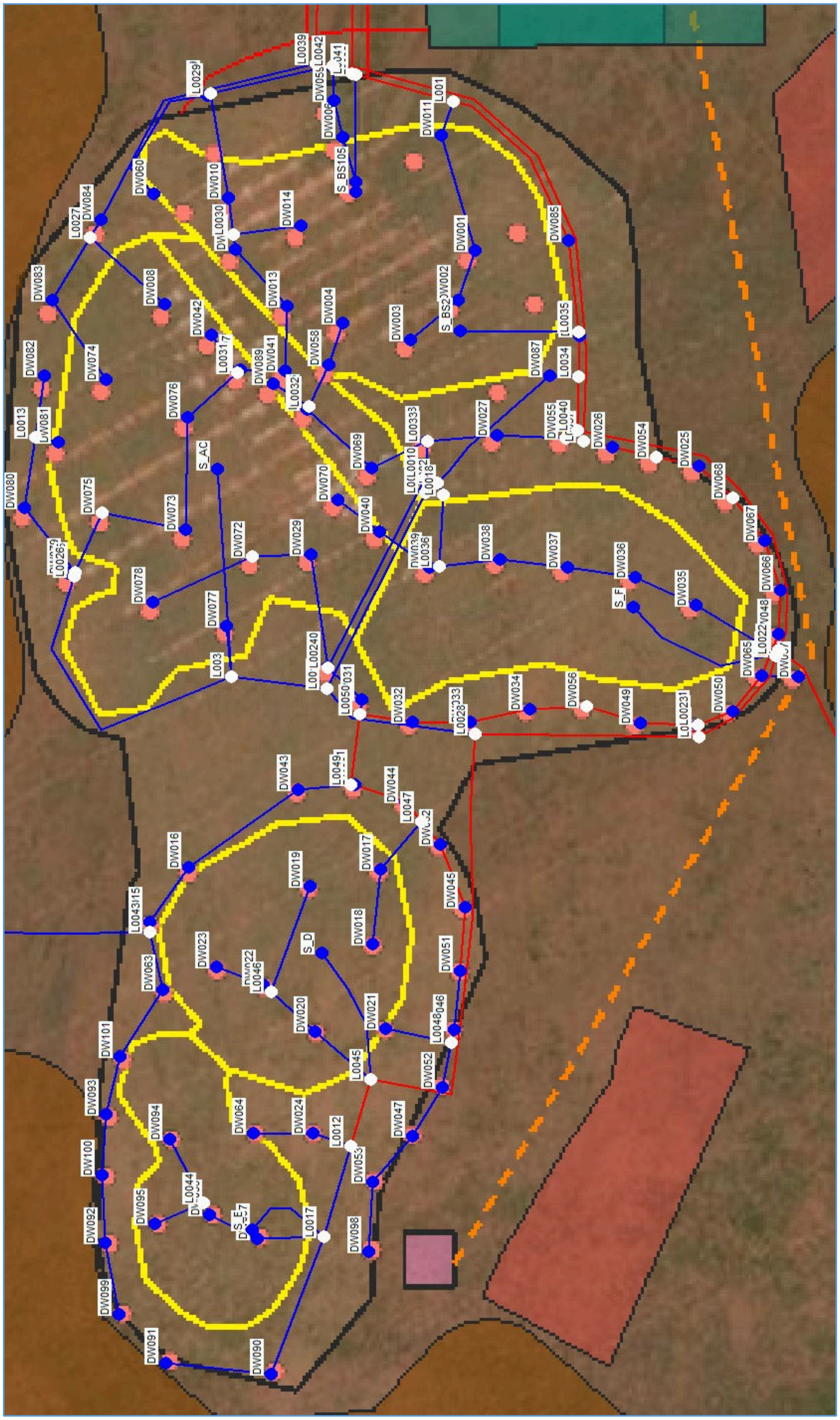
Anthony Elder Consulting was engaged by De Grey to provide an engineering design for a water management system capable of dewatering the Hemi deposits in accordance with the mine dewatering schedule and with the ability to manage water containing baseline levels of metals and elevated levels of metals.

To accommodate the management of different qualities of groundwater, a dual system was proposed such that depending on the water quality, bores could be directed to one of two piping manifolds where they would then be directed appropriately pending the levels of soluble metals.

The system included transfer ponds that had the dual benefit of allowing a buffer to smooth out variations in flow that might be caused from mechanical or operational availability issues and also allows natural chemical processes resulting from exposure to the atmosphere to occur, which further assists in improving water quality prior to redirection.

Figure 4–2 shows a hydraulic model representation of the Hemi pit area section identifying the dual piping network in those areas where elevated levels of soluble metals may be present.

Figure 4–2 Hydraulic Model Representation of the Dual Water Management System



5 SURROUNDING WATER VALUES AND USERS

5.1 Water Values

5.1.1 DWER Groundwater Resources

The Hemi area occurs within the Ashburton Sub-area of the Pilbara Groundwater Area as defined by DWER. The adjoining East Pilbara Sub-area occurs within 11 km to 16 km to the southwest and south of the Hemi deposits as shown in Figure 5–1. This plan also highlights the three Groundwater Resource systems defined by DWER in the study area:

- *Pilbara – Lower Yule Alluvial Aquifer*. The boundary of this groundwater resource coincides with the boundary of the *Yule River Water Reserve* which is in place to help protect the public drinking water supplies accessed by the Water Corporation for use in Port Hedland.
- *Pilbara – Lower Turner Alluvial Aquifer*. This is a smaller alluvial aquifer resource defined by the DWER management systems. Years ago, this resource was associated with a public drinking water borefield, but is now mainly accessed by pastoral users and also by FMG and Roy Hill for their port operations. This resource occurs over 27 kilometres north-northeast of the Hemi deposits.
- *Pilbara – Fractured Rock Aquifer*. This resource is present throughout the entire Pilbara Groundwater Area and is often recognised by DWER as including sedimentary alluvial sequences as well the underlying bedrock lithologies.

5.1.2 DWER Surface Water Resources

The Hemi Project occurs within the Yule Surface Water Allocation Area within the Port Hedland Coast Basin. Within this broader management area, the Hemi deposits occur within the Turner surface water resource area, and are also within two kilometres of the western boundary of the Yule surface water resource as defined by DWER.

5.1.3 River Pools

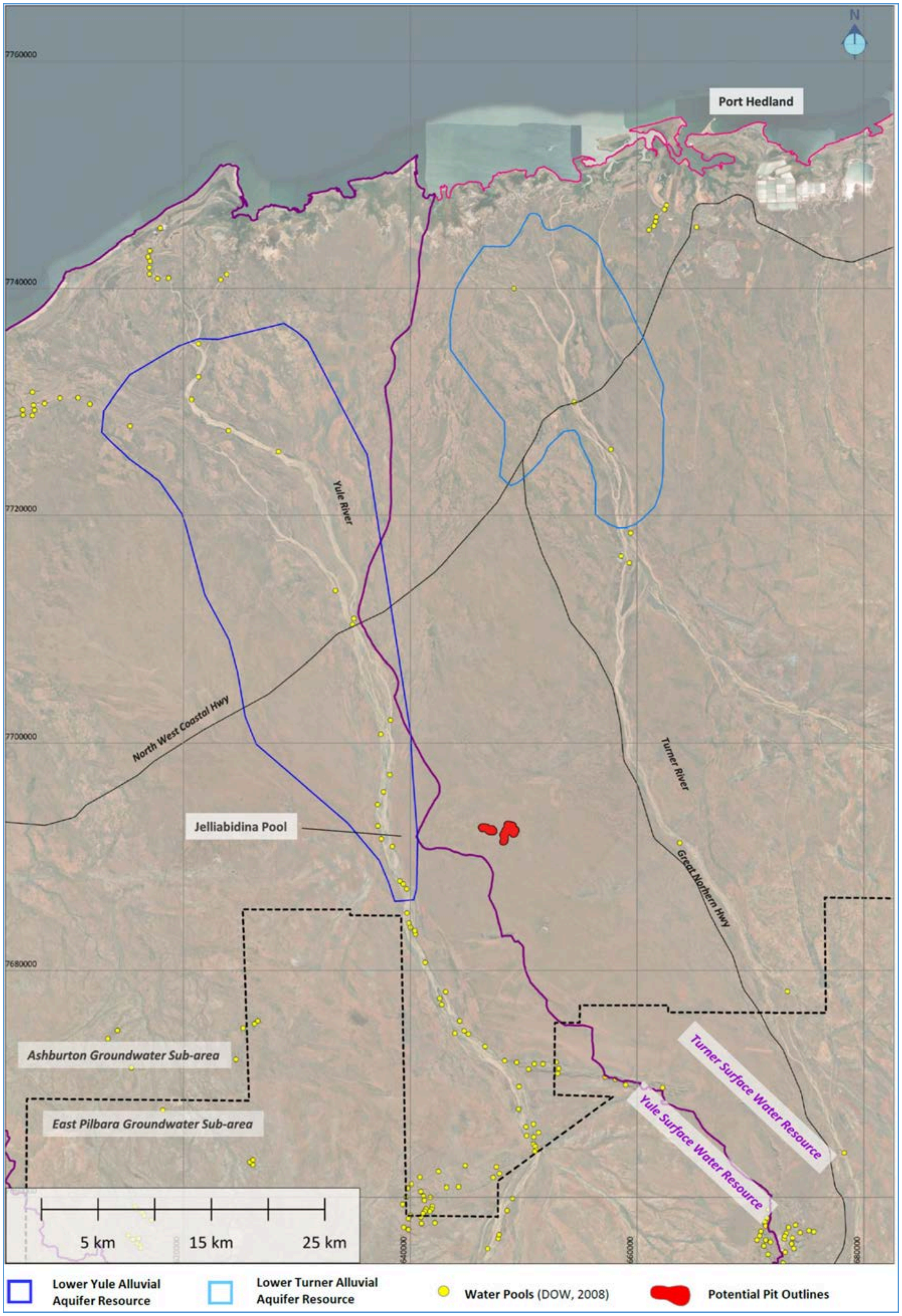
The reaches of the Turner (Kapankalanha) and Yule (Kakurrka Muri) Rivers within the study area are of significant cultural importance to the Kariyarra People.

Mapping of river pools in the Pilbara was undertaken by DWER in 2008 and indicates that most river pools in the Hemi region occur in the Yule River. Within a 20 km radius of Hemi, the DWER mapping has classified 25 pools in the Yule River; 11 are classed as intermittent, 13 as semi-permanent and one as permanent (Jelliabidina Pool). Only one (intermittent) pool occurs in the Turner River within a 20 km radius of Hemi. Sampling and surveying of several pools are reported in Geowater (2022).

5.1.4 Riparian and Groundwater Dependant Vegetation

Government vegetation mapping indicates the plains of the Hemi region between the Yule River and Turner River are dominated by grasses and shrubs in a grassland steppe type structural setting. Woodland vegetation, including groundwater dependant species, such as *Eucalyptus camuldulensis* (river redgum) and *Melaleuca argentea* (silver-leaved paperbark), are restricted to riparian settings within the current day channels of the Turner River and Yule River.

Figure 5–1 DWER Water Resource and Management Boundaries



The ecological water requirements of these riparian species were evaluated in detail in the region of the Yule River Borefield by the DoW (2013). This study ultimately led to the establishment of environmental water provisions in the form of water level criteria and controls to be adhered to by Water Corp in operating the borefield. Flora and fauna mapping and assessments are being undertaken by De Grey and include assessment of the Turner River and Yule River reaches closest to Hemi.

5.1.5 Stygofauna

Stygofauna are small, largely invertebrate, fauna that can occur within the pore spaces of aquifers. Sampling and assessment of these species has become a standard component of EIA's for most mining projects in Western Australia in recent years. The WA EPA requirements for assessing stygofauna is driven by a concern that many of these species exhibit short range endemism (geographically restricted ranges), which increases *the possibility that a species conservation status may be impacted as a result of the implementation of a* [mining] *proposal* (WA EPA, 2016).

De Grey have undertaken stygofauna and troglofaunal studies since 2020. The groundwater investigations provide input to these studies by providing monitoring bores suitable for stygofauna sampling, and by assessing the volumetric changes to aquifer resources from dewatering and water supply bores, which some regard as being related to a change of stygofauna habitat.

5.2 Existing Groundwater Users

5.2.1 Pastoral

The Hemi Deposit is situated on the Indee pastoral lease. Field visits by Geowater and De Grey staff in 2021 confirmed the presence of 39 active pastoral bores on the Indee and adjoining Mundabullangana lease within a 25 km radius of Hemi, as shown in Figure 5–2 with 11 abandoned wells and bores also identified. Details of these sites and groundwater data measured during the 2021 visits are provided in Geowater 2021 and Geowater 2022 reports.

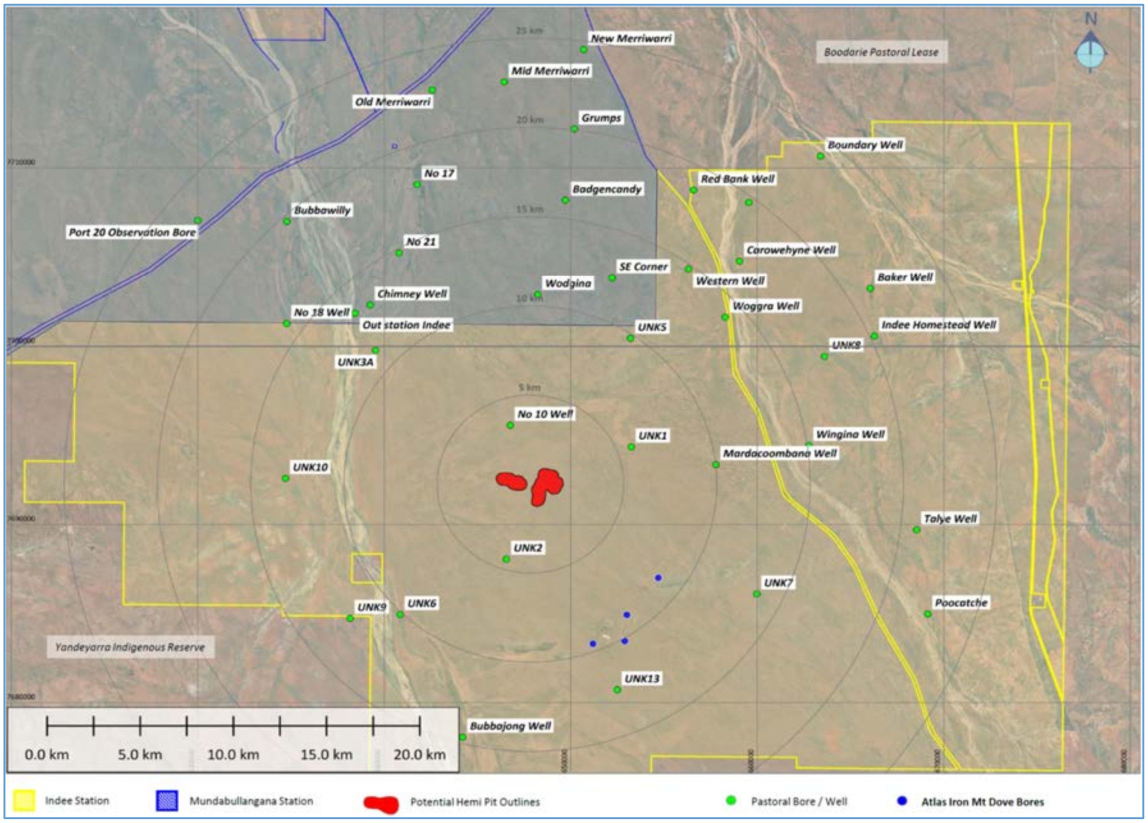
The Indee and Mundabullangana leases are active cattle properties that rely extensively on local groundwater resources for stock watering and domestic purposes. The Boodarie pastoral lease, held by BHPB, occurs to the north and east of the Indee and Mundabaullanga leases and is currently destocked. To the southwest of Hemi, no pastoral activities are undertaken on the Yandeyarra Indigenous Reserve.

5.2.2 Atlas Iron - Mt Dove

Atlas Iron Pty Ltd currently hold Groundwater Well Licence (GWL) 175319, which provides a 650 Ml annual allocation for abstraction from the Pilbara Fractured Rock Aquifer Resource. Four production bores are associated with this GWL and occur about 9 km to 10 km from the Hemi Deposit. The licence was originally obtained to support the Mt Dove iron ore mining operation, which was active in 2012 and 2013. The site then crushed ore from Wodgina before going into a care and maintenance phase in April 2015 (Atlas Iron, 2016).

For almost ten years now, groundwater use by Atlas Iron has been highly limited (relative to their allocation). Currently groundwater is abstracted to supply the Mt Dove Village, which De Grey have at times utilised on a hire basis to accommodate some of its Hemi workforce.

Figure 5–2 Active Pastoral Bores and Wells



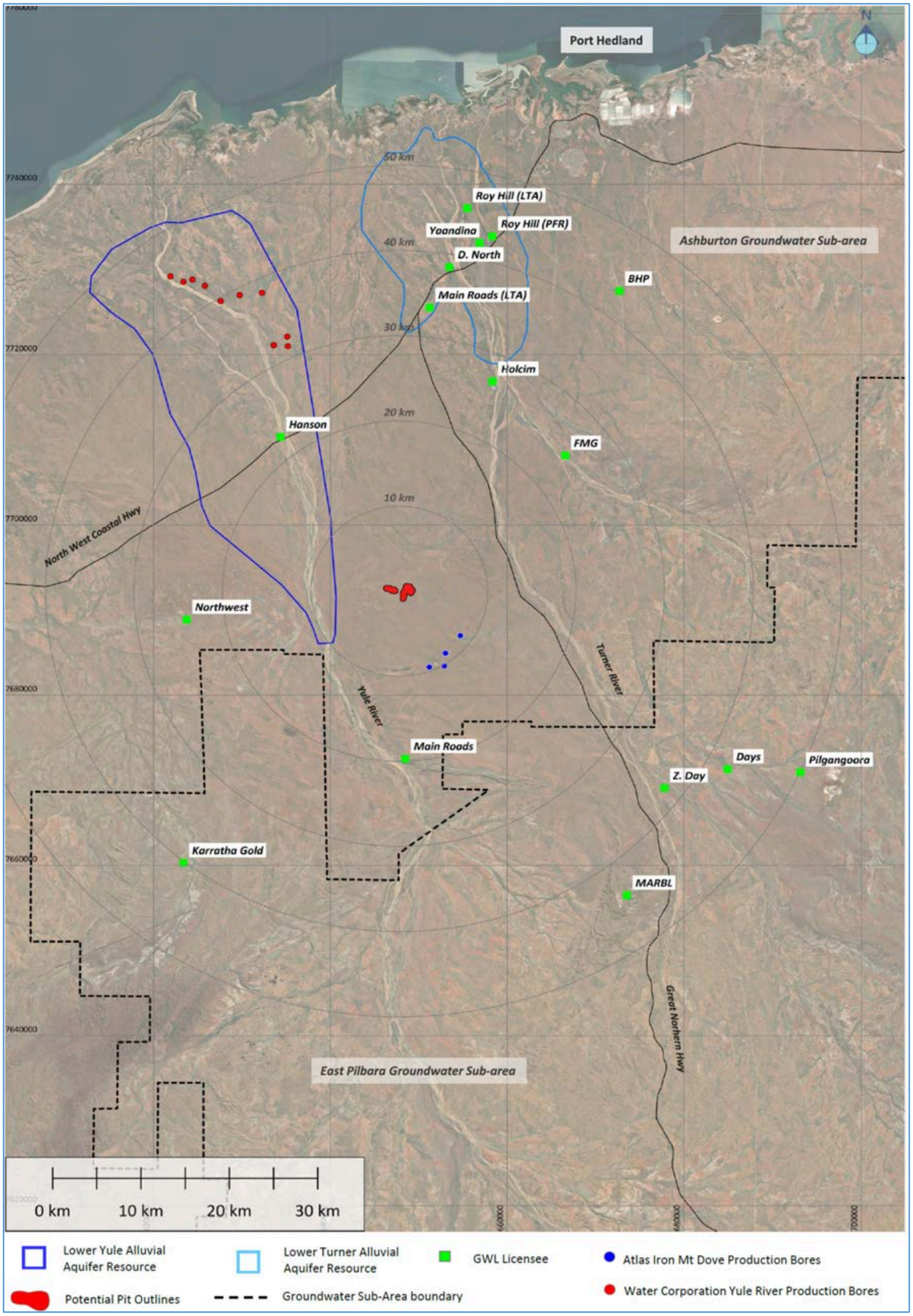
5.2.3 Water Corporation – Yule River

The Water Corporation operates the Yule River Borefield in accordance with the terms of GWL65501 to provide public and industrial water supplies to Port Hedland. Ten production bores are located near the eastern bank of the Yule River as shown in Figure 5–3. These bores are between 32 km to 45 km to the northwest of Hemi.

The GWL allows for the annual abstraction of 10,500 Ml. Public *Hansard* records highlight that abstraction is usually much lower than the allocation limit; ranging from 2,800 Ml in 2013/2014 to 7,197Ml in 2018/2019. An important aspect of water use from this borefield is the need to limit water salinity to maximum levels of about 500 mg/l to 600 mg/l. In years with significant flooding of the Yule River and resultant aquifer recharge, more low salinity water can be accessed by the borefield, compared to dry years with limited or no river flows.

Being a public drinking water source, the Yule River Borefield is protected by the Yule River Water Reserve water source protection plan, which was last updated in 2019 (DWER, 2019). The entire reserve is designated as a Priority 1 area to protect its water quality. The boundary of this reserve is shown in Figure 5–3, which highlights that the southeast edge of the reserve occurs about five kilometres from the nearest Hemi deposit.

Figure 5–3 Groundwater Licences



5.2.4 Other Licensed Groundwater Users

Table 5–1 summarises all current groundwater licence holders within a 50 km radius of Hemi, with the approximate locations of these licensees shown on Figure 5-3. The GWL details were sourced from DWERs online *Water Register* tool on 23 June 2022.

Table 5–1 Current Groundwater Well Licences (June 2022)

GWL #	Licensee	Annual Allocation (kL)	Aquifer Resource	Expiry
175319	Atlas Iron Pty Ltd	650,000	Pilbara – Fractured Rock	16/6/2025
167110	BHP Iron Ore Pty Ltd	480,000	Pilbara – Fractured Rock	18/8/2023
179392	Z, C. Day	50,000	Pilbara – Fractured Rock	14/10/2028
183717	Days Contracting	280,000	Pilbara – Fractured Rock	14/1/2029
161699	FMG Ltd	100,000	Hamersley – Fractured Rock	07/9/2024
176212	Hanson Constructions	280	Pilbara – Lower Yule Alluvial	09/9/2028
84876	Holcim (Australia) Pty Ltd	150,000	Pilbara – Fractured Rock	07/5/2023
202110	Karratha Gold Pty Ltd	95,000	Pilbara – Fractured Rock	05/11/2028
182429	Main Roads	13,750	Pilbara – Fractured Rock	30/7/2030
20856	Main Roads	10,000	Pilbara – Lower Yule Alluvial	09/6/2029
154570	MARBL Lithium Operations	5,610,000	Pilbara – Fractured Rock	27/5/2030
160528	*Northwest Nonferrous Australian Mining*	*20,000*	*Pilbara – Fractured Rock*	*12/5/2024*
18193	D. North	250	Pilbara – Lower Turner Alluvial	05/11/2025
183354	Pilgangoora Operations Pty Ltd	6,900,000	Pilbara – Fractured Rock	05/8/2029
174994	Roy Hill Infrastructure Pty Ltd	100,000	Pilbara – Fractured Rock	02/2/2024
176004	Roy Hill Infrastructure Pty Ltd	150,000	Pilbara – Lower Turner Alluvial	18/6/2029
65501	Water Corporation	10,500,000	Pilbara – Lower Yule Alluvial	14/12/2026
173692	Yaandina Family Centre	5,000	Pilbara - Alluvial	26/5/2026

The Main Roads Department of the West Australian government hold two small groundwater allocations in the region surrounding Hemi for occasional use on road maintenance works. GWL160528 is held by Northwest Nonferrous Australia Mining and is part of the De Grey suite of companies and mining tenure associated with the Withnell Deposit (formerly the Indee Gold Mine).

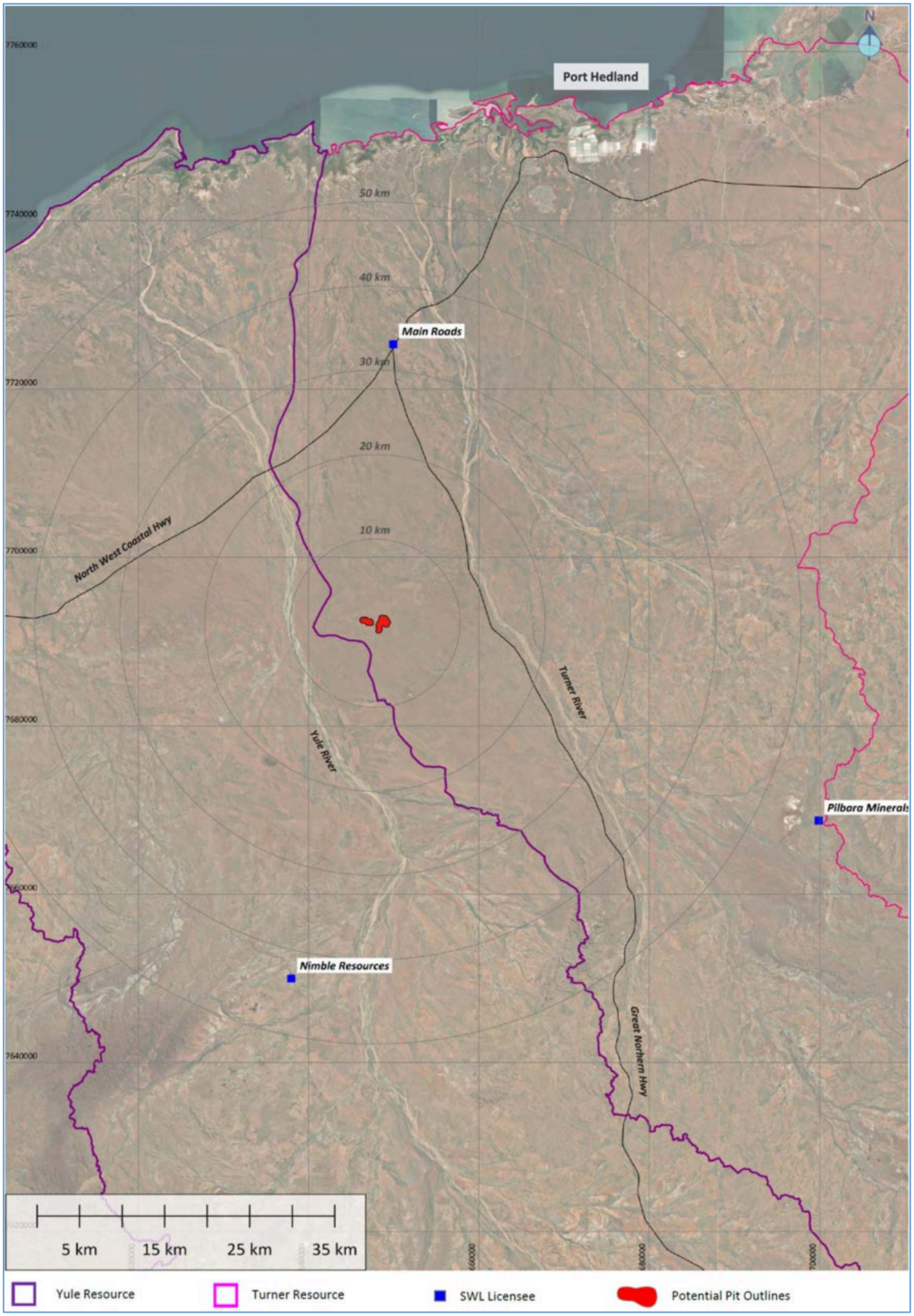
5.3 Existing Licensed Surface Water Users

Very little licensed surface water abstraction occurs in the study area. Only three surface water licenses are in force as of June 2022, as shown on Figure 5–4, and summarised in Table 5–2.

Table 5–2 Current Surface Water Licences

SWL #	Licensee	Annual Allocation (kL)	Surface Water Resource	Expiry
179532	Main Roads	1,250	Turner	16/11/2030
204450	Nimble Resources Pty Ltd	250	Yule	17/06/2030
202597	Pilbara Minerals Ltd	60,000	Turner	21/03/2029

Figure 5–4 Surface Water Licences



5.4 Other Users

5.4.1 Pastoral Users

Figure 5–5 shows the model prediction with 50 % aquifer reinjection of the maximum water table drawdown contours that occur at the end of the project, just over 12 years after mining commences. The simulations indicate that three pastoral bores on Indee Station will occur within the drawdown cone created by the project:

- UNK1 – 8 m of drawdown
- UNK2 – 9 m of drawdown
- No. 10 Well – 15 m of drawdown.

These drawdowns are highly likely to render the bores inoperable. Consequently, the recommended mitigation measures would be for De Grey to either:

- drill and construct deeper bores; or
- pipe water at a suitable rate and quality to these locations.

The available drilling and hydrogeological modelling indicate that deeper replacement bores would be feasible for sites UNK1 and No.10 Well, but that UNK2 may require the pipeline option.

The closest active pastoral bores on the Mundabullangana lease occur between 11 – 16 km to the north of Hemi (No.18 Well, Chimney Well, Wodgina and SE Corner – see Plan 3-2). No drawdown is predicted at these sites. To address any potential concerns the Mundabullangana lessee has with the security of their groundwater supply from Hemi impacts, routine monitoring of their bores and De Grey water bores closer to Hemi could be undertaken to reconcile future actual groundwater levels against simulated levels.

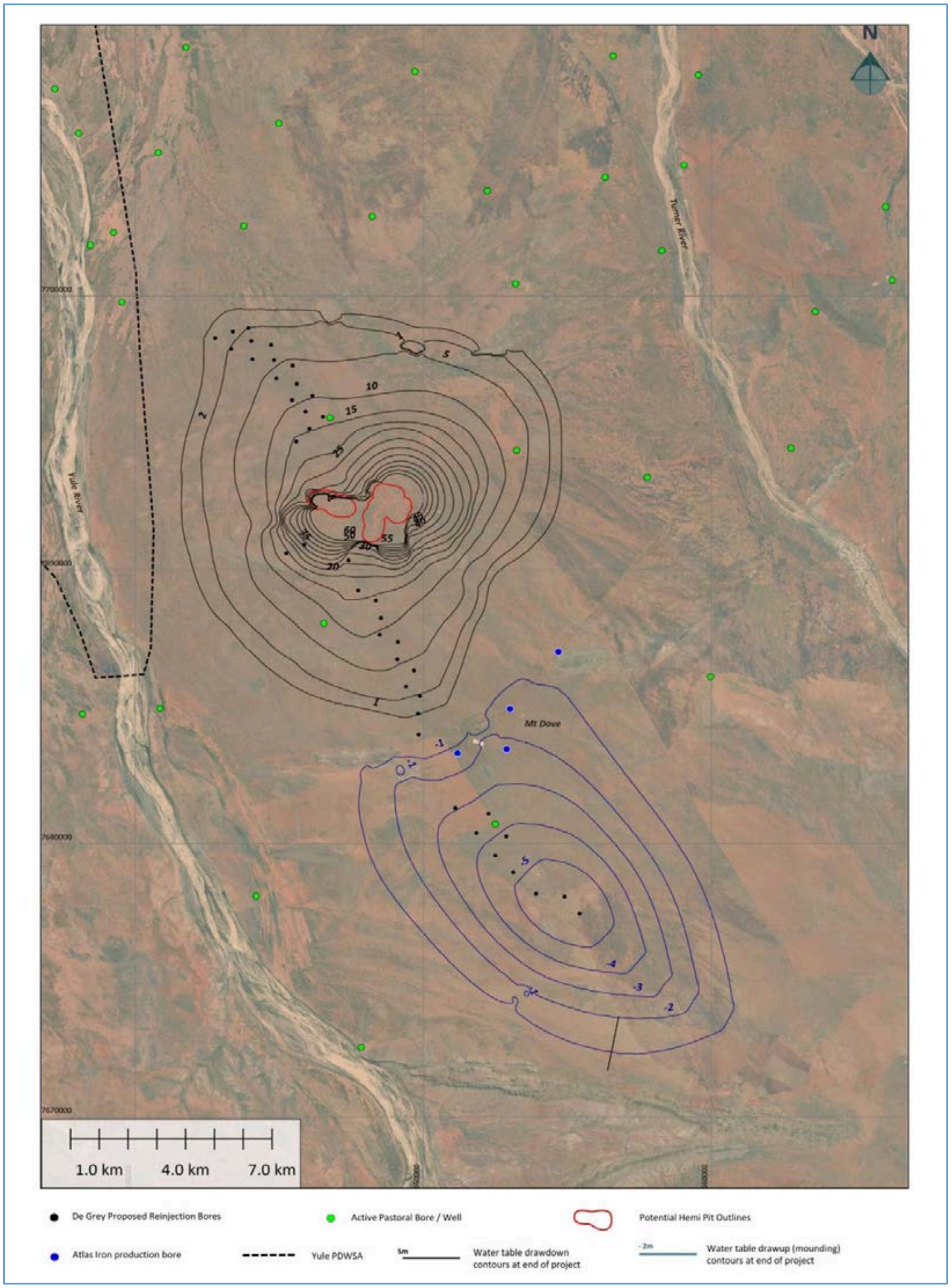
5.4.2 Atlas Iron Mt Dove

The Hemi project is predicted to affect groundwater levels at the most westerly of the four Mt Dove production bores (MDEX6) with a predicted maximum decline of just over one metre. This amount of decline is unlikely to affect operational yield or performance of this bore based on the published bore details (MWH, 2011). This assertion is based on the assumption that Atlas Iron operates the borefield in the future at its full allocation of 650 Ml/annum, with the largest individual bore yield coming from the affected bore. It is possible that future abstraction rates from the Mt Dove bores by Atlas Iron will remain at their historically low levels, in which case, the impact of a 1 m decline in the bore would be considered negligible. It is possible that the current allocation may be reduced to reflect actual usage levels when the 10 year licence term that is due to expire in June 2025.

The limited drawdown described above is partly a response of the aquifer reinjection planned by De Grey as part of the strategy to manage surplus dewatering. Without this measure, groundwater level drawdowns at the Mt Dove bores would be greater. Aquifer injection from the four most southerly reinjection bores is relatively limited, with individual bore rates restricted to 1,200 kl/day, and reinjection simulated to cease three years before the end of the Hemi Project. However, the limited reinjection would still have a positive effect on final drawdowns in the Mt Dove bores.

The proposed aquifer reinjection would not have any other adverse effects on the Mt Dove bores based on the particle tracking modelling that has been undertaken of injected water.

Figure 5–5 Maximum Operational Drawdown Contours with 50 % Aquifer Reinjection



Given the predicted lack of impact from Hemi abstraction, no direct mitigation measures are considered necessary. However, routine monitoring of De Grey bores to the south of Hemi would be undertaken and should be reconciled with groundwater monitoring data from the Mt Dove bores (either provided by Atlas Iron or as collected by De Grey under a suitable bore access agreement) by a qualified hydrogeologist.

5.4.3 Water Corporation Yule River Borefield

Groundwater abstraction and aquifer reinjection for the Hemi Project would not have an adverse impact on the operation or sustainability of the WaterCorp Yule River Borefield. Figure 5–6 shows that, during the Hemi operational period, the maximum drawdown extends about nine kilometres to the northwest of the project and that WaterCorp production bores are located a further 22 km to 36 km away. Modelling by MWH (2010) for a maximum abstraction scenario (10 Gl/annum) predicted the extent of 1 m of drawdown as shown on Figure 5–6, which indicates the distance between the two drawdown regimes is at least 15 km.

The predicted groundwater levels confirm the lack of potential for 'interference' or cumulative impacts between the two borefields. This is consistent with expectations, as the Yule River Borefield is configured and operated such that the majority of the groundwater it abstracts is low-salinity water that is replenished by large, albeit irregular, river flow events adjacent to the borefield.

5.5 Aquifer Resource Depletion

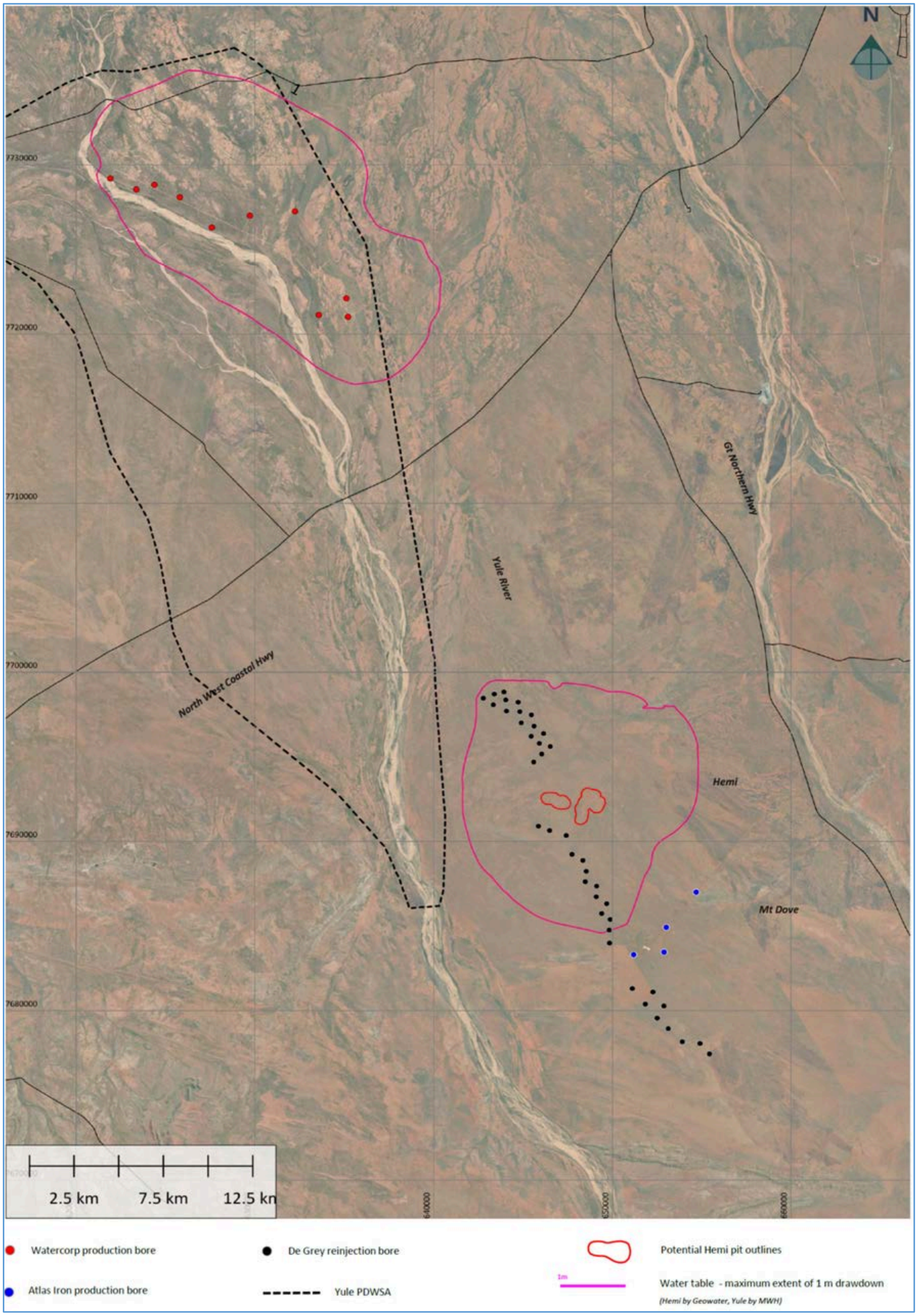
Figure 5–5 shows the maximum drawdown contours of the water table predicted at the end of mining for the base case dewatering scenario. Given the predicted drawdown extent, it infers a significant amount of the alluvial aquifer is dewatered by the Project. *Surfer* software has been used to estimate the reduction in alluvial aquifer volume:

- Within the confines of the model area, the alluvial aquifer has a total volume of 11,873 Mm³ using the December 2021 water table.
- At the conclusion of mining and processing, the alluvial aquifer has a total volume of 10,276 Mm³, which equates to an aquifer volume reduction of almost 1,600 Mm³ (or 13 % of the pre-dewatering volume).

In terms of stygofauna habitat issues, the reduction in aquifer volume may be insignificant. The pre-dewatering and end-dewatering water table surfaces have been provided to the expert consultant Bennelongia for their consideration of project impacts.

After completion of mining, groundwater levels in the region surrounding Hemi will start to recover slowly as natural recharge events occur. Prior to this, there is a potential for regional water tables to continue declining for a period following completion of mining, as the alluvial aquifer near the open pits continues to drain groundwater into the pit voids. This effect is referred to as residual drawdown.

Figure 5–6 Hemi and Yule River Borefields Drawdown Extent with 50 % Aquifer Reinjection



5.6 Dewatering Discharge to Turner River

Geowater has provided modelling outputs so that the assessment of potential impacts on surface water quality and the ecology of the river system can be completed by others (De Grey, RPM Global, Stantec, MBS Environmental).

Modelling by SWS (2022) of the surplus water schedule provided by Geowater with 50 % aquifer reinjection indicates that the wetting front within the river channel will travel downstream approximately 50 km. Figure 5–7 shows the maximum extent of inundation predicted by SWS in the Turner River within the first 12 km downstream of the proposed discharge location. The modelling by SWS is focussed on the impacts of discharge on the river during the dry season periods with no natural flows. Key reasons for the lengthy and narrow saturation front include:

- Presence of relatively narrow sub-channels within the overall river channel, as mapped from a detailed Lidar survey flown by De Grey for the purpose of the discharge modelling;
- Evaporation losses are relatively low given that the ponding created by discharge maintains a narrow water channel width (typically less than 90 m, with an average width of about 50 m);
- The infiltration losses to the subsurface and underlying water table aquifer are relatively low.

The infiltration loss terms used in the hydrology model by SWS were provided by Geowater based on the following approach and assumptions. The transient nature of seepage below the wetted riverbed was addressed by simplifying seepage into two categories:

1. ***Early stage of water seepage into the unsaturated zone above the underlying water table***. Within the investigated reaches of the river, the dry season water table occurs 2 m to 4 m below the lowest elevations of the riverbed. The geology of the unsaturated zone is relatively complex and comprises various combinations of:

   a. coarse sand and gravel deposited by current river system, with very high permeability and porosity (assumed to be 25 %);

   b. older, finer grained alluvium, with minor to moderate permeability and porosity (assumed 10 %); and

   c. weathered to near fresh bedrock of low to very low permeability and porosity (assumed 5 %).

2. ***Later ongoing stage of seepage once water table mounded to the riverbed***. Given the typical vertical permeability profiles below the riverbed, it was assumed that mounding of the water table would rise to the base of the ponded riverbed sections, at which point the ongoing seepage loss to the shallow aquifer would be largely controlled by the lateral permeability of the aquifer and the developed hydraulic gradients. Estimates of the ongoing seepage rates were made using Moundsolv v4.0 software with the Zlotnik et al, 2017 transient solution for a rectangular recharge source. This software is typically used to estimate the geometry of mounding for a given seepage (recharge) rate. For our case, the maximum mounding height was fixed as the depth to the water table below the lowest parts of the riverbed and then the recharge rate was 'reverse' calculated. Values of ongoing seepage of 0.08 Ml/day/km to 0.24 Ml/day/km of river reach were derived at different locations.

Figure 5–7 Turner River Discharge – Modelled Peak Inundation

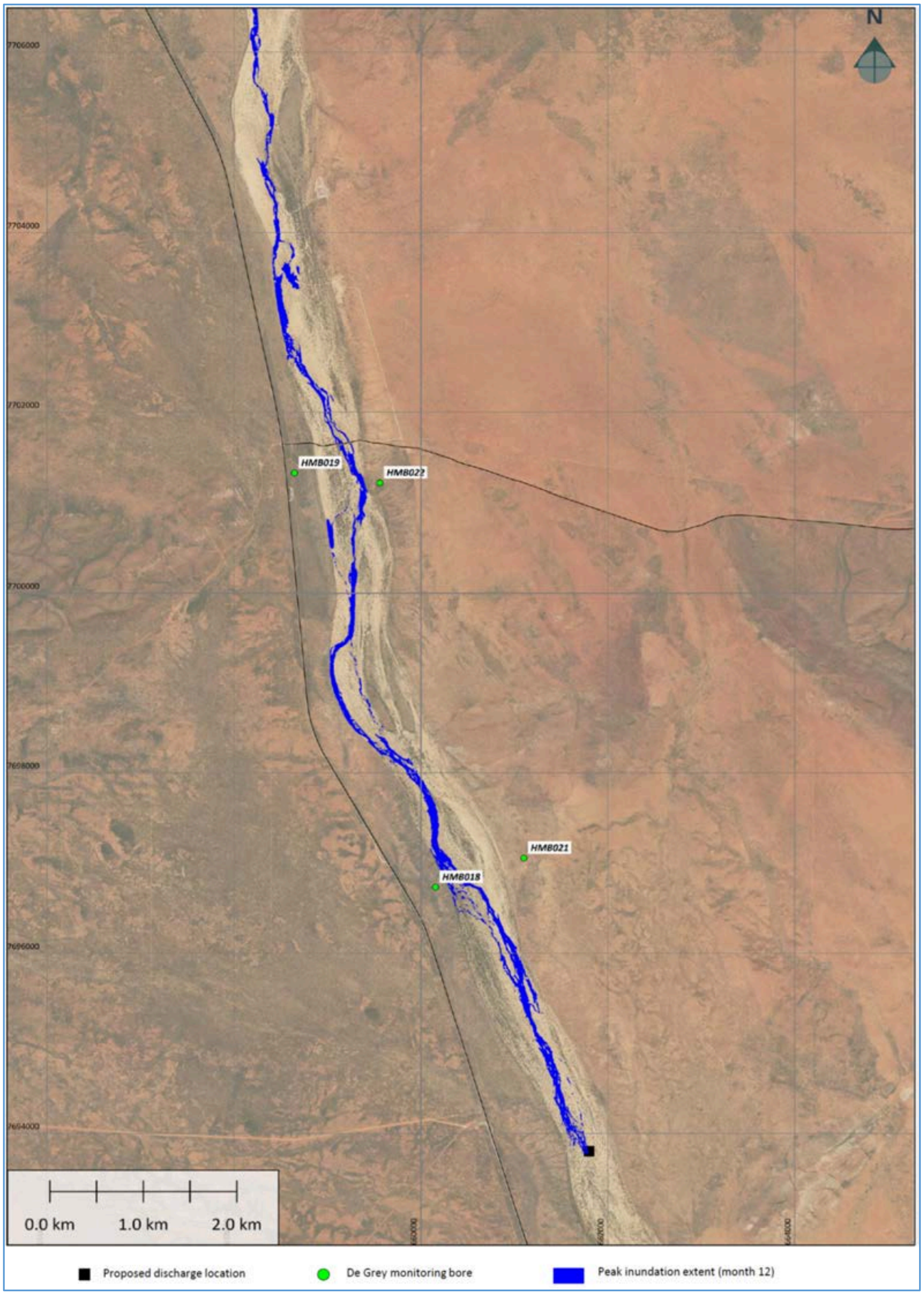


Figure 5–8 and Figure 5–9 show the geology profiles and December 2021 water table position at four different transects across the river, using the results of the monitoring bore drilling and passive seismic survey undertaken near and over the Turner River south of the Indee Station causeway in 2021. The lithology profiles and assumed porosities were then used in conjunction with the modelled saturated widths to calculate the unsaturated zone storage above the water table at each transect. Values of

between 110 Ml/km to 150 Ml/km of river reach were derived. These were treated in the hydrology model as a 'one-off' loss term as the saturated front progressed downstream over time.

Figure 5–8 Turner River Sections HMB017 to HMB020 and TRS

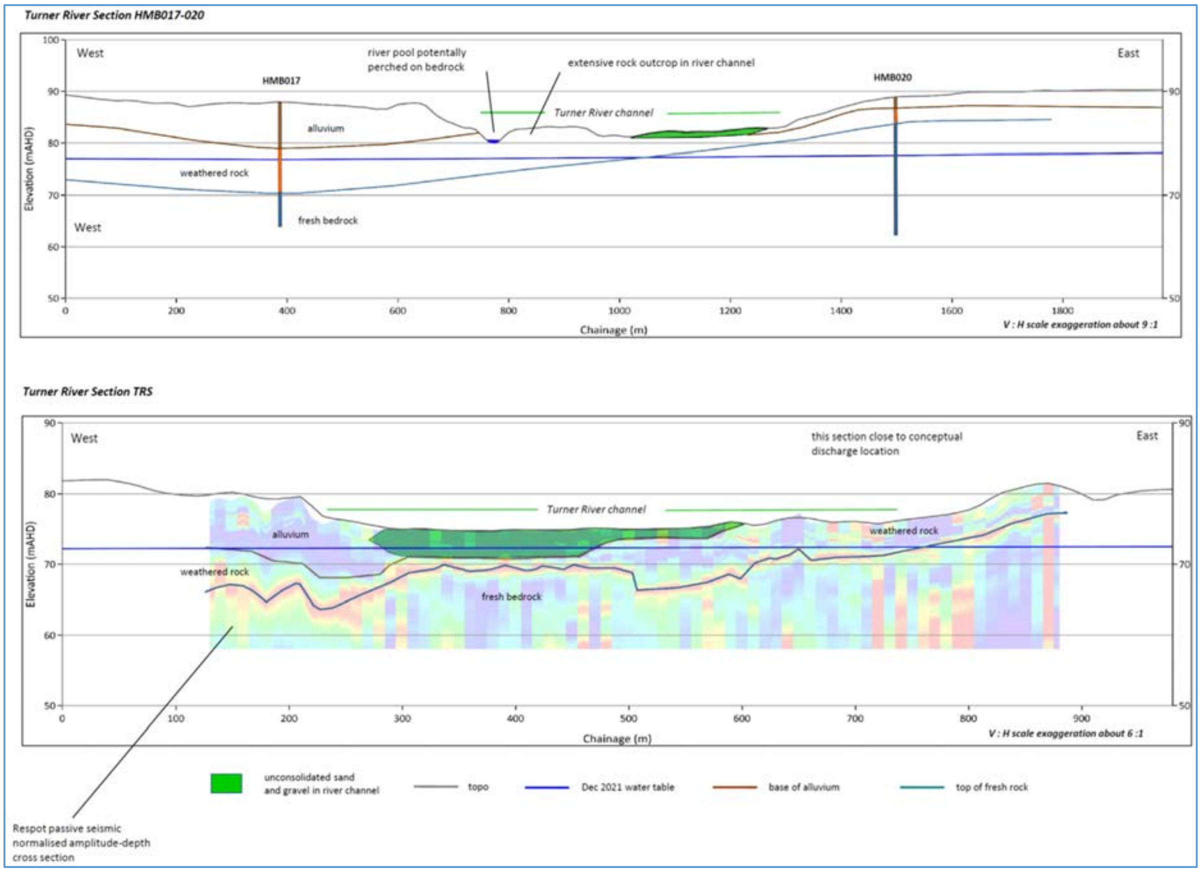
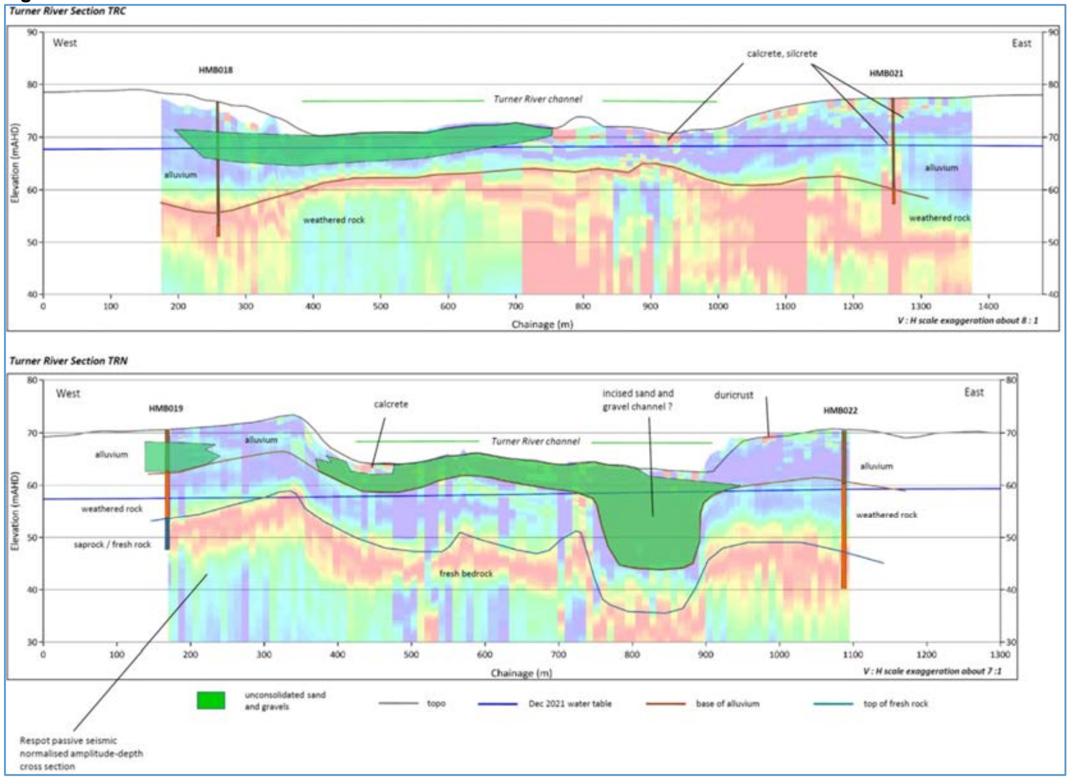


Figure 5–9 Turner River Sections TRC and TRN



The impacts of the proposed river discharge on the underlying aquifer are likely to be negligible and non-adverse for the following reasons:

- As shown on Figure 5–10, the *Moundsolv* analyses indicate that the lateral extent of water table mounding above 0.5 m is limited to within 300 m to 600 m of the water channel.
- The discharge water quality is similar to the baseline groundwater quality as shown in Table 5–3.
- The changes caused by discharge are of a smaller magnitude and short timeframe relative to the ongoing episodic natural flood events that results in recharge to the underlying and surrounding water table aquifer.

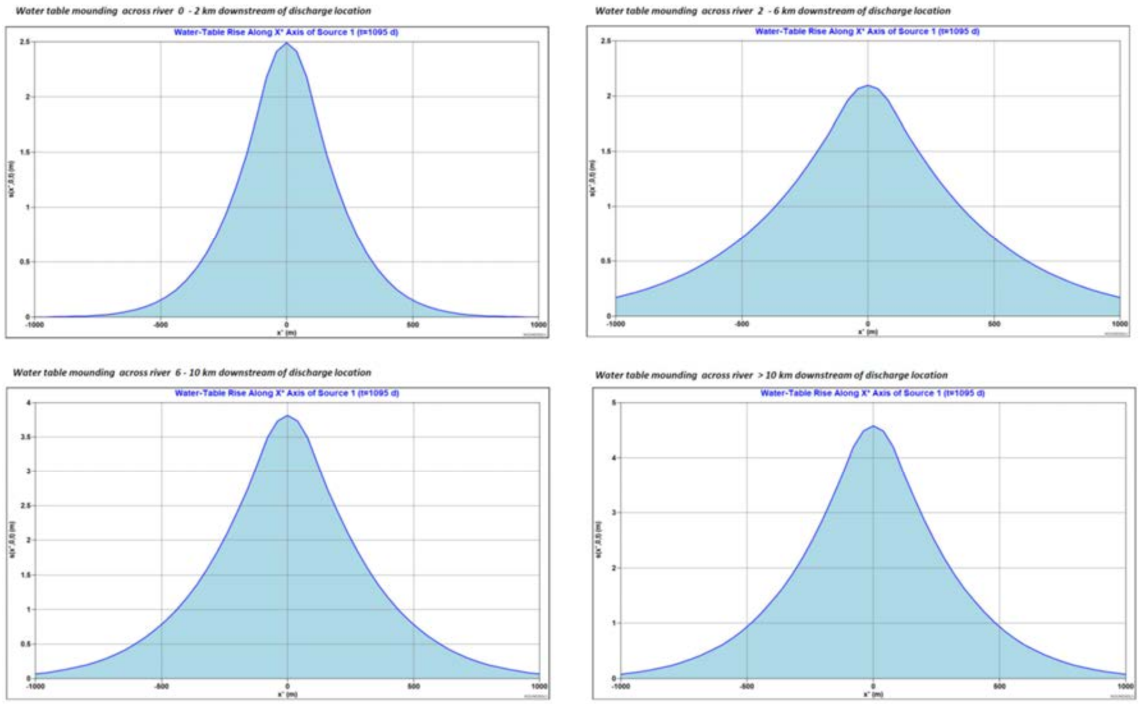
Table 5–3 Turner River and Discharge Water Quality Summary

Parameter	Unit	Dewatering Discharge [1]	Turner River Groundwater	Turner River Surface Water [2]
Salinity (as TDS)	mg/L	700 – 1,000	360 – 1,360	150 – 1,800
Suspended Solids (TSS)	mg/L	< 20	n/a	5 - 150
pH	-	7.9 – 8.4	7.4 – 8.1	6.6 – 9.4
Total Alkalinity	mg/L as $CaCO_3$	310 – 410	200 - 410	30 - 460
Hardness	mg/L as $CaCO_3$	200 - 320	250 - 510	50 - 310
Iron (dissolved)	mg/L	0.002 – 0.050	0.002 – 0.680	0.005 – 0.120
Aluminium (dissolved)	mg/L	0.005 – 0.030	0.005 – 0.020	0.005 – 0.011
Arsenic[1] (dissolved)	mg/L	0.005 – 0.024	0.001 – 0.009	0.001 – 0.010

Notes 1. Excludes bedrock bore samples from ore zones

2. Includes flowing surface water and dry season pool samples collected by De Grey and also DWER at Pincunah Gauge Station

Figure 5–10 Turner River Discharge – Predicted Water Table Mounding



5.7 River Pool and Riparian Vegetation

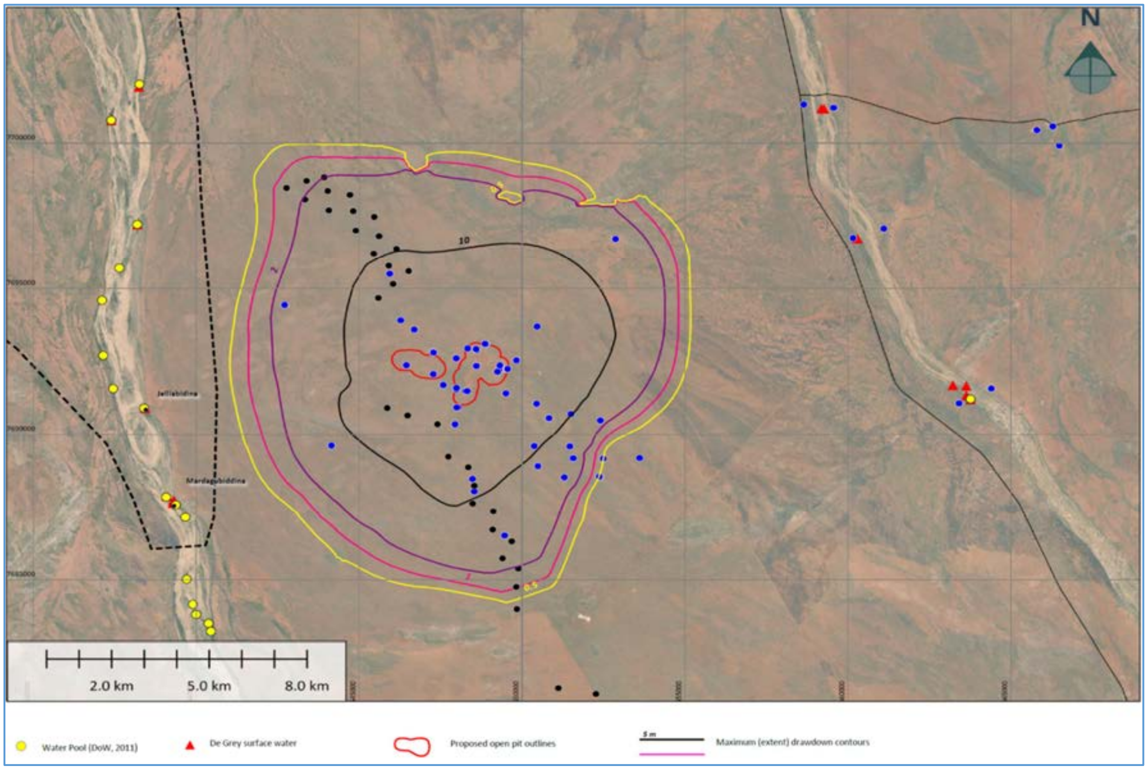
Figure 5–11 shows the maximum predicted drawdown extent of groundwater abstraction by De Grey at the completion of ore processing (13.25 years after dewatering commences) and the location of river pools mapped by the Department of Water in 2008. This plan shows that the pools in the Yule River are at least 2 km to 3 km from the maximum 0.5 m drawdown extent. Only one river pool has been identified on the Turner River in the study area and this is located 8.5 km beyond the maximum 0.5 m drawdown extent.

Based on the monitoring that has been completed at several of the Yule River pools, it is considered likely that most of the Department of Water mapped pools have at least a partial groundwater dependence. However, given the significant buffer distance of 2,000 m to 3,000 m between the closest pools and the final drawdown cone produced by De Grey, there is unlikely to be any adverse impact on river pool levels or water quality from mine dewatering by De Grey.

To confirm this assessment and provide the basis for adaptive management measures during operations, two monitoring bore transects between Hemi and the Yule River, as well as continuous surface water level logging in several river pools, are proposed.

Government mapping indicates that riparian woodland species of vegetation occur only within the current day channels of the Yule River closest to the drawdown cone developed by the Hemi operations. Given the same buffer distances for river pools also applies to the riparian vegetation, then the mine dewatering impact on the water table is unlikely to reach or affect the riparian vegetation.

Figure 5–11 Maximum Drawdown Extent and River Pools



5.8 Aquifer Reinjection

Approximately 50 % of the total dewatering volume during operations is proposed to be reinjected into the basal paleochannel aquifer via 40 bores located upgradient and downgradient of Hemi. This has the beneficial effect of reducing drawdowns near the Yule PDWSA and the Atlas Iron Mt Dove borefield as described earlier.

Potentially impacts associated with the proposed aquifer reinjection comprise:

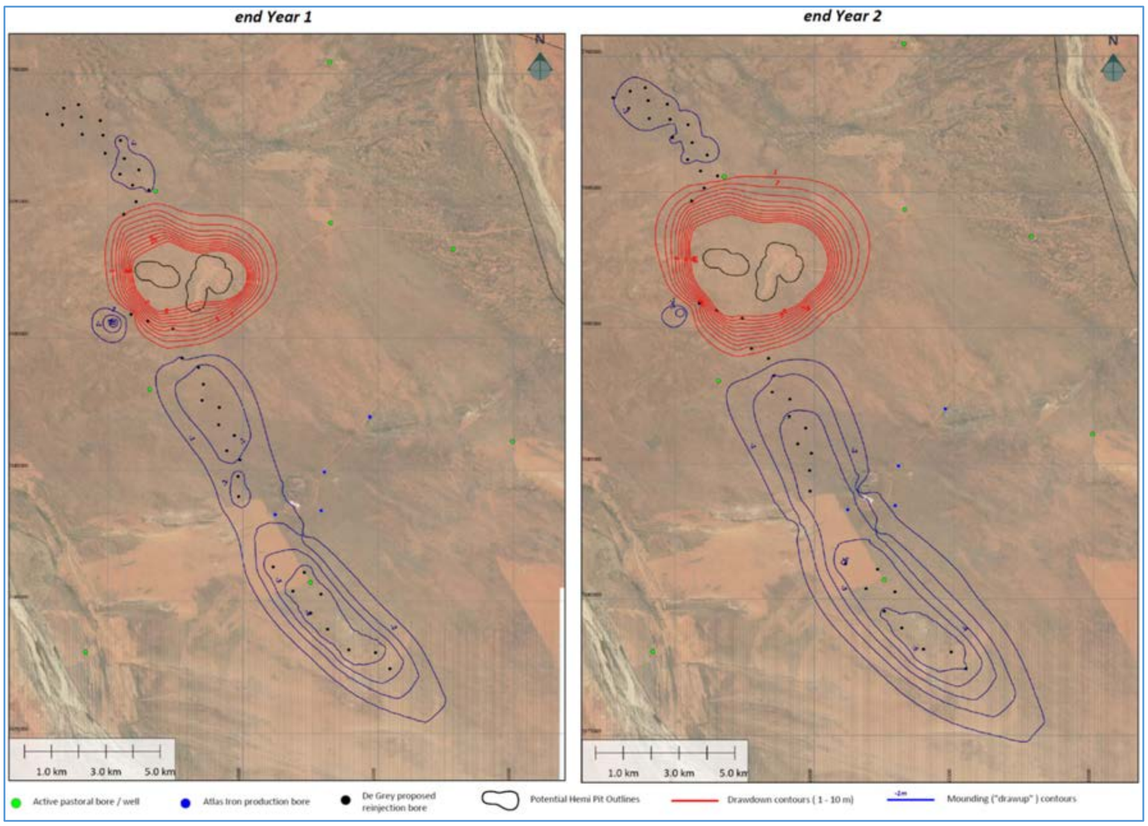
- Level of the relatively shallow water tables rises (mounding) to a level whereby:
  - shallow rooted vegetation may be impacted;
  - water logging close to or at surface impacts nearby infrastructure; or
  - salinisation of the water table zone occurs via near-surface evaporation;
- Differences in water quality between the native groundwater and reinjected water leading to impacts to nearby groundwater users and environmental values.

The awareness of these potential impacts was used explicitly in deriving the proposed reinjection bore locations, reinjection rates and volumes. A key example of this awareness was adopting the criteria to prevent the mounding of the water table from becoming any shallower than two metres below ground in the reinjection areas.

Reinjection of greater proportions of dewatering discharge was considered and simulated but was found to be less effective given the potential for greater recirculation of reinjected water back to the mine dewatering system during operations and an increase in water table rise.

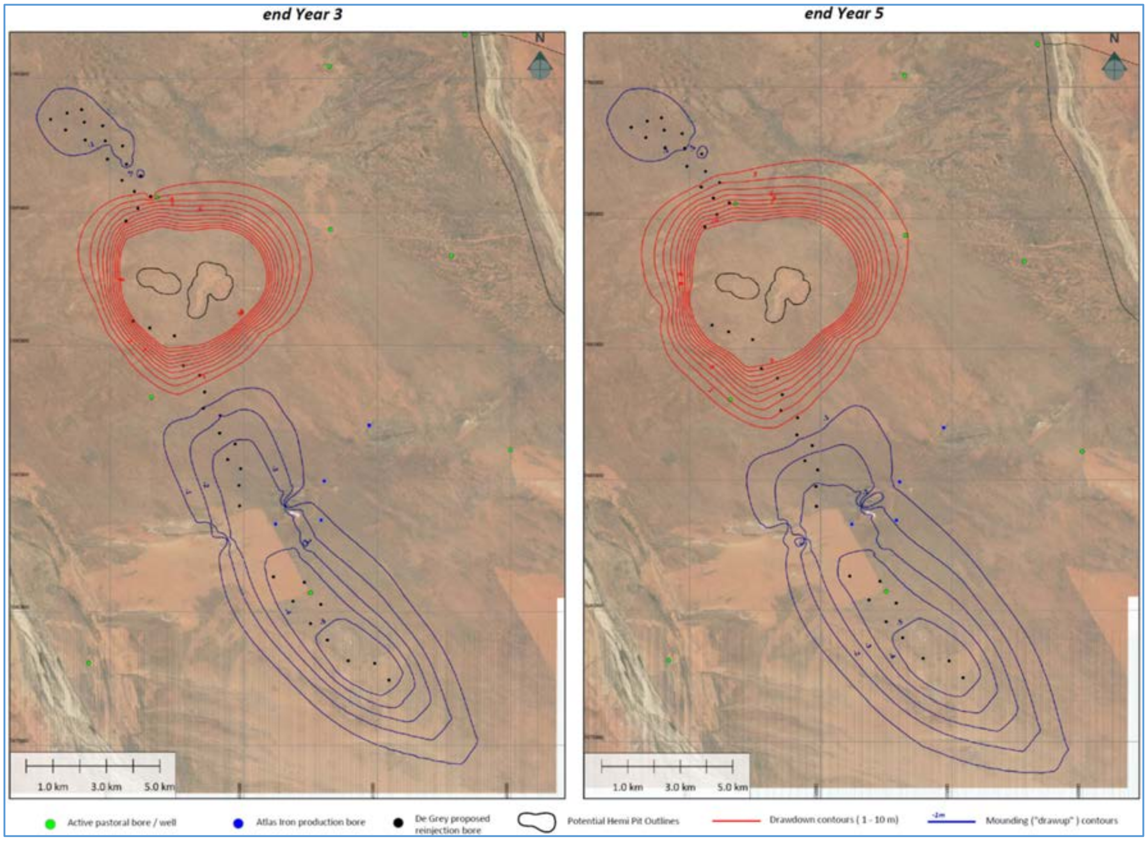
Figure 5–12 and Figure 5–13 show the predicted levels of water table mounding during the early years of the project when reinjection rates are the greatest. In the later years of the project, when reinjection rates are lower, the reinjection is focussed on the southernmost and northernmost reinjection bores to have a relatively larger effect near Mount Dove and the Yule PDWSA. The plans highlight that water table mounding is greatest in the southern reinjection borefield (where the baseline water table depth is greatest) and peaks between 4 m to 5 m around 3 years after mine dewatering commences. The simulated mounding does not cause water tables to rise higher than 2 m below ground surface at any location, and the groundwater level rise of between 1.0 m to 2.5 m in the Atlas Iron production bores would not be adverse.

Figure 5–12 - Water Table Mounding from Reinjection – Year 1 and Year 2



The water quality of reinjected water is fundamentally the same as the native groundwater present in the nearby reinjection borefield areas. The key difference relates to the dissolved arsenic levels of the dewatering discharge in some zones, given the association of arsenopyrite with gold mineralisation at Hemi. Baseline levels of arsenic in the proposed reinjection areas are between 0.005 mg/l to 0.010 mg/l. Where dissolved arsenic levels exist in those zones in proximity to mine dewatering bores and in-pit sumps, the delivery of that water would be managed as discussed earlier.

Figure 5–13 Water Table Mounding from Reinjection – Year 3 and Year 5



5.8.1 Reinjection of Elevated Soluble Metals (including Arsenic)

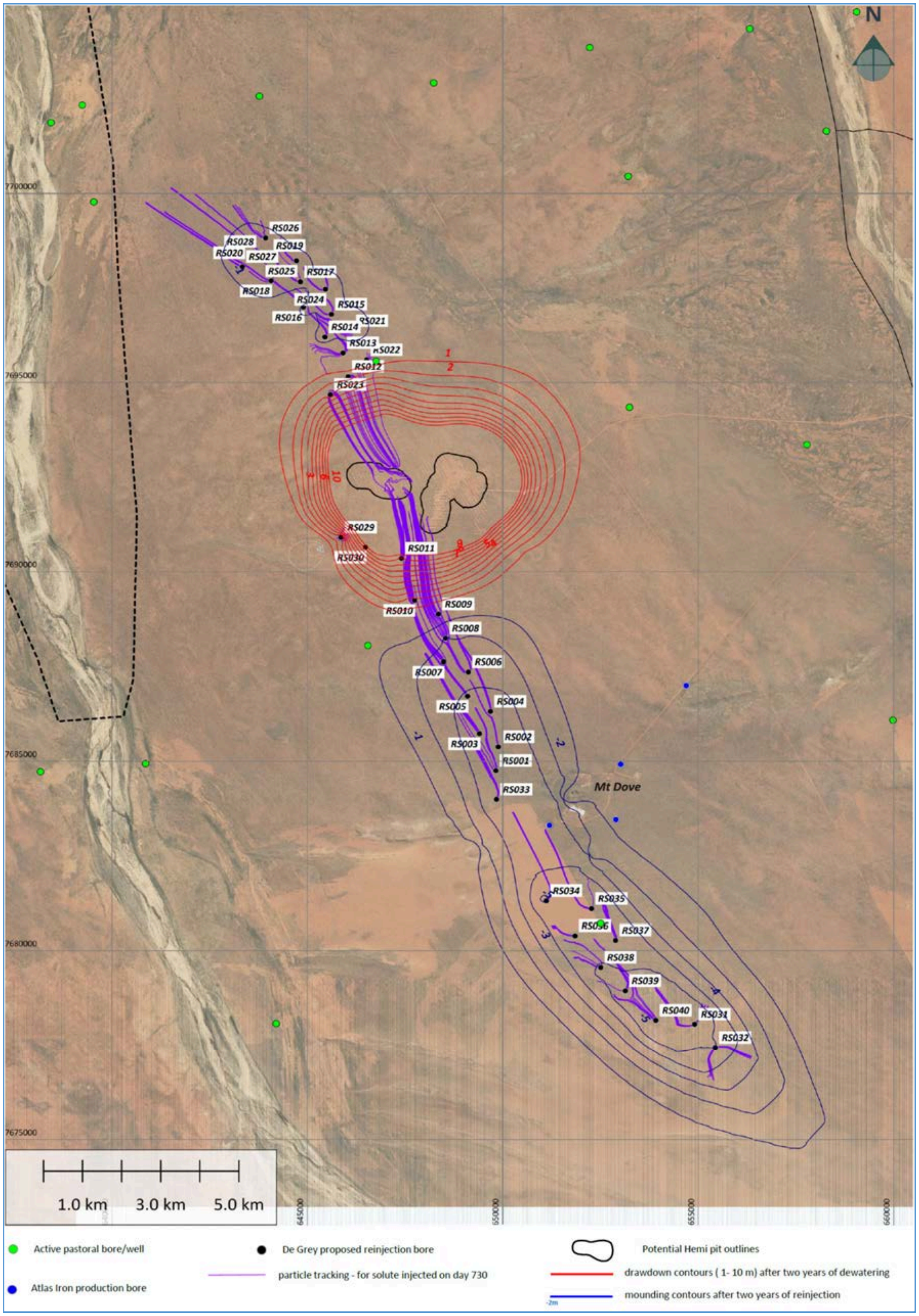
Two years after mine dewatering commences, any zones containing elevated levels of soluble metals including arsenic will be directed to the processing plant, where the process flowsheet ensures that adverse impacts are mitigated. Prior to this point in time, it is proposed that the aquifer reinjection system would be designed in a manner that would manage this groundwater.

The proposed system for managing elevated soluble metals that has been developed jointly by Geowater and De Grey assigns which dewatering bores and sumps (based on the water quality) are to be directed to specific aquifer reinjection bores that are known to recirculate back to the mine dewatering zone.

A detailed spreadsheet model utilising simulated pumping rates and groundwater levels from individual bores at quarterly intervals from within the groundwater model produces flow weighted calculations of arsenic concentrations for each individual bore and then determines which pipeline system that the groundwater would be directed to. Over the life of mine, the groundwater would be directed to the recirculation aquifer reinjection bores, the non-recirculation aquifer reinjection bores, the processing plant, or the Turner River discharge.

Particle tracking within the groundwater model confirms that eight reinjection bores (two on north side and six on south side) will recirculate groundwater back to the mine dewatering system within the life of the project. Figure 5–14 shows the particle tracking of water that is reinjected exactly two years after dewatering commences. This represents the time that the processing plant operations would commence and when groundwater with elevated soluble metals can be managed as part of the processing flowsheet.

Figure 5–14 Reinjection Bore Particle Tracking



The model scenario for the particle tracking shown on Figure 5–14 includes the assumption that Mt Dove resumes abstraction to their full allocation limit of 650 Ml/annum, with individual pumping rates assigned at ratios that match the recommended bore rates from MW (2011). This shows no potential for the Mt Dove bores to capture reinjected water from Hemi mine dewatering system.

The injection and subsequent recapture of dewatering discharge with elevated soluble arsenic assumes that the soluble arsenic remains soluble and does not precipitate or accumulate significantly within the alluvial aquifer system. Geochemical assessments of the aquifer material at the proposed reinjection sites is underway as part of the DFS to confirm this.

5.9 TSF

The design of any TSF includes an engineering specification relating to the degree of controlled seepage that in turn allows for the construction of a stable landform during operations and in the long term.

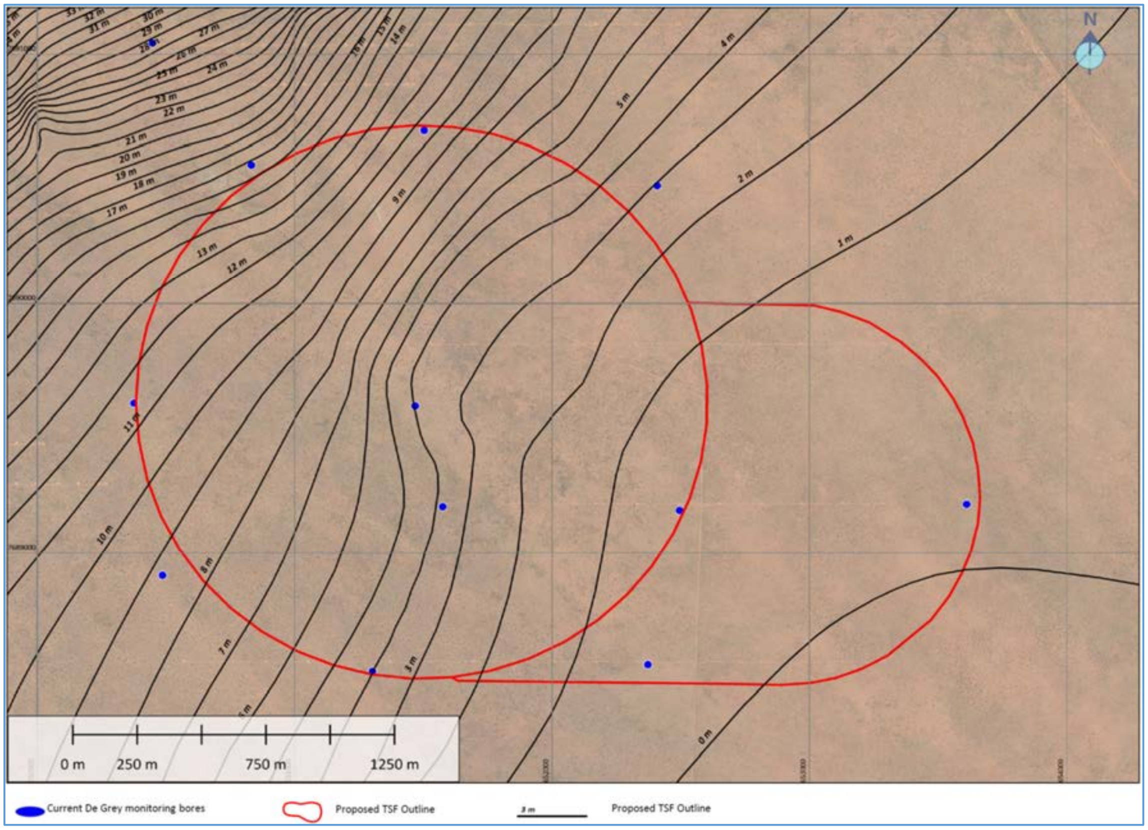
The degree of controlled seepage is assessed in relation to any potential impact upon the underlying water table. As should be the case with such an engineering design, the assessment of this was included as part of the numeric groundwater modelling.

The design estimate of controlled seepage provided by CMW as part of their TSF design work consists of a volumetric rate of 0.057Ml/day over a circular area of 10 ha in proximity to the central decant of the TSF. This controlled seepage rate was applied to the groundwater model as a linear recharge rate of 208 mm/annum across the 10 ha starting on day 639 of the groundwater model calendar, that is, at the commencement of processing plant operations.

The groundwater modelling results confirmed that there would be no mounding of the water table beneath the TSF during the operational phase. These results were expected ahead of the modelling, given the relatively low level of controlled seepage that was designed, the permeability of the alluvial aquifer, and the proximity to the dewatering effects of the pit.

Figure 5–15 shows the drawdown contours predicted at the end of the operational phase in the TSF area and highlights that drawdown (due to mine dewatering) of up to 15 m has been modelled, which dominates the groundwater regime beneath the majority of the TSF. The contours near the centre of the main TSF show a small distortion, which would be a result of the simulated seepage.

Figure 5–15 Maximum Drawdown Beneath TSF



6 MODEL UNCERTAINTY

All groundwater models that seek to predict the behaviour of most aquifer systems over large areas and long time periods are challenged by the issue of accuracy and uncertainty. The three most significant aspects of the groundwater system in the Hemi region considered to be affect certainty in the modelling of dewatering inflows and regional impacts are discussed below:

1. ***Fractured Rock Aquifer Settings at Hemi***

This aspect has significance to dewatering inflows, system design and surrounding environmental impacts. By design, one test production bore to date has been installed at Hemi (HPB010 in September 2021) within a fresh bedrock, fractured aquifer zone setting. The results of drill core logging and structural interpretations by De Grey were utilised by Geowater to develop several enhanced permeability zones related to igneous intrusive contact zones and the later stage set of NW-trending major faults. If the amount and degree of fracture zone permeability within fresh and transitional bedrock is more than what has been interpreted and modelled, there would be a tendency for

i. inflows to be higher through bedrock where these zones occur (not everywhere); and
ii. drawdown extent within the shallow alluvial aquifer could be increased if the fracture zones have a long extent outwards and away from the pit boundaries, as fracture zones typically store very little water themselves but act as flow conduits for overlying aquifers to drain into and through.

Given the amount of geological evidence gained from the extensive diamond drilling programme at Hemi, the potential for materially significant changes to modelled inflows and dewatering extents is considered low and not an impediment to EIA studies. Four to six fractured rock production bores are proposed for the DFS stage (Geowater, 2022) to test the conceptual model.

2. ***Regional location of paleochannel aquifer***

This aspect has significance to the potential for environmental impact issues rather than to the amount and timing of dewatering inflows. The Hemi and regional drilling by De Grey, as well as the Mt Dove borefield provides a high level of confidence in mapping the location and nature of the main palaeochannel aquifer over a reach of about 16 km (about 4 km north of Diucon and 10 km south of Falcon). The location and nature of the palaeochannel aquifer upstream and downstream of this reach is less certain. Depending on the actual headwaters location, there is a possibility that the palaeochannel becomes smaller and perhaps less permeable in the upstream (south) direction. Given the significant amount of bedrock near the Yule River and Turner River in the southern part of the model area and the related likelihood that the palaeochannel aquifer is not close to the rivers here, the consequence of the palaeochannel aquifer being in a different location to that modelled, or being less transmissive, is not considered significant, as the potential for greater drawdowns or river interactions are lower.

To the north of Hemi, the interpreted change in the direction of the palaeochannel from northerly to northwesterly is less certain. It is possible that the paleochannel continues in a more northerly direction than modelled. Given the lower paleochannel zone has a strong control on the extent and shape of water table drawdown, if it located significantly further east than modelled, the potential for drawdowns from the Hemi Project near the Yule River decreases. If the palaeochannel was located further east, it is still interpreted that a strong, if not, direct geologic and hydraulic connection occurs between the Hemi palaeochannel and Yule River Borefield. The current models provide what is considered a slightly conservative interpretation in terms of the paleochannel location and its role in potential environmental impacts.

3. ***Long term episodic river recharge***

The amount of recharge to the alluvial aquifer within the groundwater model domain from episodic river flows and floodplain inundation could be underestimated in the current prediction models by comparison to other relevant Pilbara groundwater models. The approach adopted for the Hemi steady state model is considered warranted given the distance of Hemi from the rivers and the degree of groundwater level data in the areas of interest. Given the relatively short time frame of dewatering (13 years) to the timescale of larger natural flood size variability, the potentially low river recharge rates used in the predictive models may not be a significant issue and tend towards a somewhat conservative estimate of dewatering extents.

7 GROUNDWATER & SURFACE WATER MONITORING TO SUPPORT LICENSING

7.1 Licensing and Operating Strategy Process

The groundwater and surface water monitoring programme outlined will, as expected, require updating over time. The monitoring programme would also, if required, address any new baseline monitoring infrastructure or water related issues that may be determined during the DFS stage.

Given the scale of intended groundwater use, the application to DWER for a 5C GWL for Hemi will include the a requirement for De Grey to develop and submit a *water resource operating strategy* as defined by DWER (2020b). The intent of the DWER operating strategy policy is to use the State's water licensing process *when granting access to the state's water resources to better manage the resources by:*

- adopting a flexible approach to the production of a water resource operating strategy to satisfactorily address issues related to the taking of water from a particular water resource at a specific location
- increasing the licensee's awareness of their responsibilities and their participation in managing the water resources and specifically managing the impacts of taking and using water
- utilising the licensee's knowledge of the local area and their industry to address site specific and operational issues related to the taking and use of water
- support the principle of water conservation where water taken is used in an efficient and productive manner
- ensure licensees have considered risk and contingency options should water shortages or unexpected impacts from water abstraction occur

The water monitoring programme becomes a segment of the operating strategy with both submitted in draft form at the time of submitting the 5C GWL application. A final agreed operating strategy is determined after review and inputs from DWER are addressed by the licensee. The finalised operating strategy then becomes a binding GWL condition.

7.2 Surface Water Monitoring

Table 7–1 provides a brief summary of existing surface water monitoring activities undertaken at the Project, based on the current awareness of groundwater and surface water interactions in the study area (Baseline Period). An indicative proposed monitoring summary (Operational Period) is also included as the Project intends to release a portion of the mine dewatering surplus to the Turner River for a 2 to 3 year time frame. Yule River monitoring is focussed on river pool levels and water quality, whilst the Turner River monitoring is focussed on river flows and associated water levels and quality, for both natural and discharged flows.

The surface water monitoring conducted by De Grey will be supplemented by other datasets to inform technical periodic review of the river systems and potential mine impacts:

- Climate data from automated weathering stations located at each De Grey accommodation village;
- 2 to 3 dedicated rainfall logging stations at and near Hemi;
- Aerial drone surveys flown by De Grey on an as required basis;
- Public domain datasets such as *SILO* rainfall and satellite imagery if required;

- WA DWER gauging station data from the Jelliabidina site (Yule River) and Pincunah station (Turner River).

Table 7–1 Surface Water Monitoring Summary

River	Locations	Parameters	Frequency	Comments
Baseline Period				
Yule River	5 x river pools	Water level	Quarterly, ad-hoc (after floods)	Locations include (including Jelliabiddina and Marda)
		Water quality - basic	Quarterly	Basic suite includes EC, TDS, pH, DO, ORP, turbidity
		Water quality - detailed	6-monthly	Detailed suite includes above, major and minor ions, nutrients, trace metals
Turner River	4 x river pools	Water level	Quarterly, ad-hoc (after floods)	Locations are Meerandanganna Pool, North West Coastal Highway, nr Holcim Quarry and pool 2 km upstream of discharge locations)
		Water quality - basic	Quarterly	As per Yule River
		Water quality - detailed	6-monthly	As per Yule River
	Discharge point, Indee Station Causeway	Water level	Hourly	
Operational Period				
Yule River	As for baseline period except water levels in pools to be 6-hourly data from loggers			
Turner River	Discharge point, Indee Station Crossing	Flow and levels	Continuous	
		Water Quality	Weekly	Basic and detailed suite
	4 x river pools	Water Quality	Monthly	Basic and detailed suite

7.3 Groundwater Monitoring

Table 7–2 provides a summary of existing and proposed groundwater monitoring for the remainder of the baseline (pre-dewatering) period. A summary of indicative proposed monitoring for the operational period is provided in Table 7–3 and highlights a high-level split between monitoring purposes of dewatering system effectiveness and environmental impact purposes. There is some overlap of monitoring data between the two purposes and invariably all the datasets are used during periodic reviews. Such reviews are also supported by using surface water and auxiliary data. Groundwater related data from surrounding groundwater users may be used during technical reviews.

7.4 Water Management Trigger-Action-Response Plans

As part of preparing the *water resource operating strategy* and other site water management plans, the full set of baseline data and concluded environmental impact assessments will be used to develop Trigger Action Response Plans (TARP's). Trigger levels will be established as numeric values of various surface water and groundwater water attributes at different locations and times. If these levels are approached and/or exceeded, a set of binding technical actions and management responses will be initiated.

The water TARP's will be aligned with the risk profile of each known and potential environmental and third party impact issue.

Table 7–2 Groundwater Monitoring Summary – Baseline Period

Location / Group	Purpose	Sites	Parameters	Frequency	Comments
Turner River	Baseline variation, surface water-groundwater interactions	6 x mb's (HMB017 - 022)	1. Swls 2. EC profiling 3. Water quality - detailed	1. 6-hourly 2. 6-monthly 3. 6-monthly	6 hourly swls derived from pressure transducer loggers
Hemi Deposit, Wingina Camp	Existing 5C GWL compliance	8 x pb's (WPB001 - 002, HPB001 - HPB005, HERC026.	1. Volumes 2. Water quality - basic suite 3. Water quality - detailed	1. Monthly 2. Monthly 3. Annual	
Hemi – Pit and TSF areas	Baseline variation	26 x mb's	1. Swls 2. EC profiling 3. Water quality - detailed	1. some bores 6 hourly, some bores monthly 2. subset of bores done 6-monthly 3. subset of bores done 6-monthly	Additional bedrock bore sites planned for installation in pit areas during DFS. 6-hourly swls derived from pressure transducer loggers.
Hemi – Reinjection and Regional areas	Baseline variation	8 x mb's	As above	As above	Additional bores planned for installation in DFS
Pastoral	Baseline variation	39 x pastoral bores and wells	1. Swls 2. Water quality - basic 3. Water quality detailed	1. 6 monthly (all sites) 2. 6 monthly (all sites) 3. 6 monthly (subset of sites, ~ 6)	
Hemi – Yule Transects	Baseline and baseline variation	12 x mb's	As above	As above	New sites to be installed during DFS on western and north-western transects between Hemi and Yule River

Abbreviations: swl = static groundwater level, mb = monitoring bore, pwl = pumping groundwater level, pb = production bore

Table 7–3 Groundwater Monitoring Summary – Operational Phase

Area / Group	Sites	Parameters	Frequency	Comments
		Dewatering and Reinjection System Effectiveness		
Hemi Pits	All active dewatering pb's	1. Pwl's 2. Water quality – detailed 3. Flow rates and volumes	1. Continuous 2. 6-monthy 3. Hourly	Parameters (1) and (3) Via telemetry/SCADA system – for individual bores
	All nearby mb's and inactive pb's	1. Swl's	1. 6 hourly	Via loggers or telemetry system
	Active in-pit sumps	1. Water quality – detailed 2. Flow rates and volumes	1. Monthly 2. Daily	Samples collected 'per Pit'
Reinjection Borefields	All active reinjection pb's	1. Pressure head at collar 2. Flow rates and volumes	1. Continuous 2. Hourly	Parameters (1) and (2) Via telemetry/SCADA system – for individual bores.
	All active 'control' mb's	1. Swls	1. Continuous	Via logger or telemetry system
	All nearby mb's	1. Swls 2. EC profiling 3. Water quality detailed	1. 6 hourly 2. subset of bores done 6 monthly 3. subset of bores done 6 monthly	Parameter (1) via loggers or telemetry
Dewatering Discharge to End Uses	Turner River, Low Arsenic Reinjection, High Arsenic Reinjection, Dust Suppression	1. Water quality – basic 2. Water quality - detailed	1. Weekly 2. Monthly	
		Potential Environmental Impacts		
Turner River	6 x mb's (HMB017 – 022)	1. Swl's 2. EC profiling 3. Water quality – detailed	1. 6 hourly 2. 6 monthly 3. 6 monthly	Parameter (1) via loggers or telemetry
Hemi-Yule River Transects	12 x mb's	As Above	As Above	As Above
Hemi - TSF				
Hemi - Regional	All mb's not already captured above	As Above	1. 6 hourly or monthly	Parameter (1) via loggers or manual measurements
Pastoral	39 x pastoral bores and wells	1. Swl's 2. Water quality – basic 3. Water quality detailed	1. 6 monthly (all sites) 2. 6 monthly (all sites) 3. 6 monthly (subset of sites, ~ 6)	

7.5 Periodic Reviews

In relation to Groundwater Well Licence (GWL) conditions and other regulatory compliance requirements, regular reviews and reporting will be prepared and submitted to DWER. Groundwater use and impact reports will conform to the reporting requirements stipulated by DWER (2009) and would be submitted according to the proposed schedule below:

- *Groundwater monitoring review* reports are proposed to be completed annually for the first three years of dewatering and biennially thereafter.
- A cycle of *groundwater monitoring summary* reports are proposed to be completed biennially from Year 4 onwards.

Groundwater monitoring summary reports have a focus on just the 12 month reporting period, whereas *groundwater monitoring review* reports incorporate all data on a project-to-date basis and include more detailed assessment of trends and potential impacts in the surrounding environment.

The *water resource operating strategy* may need to be amended from time to time and if so, would be done in consultation with DWER and their published requirements (2009). At a minimum, De Grey would review the water resource operating strategy every three years.

Reviews and updates to the conceptual and numeric groundwater models would be undertaken on an as needed basis. Updated models involving changes related to environmental impacts would be shared with DWER as required. It is possible that new local scale models may be developed for such applications as detailed dewatering designs.

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Appendix A

Pastoral Bores and Wells Summary

ID	Status at end Dec 2021	Surveyed Easting (GDA94 MGA Z50)	Surveyed Northing (GDA94 MGA Z50)	Survyed Reference Point Elevation (mAHD)	Ground elevation (mAHD)	Reference Point Stickup (m above ground level)	Reference Point Description	base of well / bore (m below reference point)	water level Apr 2021 (m below reference point)	EC Apr 2021 (us/cm)	Apr 2021 pH	water level Dec 2021 (m below reference point)	EC Dec 2021 (us/cm)	Dec 2021 pH
Badgencandy	active	649717.00	7708187.13	46.97	46.72	0.25	top of 150 mm PVC	nr				10.30	3,430	8.4
Baker Well	active	666061.21	7703252.56	69.08	68.88	0.20	top of ABN well	nr				5.02	2,450	6.6
Boundary Well	active	663402.12	7710658.50	55.31	55.11	0.20	top of concrete ring	11.9				6.22	854	7.3
Bubbajong Well	active	644207.05	7678069.09	80.23	79.9	0.35	top of concrete ring	8.9	6.80	896	7.6	8.14	920	7.5
Bubbawilly	active	634787.11	7706998.05	45.06	44.71	0.35	Top of steel casing	nr				8.03	606	7.6
Carowehyne Well	active	659056.73	7704776.19	63.40	63.1	0.25	top of concrete ring	12.7	7.71	1,637	7.8	9.26	1,135	7.4
Chimney Well	active	639247.05	7702319.17	51.40	50.85	0.55	top of 150 mm PVC	nr				5.42	1,691	7.5
Chituma Well	active	659552.02	7708066.73	58.10	57.4	0.70	top of 150 mm PVC	nr	nr	1,676	7.2	8.69	1,312	6.7
Granite Well	abandoned	663638.05	7685135.58	97.43	97.1	0.30	top of concrete ring	10.9	2.72	9,370	7.3	4.33		
Grumps	active	650203.05	7712171.12	44.31	43.81	0.50	top of 150 mm PVC	nr				12.90	3,750	8.3
Indee Homestead Well	active	666289.50	7700574.46	75.22	75.2	0.00	top of well	19.6	10.05	3,420	7.9	10.52	3,530	7.2
Mardacoombana Well	active	657781.16	7693360.85	77.50	77.5	0.00	top rail track on top of well	16.5	11.63	2,860	7.9	12.37	2,810	7.6
Mid Merriwarri	active	646435.24	7714804.02	37.70	37.04	0.66	top of 150 mm PVC	nr				11.18	4,360	7.1
New Merriwarri	active	650691.68	7716624.95	38.82	38.06	0.76	top of concrete ring	19.24				12.05	2,330	7.9
No 10 Well	active	646762.68	7695562.38	63.41	62.8	0.65	top of 100 mm PVC	nr	6.42	1,435	7.7	6.82	1,480	7.3
No 11 Well	abandoned	648176.15	7701271.55	57.23	56.6	0.65	top of 150 mm PVC	17.3	10.02	2,350	7.1	10.32	2,710	7.0
No 12 Well	abandoned	643650.82	7701539.54	52.75	52.3	0.43	top of 150 mm PVC	nr	6.57			6.99		
No 17	active	641772.90	7709070.65	43.07	42.32	0.75	top of 150 mm PVC	nr				11.79	2,004	7.5
No 18 Well	active	634775.53	7701278.40	51.86	51.63	0.23	Lip of corrugated iron	8.7				7.69	720	7.3
No 21	active	640802.21	7705232.19	48.05	47.40	0.65	top of corrugated iron	8.75				6.84	2,024	7.4
Old Merriwarri	active	642572.48	7714356.53	37.39	36.64	0.75	top of concrete ring	nr				12.30	3,260	7.4
Out station Indee	abandoned	638445.07	7701854.00	tba	tba	0.05	top of 150 mm PVC	nr				7.21	1,000	6.9
Poocatche	active	669141.11	7684972.34	102.32	101.92	0.40	lowest groove in PVC	nr				7.22	1,135	7.0
Port 20 Observation Bore	abandoned	630004.57	7707054.29	41.12	40.87	0.25	top of concrete ring	15.0				7.95	1,628	8.0
Red Bank Well	active	656592.73	7708755.56	56.52	56.0	0.50	top of 100 mm PVC	nr	10.21	881	7.9	10.75	773	7.7
SE Corner	active	652225.99	7703835.55	56.39	55.82	0.57	top of 150 mm PVC	nr				12.90	4,720	7.7
Talye Well	active	668546.51	7689687.99	96.21	96.1	0.15	top of corrugated iron	10.9	6.30	1,960	7.5	7.07	1,777	7.5
Talyebinya Well	abandoned	660112.61	7699763.19	73.06	73.1	0.00	top of concrete ring	13.1	11.31	5,280	8.2	12.07	6,470	7.6
Top Well	abandoned	665965.46	7680420.28	106.45	106.55	-0.10	Metal pipe above iron grid	nr				6.85		
UNK1	active	653243.42	7694350.76	70.90	70.5	0.40	top of 150 mm PVC	nr	7.51	1,760	8.1	7.83	1,751	7.7
UNK10	active	634709.77	7692578.34	63.00	62.52	0.48	top of 150 mm PVC	nr				11.18	3,460	7.4
UNK11	abandoned	666244.57	7694638.77	85.47	85.47	0.00	Edge of concrete well	10.9				9.43	1,124	10.9
UNK12	abandoned	671587.50	7684783.58	108.90	108.10	0.80	Edge of concrete well	24.9				6.62	28	6.8
UNK13	active	652505.26	7680713.11	84.54	84.19	0.35	Notch in 150mm (between bolts)	nr				7.70	1,074	7.9
UNK2	active	646554.28	7688043.13	72.24	72.2	0.00	top of concrete ring	9.8	5.95	1,712	8.1	7.45	1,440	7.6
UNK3A	active	639539.91	7699775.11	53.83	53.4	0.40	top of 100 mm PVC	nr	nr	1,204	7.4	nr		
UNK3B	abandoned	639552.71	7699733.39	54.33	54.0	0.33	top of 100 mm PVC	5.2				dry		
UNK4	inactive	658794.03	7701673.33	65.67	65.5	0.20	top of 150 mm PVC	54.9	6.48	662	7.5	8.93	699	7.0
UNK5	active	653209.25	7700447.59	61.86	61.6	0.30	top of 100 mm PVC	nr	9.28	4,790	7.5	9.59	4,770	7.5
UNK6	active	640865.03	7684936.98	74.10	73.7	0.35	top of 150 mm PVC	nr	7.10	943	8.1	7.52	926	8.5
UNK7	active	659980.24	7686088.21	91.47	91.3	0.20	top of 100 mm PVC	nr	5.83	1,226	7.3	7.82	1,291	7.1
UNK8	active	663614.13	7699434.11	74.52	74.1	0.45	top of concrete ring	12.5	9.63	5,240	7.3	10.00	4	6.9
UNK9	active	638177.46	7684724.63	72.63	72.15	0.48	top of 100 mm PVC	nr				7.75	985	7.2
Western Well	active	656317.15	7704330.62	62.45	62.1	0.40	top of concrete ring	12.9	11.88	829	7.4	12.80	829	7.4
Wingina Well	active	662769.11	7694431.95	84.18	83.8	0.35	top of concrete ring	14.2	11.36	4,460	7.8	11.51	3,750	7.6
Wodgina	active	648232.71	7702904.33	54.49	53.84	0.65	top of 150 mm PVC	nr				9.89	1,969	8.2
Woggra Well	active	658281.43	7701628.90	67.53	67.5	0.00	top of 150 mm PVC	nr	9.13	767	7.3	10.71	808	7.0
Woomerina	active	647850.43	7672545.72	91.68	91.38	0.30	Top of steel casing (Between bolts)	nr				10.19	706	7.4
WWB1	inactive	664832.37	7694254.43	85.62	85.2	0.45	top of 150 mm PVC	49.1	11.06	1,890	8.3	11.51	2,226	7.9

Appendix B

Surface Water Quality Summary Results

Analyte grouping/Analyte	**Dissolved or Total Metals**	**Unit**	**LOR**	**YR01 02/01/2022**	**YR02 02/01/2022**	**YR03 02/01/2022**	**YR04 02/01/2022**	**TR01 03/01/2022**	**YR01 10/02/2022**	**YR02 10/02/2022**	**YR03 10/02/2022**	**TR01 11/02/2022**	**YR01 13/03/2022**	**YR02 13/03/2022**	**YR03 13/03/2022**	**TR01 13/03/2022**	**TR08 13/03/2022**
pH Value		pH Unit	0.01	8.63	8.15	8.92	8.38	9.27	8.23	8.43	8.9	9.41	8.26	8	8.9	8.91	8.49
Electrical Conductivity @ 25°C		µS/cm	1	1290	459	3140	658	3200	1300	478	3280	3030	1740	525	3200	269	888
Total Dissolved Solids @180°C		mg/L	10	788	258	1820	460	1800	738	264	1880	1690	1040	294	1850	165	663
Suspended Solids (SS)		mg/L	5	6	17	9	27	147	14	<5	19	53	7	<5	<5	<5	128
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	35	<1	170	9	193	<1	6	169	172	<1	<1	165	15	25
Bicarbonate Alkalinity as CaCO3		mg/L	1	389	170	592	285	272	398	168	624	251	475	193	575	77	302
Total Alkalinity as CaCO3		mg/L	1	424	170	762	294	465	398	174	793	422	475	193	740	92	327
Silicon as SiO2		mg/L	0.1	38.3	28.6	32.2	49.5	15.1	37.9	31.8	31.8	22.4	39.2	31.1	29	20.9	22.7
Sulfate as SO4 - Turbidimetric		mg/L	1	<1	<1	53	<1	61	2	4	39	25	<1	5	42	3	<5
Chloride		mg/L	1	225	50	661	50	798	212	53	687	786	366	52	695	28	112
Calcium		mg/L	1	30	24	17	25	8	32	23	15	7	43	37	21	20	50
Magnesium		mg/L	1	34	12	76	16	71	30	10	74	60	41	14	87	9	30
Sodium		mg/L	1	189	60	557	95	531	180	62	557	478	296	67	599	28	113
Potassium		mg/L	1	8	3	11	10	24	8	3	14	22	11	4	15	6	17
Mercury	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	Dissolved	µg/L	5	<5	<5	<5	8	<5	<5	<5	<5	<5	<5	<5	<5	9	5
Iron	Dissolved	µg/L	2	29	20	9	600	17	50	23	6	8	52	56	9	17	5
Antimony	Dissolved	µg/L	0.2	<0.2	<0.2	0.8	<0.2	0.4	<0.2	<0.2	1	0.5	<0.2	<0.2	0.8	<0.2	0.4
Selenium	Dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.4	<0.2	<0.2	0.2	<0.2	0.6
Arsenic	Dissolved	µg/L	0.2	2.1	0.4	5.8	4.2	8	2.9	0.7	5.4	9.8	3.2	0.4	5.8	2.8	7.7
Barium	Dissolved	µg/L	0.5	186	75.7	99.2	183	101	205	86.6	86.8	155	222	66.9	88.1	78.8	202
Beryllium	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	Dissolved	µg/L	5	265	105	836	315	740	338	130	918	807	495	94	895	68	440
Bismuth	Dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	Dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	Dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3
Cobalt	Dissolved	µg/L	0.1	0.2	0.1	0.2	0.6	0.2	0.3	0.2	0.3	0.4	0.2	<0.1	0.2	0.3	2.7
Copper	Dissolved	µg/L	0.5	0.6	0.6	0.9	2.7	1.4	<0.5	0.5	<0.5	1.4	<0.5	<0.5	<0.5	1.2	4.5
Lead	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lithium	Dissolved	µg/L	0.5	1.7	0.9	2.9	1.1	10.2	1.4	0.9	3	9.6	2.1	1	3.1	1.8	2.1
Manganese	Dissolved	µg/L	0.5	64.7	4.8	6.5	886	16	98.8	36.7	1.3	3.4	45.8	68.4	2.2	6.3	132
Molybdenum	Dissolved	µg/L	0.1	0.6	0.8	3.6	1	3.4	1	1	3.9	3.5	1	0.7	3.9	1	5.5
Nickel	Dissolved	µg/L	0.5	<0.5	<0.5	1	1.3	1.6	<0.5	<0.5	1	1.4	0.5	<0.5	0.8	1.7	19.2
Silver	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	Dissolved	µg/L	1	423	177	420	416	75	348	181	296	62	523	237	328	181	490
Tellurium	Dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	Dissolved	µg/L	0.0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	Dissolved	µg/L	0.2	<0.2	<0.2	<0.2	0.4	0.2	<0.2	0.5	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	Dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	Dissolved	µg/L	0.05	0.5	2.22	18.2	1.13	4.84	0.77	2.29	18.8	5.65	0.68	2.07	19.3	1.39	8.45
Vanadium	Dissolved	µg/L	0.2	2.2	1.6	9.8	3.1	8.6	1.4	4.7	10.4	9.8	0.5	0.3	8.5	4.8	11.2
Zinc	Dissolved	µg/L	1	10	9	10	21	9	11	8	8	8	12	1	9	4	17
Nitrate as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.09	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01
Total Anions		meq/L	0.01	14.8	4.81	35	7.28	33.1	14	5.05	36	31.1	19.8	5.43	35.3	2.69	9.69

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	YR01 02/01/2022	YR02 02/01/2022	YR03 02/01/2022	YR04 02/01/2022	TR01 03/01/2022	YR01 10/02/2022	YR02 10/02/2022	YR03 10/02/2022	TR01 11/02/2022	YR01 13/03/2022	YR02 13/03/2022	YR03 13/03/2022	TR01 13/03/2022	TR08 13/03/2022
Total Cations		meq/L	0.01	12.7	4.87	31.6	6.95	30	12.1	4.74	31.4	26.6	18.7	6.02	34.6	3.11	10.3
Ionic Balance		%	0.01	7.62	0.67	5.05	2.33	4.95	7.19	3.17	6.83	7.76	2.96	5.14	0.88	7.23	3.1
Bromide		mg/L	0.01	0.557	0.154	1.78	0.174	2.25	0.521	0.016	2.14	2.51	0.774	0.016	1.89	0.012	0.399
Aluminium	Total	µg/L	5						206	9	333	85	26	----	----	----	5810
Iron	Total	µg/L	2						985	57	546	266	490	----	----	----	7570
Antimony	Total	µg/L	0.2						<0.2	<0.2	1.1	0.5	<0.2	----	----	----	0.4
Selenium	Total	µg/L	0.2						<0.2	<0.2	<0.2	0.2	<0.2	----	----	----	0.4
Arsenic	Total	µg/L	0.2						3.1	0.7	6.1	11.1	3.2	----	----	----	9.2
Barium	Total	µg/L	0.5						187	39.1	85.4	60.3	206	----	----	----	208
Beryllium	Total	µg/L	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	----	----	----	0.4
Boron	Total	µg/L	5						328	107	885	739	518	----	----	----	416
Bismuth	Total	µg/L	0.05						<0.05	<0.05	<0.05	<0.05	<0.05	----	----	----	0.08
Cadmium	Total	µg/L	0.05						<0.05	<0.05	<0.05	<0.05	<0.05	----	----	----	<0.05
Chromium	Total	µg/L	0.2						0.8	<0.2	1.2	0.6	0.2	----	----	----	36
Cobalt	Total	µg/L	0.1						0.4	0.1	0.6	0.4	0.2	----	----	----	9.2
Copper	Total	µg/L	0.5						0.8	<0.5	2.2	1.5	<0.5	----	----	----	12.8
Lead	Total	µg/L	0.1						0.1	<0.1	0.4	0.2	<0.1	----	----	----	4.5
Lithium	Total	µg/L	0.5						1.6	0.8	3.5	9.9	2.1	----	----	----	5.6
Manganese	Total	µg/L	0.5						341	31	51.2	157	266	----	----	----	715
Molybdenum	Total	µg/L	0.1						1.4	1.4	5.6	4.8	1.5	----	----	----	2.8
Nickel	Total	µg/L	0.5						1.2	<0.5	2.6	2.6	0.7	----	----	----	39.6
Silver	Total	µg/L	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	----	----	----	<0.1
Strontium	Total	µg/L	1						392	202	358	76	465	----	----	----	453
Thallium	Total	µg/L	0.02						<0.02	<0.02	<0.02	<0.02	<0.02	----	----	----	0.08
Thorium	Total	µg/L	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	----	----	----	1.6
Tin	Total	µg/L	0.2						<0.2	<0.2	1	<0.2	<0.2	----	----	----	<0.2
Titanium	Total	µg/L	1						4	<1	7	2	<1	----	----	----	89
Uranium	Total	µg/L	0.05						1.06	2.79	23.4	6.74	0.76	----	----	----	9.79
Vanadium	Total	µg/L	0.2						1.9	4.4	11.5	9.9	0.7	----	----	----	25.5
Zinc	Total	µg/L	1						2	<1	8	2	<1	----	----	----	13
Tellurium	Total	µg/L	0.2						<0.2	<0.2	<0.2	<0.2	<0.2	----	----	----	<0.2
Mercury	Total	µg/L	0.1														<0.1

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	TR01 26/04/2022	TR south 03/06/2022	TR North 03/06/2022	TR South 06/06/2022	TR North 06/06/2022	YR04 19/06/2022	YR05 21/06/2022	YR06 21/06/2022	YR07 19/06/2022
pH Value		pH Unit	0.01	8.07	7.94	7.74	7.97	8.04	8.59	8.72	8.81	8.3
Electrical Conductivity @ 25°C		µS/cm	1	236	235	225	234	258	224	343	337	405
Total Dissolved Solids @180°C		mg/L	10	146	155	143	158	158	136	180	182	221
Suspended Solids (SS)		mg/L	5	13	<5	<5	<5	<5	10	5	<5	11
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	6	14	17	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	112	53	48	53	79	70	104	99	153
Total Alkalinity as CaCO3		mg/L	1	112	53	48	53	79	76	118	116	153
Silicon as SiO2		mg/L	0.1	16.0	11.6	11.3	12.6	13.2	12.9	13.9	13.6	19.3
Sulfate as SO4 - Turbidimetric		mg/L	1	2	16	15	15	17	9	11	11	19
Chloride		mg/L	1	11	33	30	31	34	24	39	37	33
Calcium		mg/L	1	26	10	9	10	11	14	17	13	26
Magnesium		mg/L	1	7	5	5	6	6	4	9	7	8
Sodium		mg/L	1	13	30	28	30	33	32	58	41	50
Potassium		mg/L	1	4	2	2	2	3	3	3	2	2
Mercury	Dissolved	µg/L	0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	Dissolved	µg/L	5	<5	11	<5	6	7	7	<5	<5	<5
Iron	Dissolved	µg/L	2	13	10	8	9	8	9	4	3	18
Antimony	Dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	Dissolved	µg/L	0.2	<0.2	0.4	0.2	0.3	0.3	<0.2	<0.2	<0.2	<0.2
Arsenic	Dissolved	µg/L	0.2	1.4	0.7	0.7	0.6	0.7	0.6	0.5	0.4	0.5
Barium	Dissolved	µg/L	0.5	106	92.9	73.7	83.8	62.3	69.9	69.4	59.5	113
Beryllium	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	Dissolved	µg/L	5	39	55	45	44	44	16	23	28	22
Bismuth	Dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	Dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	Dissolved	µg/L	0.2	<0.2	0.5	0.7	0.5	0.6	0.4	<0.2	<0.2	<0.2
Cobalt	Dissolved	µg/L	0.1	0.3	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Copper	Dissolved	µg/L	0.5	0.7	1	0.8	0.7	0.7	1.7	0.6	<0.5	0.5
Lead	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lithium	Dissolved	µg/L	0.5	1	1.8	1.4	1.7	1.5	0.8	0.7	0.6	0.6
Manganese	Dissolved	µg/L	0.5	42.5	3.7	2.3	2.4	1.8	1.8	1.6	1.5	10.6
Molybdenum	Dissolved	µg/L	0.1	0.8	0.9	0.9	0.8	0.8	0.8	1.1	1.1	1
Nickel	Dissolved	µg/L	0.5	1.6	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Silver	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	Dissolved	µg/L	1	171	64	59	61	66	112	145	147	166
Tellurium	Dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	Dissolved	µg/L	0.0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	Dissolved	µg/L	0.2	<0.2	0.4	0.6	<0.2	<0.2	0.3	<0.2	<0.2	<0.2
Titanium	Dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	Dissolved	µg/L	0.05	1.37	0.65	0.52	0.71	0.74	1.72	2.44	2.26	1.89
Vanadium	Dissolved	µg/L	0.2	2.3	1.9	1.9	2.3	2.4	6.3	4.9	4.7	3
Zinc	Dissolved	µg/L	1	15	30	18	12	8	3	7	6	26
Nitrate as N		mg/L	0.01	<0.02	1.08	1	1.2	1.12	<0.01	<0.01	<0.01	<0.01
Total Anions		meq/L	0.01	2.59	2.32	2.12	2.24	2.89	2.38	3.69	3.59	4.38

Analyte grouping/Analyte	**Dissolved or Total Metals**	**Unit**	**LOR**	**TR01 26/04/2022**	**TR south 03/06/2022**	**TR North 03/06/2022**	**TR South 06/06/2022**	**TR North 06/06/2022**	**YR04 19/06/2022**	**YR05 21/06/2022**	**YR06 21/06/2022**	**YR07 19/06/2022**
Total Cations		meq/L	0.01	2.54	2.27	2.13	2.35	2.55	2.5	4.19	3.06	4.18
Ionic Balance		%	0.01	0.94	1.23	0.28	2.24	6.18	2.33	6.37	7.99	2.35
Bromide		mg/L	0.01	0.01	0.071	0.064	0.065	0.076	0.055	0.106	0.108	0.087
Aluminium	Total	µg/L	5	521	2970	2460	1600	1160	523	15	23	54
Iron	Total	µg/L	2	666	1620	1390	879	616	484	19	33	198
Antimony	Total	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	Total	µg/L	0.2	<0.2	0.4	0.2	0.3	0.3	0.2	0.2	<0.2	<0.2
Arsenic	Total	µg/L	0.2	1.7	1	1	0.9	0.9	0.6	0.5	0.5	0.6
Barium	Total	µg/L	0.5	73.4	24.4	22.6	20.7	28	26.7	30.3	25.1	72.8
Beryllium	Total	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	Total	µg/L	5	37	25	21	21	23	38	61	57	53
Bismuth	Total	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	Total	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	Total	µg/L	0.2	1.3	6.1	5.9	3.6	2.7	1.5	0.2	0.2	0.3
Cobalt	Total	µg/L	0.1	0.6	0.4	0.4	0.2	0.2	0.5	<0.1	<0.1	0.2
Copper	Total	µg/L	0.5	1.1	1.8	1.6	1.2	1.6	2.6	1	0.7	0.6
Lead	Total	µg/L	0.1	0.3	0.5	0.4	0.3	0.2	0.3	<0.1	<0.1	0.1
Lithium	Total	µg/L	0.5	1.4	5.6	3.8	3.2	2.7	1.6	0.8	0.8	0.8
Manganese	Total	µg/L	0.5	114	16.3	13.1	8.9	7.6	35.7	8	10.8	73.3
Molybdenum	Total	µg/L	0.1	1	1.2	1.2	1	1.1	1.2	1.4	1.4	1.3
Nickel	Total	µg/L	0.5	2.4	3.2	2.9	1.9	1.6	1.1	<0.5	<0.5	<0.5
Silver	Total	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	Total	µg/L	1	192	64	59	62	69	114	149	146	174
Thallium	Total	µg/L	0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	Total	µg/L	0.1	<0.1	0.5	0.3	0.2	0.2	0.1	<0.1	<0.1	<0.1
Tin	Total	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	Total	µg/L	1	5	73	63	30	23	11	<1	<1	<1
Uranium	Total	µg/L	0.05	1.63	1.09	0.8	0.95	0.9	2.03	2.62	2.62	2.22
Vanadium	Total	µg/L	0.2	3.3	4.9	4.6	3.8	3.6	7.7	5.6	5.2	3.8
Zinc	Total	µg/L	1	<1	2	2	<1	5	3	2	<1	<1
Tellurium	Total	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Mercury	Total	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.4	<0.5

Appendix C

De Grey Bore Summary

Bore ID	Surveyed Easting (GDA94 MGA Z50)	Surveyed Northing (GDA94 MGA Z50)	Ground elevation (mAHD)	Top of casing elevation (mAHD)	Drilled depth (mbgl)	Cased depth (mbgl)	Casing stick up (magl)	Started	Completed	Hole diameter production zone (mm)	Minimum casing ID (mm)	Slotted interval (mbgl)	Lithology of Slotted Interval	Slot aperture (mm)	Initial swl (mbtoc)	Max Airlift yield (L/sec) - development	Max EC (uS/cm) - development	Minimum pH - development	Drilling Company	Drill method(s)
PRODUCTION BORES																				
HPB001	647585.34	7691688.31	68.69	69.29	36.0	27.00	0.60	01-Dec-20	02-Dec-20	205	154	3.0 - 27.0	alluvium	1.0	6.06	4	1,385	8.2	Topdrill	RC
HPB002	646452.08	7692367.61	66.78	67.35	30.0	29.00	0.57	30-Aug-21	31-Aug-21	216	154	17.0 - 29.0	alluvium	1.0	5.95	4	1,151	8.15	Topdrill	MR
HPB003	647278.04	7692060.93	67.69	68.19	47.2	46.70	0.50	28-Aug-21	29-Aug-21	216	154	28.7 - 46.7	alluvium	1.0	6.03	4	1,227	8.08	Topdrill	MR
HPB004	647982.57	7692605.38	66.79	67.11	36.0	35.33	0.32	31-Aug-21	01-Sep-21	216	154	17.33 - 35.33	alluvium	1.0	5.95	4	1,447	8.21	Topdrill	MR
HPB005	649505.74	7691404.98	69.88	70.43	36.0	35.35	0.55	02-Sep-21	03-Sep-21	216	154	17.35 - 35.35	alluvium	1.0	6.45	5	1,530	8.06	Topdrill	MR
HPB006	647997.90	7690923.57	70.91	71.26	60.0	54.90	0.35	22-Aug-21	29-Aug-21	375	254	24.9 - 54.9	alluvium (palaeochannel)	1.0	6.52	40-50	1,265	7.95	Austral	MR
HPB007	647991.44	7691591.23	69.32	69.72	60.0	22.56	0.40	29-Aug-21	01-Sep-21	375	203	4.56 - 22.56	alluvium	1.0	6.64	20-25	1,391	7.99	Austral	MR
HPB008	648869.81	7693099.93	67.16	67.62	47.0	45.34	0.46	01-Sep-21	06-Sep-21	375	254	9.34 - 15.34 & 21.34 - 33.34	alluvium	1.0	5.78	10	1,659	8.07	Austral	MR
HPB009	649559.35	7692238.84	69.05	69.41	49.0	47.19	0.36	06-Sep-21	10-Sep-21	311	203	23.9 - 29.9 & 35.9 - 41.9	alluvium	1.0	6.12	35	1,583	8.03	Austral	MR
HPB010	648319.35	7691481.77	69.51	69.99	131.0	119.00	0.48	29-Sep-21	16-Oct-21	311	203	94-118?	saprock-bedrock (MIIRK-sedimens)	1.0	6.70	8	1,800	8.44	Austral	MR/AR
HPB011	648590.74	7692924.28	67.20	67.45	47.0	46.25	0.25	22-Oct-21	30-Oct-21	311	203	28.2 - 46.2	saprock (MIRK)	1.0	5.70	nr	nr	nr	Austral	MR
HPB012	647288.63	7692802.89	66.67	67.15	48.0	41.93	0.48	01-Nov-21	03-Nov-21	375	254	17.93 - 35.93	alluvium (palaeochannel)	1.0	6.70	40	1,267	8.09	Austral	MR/AR
MONITORING BORES																				
HMB012D	649535.35	7692229.93	69.12	69.67	49.0	26.15	0.55	10-Sep-21	13-Sep-21	216	54	37.7 - 43.7	alluvium (basal)	2.0	6.21	0.5-1	1,638	8	Austral	AC
HMB012S	649535.31	7692229.97	69.09	69.64	49.0	43.70	0.55	10-Sep-21	13-Sep-21	216	54	23.15 - 26.15	alluvium (intermediate)	2.0	6.21	0.5-1	1,640	8.07	Austral	AC
HMB013	648044.11	7690920.47	70.86	71.49	37.0	35.80	0.63	15-Sep-21	16-Sep-21	127	54	23.2 - 35.2	alluvium (basal)	2.0	6.75	nr	1,267	7.85	Austral	AC
HMB014	647986.31	7691541.07	69.23	69.86	29.0	26.12	0.63	16-Sep-21	17-Sep-21	127	54	2.1 - 26.1	alluvium	2.0	6.53	nr	1,320	8.23	Austral	AC
HMB015	648892.09	7693088.18	67.31	67.92	35.0	33.04	0.61	17-Sep-21	18-Sep-21	138	54	3.04 - 33.04	alluvium	2.0	6.00	1	1,470	8.29	Austral	AC
HMB016	649543.45	7692230.91	69.03	69.65	11.0	10.78	0.62	18-Sep-21	18-Sep-21	138	54	4.78 - 10.78	alluvium (shallow)	2.0	6.20	0.3	1,610	8.31	Austral	AC
HMB017	663410.55	7691061.03	87.75	88.32	24.0	23.88	0.57	19-Sep-21	20-Sep-21	132	54	11.88 - 23.88	saprock-bedrock	2.0	11.10	0.15	1,910	8.18	Austral	AC/AR
HMB018	660156.48	7696734.69	75.99	76.62	24.0	23.22	0.63	20-Sep-21	21-Sep-21	132	54	11.22 - 23.22	alluvium	2.0	8.68	0.4	907	7.98	Austral	AR
HMB019	658648.67	7701322.66	69.74	70.41	23.2	23.20	0.67	22-Sep-21	22-Sep-21	138	54	11.23 - 23.23	saprolite-saprock	2.0	12.18	<0.1	640	8.44	Austral	AC
HMB020	664401.32	7691571.72	88.48	89.03	28.0	28.00	0.55	22-Sep-21	23-Sep-21	132	54	10.0 - 28.0	bedrock (schist)	2.0	11.02	0	nr	nr	Austral	AR
HMB021	661103.91	7697057.97	77.08	77.57	20.0	19.86	0.49	23-Sep-21	24-Sep-21	138	54	7.86 - 19.86	alluvium-saprolite	2.0	8.50	0.15	1,750	8.18	Austral	AC
HMB022	659561.97	7701213.71	70.35	70.88	30.0	28.28	0.53	24-Sep-21	24-Sep-21	138	54	10.28 - 28.28	saprolite-saprock	2.0	10.80	0.5	960	8.14	Austral	AC/AR
HMB023D	648267.91	7691484.36	69.53	70.08	113.0	112.10	0.55	26-Sep-21	29-Sep-21	216	54	100.1 - 112.1	saprolite-saprock (siltstone)	2.0	6.66	1.5	1,430	7.8	Austral	MR
HMB023S	648267.91	7691484.40	69.52	70.06	113.0	22.10	0.54	26-Sep-21	29-Sep-21	216	54	4.1 - 22.1	alluvium	2.0	6.65	1	1,349	8.1	Austral	MR
HMB024D	648611.46	7692882.12	67.17	67.82	38.0	37.00	0.65	18-Oct-21	19-Oct-21	216	54	31.0 - 37.0	saprock (IIRK)	2.0	5.99	nr	nr	nr	Austral	MR
HMB024S	648611.50	7692882.15	67.14	67.79	38.0	16.90	0.65	18-Oct-21	19-Oct-21	216	54	4.9 - 16.90	alluvium	2.0	6.06	nr	nr	nr	Austral	MR
HMB025D	649323.58	7692365.87	68.73	69.38	51.0	49.75	0.65	28-Oct-21	31-Oct-21	216	54	43.75 - 49.75	saprock (IIRK)	2.0	6.51	0.05	1757	8.69	Austral	MR
HMB025S	649323.60	7692365.86	68.68	69.33	51.0	21.00	0.66	28-Oct-21	31-Oct-21	216	54	3.0 - 21.0	alluvium	2.0	6.45	0.5	1597	8.5	Austral	MR
HMB026	647272.64	7692827.92	66.61	67.20	44.0	39.58	0.59	6-Nov-21	6-Nov-21	216	54	3.58 - 39.58	alluvium	2.0	6.82	nr	1,277	8.28	Austral	MR
HMB027D	649470.60	7686519.84	75.90	76.48	47.0	43.92	0.58	08-Nov-21	09-Nov-21	216	54	37.92 - 43.92	alluvium (basal)	2.0	6.55	nr	1,270	7.95	Austral	MR
HMB027S	649470.67	7686519.84	75.91	76.50	47.0	18.22	0.59	08-Nov-21	09-Nov-21	216	54	6.22-18.22	alluvium (upper)	2.0	6.41	nr	1,350	8.18	Austral	MR
HMB028D	648481.12	7688471.36	74.45	75.18	51.0	45.28	0.73	10-Nov-21	12-Nov-21	216	54	39.28 - 45.28	alluvium (basal)	2.0	7.46	nr	1,245	8.06	Austral	MR
HMB028S	648481.12	7688471.45	74.56	75.27	51.0	25.98	0.71	10-Nov-21	12-Nov-21	216	54	4.98-25.98	alluvium (upper)	2.0	7.41	0.6	1,260	8.14	Austral	MR
HMB029D	646278.13	7693908.12	64.17	64.81	40.5	39.40	0.64	12-Nov-21	14-Nov-21	216	54	33.4-39.4	alluvium (basal)	2.0	6.57	1.7	1,291	7.83	Austral	MR
HMB029S	646278.07	7693908.09	64.18	64.81	40.5	16.82	0.64	12-Nov-21	14-Nov-21	216	54	4.82- 16.82	alluvium (upper)	2.0	6.58	0.7	1,336	8.10	Austral	MR
HMB030D	645938.96	7695499.41	61.34	61.98	50.0	44.93	0.64	16-Nov-21	18-Nov-21	216	54	35.93 - 44.93	alluvium (basal)	2.0	5.77	nr	1,285	7.53	Austral	MR
HMB030S	645939.02	7695499.48	61.36	61.98	50.0	15.86	0.62	16-Nov-21	18-Nov-21	216	54	5.86 - 15.86	alluvium (upper)	2.0	5.90	approx 0.5	1,334	7.95	Austral	MR
HMB031	651575.73	7689185.89	75.13	75.99	15.0	14.79	0.86	10-Mar-22	10-Mar-22	143	54	8.79 - 14.79	alluvium	2.0	6.97	0.2	1,375	8.01	Topdrill	RC
HMB032	652495.41	7689170.74	75.95	76.80	15.0	15.00	0.85	10-Mar-22	10-Mar-22	143	54	9.0 - 15.0	alluvium	2.0	6.80	0.2	1,657	8.12	Topdrill	RC
HMB033	651302.08	7688522.86	75.84	76.69	15.2	15.20	0.85	10-Mar-22	11-Mar-22	143	54	9.2 - 15.2	alluvium	2.0	7.43	0.2	1,479	8.21	Topdrill	RC
HMB034	652373.01	7688550.16	76.80	77.65	20.1	20.05	0.85	11-Mar-22	11-Mar-22	143	54	8.05 - 20.05	alluvium and weathered bedrock	2.0	6.93	0.4	1,623	8.07	Topdrill	RC
HMB035	653611.12	7689196.00	77.67	78.32	20.0	19.98	0.65	11-Mar-22	11-Mar-22	143	54	8.0 - 20.0	alluvium and weathered bedrock	2.0	7.42	0.2	2,001	8.31	Topdrill	RC
HMB036	650487.02	7688909.30	73.84	74.39	24.0	23.25	0.55	17-May-22	17-May-22	143	54	5.25 - 23.25	alluvium	2.0	6.92	~0.5	1465	7.69	Topdrill	RC
HMB037	651468.37	7689588.25	74.30	75.00	23.0	22.70	0.70	18-May-22	18-May-22	143	54	7.7 - 22.7	alluvium and weathered bedrock	2.0	7.04	<=0.2	1606	8.09	Topdrill	RC
HMB038	650375.71	7689599.53	72.98	73.48	17.5	17.50	0.50	18-May-22	18-May-22	143	54	5.5 - 17.5	alluvium	2.0	6.76	<=0.2	1478	8.08	Topdrill	RC
HMB039	652408.25	7690475.00	74.00	74.45	17.0	17.00	0.45	19-May-22	19-May-22	143	54	5.0 - 17.0	alluvium and weathered bedrock	2.0	6.52	<=0.1	1631	8.35	Topdrill	RC
HMB040	650831.92	7690557.45	73.30	73.80	17.2	17.20	0.50	19-May-22	19-May-22	143	54	5.2 - 17.2	weathered bedrock	2.0	8.39	~0.2 - 0.3	1601	8.08	Topdrill	RC
HMB041	651503.35	7690694.42	72.26	72.86	15.0	14.65	0.60	19-May-22	19-May-22	143	54	8.65 - 14.65	alluvium	2.0	6.91	<=0.2	1636	8.21	Topdrill	RC
HMB042	650447.82	7691044.27	71.19	71.79	21.0	20.20	0.60	19-May-22	19-May-22	143	54	6.2 - 20.2	alluvium and weathered bedrock	2.0	6.85	~0.1	1560	8.37	Topdrill	RC

Appendix D

Groundwater Quality Summary Results

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB001 02/12/2020	HMB002 02/12/2020	HMB003 03/12/2020	HMB004 03/12/2020	HMB005 03/12/2020	HMB006 04/12/2020	HMB007 03/12/2020	HMB008 03/12/2020	HMB009 03/12/2020	HMB010 03/12/2020	HMB011 04/12/2020	HPB001 02/12/2020	WPB001 05/12/2020	HMB001 22/04/2021	HMB002 22/04/2021	HMB003 22/04/2021	HMB004 23/04/2021	HMB005 23/04/2021	HMB006 23/04/2021	HMB007 22/04/2021	HMB008 21/04/2021	HMB009 21/04/2021
pH Value		pH Unit	0.01	8.35	8.44	8.43	8.48	8.48	8.38	8.47	8.44	8.45	8.47	8.40	8.30	8.34	8.04	8.02	8.06	7.98	7.94	7.93	8.04	8.08	8.08
Electrical Conductivity @ 25°C		µS/cm	1	1470	1500	1500	1530	1670	1780	1280	1260	989	1030	1250	1280	11400	1310	1450	1440	1490	1600	2100	1220	1190	1020
Total Dissolved Solids @180°C		mg/L	10	890	898	898	929	1030	1070	794	768	598	661	754	798	6920	746	829	865	1030	985	1240	760	732	614
Suspended Solids (SS)		mg/L	5	15	118	49	173	754	304	117	93	257	224	58	60	206	<5	5	<5	<5	49	<5	72	<5	<5
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	8	19	19	24	23	14	22	18	15	18	14	3	11	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	358	346	353	354	351	345	340	314	265	281	311	331	456	348	361	369	374	370	442	325	316	286
Total Alkalinity as CaCO3		mg/L	1	366	365	372	378	373	359	362	332	281	300	325	335	468	348	361	369	374	370	442	325	316	286
Silicon as SiO2		mg/L	0.1	91.0	88.6	93.1	86.9	78.2	102.0	90.3	93.7	80.0	82.1	81.0	91.2	26.1	89.9	86.5	93.2	83.1	66.8	98.2	93.9	95.7	77.6
Sulfate as SO4 - Turbidimetric		mg/L	1	63	66	62	65	77	43	39	36	22	26	43	42	740	46	61	53	62	79	45	40	34	23
Chloride		mg/L	1	233	238	241	245	284	350	191	183	126	125	183	187	3160	204	245	248	259	290	473	198	185	145
Calcium		mg/L	1	32	30	30	34	32	42	34	35	33	31	36	36	91	26	30	28	30	30	41	34	33	33
Magnesium		mg/L	1	56	54	53	58	53	61	44	43	30	30	44	44	190	46	56	52	56	56	64	45	41	32
Sodium		mg/L	1	196	197	195	202	232	225	160	155	126	140	157	161	2180	183	189	195	194	225	296	157	157	128
Potassium		mg/L	1	13	14	13	14	16	19	13	13	10	10	13	13	32	12	12	12	13	15	22	12	13	10
Mercury	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	dissolved	µg/L	5	<5	6	<5	6	<5	<5	<5	5	<5	9	5	26	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron	dissolved	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	5	3	29	12	<2	<2	<2	5	<2	<2	4	<2	<2
Antimony	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	dissolved	µg/L	0.2	3.0	3.1	3.1	3.6	4.2	5.5	3.0	2.9	2.1	2.0	3.0	2.9	2.3	2.8	3.1	3.2	3.8	3.8	6.7	3.0	2.7	2.1
Arsenic	dissolved	µg/L	0.2	15.8	51.8	30.2	9.9	54.4	5.0	6.1	5.5	4.7	6.2	3.4	6.5	1.1	10.3	56.0	11.3	10.1	47.7	4.3	5.8	4.7	4.4
Barium	dissolved	µg/L	0.5	122.0	116.0	126.0	140.0	186.0	257.0	170.0	157.0	172.0	214.0	124.0	163.0	52.3	117.0	128.0	139.0	136.0	122.0	210.0	141.0	180.0	212.0
Beryllium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	dissolved	µg/L	5	490	504	506	592	695	716	488	494	342	341	475	497	856	539	545	595	666	752	860	513	497	352
Bismuth	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.36	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	dissolved	µg/L	0.2	3.6	3.7	2.9	3.2	3.5	1.7	3.0	2.8	3.1	2.7	3.1	1.8	<0.2	2.0	3.6	2.4	3.1	3.6	1.0	3.0	2.2	2.5
Cobalt	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4	<0.5	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lithium	dissolved	µg/L	0.5	17.8	18.1	18.6	18.6	15.6	18.5	20.6	21.0	5.0	4.6	14.9	22.0	52.7	20.0	20.6	21.6	22.2	19.2	20.6	24.6	18.1	6.0
Manganese	dissolved	µg/L	0.5	1.2	0.9	0.9	<0.5	48.7	1.6	4.1	2.2	0.7	6.0	13.8	8.9	121.0	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5
Molybdenum	dissolved	µg/L	0.1	6.7	6.6	7.0	6.3	6.2	1.9	5.7	5.4	3.7	5.2	5.3	5.6	7.9	6.0	6.5	6.9	6.5	6.2	1.6	5.6	4.4	3.0
Nickel	dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	3.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	dissolved	µg/L	1	614	624	614	664	606	804	581	597	483	521	509	586	3130	590	638	605	663	633	835	582	617	520
Tellurium	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	dissolved	µg/L	0.0	<0.02	<0.02	<0.02	<0.02	0.0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2
Titanium	dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	dissolved	µg/L	0.05	42.80	47.50	44.60	47.60	36.70	16.80	25.30	23.30	7.37	8.26	19.30	27.70	35.80	34.20	45.50	39.40	46.20	41.50	19.00	27.50	19.30	7.70
Vanadium	dissolved	µg/L	0.2	30.8	30.8	34.3	32.8	22.7	20.4	25.0	28.9	24.0	30.0	17.9	27.1	1.0	34.0	31.3	35.7	33.7	26.3	21.8	29.3	28.1	25.4
Zinc	dissolved	µg/L	1	8	10	8	8	13	12	10	8	10	10	52	15	18	13	13	14	13	16	14	10	14	14
Nitrate as N		mg/L	0.01	6.53	6.20	6.75	6.52	6.28	7.14	7.86	8.47	7.13	8.58	7.07	7.62	1.58	7.12	6.76	7.51	7.01	6.31	8.07	8.55	11.30	8.05
Total Anions		meq/L	0.01	15.20	15.40	15.50	15.80	17.10	17.90	13.40	12.50	9.63	10.10	12.60	12.80	114.00	13.70	15.40	15.50	16.10	17.20	23.10	12.90	12.20	10.30
Total Cations		meq/L	0.01	15.10	14.90	14.70	15.60	16.40	17.40	12.60	12.40	9.85	10.40	12.60	12.80	116.00	13.40	14.60	14.50	14.90	16.30	20.80	12.50	12.20	10.10
Ionic Balance		%	0.01	0.44	1.69	2.81	0.64	1.81	1.56	3.16	0.74	1.16	1.47	0.11	0.35	0.84	1.17	2.53	3.36	3.85	2.81	5.38	1.48	0.24	0.88
Bromide		mg/L	0.01	0.67	0.60	0.58	0.61	0.71	0.97	0.47	0.43	0.30	0.29	0.45	0.43	7.51	0.60	0.73	0.74	0.77	0.87	1.57	0.59	0.53	0.45
Gross beta		Bq/L	0.1																						
Gross alpha		Bq/L	0.05																						
Gross beta activity - 40K		Bq/L	0.1																						
Radium 226		Bq/L	0.01																						
Radium 228		Bq/L	0.08																						
Iron	dissolved	mg/L	0.05																						
Arsenobetaine (ASB)	dissolved	µg/L	1																						
Arsenious Acid (As (III))	dissolved	µg/L	0.5																						
Dimethylarsenic Acid (DMA)	dissolved	µg/L	1																						
Monomethylarsonic Acid (MMA)	dissolved	µg/L	1																						
Arsenic Acid (As (V))	dissolved	µg/L	0.5																						
Trivalent Chromium	dissolved	mg/L	0.001																						
Hexavalent Chromium	dissolved	mg/L	0.001																						
Ferrous Iron	dissolved	mg/L	0.05																						
Ferric Iron	dissolved	mg/L	0.05																						

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB001 02/12/2020	HMB002 02/12/2020	HMB003 03/12/2020	HMB004 03/12/2020	HMB005 03/12/2020	HMB006 04/12/2020	HMB007 03/12/2020	HMB008 03/12/2020	HMB009 03/12/2020	HMB010 03/12/2020	HMB011 04/12/2020	HPB001 02/12/2020	WPB001 05/12/2020	HMB001 22/04/2021	HMB002 22/04/2021	HMB003 22/04/2021	HMB004 23/04/2021	HMB005 23/04/2021	HMB006 23/04/2021	HMB007 22/04/2021	HMB008 21/04/2021	HMB009 21/04/2021
Mercury	total	mg/L	0.0001																						
Aluminium	total	µg/L	5																						
Iron	total	µg/L	2																						
Antimony	total	µg/L	0.2																						
Selenium	total	µg/L	0.2																						
Arsenic	total	µg/L	0.2																						
Barium	total	µg/L	0.5																						
Beryllium	total	µg/L	0.1																						
Boron	total	µg/L	5																						
Bismuth	total	µg/L	0.05																						
Cadmium	total	µg/L	0.05																						
Chromium	total	µg/L	0.2																						
Cobalt	total	µg/L	0.1																						
Copper	total	µg/L	0.5																						
Lead	total	µg/L	0.1																						
Lithium	total	µg/L	0.5																						
Manganese	total	µg/L	0.5																						
Molybdenum	total	µg/L	0.1																						
Nickel	total	µg/L	0.5																						
Silver	total	µg/L	0.1																						
Strontium	total	µg/L	1																						
Thallium	total	µg/L	0.02																						
Thorium	total	µg/L	0.1																						
Tin	total	µg/L	0.2																						
Titanium	total	µg/L	1																						
Uranium	total	µg/L	0.05																						
Vanadium	total	µg/L	0.2																						
Zinc	total	µg/L	1																						
Tellurium	total	µg/L	0.2																						

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB010 21/04/2021	HMB011 22/04/2021	INDEE HOMESTEAD 22/04/2021	HERC026 22/04/2021	UNK1 23/04/2021	UNK2 23/04/2021	NO 10 WELL 23/04/2021	HMB001 20/10/2021	HMB002 20/10/2021	HMB003 20/10/2021	HMB003 20/10/2021	HMB004 20/10/2021	HMB005 20/10/2021	HMB006 20/10/2021	HMB007 20/10/2021	HMB008 21/10/2021	HMB009 21/10/2021	HMB010 21/10/2021	HMB011 21/10/2021	HPB001 21/10/2021	HERC026 21/10/2021	Colins Well 21/10/2021	HPB999 21/10/2021
pH Value		pH Unit	0.01	8.07	8.05	7.89	8.26	8.41	8.41	8.21	8.21	8.17	8.24	8.16	8.15	8.13	8.09	8.23	8.25	8.17	8.24	8.27	8.19	8.35	8.00	6.14
Electrical Conductivity @ 25°C		µS/cm	1	996	1270	3420	1450	1750	1580	1410	1340	1440	1450	1460	1490	1610	2020	1230	1160	995	997	1290	1220	1460	3460	2
Total Dissolved Solids @180°C		mg/L	10	616	768	1950	872	1070	1010	854	828	866	881	872	907	957	1160	756	734	618	629	761	750	874	2010	<10
Suspended Solids (SS)		mg/L	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	7	<5	<5	26	<5	<5	10	<5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	22	16	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	8	<1	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	304	335	377	369	423	278	368	376	375	392	382	393	394	424	340	335	306	323	352	347	392	397	<1
Total Alkalinity as CaCO3		mg/L	1	304	335	377	369	445	295	368	376	375	392	382	393	394	424	340	335	306	323	352	347	400	397	<1
Silicon as SiO2		mg/L	0.1	76.6	90.7	50.2	85.5	110.0	100.0	86.0	95.2	83.5	95.7	96.5	84.3	74.0	101.0	89.0	99.4	81.5	84.4	91.5	87.8	87.2	51.9	<0.1
Sulfate as SO4 - Turbidimetric		mg/L	1	23	43	178	60	42	44	55	45	58	50	51	58	75	46	40	32	22	22	42	52	66	167	<1
Chloride		mg/L	1	125	205	861	253	333	296	230	210	235	240	235	248	278	425	192	170	139	129	199	189	244	788	<1
Calcium		mg/L	1	29	32	66	29	28	56	30	24	27	24	25	28	25	41	28	27	30	25	29	28	26	62	<1
Magnesium		mg/L	1	30	44	114	54	66	49	51	42	49	48	49	52	48	62	38	35	29	27	39	38	50	107	<1
Sodium		mg/L	1	134	165	469	188	243	199	191	174	174	186	190	189	210	260	147	144	124	128	155	148	180	448	<1
Potassium		mg/L	1	9	12	13	12	19	13	12	11	11	12	12	13	14	20	11	12	9	8	12	11	11	12	<1
Mercury	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	dissolved	µg/L	5	<5	<5	6	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron	dissolved	µg/L	2	2	<2	<2	<2	<2	5	2	<2	<2	<2	<2	<2	<2	4	13	<2	13	3	<2	<2	<2	<2	<2
Antimony	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	dissolved	µg/L	0.2	2.0	3.0	2.6	3.2	4.9	5.8	2.9	2.7	2.8	3.0	2.9	3.4	3.5	6.2	2.6	2.5	1.9	2.0	2.6	2.6	2.8	2.2	<0.2
Arsenic	dissolved	µg/L	0.2	4.9	6.7	2.4	31.3	5.6	3.1	21.5	13.4	72.7	14.1	14.0	12.8	65.5	5.0	7.4	5.6	5.6	6.0	8.4	8.5	40.4	3.0	<0.2
Barium	dissolved	µg/L	0.5	224.0	159.0	98.2	136.0	216.0	291.0	124.0	122.0	126.0	141.0	145.0	133.0	111.0	254.0	152.0	178.0	203.0	237.0	161.0	158.0	129.0	85.2	16.7
Beryllium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	dissolved	µg/L	5	344	492	396	546	823	407	586	495	484	514	503	564	669	734	466	495	258	270	469	464	489	329	17
Bismuth	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	0.06	<0.05
Chromium	dissolved	µg/L	0.2	2.4	2.8	<0.2	2.7	0.7	0.9	2.9	2.3	3.4	2.3	2.3	2.8	3.3	1.1	2.9	1.9	2.4	2.3	2.6	3.0	2.8	0.2	<0.2
Cobalt	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	dissolved	µg/L	0.5	<0.5	<0.5	0.8	0.7	9.5	12.7	23.3	<0.5	0.5	<0.5	<0.5	1.2	<0.5	127.0	<0.5	<0.5	1.8	<0.5	<0.5	<0.5	1.4	6.9	0.7
Lead	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	0.2	<0.1
Lithium	dissolved	µg/L	0.5	5.4	21.9	20.9	20.4	23.0	11.9	20.5	20.6	19.6	21.3	21.0	21.1	18.8	20.9	23.6	18.6	5.5	5.2	22.6	24.0	20.2	21.5	<0.5
Manganese	dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	0.6	0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5
Molybdenum	dissolved	µg/L	0.1	4.1	5.6	4.9	6.7	3.1	2.0	6.0	6.2	6.6	6.8	6.8	6.5	6.0	3.6	5.6	3.9	3.1	4.0	5.6	5.5	6.9	4.9	<0.1
Nickel	dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	1.6	3.6	<0.5
Silver	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	dissolved	µg/L	1	525	596	1490	625	908	834	628	697	773	748	746	803	797	1100	720	777	639	650	715	711	755	1860	2
Tellurium	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	dissolved	µg/L	0.0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	0.6	<0.2
Titanium	dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	dissolved	µg/L	0.05	8.53	30.50	84.10	43.90	40.90	7.29	40.00	34.20	42.20	38.30	38.50	44.00	40.00	18.20	24.60	18.20	7.16	7.71	26.60	25.90	40.50	77.80	<0.05
Vanadium	dissolved	µg/L	0.2	30.0	28.8	5.3	33.9	31.6	20.0	30.9	33.4	29.7	33.8	33.8	31.4	26.7	19.7	27.5	26.3	23.1	27.8	27.9	27.7	31.8	5.0	<0.2
Zinc	dissolved	µg/L	1	13	14	17	18	10	12	17	16	19	17	16	17	18	40	16	16	21	17	16	19	31	35	10
Nitrate as N		mg/L	0.01	9.33	8.05	3.46	7.16	7.87	32.80	7.84	7.10	6.56	7.35	7.35	6.86	6.36	7.68	8.37	10.70	7.82	9.01	7.85	8.03	6.99	3.23	<0.01
Total Anions		meq/L	0.01	10.10	13.40	35.50	15.80	19.20	15.20	15.00	14.40	15.30	15.60	15.30	16.00	17.30	21.40	13.00	12.20	10.50	10.60	13.50	13.30	16.20	33.60	<0.01
Total Cations		meq/L	0.01	9.98	12.70	33.40	14.40	17.90	15.80	14.30	12.50	13.20	13.50	13.80	14.20	14.70	19.00	11.20	10.80	9.51	9.24	11.70	11.20	13.50	31.70	<0.01
Ionic Balance		%	0.01	0.52	2.57	3.07	4.59	3.44	2.12	2.31	6.95	7.35	7.19	5.04	6.02	8.09	6.06	7.60	5.91	4.93	6.61	7.19	8.55	9.15	2.97	<0.01
Bromide		mg/L	0.01	0.40	0.62	2.81	0.76	1.13	0.79	0.68	0.68	0.79	0.79	0.79	0.82	0.94	1.57	0.62	0.52	0.40	0.36	0.63	0.63	0.71	2.71	<0.010
Gross beta		Bq/L	0.1																							
Gross alpha		Bq/L	0.05																							
Gross beta activity - 40K		Bq/L	0.1																							
Radium 226		Bq/L	0.01																							
Radium 228		Bq/L	0.08																							
Iron	dissolved	mg/L	0.05																							
Arsenobetaine (ASB)	dissolved	µg/L	1																							
Arsenious Acid (As (III))	dissolved	µg/L	0.5																							
Dimethylarsenic Acid (DMA)	dissolved	µg/L	1																							
Monomethylarsonic Acid (MMA)	dissolved	µg/L	1																							
Arsenic Acid (As (V))	dissolved	µg/L	0.5																							
Trivalent Chromium	dissolved	mg/L	0.001																							
Hexavalent Chromium	dissolved	mg/L	0.001																							
Ferrous Iron	dissolved	mg/L	0.05																							
Ferric Iron	dissolved	mg/L	0.05																							

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB010 21/04/2021	HMB011 22/04/2021	INDEE HOMESTEAD 22/04/2021	HERC026 22/04/2021	UNK1 23/04/2021	UNK2 23/04/2021	NO 10 WELL 23/04/2021	HMB001 20/10/2021	HMB002 20/10/2021	HMB003 20/10/2021	HMB003 20/10/2021	HMB004 20/10/2021	HMB005 20/10/2021	HMB006 20/10/2021	HMB007 20/10/2021	HMB008 21/10/2021	HMB009 21/10/2021	HMB010 21/10/2021	HMB011 21/10/2021	HPB001 21/10/2021	HERC026 21/10/2021	Colins Well 21/10/2021	HPB999 21/10/2021
Mercury	total	mg/L	0.0001																							
Aluminium	total	µg/L	5																							
Iron	total	µg/L	2																							
Antimony	total	µg/L	0.2																							
Selenium	total	µg/L	0.2																							
Arsenic	total	µg/L	0.2																							
Barium	total	µg/L	0.5																							
Beryllium	total	µg/L	0.1																							
Boron	total	µg/L	5																							
Bismuth	total	µg/L	0.05																							
Cadmium	total	µg/L	0.05																							
Chromium	total	µg/L	0.2																							
Cobalt	total	µg/L	0.1																							
Copper	total	µg/L	0.5																							
Lead	total	µg/L	0.1																							
Lithium	total	µg/L	0.5																							
Manganese	total	µg/L	0.5																							
Molybdenum	total	µg/L	0.1																							
Nickel	total	µg/L	0.5																							
Silver	total	µg/L	0.1																							
Strontium	total	µg/L	1																							
Thallium	total	µg/L	0.02																							
Thorium	total	µg/L	0.1																							
Tin	total	µg/L	0.2																							
Titanium	total	µg/L	1																							
Uranium	total	µg/L	0.05																							
Vanadium	total	µg/L	0.2																							
Zinc	total	µg/L	1																							
Tellurium	total	µg/L	0.2																							

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HPB008 28/10/2021	HPB009 08/11/2021	HPB006 08/11/2021	HPB007 13/11/2021	HPB010 17/11/2021	HPB011 23/11/2021	HPB012 22/11/2021	HMB026 01/12/2021	HMB016 02/12/2021	HMB012S 02/12/2021	HMB018 21/12/2021	HMB019 21/12/2021	HMB019 21/12/2021	HMB022 21/12/2021	HMB022 18/12/2021	HMB024D 20/12/2021	HMB028D 20/12/2021	HMB025D 18/01/2022	HMB023D 18/01/2022	HMB022 low flow 18/01/2022	HMB022 Hydrasleeve 18/01/2022	HMB021 18/01/2022	HMB020 18/01/2022	HMB017 19/01/2022
pH Value		pH Unit	0.01	8.18	8.27	8.29	8.13	8.31	9.10	8.40	8.00	8.09	8.00	8.1	8	7.96	7.9	7.87	8.01	8.29	8.23	8.06	7.95	7.92	7.96	7.89	7.75
Electrical Conductivity @ 25°C		µS/cm	1	1480	1500	1260	1270	1320	1560	1250	1220	1500	1480	803	626	627	902	901	1970	1250	1660	1440	965	921	1850	2370	1880
Total Dissolved Solids @180°C		mg/L	10	882	886	766	780	749	871	742	752	926	920	470	362	370	519	554	1210	740	1030	847	530	514	1220	1360	1120
Suspended Solids (SS)		mg/L	5	<5	<5	<5	<5	<5	<5	<5	7	<5	<5	158	211	1210	558	1320	34	<5	14	6	9	452	<5	274	8
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	3	84	14	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	394	395	346	357	336	251	336	349	394	406	201	284	278	324	325	582	339	509	408	329	323	253	408	328
Total Alkalinity as CaCO3		mg/L	1	394	395	346	357	338	335	350	349	394	406	201	284	278	324	325	582	339	509	408	329	323	253	408	328
Silicon as SiO2		mg/L	0.1	88.0	95.7	94.1	93.4	69.8	33.5	90.8	87.4	95.7	86.9	49.5	32.9	32.5	27.8	27.4	42.1	87.1	92.5	41.6	28.7	28.7	82.8	42.1	42.7
Sulfate as SO4 - Turbidimetric		mg/L	1	63	67	45	56	60	86	48	51	55	54	12	9	10	26	24	96	40	41	55	27	23	60	73	82
Chloride		mg/L	1	249	250	191	197	226	302	205	202	276	266	153	41	42	112	108	279	193	252	222	116	109	443	547	408
Calcium		mg/L	1	24	23	26	28	32	13	30	29	26	28	46	46	50	41	40	34	35	34	36	68	66	63	88	92
Magnesium		mg/L	1	52	52	40	41	47	12	42	40	55	53	37	34	33	43	42	51	47	50	47	41	40	70	74	61
Sodium		mg/L	1	198	198	160	162	176	289	168	161	199	212	63	33	37	68	67	322	155	234	189	70	68	196	273	192
Potassium		mg/L	1	13	14	13	12	12	28	12	12	14	13	4	2	3	3	3	10	11	18	12	3	3	8	9	6
Mercury	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	dissolved	µg/L	5	<5	<5	<5	<5	<5	5	27	<5	<5	<5	<5	<5	<5	21	<5	<5	<5	<5	20	7	<5	<5	<5	<5
Iron	dissolved	µg/L	2	<2	<2	<2	<2	<2	6	<2	4	5	<2	<2	19	<2	64	81	1240	2	48	154	208	684	<2	469	2
Antimony	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	dissolved	µg/L	0.2	2.9	2.9	2.6	2.5	2.5	2.2	3.2	2.8	3.3	2.4	0.4	0.6	0.6	0.5	0.3	<0.2	3.1	0.2	<0.2	0.9	<0.2	2	0.5	0.5
Arsenic	dissolved	µg/L	0.2	59.0	13.4	8.9	8.3	27.2	705.0	12.3	8.0	9.1	12.8	1.8	1	0.9	1.7	2.6	290	7.1	52.6	818	4.9	9	5.2	2.2	0.6
Barium	dissolved	µg/L	0.5	133.0	135.0	145.0	129.0	88.8	11.7	136.0	129.0	142.0	147.0	194	161	206	250	258	258	124	143	198	196	250	440	447	146
Beryllium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	dissolved	µg/L	5	776	690	603	476	484	414	510	490	573	555	114	117	121	121	120	559	503	536	455	95	99	279	652	373
Bismuth	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11
Chromium	dissolved	µg/L	0.2	2.9	2.5	2.8	3.0	3.3	3.6	3.1	3.1	2.1	0.5	1.1	1.2	1	0.2	<0.2	<0.2	2.9	<0.2	<0.2	<0.2	<0.2	1.6	<0.2	<0.2
Cobalt	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	4.7	2.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.4	1.3	2.5	<0.1	<0.1	0.2	1.2	0.9	<0.1	8.6	0.3
Copper	dissolved	µg/L	0.5	0.5	0.7	<0.5	0.9	2.2	1.6	1.8	0.7	2.1	<0.5	0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	<0.5	<0.5
Lead	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lithium	dissolved	µg/L	0.5	25.2	22.9	25.2	22.1	17.3	70.5	22.6	18.4	17.1	18.7	11.5	4.3	4.2	7.5	7.8	57.4	25.5	49.3	25.7	12.1	19.2	21.4	63.5	49.6
Manganese	dissolved	µg/L	0.5	3.6	<0.5	0.6	5.4	54.7	32.3	<0.5	1.2	1.0	99.5	2.4	1	2.3	326	469	2930	1.5	206	1240	409	921	0.5	2350	116
Molybdenum	dissolved	µg/L	0.1	5.9	5.9	5.4	5.2	6.0	19.2	5.4	4.9	5.2	6.0	0.9	0.8	0.9	1.3	1.2	10.5	5.5	5.3	6.6	1.2	1.5	1	5.5	2.8
Nickel	dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	2.5	2.1	<0.5	0.8	0.7	0.8	<0.5	<0.5	1.1	5.7	1.1	1.5	<0.5	<0.5	0.5	1.4	<0.5	<0.5	15.2	0.6
Silver	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	dissolved	µg/L	1	738	752	680	642	662	174	613	534	649	628	569	488	481	528	517	739	622	770	763	586	586	1120	907	840
Tellurium	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	dissolved	µg/L	0.0	<0.02	<0.02	<0.02	<0.02	0.1	<0.02	<0.02	<0.02	<0.02	0.0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.06
Thorium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	dissolved	µg/L	0.2	0.5	<0.2	0.8	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2
Titanium	dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	dissolved	µg/L	0.05	46.20	44.10	29.40	32.40	31.80	20.50	26.60	31.30	40.40	40.00	6.07	9.01	8.97	7.85	7.9	8.15	26.8	44.9	18.6	8.61	7.1	20.4	18.7	27
Vanadium	dissolved	µg/L	0.2	35.5	36.6	30.5	30.8	21.1	45.6	27.8	28.8	33.1	30.5	8.6	5	5.1	2.4	2.4	0.7	26.7	6.8	2	2.1	0.6	13	2.7	7.2
Zinc	dissolved	µg/L	1	15	15	15	13	15	4	14	11	17	15	15	28	34	38	34	2	8	2	6	8	4	13	15	11
Nitrate as N		mg/L	0.01	6.66	7.10	8.09	7.08	6.96	0.01	8.07	6.88	6.20	4.07	0.82	1.79	1.78	0.2	0.08	<0.01	7.32	0.12	<0.01	0.65	0.01	3.39	0.14	0.38
Total Anions		meq/L	0.01	16.20	16.30	13.20	13.80	14.40	17.00	13.80	13.70	16.80	16.70	8.58	7.02	6.95	10.2	10	21.5	13	18.1	15.6	10.4	10	18.8	25.1	19.8
Total Cations		meq/L	0.01	14.40	14.40	11.90	12.10	13.40	14.90	12.60	12.00	14.80	15.30	8.18	6.58	6.9	8.62	8.44	20.2	12.6	16.4	14.2	9.89	9.62	17.6	22.6	18.1
Ionic Balance		%	0.01	5.83	6.32	5.40	6.66	3.42	6.51	4.58	6.53	6.21	4.45	2.38	3.22	0.36	8.27	8.63	3.22	1.6	4.86	4.59	2.55	1.97	3.2	5.27	4.36
Bromide		mg/L	0.01	0.67	0.68	0.60	0.02	0.57	0.63	0.61	0.19	0.31	0.29	0.428	0.131	0.132	0.323	0.322	0.864	0.613	0.63	0.611	0.301	0.287	1.25	1.55	1.06
Gross beta		Bq/L	0.1																								
Gross alpha		Bq/L	0.05																								
Gross beta activity - 40K		Bq/L	0.1																								
Radium 226		Bq/L	0.01																								
Radium 228		Bq/L	0.08																								
Iron	dissolved	mg/L	0.05																								
Arsenobetaine (ASB)	dissolved	µg/L	1																								
Arsenious Acid (As (III))	dissolved	µg/L	0.5																								
Dimethylarsenic Acid (DMA)	dissolved	µg/L	1																								
Monomethylarsonic Acid (MMA)	dissolved	µg/L	1																								
Arsenic Acid (As (V))	dissolved	µg/L	0.5																								
Trivalent Chromium	dissolved	mg/L	0.001																								
Hexavalent Chromium	dissolved	mg/L	0.001																								
Ferrous Iron	dissolved	mg/L	0.05																								
Ferric Iron	dissolved	mg/L	0.05																								

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HPB008 28/10/2021	HPB009 08/11/2021	HPB006 08/11/2021	HPB007 13/11/2021	HPB010 17/11/2021	HPB011 23/11/2021	HPB012 22/11/2021	HMB026 01/12/2021	HMB016 02/12/2021	HMB012S 02/12/2021	HMB018 21/12/2021	HMB019 21/12/2021	HMB019 21/12/2021	HMB022 21/12/2021	HMB022 18/12/2021	HMB024D 20/12/2021	HMB028D 20/12/2021	HMB025D 18/01/2022	HMB023D 18/01/2022	HMB022 low flow 18/01/2022	HMB022 Hydrasleeve 18/01/2022	HMB021 18/01/2022	HMB020 18/01/2022	HMB017 19/01/2022
Mercury	total	mg/L	0.0001																								
Aluminium	total	µg/L	5																								
Iron	total	µg/L	2																								
Antimony	total	µg/L	0.2																								
Selenium	total	µg/L	0.2																								
Arsenic	total	µg/L	0.2																								
Barium	total	µg/L	0.5																								
Beryllium	total	µg/L	0.1																								
Boron	total	µg/L	5																								
Bismuth	total	µg/L	0.05																								
Cadmium	total	µg/L	0.05																								
Chromium	total	µg/L	0.2																								
Cobalt	total	µg/L	0.1																								
Copper	total	µg/L	0.5																								
Lead	total	µg/L	0.1																								
Lithium	total	µg/L	0.5																								
Manganese	total	µg/L	0.5																								
Molybdenum	total	µg/L	0.1																								
Nickel	total	µg/L	0.5																								
Silver	total	µg/L	0.1																								
Strontium	total	µg/L	1																								
Thallium	total	µg/L	0.02																								
Thorium	total	µg/L	0.1																								
Tin	total	µg/L	0.2																								
Titanium	total	µg/L	1																								
Uranium	total	µg/L	0.05																								
Vanadium	total	µg/L	0.2																								
Zinc	total	µg/L	1																								
Tellurium	total	µg/L	0.2																								

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB023S 19/01/2022	HMB013 19/01/2022	HMB030S 20/01/2022	HMB030D 20/01/2022	HMB029D 20/01/2022	HMB029S 20/01/2022	HPB004 14/01/2022	HPB002 17/01/2022	HPB003 20/01/2022	HMB014 20/01/2022	HMB014 20/01/2022	HMB020 21/01/2022	HMB020 21/01/2022	HMB001 23/04/2022	HMB002 25/04/2022	HMB003 23/04/2022	HMB004 23/04/2022	HMB005 25/04/2022	HMB006 23/04/2022	HMB007 23/04/2022	HMB008 23/04/2022	HMB009 23/04/2022	HMB010 23/04/2022	HMB011 23/04/2022
pH Value		pH Unit	0.01	8.18	8.21	8.31	8.22	8.21	8	8.3	8.24	8.23	8.04	8.18	7.87	7.87	7.93	7.94	7.97	7.87	8.18	7.81	7.91	7.97	7.89	7.95	7.93
Electrical Conductivity @ 25°C		µS/cm	1	1600	1290	1310	1260	1210	2960	1440	1140	1220	1290	1300	2310	2320	1220	1450	1490	1520	1600	1840	1220	1090	995	992	1270
Total Dissolved Solids @180°C		mg/L	10	968	760	763	755	734	1920	856	673	727	851	788	1310	1350	731	842	882	885	924	1090	770	702	596	612	760
Suspended Solids (SS)		mg/L	5	1850	<5	<5	<5	<5	<5	<5	<5	<5	1900	<5	85	66	12	8	14	22	40	17	226	34	32	56	21
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	368	350	367	346	336	426	381	315	337	366	359	409	413	361	380	379	390	383	398	338	333	295	315	350
Total Alkalinity as CaCO3		mg/L	1	368	350	368	346	336	426	381	315	337	366	359	409	413	361	380	379	390	383	398	338	333	295	315	350
Silicon as SiO2		mg/L	0.1	108	94.1	67.7	89	89.3	71.5	94.8	84.5	88.6	88.1	87.3	41.3	39.6	95.7	88	98.3	88.8	74.1	100	92.6	105	86	87.3	93.5
Sulfate as SO4 - Turbidimetric		mg/L	1	58	44	57	43	38	80	60	32	37	51	50	74	80	41	60	53	62	78	45	40	29	23	23	44
Chloride		mg/L	1	283	183	195	187	184	723	228	169	184	203	203	558	564	174	240	246	257	282	380	202	156	141	124	199
Calcium		mg/L	1	28	33	37	34	35	82	30	40	35	32	30	84	85	22	30	29	31	31	44	34	31	33	34	33
Magnesium		mg/L	1	38	43	45	43	43	115	51	41	43	46	44	73	73	36	53	51	55	55	59	43	38	31	32	42
Sodium		mg/L	1	227	154	164	152	146	324	179	135	144	176	173	280	283	169	177	191	186	210	227	150	136	121	123	156
Potassium		mg/L	1	12	11	12	11	11	19	11	10	11	12	12	10	10	12	13	13	13	15	32	12	12	10	9	12
Mercury	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	dissolved	µg/L	5	<5	<5	<5	<5	<5	5	<5	<5	<5	<5	<5	<5	<5	<5	8	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron	dissolved	µg/L	2	20	<2	257	5	<2	1580	<2	<2	<2	<2	<2	<2	<2	<2	3	<2	<2	<2	<2	<2	<2	<2	<2	<2
Antimony	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	dissolved	µg/L	0.2	3.2	2.9	0.4	2.8	3	0.3	3	2.6	2.8	2.6	2.7	0.8	0.7	2.3	3	3.3	3.5	3.9	5.9	2.9	2.4	2	1.9	2.8
Arsenic	dissolved	µg/L	0.2	9.2	8.3	7.2	10	9	6.3	16.6	5.5	7.6	8.2	8.2	1.4	1.3	8	52.8	10.5	10.1	55.6	4.2	6	4.2	4.6	4.4	6.8
Barium	dissolved	µg/L	0.5	302	150	474	148	163	1150	153	175	178	120	69.6	420	428	130	108	128	133	101	198	145	152	190	241	143
Beryllium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	dissolved	µg/L	5	597	533	546	531	540	536	576	520	538	446	444	574	598	484	412	467	500	561	627	416	398	297	258	417
Bismuth	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	dissolved	µg/L	0.2	1.9	3.1	0.6	2.4	2.9	0.2	3	2.6	2.6	4.1	3.4	<0.2	<0.2	1.1	3.2	2.2	2.9	3.8	1.4	3.1	1.4	2.5	2.2	2.7
Cobalt	dissolved	µg/L	0.1	<0.1	<0.1	0.8	<0.1	<0.1	1.3	<0.1	<0.1	<0.1	<0.1	<0.1	4.6	3.7	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	dissolved	µg/L	0.5	0.5	1	<0.5	<0.5	<0.5	0.6	2.4	2	3.6	<0.5	<0.5	2.4	5.5	1.3	2	1	0.6	<0.5	2.1	<0.5	0.6	1.4	<0.5	1.1
Lead	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lithium	dissolved	µg/L	0.5	19.2	23.7	23.1	22.8	22.5	50.4	21	21.2	23.1	18.1	18.5	60.7	62.1	12.2	17.3	16.9	18.1	16.4	18.2	20.1	13.1	5.3	4.4	19.4
Manganese	dissolved	µg/L	0.5	1.7	0.7	1040	10.4	2.3	3100	8.7	<0.5	<0.5	<0.5	0.8	2010	2100	<0.5	8.5	<0.5	<0.5	2	0.6	<0.5	<0.5	<0.5	<0.5	0.8
Molybdenum	dissolved	µg/L	0.1	4	5	6.3	4.8	4.4	4.3	5.6	3.7	4.5	4.9	5.1	7.3	7.5	4.9	5.3	5.8	5.5	5.3	3.5	4.6	2.8	2.7	2.8	4.6
Nickel	dissolved	µg/L	0.5	2	<0.5	1	<0.5	<0.5	2.1	<0.5	<0.5	<0.5	1.5	0.6	8.6	7.1	<0.5	<0.5	<0.5	<0.5	<0.5	4.3	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	dissolved	µg/L	1	639	687	708	700	689	1940	729	679	707	638	628	829	834	453	579	547	602	576	712	533	560	467	529	535
Tellurium	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	dissolved	µg/L	0.0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.06	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	dissolved	µg/L	0.2	0.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	2.1	<0.2	<0.2	<0.2	0.3	0.3	<0.2	<0.2	<0.2	<0.2
Titanium	dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	dissolved	µg/L	0.05	25.6	31.4	34.9	26.5	23.8	16.8	40.5	18.9	23.7	32.1	31.7	26.1	26	23.6	40.4	35.3	43.7	37.2	17	24.1	16.4	6.94	7.6	26
Vanadium	dissolved	µg/L	0.2	25.3	26.4	0.8	23.4	25.1	1.6	31.3	23.3	26.2	27.1	27.2	3.4	2.2	32.3	31	35	32.8	26.6	20.8	29	26.2	25.6	29.2	29.3
Zinc	dissolved	µg/L	1	74	12	13	10	8	12	17	17	18	4	1	17	17	20	40	17	21	20	22	16	16	20	19	20
Nitrate as N		mg/L	0.01	6.71	6.69	0.65	6.16	6.82	0.38	6.57	7.34	7.5	6.51	6.67	0.08	0.05	7.34	6.13	6.98	6.53	5.8	7.2	7.93	9.15	7.43	8.84	7.41
Total Anions		meq/L	0.01	16.5	13.1	14	13.1	12.7	30.6	15.3	11.7	12.7	14.1	13.9	25.4	25.8	13	15.6	15.6	16.3	17.2	19.6	13.3	11.6	10.4	10.3	13.5
Total Cations		meq/L	0.01	14.7	12.2	13	12.1	11.9	28.1	13.8	11.5	11.8	13.3	13	22.6	22.8	11.7	13.9	14.3	14.5	15.6	17.7	12.1	10.9	9.72	9.91	12.2
Ionic Balance		%	0.01	5.88	3.59	3.88	3.79	3.16	4.15	5.27	0.98	3.52	2.75	3.68	5.86	6.19	5.09	5.83	4.45	5.96	5	4.99	4.8	3.37	3.16	1.78	5.16
Bromide		mg/L	0.01	0.721	0.503	0.539	0.515	0.499	2.03	0.625	0.466	0.508	0.535	0.533	1.51	1.52	<0.020	<0.050	<0.050	0.708	0.802	1.27	0.544	0.454	0.446	0.403	0.646
Gross beta		Bq/L	0.1														----	----	----	----	----	----	----	----	----	----	----
Gross alpha		Bq/L	0.05														----	----	----	----	----	----	----	----	----	----	----
Gross beta activity - 40K		Bq/L	0.1														----	----	----	----	----	----	----	----	----	----	----
Radium 226		Bq/L	0.01														----	----	----	----	----	----	----	----	----	----	----
Radium 228		Bq/L	0.08														----	----	----	----	----	----	----	----	----	----	----
Iron	dissolved	mg/L	0.05														----	----	----	----	----	----	----	----	----	----	----
Arsenobetaine (ASB)	dissolved	µg/L	1														----	<1	----	----	<1	----	----	----	----	----	----
Arsenious Acid (As (III))	dissolved	µg/L	0.5														----	<0.5	----	----	<0.5	----	----	----	----	----	----
Dimethylarsenic Acid (DMA)	dissolved	µg/L	1														----	<1	----	----	<1	----	----	----	----	----	----
Monomethylarsonic Acid (MMA)	dissolved	µg/L	1														----	<1	----	----	<1	----	----	----	----	----	----
Arsenic Acid (As (V))	dissolved	µg/L	0.5														----	49.8	----	----	51	----	----	----	----	----	----
Trivalent Chromium	dissolved	mg/L	0.001														----	<0.001	----	----	<0.001	----	----	----	----	----	----
Hexavalent Chromium	dissolved	mg/L	0.001														----	0.004	----	----	0.004	----	----	----	----	----	----
Ferrous Iron	dissolved	mg/L	0.05														----	<0.05	----	----	<0.05	----	----	----	----	----	----
Ferric Iron	dissolved	mg/L	0.05														----	----	----	----	----	----	----	----	----	----	----

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB023S 19/01/2022	HMB013 19/01/2022	HMB030S 20/01/2022	HMB030D 20/01/2022	HMB029D 20/01/2022	HMB029S 20/01/2022	HPB004 14/01/2022	HPB002 17/01/2022	HPB003 20/01/2022	HMB014 20/01/2022	HMB014 20/01/2022	HMB020 21/01/2022	HMB020 21/01/2022	HMB001 23/04/2022	HMB002 25/04/2022	HMB003 23/04/2022	HMB004 23/04/2022	HMB005 25/04/2022	HMB006 23/04/2022	HMB007 23/04/2022	HMB008 23/04/2022	HMB009 23/04/2022	HMB010 23/04/2022	HMB011 23/04/2022
Mercury	total	mg/L	0.0001														----	----	----	----	<0.0001	----	<0.0001	----	----	----	----
Aluminium	total	µg/L	5														----	----	----	----	1240	----	6560	----	----	----	----
Iron	total	µg/L	2														----	----	----	----	1710	----	7350	----	----	----	----
Antimony	total	µg/L	0.2														----	----	----	----	<0.2	----	<0.2	----	----	----	----
Selenium	total	µg/L	0.2														----	----	----	----	3.6	----	2.6	----	----	----	----
Arsenic	total	µg/L	0.2														----	----	----	----	58.8	----	7.7	----	----	----	----
Barium	total	µg/L	0.5														----	----	----	----	77.6	----	139	----	----	----	----
Beryllium	total	µg/L	0.1														----	----	----	----	<0.1	----	0.3	----	----	----	----
Boron	total	µg/L	5														----	----	----	----	607	----	417	----	----	----	----
Bismuth	total	µg/L	0.05														----	----	----	----	<0.05	----	0.06	----	----	----	----
Cadmium	total	µg/L	0.05														----	----	----	----	<0.05	----	<0.05	----	----	----	----
Chromium	total	µg/L	0.2														----	----	----	----	8.8	----	25.6	----	----	----	----
Cobalt	total	µg/L	0.1														----	----	----	----	1.2	----	4.8	----	----	----	----
Copper	total	µg/L	0.5														----	----	----	----	1.7	----	14.9	----	----	----	----
Lead	total	µg/L	0.1														----	----	----	----	0.9	----	4	----	----	----	----
Lithium	total	µg/L	0.5														----	----	----	----	19.1	----	28	----	----	----	----
Manganese	total	µg/L	0.5														----	----	----	----	91.1	----	104	----	----	----	----
Molybdenum	total	µg/L	0.1														----	----	----	----	6.4	----	2.9	----	----	----	----
Nickel	total	µg/L	0.5														----	----	----	----	3.3	----	13.4	----	----	----	----
Silver	total	µg/L	0.1														----	----	----	----	<0.1	----	<0.1	----	----	----	----
Strontium	total	µg/L	1														----	----	----	----	693	----	648	----	----	----	----
Thallium	total	µg/L	0.02														----	----	----	----	<0.02	----	0.09	----	----	----	----
Thorium	total	µg/L	0.1														----	----	----	----	0.4	----	2.5	----	----	----	----
Tin	total	µg/L	0.2														----	----	----	----	<0.2	----	0.3	----	----	----	----
Titanium	total	µg/L	1														----	----	----	----	25	----	142	----	----	----	----
Uranium	total	µg/L	0.05														----	----	----	----	46.8	----	30.7	----	----	----	----
Vanadium	total	µg/L	0.2														----	----	----	----	31.2	----	46.1	----	----	----	----
Zinc	total	µg/L	1														----	----	----	----	4	----	19	----	----	----	----
Tellurium	total	µg/L	0.2														----	----	----	----	<0.2	----	<0.2	----	----	----	----

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB012D 23/04/2022	HMB012S 23/04/2022	HMB013 23/04/2022	HMB014 24/04/2022	HMB016 23/04/2022	HMB017 23/04/2022	HMB018 23/04/2022	HMB019 24/04/2022	HMB020 23/04/2022	HMB021 24/04/2022	HMB022 24/04/2022	HMB023D 25/04/2022	HMB023S 24/04/2022	HMB024D 25/04/2022	HMB024S 24/04/2022	HMB025D 25/04/2022	HMB025S 24/04/2022	HMB026 24/04/2022	HMB027D 24/04/2022	HMB027S 24/04/2022	HMB028D 24/04/2022	HMB028S 24/04/2022	HMB029D 24/04/2022	HMB029S 24/04/2022
pH Value		pH Unit	0.01	7.95	7.95	7.96	7.93	7.93	7.44	7.8	7.85	7.64	7.75	7.74	7.86	8	7.91	8.32	7.84	8.21	8	7.99	8.08	8	8.03	7.91	7.93
Electrical Conductivity @ 25°C		µS/cm	1	1510	1500	1240	1310	1520	1680	741	629	2360	1800	929	1380	1590	1680	1510	1570	1560	1250	1230	1200	1240	1240	1210	1280
Total Dissolved Solids @180°C		mg/L	10	899	893	720	805	916	1000	488	359	1340	1130	523	806	888	961	910	955	940	797	755	740	730	732	745	747
Suspended Solids (SS)		mg/L	5	10	110	<5	9	60	51	222	371	56	414	259	<5	18	133	20	350	313	20	6	136	9	28	20	71
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	5	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	401	384	343	356	399	309	194	280	428	252	317	376	357	416	365	437	418	348	338	352	340	337	338	345
Total Alkalinity as CaCO3		mg/L	1	401	384	343	356	399	309	194	280	428	252	317	376	357	416	370	437	418	348	338	352	340	337	338	345
Silicon as SiO2		mg/L	0.1	83.4	93.2	88.4	86.6	95	38.2	52.7	35.2	37.4	81.7	27.5	44.6	105	55.6	75.2	62.1	48.2	92.2	95.7	97.8	92.9	99.9	86.6	66.4
Sulfate as SO4 - Turbidimetric		mg/L	1	57	52	46	52	55	70	12	10	77	61	32	57	61	115	95	71	55	48	40	38	40	40	38	58
Chloride		mg/L	1	254	251	189	207	267	394	138	44	583	472	123	232	294	273	257	257	258	182	185	169	184	180	176	192
Calcium		mg/L	1	30	30	33	32	29	84	44	53	88	60	67	35	32	39	37	34	32	33	33	34	34	33	35	36
Magnesium		mg/L	1	55	61	42	44	56	54	33	32	73	65	40	42	42	56	40	49	30	42	43	40	43	40	41	41
Sodium		mg/L	1	183	207	151	164	194	179	61	34	265	185	70	204	217	229	208	240	242	155	149	150	148	147	144	163
Potassium		mg/L	1	13	13	12	12	15	6	4	3	10	8	4	10	14	9	12	12	19	12	12	12	12	13	12	12
Mercury	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	dissolved	µg/L	5	8	61	<5	<5	<5	<5	<5	<5	<5	<5	<5	16	<5	<5	68	<5	24	<5	<5	11	<5	<5	6	<5
Iron	dissolved	µg/L	2	<2	<2	<2	<2	<2	4	<2	<2	621	<2	1200	139	<2	<2	47	16	<2	<2	<2	<2	<2	<2	<2	42
Antimony	dissolved	µg/L	0.2	<0.2	0.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	0.6	0.4	0.7	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	0.2
Selenium	dissolved	µg/L	0.2	2.1	2.8	2.6	2.6	3.4	0.4	0.3	0.6	<0.2	1.9	0.3	<0.2	2.9	2	1.6	2.1	2.7	2.7	2.9	2.8	2.7	2.5	2.4	1.2
Arsenic	dissolved	µg/L	0.2	10	12.3	7.3	7.6	7.7	0.6	1.7	0.9	2.2	4.4	4	671	8.6	408	192	52.7	51.4	8.2	6.6	5.3	6.4	5.2	7.8	5.3
Barium	dissolved	µg/L	0.5	142	104	137	98.2	137	102	196	102	491	385	222	179	138	152	204	408	178	135	117	174	129	146	146	502
Beryllium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	dissolved	µg/L	5	438	432	406	406	493	304	84	77	526	208	81	399	448	445	439	463	459	411	413	432	412	430	410	448
Bismuth	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	dissolved	µg/L	0.2	<0.2	1.5	3.4	3.5	2.2	<0.2	1.2	1	<0.2	1.6	<0.2	<0.2	2.1	<0.2	<0.2	<0.2	<0.2	3.2	2.9	1.9	2.9	2.4	1.8	<0.2
Cobalt	dissolved	µg/L	0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	1.5	0.1	<0.1	<0.1	0.2	1.3	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	1.4
Copper	dissolved	µg/L	0.5	0.8	0.6	<0.5	<0.5	0.8	<0.5	0.8	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	2	0.8	<0.5	1	<0.5	<0.5	1	<0.5
Lead	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
Lithium	dissolved	µg/L	0.5	17	15.2	20.1	17.1	15.8	40.6	9.8	3.8	50.6	19.6	12.2	22.2	18.1	18.9	21	23.7	20.7	19.9	22	21.3	21.3	16.9	19.4	22.7
Manganese	dissolved	µg/L	0.5	237	11.7	<0.5	1.6	<0.5	28.3	1.4	0.6	2610	0.7	688	956	0.6	33.5	462	592	21.1	0.6	0.6	7.4	1.3	<0.5	35.4	1250
Molybdenum	dissolved	µg/L	0.1	5.6	4.8	4.9	5.1	5	2.8	1	0.9	5	1.1	2	7.4	4.1	7.8	12.8	9.7	13.8	5.4	5.3	4.6	5	4	4.5	7.4
Nickel	dissolved	µg/L	0.5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	0.7	<0.5	<0.5	0.8	0.9	1.8	1.2	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	1.8
Silver	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	dissolved	µg/L	1	571	421	513	513	584	583	451	419	717	844	451	547	518	619	528	700	438	513	527	512	520	545	502	539
Tellurium	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	dissolved	µg/L	0.0	0.03	<0.02	<0.02	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	dissolved	µg/L	0.2	0.3	0.2	<0.2	<0.2	<0.2	3.8	2.4	1.6	0.9	0.9	0.6	<0.2	<0.2	0.5	<0.2	2.7	1.1	1.9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	dissolved	µg/L	0.05	39	27.5	26.4	31.7	33.7	24.6	5.19	8.4	18.9	19.8	14.6	17.1	25.4	36.8	31.3	43.3	45.9	28.7	25.2	24.1	24.4	20.7	22.6	25.6
Vanadium	dissolved	µg/L	0.2	25.9	28	27.9	27.9	32.4	8.5	8.9	5.1	0.5	13.8	1.9	2.6	27.5	25.2	3.3	22.5	33.3	28.5	29.9	32.5	29.4	29.8	25.7	2.5
Zinc	dissolved	µg/L	1	21	13	17	15	18	14	22	15	10	21	24	4	27	20	12	42	10	21	14	22	14	14	24	38
Nitrate as N		mg/L	0.01	2.4	6.53	7.21	6.94	6.52	0.32	0.82	1.8	<0.01	3.58	0.24	<0.01	7.2	1.6	0.01	1.38	3.14	6.96	7.62	7.5	8.02	8.24	6.34	1.18
Total Anions		meq/L	0.01	16.4	15.8	13.1	14	16.6	18.7	8.02	7.04	26.6	19.6	10.5	15.2	16.7	18.4	16.6	17.4	16.8	13.1	12.8	12.6	12.8	12.6	12.5	13.5
Total Cations		meq/L	0.01	14.3	15.8	12	12.6	14.9	16.6	7.67	6.83	22.2	16.6	9.78	14.3	14.8	16.7	14.5	16.5	15.1	12.2	12	11.8	12	11.7	11.7	12.6
Ionic Balance		%	0.01	6.67	0.06	4.63	5.16	5.62	6.14	2.24	1.51	9.06	8.35	3.39	3.08	5.85	4.72	6.84	2.9	5.32	3.7	3.35	3.16	3.37	4.02	3.38	3.64
Bromide		mg/L	0.01	0.713	0.71	0.617	0.571	0.755	1.08	0.411	0.14	1.64	1.47	0.364	0.641	0.82	0.781	0.744	0.689	0.709	0.627	0.65	0.58	0.646	0.601	0.602	0.549
Gross beta		Bq/L	0.1	----	----	----	----	----	----	----	----	----	----	----	0.64	----	----	----	1.08	----	----	----	----	----	----	----	----
Gross alpha		Bq/L	0.05	----	----	----	----	----	----	----	----	----	----	----	0.84	----	----	----	1.72	----	----	----	----	----	----	----	----
Gross beta activity - 40K		Bq/L	0.1	----	----	----	----	----	----	----	----	----	----	----	0.35	----	----	----	0.63	----	----	----	----	----	----	----	----
Radium 226		Bq/L	0.01	----	----	----	----	----	----	----	----	----	----	----	<0.01	----	----	----	0.05	----	----	----	----	----	----	----	----
Radium 228		Bq/L	0.08	----	----	----	----	----	----	----	----	----	----	----	<0.08	----	----	----	<0.08	----	----	----	----	----	----	----	----
Iron	dissolved	mg/L	0.05	----	----	----	----	----	----	----	----	----	----	----	0.13	----	<0.05	----	<0.05	----	----	----	----	----	----	----	----
Arsenobetaine (ASB)	dissolved	µg/L	1	----	----	----	----	----	----	----	----	----	----	----	<5	----	<10	----	<1	----	----	----	----	----	----	----	----
Arsenious Acid (As (III))	dissolved	µg/L	0.5	----	----	----	----	----	----	----	----	----	----	----	248	----	<1.0	----	<0.5	----	----	----	----	----	----	----	----
Dimethylarsenic Acid (DMA)	dissolved	µg/L	1	----	----	----	----	----	----	----	----	----	----	----	<5	----	<10	----	<1	----	----	----	----	----	----	----	----
Monomethylarsonic Acid (MMA)	dissolved	µg/L	1	----	----	----	----	----	----	----	----	----	----	----	<5	----	<10	----	<1	----	----	----	----	----	----	----	----
Arsenic Acid (As (V))	dissolved	µg/L	0.5	----	----	----	----	----	----	----	----	----	----	----	2.6	----	390	----	48.8	----	----	----	----	----	----	----	----
Trivalent Chromium	dissolved	mg/L	0.001	----	----	----	----	----	----	----	----	----	----	----	<0.001	----	<0.001	----	<0.001	----	----	----	----	----	----	----	----
Hexavalent Chromium	dissolved	mg/L	0.001	----	----	----	----	----	----	----	----	----	----	----	<0.001	----	<0.001	----	<0.001	----	----	----	----	----	----	----	----
Ferrous Iron	dissolved	mg/L	0.05	----	----	----	----	----	----	----	----	----	----	----	<0.05	----	<0.05	----	<0.05	----	----	----	----	----	----	----	----
Ferric Iron	dissolved	mg/L	0.05	----	----	----	----	----	----	----	----	----	----	----	0.13	----	<0.05	----	<0.05	----	----	----	----	----	----	----	----

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB012D 23/04/2022	HMB012S 23/04/2022	HMB013 23/04/2022	HMB014 24/04/2022	HMB016 23/04/2022	HMB017 23/04/2022	HMB018 23/04/2022	HMB019 24/04/2022	HMB020 23/04/2022	HMB021 24/04/2022	HMB022 24/04/2022	HMB023D 25/04/2022	HMB023S 24/04/2022	HMB024D 25/04/2022	HMB024S 24/04/2022	HMB025D 25/04/2022	HMB025S 24/04/2022	HMB026 24/04/2022	HMB027D 24/04/2022	HMB027S 24/04/2022	HMB028D 24/04/2022	HMB028S 24/04/2022	HMB029D 24/04/2022	HMB029S 24/04/2022
Mercury	total	mg/L	0.0001	----	<0.0001	----	----	----	----	<0.0001	----	----	<0.0001	<0.0001	----	----	<0.0001	----	<0.0001	----	<0.0001	----	<0.0001	----	----	----	<0.0001
Aluminium	total	µg/L	5	----	1750	----	----	----	----	2820	----	----	1990	2400	----	----	723	----	11000	----	3190	----	3420	----	----	----	2160
Iron	total	µg/L	2	----	1350	----	----	----	----	3250	----	----	2770	4580	----	----	847	----	14800	----	2420	----	4470	----	----	----	2860
Antimony	total	µg/L	0.2	----	0.4	----	----	----	----	<0.2	----	----	0.2	<0.2	----	----	0.6	----	0.7	----	0.2	----	0.4	----	----	----	0.3
Selenium	total	µg/L	0.2	----	3	----	----	----	----	0.3	----	----	1.7	0.3	----	----	1.9	----	1.7	----	2.6	----	2.6	----	----	----	1.3
Arsenic	total	µg/L	0.2	----	13.4	----	----	----	----	2.6	----	----	6.2	4.9	----	----	450	----	71.6	----	9.4	----	6.5	----	----	----	7
Barium	total	µg/L	0.5	----	178	----	----	----	----	157	----	----	427	226	----	----	171	----	551	----	116	----	178	----	----	----	584
Beryllium	total	µg/L	0.1	----	<0.1	----	----	----	----	0.1	----	----	<0.1	<0.1	----	----	<0.1	----	0.4	----	<0.1	----	0.2	----	----	----	0.1
Boron	total	µg/L	5	----	482	----	----	----	----	74	----	----	200	74	----	----	472	----	418	----	434	----	422	----	----	----	454
Bismuth	total	µg/L	0.05	----	<0.05	----	----	----	----	<0.05	----	----	<0.05	<0.05	----	----	<0.05	----	0.07	----	<0.05	----	<0.05	----	----	----	<0.05
Cadmium	total	µg/L	0.05	----	0.05	----	----	----	----	<0.05	----	----	<0.05	<0.05	----	----	<0.05	----	<0.05	----	<0.05	----	0.07	----	----	----	<0.05
Chromium	total	µg/L	0.2	----	8.6	----	----	----	----	12.1	----	----	10.7	14.2	----	----	3.4	----	128	----	12	----	15.7	----	----	----	5.2
Cobalt	total	µg/L	0.1	----	6.2	----	----	----	----	1.6	----	----	1.6	5	----	----	3.8	----	17.9	----	1.3	----	3.7	----	----	----	3.5
Copper	total	µg/L	0.5	----	6.4	----	----	----	----	3.4	----	----	3.2	2.2	----	----	3	----	29.6	----	3.3	----	6.7	----	----	----	3.4
Lead	total	µg/L	0.1	----	1.3	----	----	----	----	1.4	----	----	0.9	0.8	----	----	0.9	----	3.9	----	0.9	----	3.3	----	----	----	2.1
Lithium	total	µg/L	0.5	----	19.3	----	----	----	----	11.4	----	----	21.1	13.1	----	----	20	----	34.7	----	22.5	----	22.8	----	----	----	24.2
Manganese	total	µg/L	0.5	----	1790	----	----	----	----	59.9	----	----	47.5	762	----	----	437	----	1070	----	53.4	----	151	----	----	----	1390
Molybdenum	total	µg/L	0.1	----	6.1	----	----	----	----	0.9	----	----	1.3	2.2	----	----	10.2	----	10.6	----	6.1	----	5.3	----	----	----	9.6
Nickel	total	µg/L	0.5	----	7.1	----	----	----	----	7.2	----	----	7.1	18	----	----	4.2	----	57.7	----	5.9	----	10.3	----	----	----	5.9
Silver	total	µg/L	0.1	----	<0.1	----	----	----	----	<0.1	----	----	<0.1	<0.1	----	----	<0.1	----	<0.1	----	<0.1	----	<0.1	----	----	----	<0.1
Strontium	total	µg/L	1	----	670	----	----	----	----	547	----	----	1010	543	----	----	735	----	865	----	601	----	613	----	----	----	656
Thallium	total	µg/L	0.02	----	0.02	----	----	----	----	0.03	----	----	<0.02	<0.02	----	----	0.05	----	0.19	----	<0.02	----	0.05	----	----	----	0.03
Thorium	total	µg/L	0.1	----	0.5	----	----	----	----	0.9	----	----	0.4	0.4	----	----	0.2	----	2.8	----	0.6	----	1.8	----	----	----	1.6
Tin	total	µg/L	0.2	----	<0.2	----	----	----	----	3.2	----	----	1.2	0.8	----	----	0.7	----	0.5	----	2.6	----	0.2	----	----	----	<0.2
Titanium	total	µg/L	1	----	46	----	----	----	----	48	----	----	22	27	----	----	21	----	377	----	53	----	58	----	----	----	40
Uranium	total	µg/L	0.05	----	44.8	----	----	----	----	6.36	----	----	23	15.9	----	----	43.3	----	52.1	----	33	----	27.8	----	----	----	31.1
Vanadium	total	µg/L	0.2	----	40.4	----	----	----	----	14.9	----	----	18.2	8.6	----	----	26.8	----	57.9	----	34.4	----	40.3	----	----	----	6.9
Zinc	total	µg/L	1	----	24	----	----	----	----	8	----	----	10	18	----	----	18	----	45	----	8	----	23	----	----	----	11
Tellurium	total	µg/L	0.2	----	<0.2	----	----	----	----	<0.2	----	----	<0.2	<0.2	----	----	<0.2	----	<0.2	----	<0.2	----	<0.2	----	----	----	<0.2

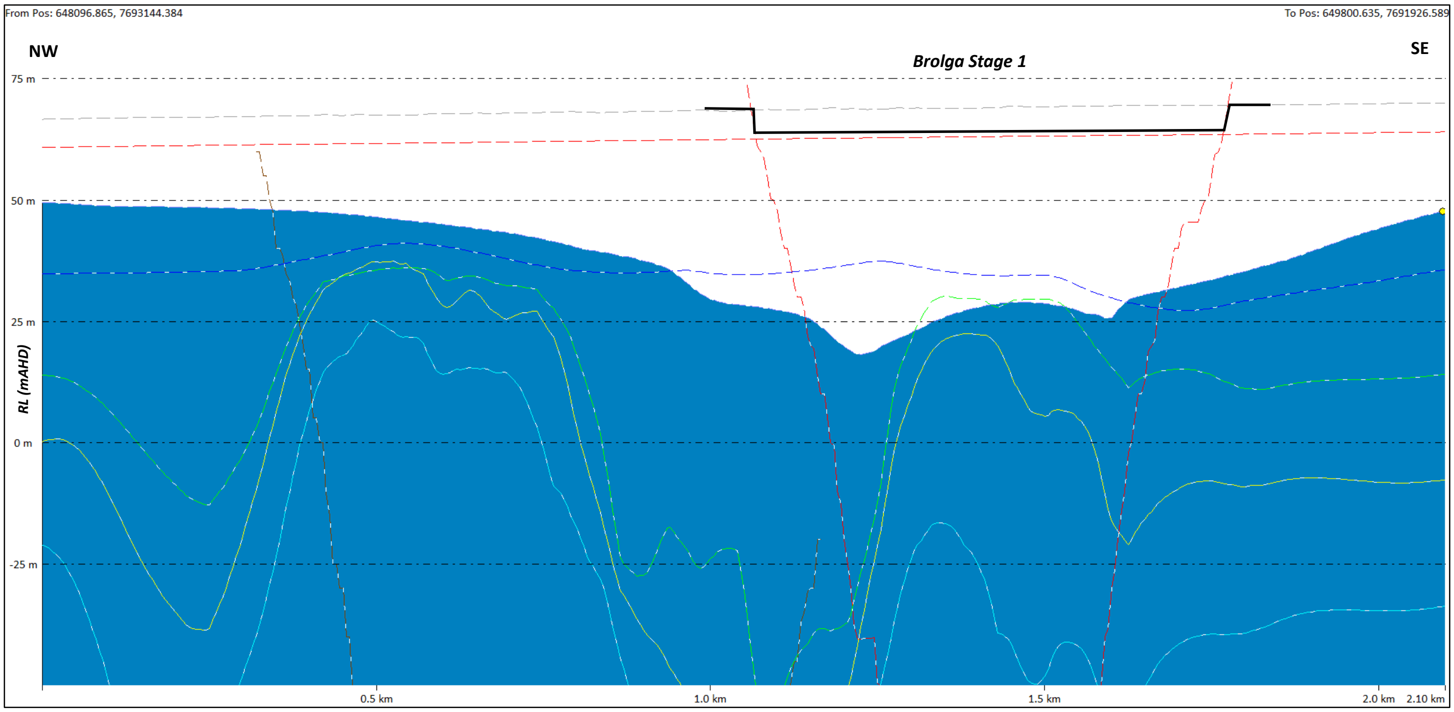
Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB030D 24/04/2022	HMB030S 24/04/2022	HMB034 25/04/2022	HMB035 25/04/2022	HPB001 24/04/2022	HPB011 25/04/2022	HMB036 12/06/2022	HMB037 12/06/2022	HMB039 12/06/2022	HMB040 12/06/2022	HMB042 12/06/2022	HMB040 29/06/2022
pH Value		pH Unit	0.01	8.07	7.9	8.09	7.94	8.16	8.86	8.05	8.13	8.02	7.97	8.02	7.96
Electrical Conductivity @ 25°C		µS/cm	1	1240	1270	1510	1970	1250	1340	1360	1400	1570	1430	1460	1420
Total Dissolved Solids @180°C		mg/L	10	844	762	938	1170	771	750	832	851	922	842	918	770
Suspended Solids (SS)		mg/L	5	21	220	<5	42	<5	36	<5	<5	39	186	168	20
Hydroxide Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3		mg/L	1	<1	<1	<1	<1	<1	48	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3		mg/L	1	339	341	396	460	343	255	381	416	372	384	412	426
Total Alkalinity as CaCO3		mg/L	1	339	341	396	460	343	303	381	416	372	384	412	426
Silicon as SiO2		mg/L	0.1	86.1	87.2	115	87.7	93.8	24.5	96.2	107	91.4	57.9	94.8	67.9
Sulfate as SO4 - Turbidimetric		mg/L	1	44	48	54	67	40	59	50	41	56	65	51	53
Chloride		mg/L	1	186	192	241	354	183	238	238	238	270	238	245	240
Calcium		mg/L	1	34	35	30	39	34	26	31	26	34	31	32	35
Magnesium		mg/L	1	43	42	64	66	43	25	52	58	69	51	63	57
Sodium		mg/L	1	151	156	177	289	151	230	184	176	188	176	190	186
Potassium		mg/L	1	12	12	15	13	12	10	13	17	16	14	14	15
Mercury	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium	dissolved	µg/L	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5
Iron	dissolved	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Antimony	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	dissolved	µg/L	0.2	2.8	3.2	3.3	5.5	2.8	0.5	3	3.5	4.1	3.3	3.5	3.2
Arsenic	dissolved	µg/L	0.2	10	8.8	8.6	6	7	636	6.5	9.9	6	3.7	14.3	4.3
Barium	dissolved	µg/L	0.5	142	192	134	122	144	25.4	142	122	136	125	165	119
Beryllium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	dissolved	µg/L	5	404	420	461	664	379	298	473	528	565	530	550	490
Bismuth	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	dissolved	µg/L	0.05	<0.05	<0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	dissolved	µg/L	0.2	2.6	2.1	1.1	1.2	3	<0.2	2.4	1.1	1.9	<0.2	1.8	<0.2
Cobalt	dissolved	µg/L	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	0.2
Copper	dissolved	µg/L	0.5	0.7	1	<0.5	2.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lithium	dissolved	µg/L	0.5	20	18.8	17.3	30.8	21.6	26.4	22.2	20.6	23.1	14.8	24.7	14.1
Manganese	dissolved	µg/L	0.5	12.3	29.7	1.2	13.1	<0.5	28.6	<0.5	0.8	<0.5	22.5	1	20.7
Molybdenum	dissolved	µg/L	0.1	4.9	5.1	5.1	6.7	4.8	13	5.6	3.9	3.7	5	5.3	4.8
Nickel	dissolved	µg/L	0.5	<0.5	1.4	<0.5	0.8	<0.5	0.6	<0.5	<0.5	<0.5	0.9	<0.5	0.7
Silver	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	dissolved	µg/L	1	527	525	666	797	594	382	598	680	796	556	670	617
Tellurium	dissolved	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	dissolved	µg/L	0.0	<0.02	0.04	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Thorium	dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	dissolved	µg/L	0.2	<0.2	0.4	3.6	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	dissolved	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	dissolved	µg/L	0.05	25.7	26.6	30.2	53.3	25.9	8.93	30.3	30.6	34.2	17.1	40.1	23.5
Vanadium	dissolved	µg/L	0.2	28.6	39.7	34.8	31.2	27.9	4.4	32	39.2	32	15.7	35	21.2
Zinc	dissolved	µg/L	1	14	35	16	23	15	2	57	18	37	1270	22	841
Nitrate as N		mg/L	0.01	7.07	7.09	6.57	7.27	7.67	0.1	7.43	6.21	8.09	3.48	6.2	3.81
Total Anions		meq/L	0.01	12.9	13.2	15.8	20.6	12.8	14	15.4	15.9	16.2	15.7	16.2	16.4
Total Cations		meq/L	0.01	12.1	12.3	14.8	20.3	12.1	13.6	14.2	14.2	16	13.8	15.4	14.9
Ionic Balance		%	0.01	3.3	3.65	3.22	0.71	2.95	1.38	4.08	5.72	0.78	6.72	2.53	4.71
Bromide		mg/L	0.01	0.638	0.56	0.786	1.22	<2.00	0.737	0.632	0.659	0.835	0.733	0.713	0.708
Gross beta		Bq/L	0.1	----	----	----	1.04	----	0.46						
Gross alpha		Bq/L	0.05	----	----	----	3.21	----	0.43						
Gross beta activity - 40K		Bq/L	0.1	----	----	----	0.66	----	0.16						
Radium 226		Bq/L	0.01	----	----	----	0.02	----	<0.01						
Radium 228		Bq/L	0.08	----	----	----	<0.08	----	<0.08						
Iron	dissolved	mg/L	0.05	----	----	----	<0.05	----	<0.05						
Arsenobetaine (ASB)	dissolved	µg/L	1	----	----	----	<1	----	<10						
Arsenious Acid (As (III))	dissolved	µg/L	0.5	----	----	----	<0.5	----	665						
Dimethylarsenic Acid (DMA)	dissolved	µg/L	1	----	----	----	<1	----	<10						
Monomethylarsonic Acid (MMA)	dissolved	µg/L	1	----	----	----	<1	----	<10						
Arsenic Acid (As (V))	dissolved	µg/L	0.5	----	----	----	5.7	----	9.2						
Trivalent Chromium	dissolved	mg/L	0.001	----	----	----	<0.001	----	<0.001						
Hexavalent Chromium	dissolved	mg/L	0.001	----	----	----	0.002	----	<0.001						
Ferrous Iron	dissolved	mg/L	0.05	----	----	----	<0.05	----	<0.05						
Ferric Iron	dissolved	mg/L	0.05	----	----	----	<0.05	----	<0.05						

Analyte grouping/Analyte	Dissolved or Total Metals	Unit	LOR	HMB030D 24/04/2022	HMB030S 24/04/2022	HMB034 25/04/2022	HMB035 25/04/2022	HPB001 24/04/2022	HPB011 25/04/2022	HMB036 12/06/2022	HMB037 12/06/2022	HMB039 12/06/2022	HMB040 12/06/2022	HMB042 12/06/2022	HMB040 29/06/2022
Mercury	total	mg/L	0.0001	----	<0.0001	----	----	----	----	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Aluminium	total	µg/L	5	----	2750	----	----	----	----	32	9	932	3300	3060	765
Iron	total	µg/L	2	----	3490	----	----	----	----	49	10	1080	6850	3900	1450
Antimony	total	µg/L	0.2	----	0.2	----	----	----	----	<0.2	<0.2	<0.2	0.2	<0.2	0.2
Selenium	total	µg/L	0.2	----	3	----	----	----	----	2.7	2.9	3.5	2.7	2.8	2.7
Arsenic	total	µg/L	0.2	----	9.9	----	----	----	----	5.9	9.1	5.8	4.5	14	4.4
Barium	total	µg/L	0.5	----	187	----	----	----	----	123	96.2	129	126	142	102
Beryllium	total	µg/L	0.1	----	0.1	----	----	----	----	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Boron	total	µg/L	5	----	418	----	----	----	----	526	600	612	578	548	484
Bismuth	total	µg/L	0.05	----	<0.05	----	----	----	----	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	total	µg/L	0.05	----	<0.05	----	----	----	----	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	total	µg/L	0.2	----	11.7	----	----	----	----	**2.6**	**1.3**	**5.2**	**67.1**	**18.1**	13.7
Cobalt	total	µg/L	0.1	----	3.5	----	----	----	----	**<0.1**	**<0.1**	**0.6**	**9.7**	**2.9**	2.1
Copper	total	µg/L	0.5	----	5.2	----	----	----	----	<0.5	<0.5	0.9	29.4	3.5	6.6
Lead	total	µg/L	0.1	----	2.1	----	----	----	----	<0.1	<0.1	0.4	2	1.7	0.4
Lithium	total	µg/L	0.5	----	21	----	----	----	----	19.6	18.2	19.7	13.8	21.6	13.7
Manganese	total	µg/L	0.5	----	147	----	----	----	----	2.8	1	15.1	188	85.1	52.9
Molybdenum	total	µg/L	0.1	----	5.7	----	----	----	----	7.6	5.1	4.7	5.6	5.5	5.9
Nickel	total	µg/L	0.5	----	8.5	----	----	----	----	<0.5	<0.5	2.2	88.4	12	19.2
Silver	total	µg/L	0.1	----	<0.1	----	----	----	----	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Strontium	total	µg/L	1	----	587	----	----	----	----	606	696	783	550	692	638
Thallium	total	µg/L	0.02	----	0.08	----	----	----	----	<0.02	<0.02	<0.02	0.05	0.04	0.03
Thorium	total	µg/L	0.1	----	1.6	----	----	----	----	<0.1	<0.1	0.2	1.5	1.4	0.2
Tin	total	µg/L	0.2	----	<0.2	----	----	----	----	<0.2	<0.2	<0.2	0.2	<0.2	<0.2
Titanium	total	µg/L	1	----	42	----	----	----	----	<1	<1	11	100	63	23
Uranium	total	µg/L	0.05	----	32.6	----	----	----	----	36	37.6	41.4	21.7	47.5	27.9
Vanadium	total	µg/L	0.2	----	47.5	----	----	----	----	33	40.9	35.7	30.6	43.8	24.8
Zinc	total	µg/L	1	----	18	----	----	----	----	133	11	79	3630	16	1380
Tellurium	total	µg/L	0.2	----	<0.2	----	----	----	----	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Appendix E

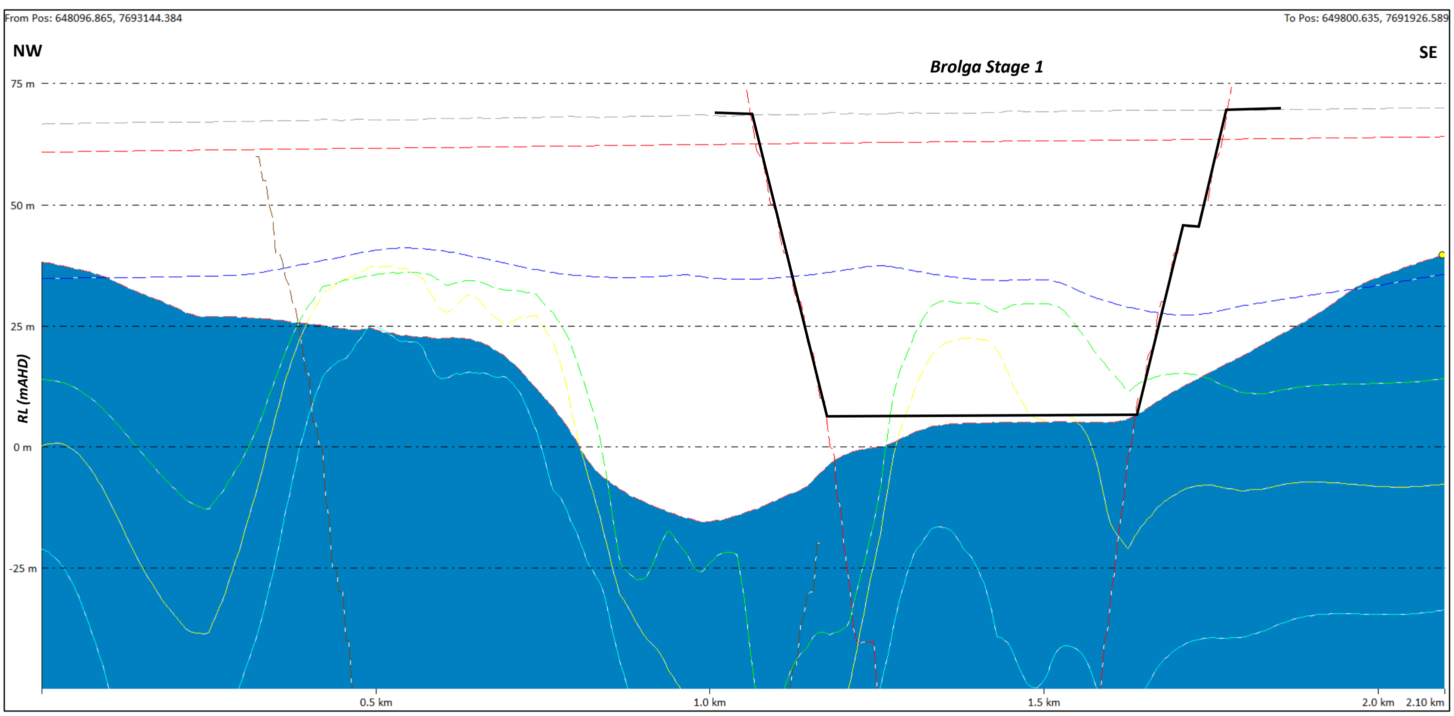
Transient Dewatering Cross Sections

Groundwater Level 1 year after start dewatering



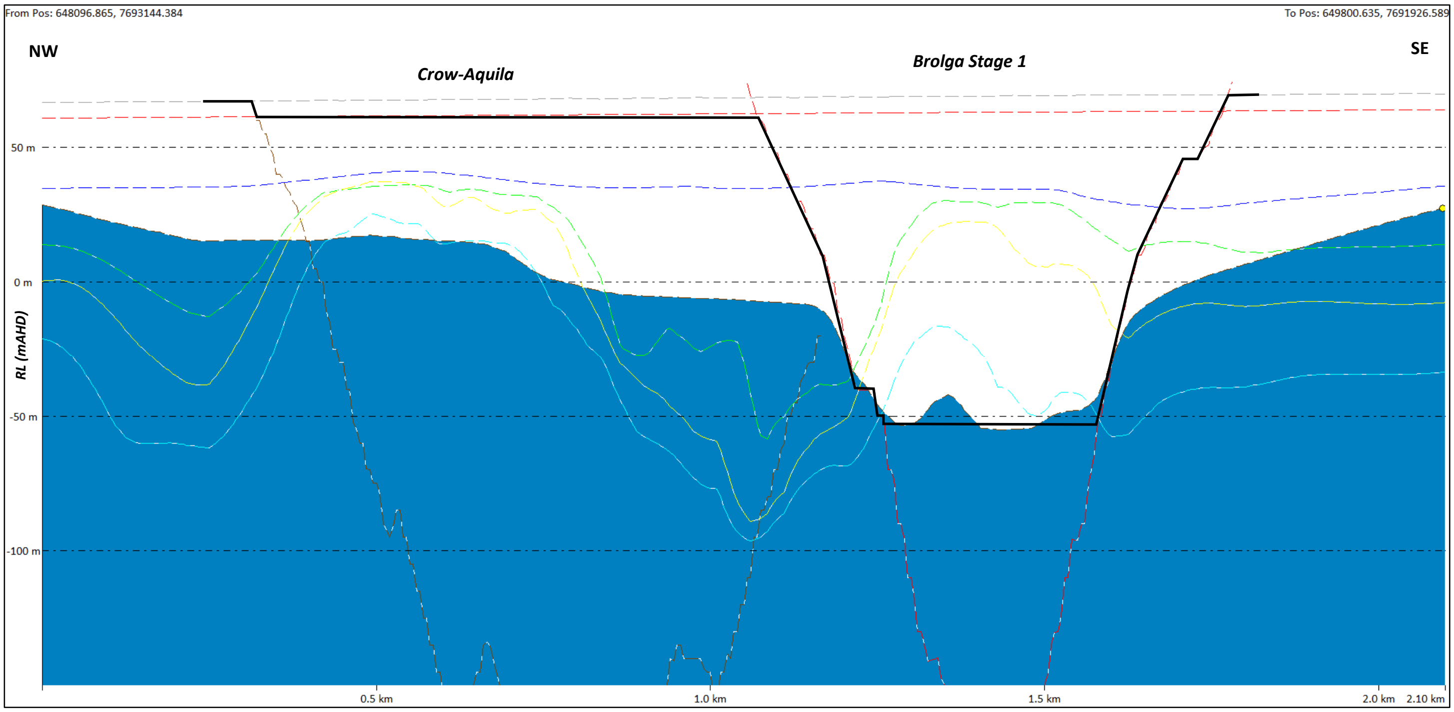
- progressive pit outline
- ground surface
- base of saprolite
- pre-dewatering water table
- base of saprock
- saturated zone
- base of alluvium
- base of slightly weathered (top of fresh) rock

Groundwater Level 2 years after start dewatering



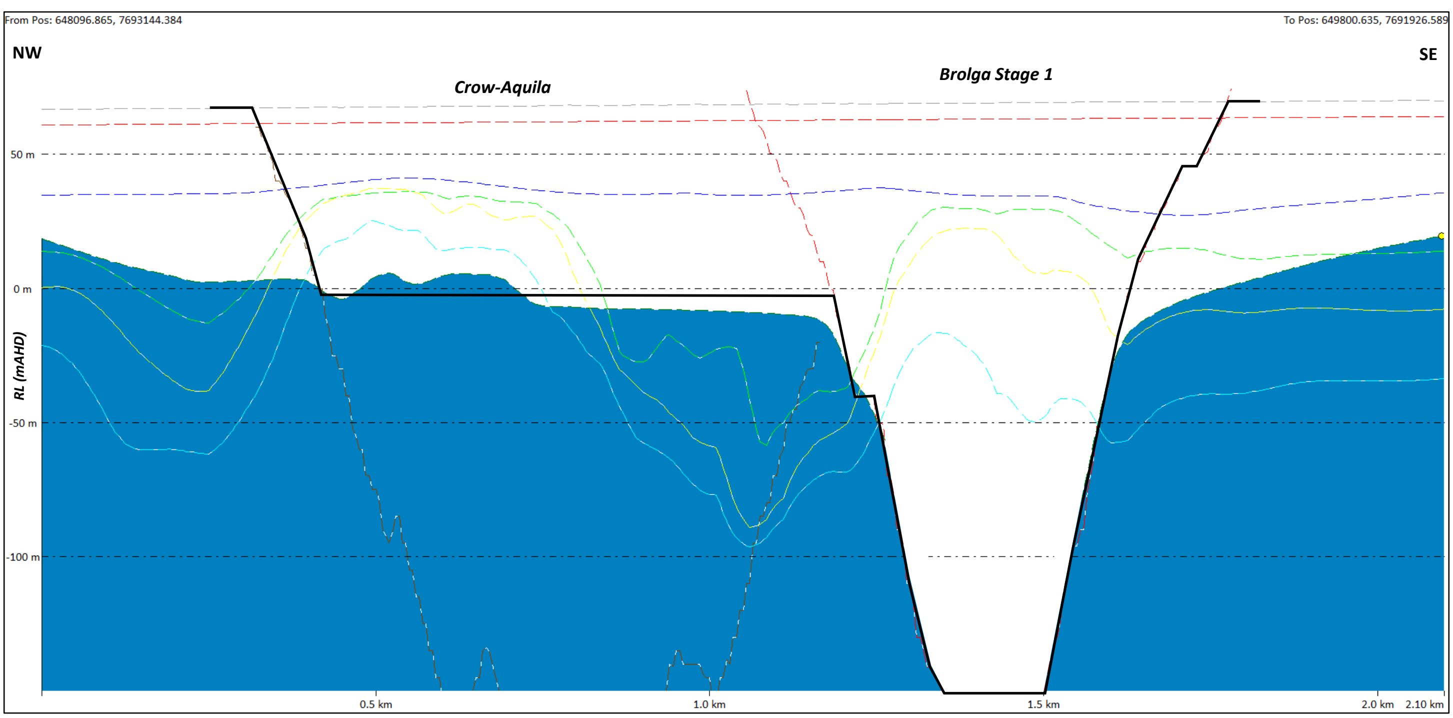
Client	*DE GREY MINING LTD*	**Brolga Stage 1 - Crow Dewatering Section Yr 1 & Yr 2**	**Plan Title**
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-1**	**Plan Number**
Geowater CONSULTING	A4P		
	Project #	1006-001	File reference

Groundwater Level 3 years after start dewatering



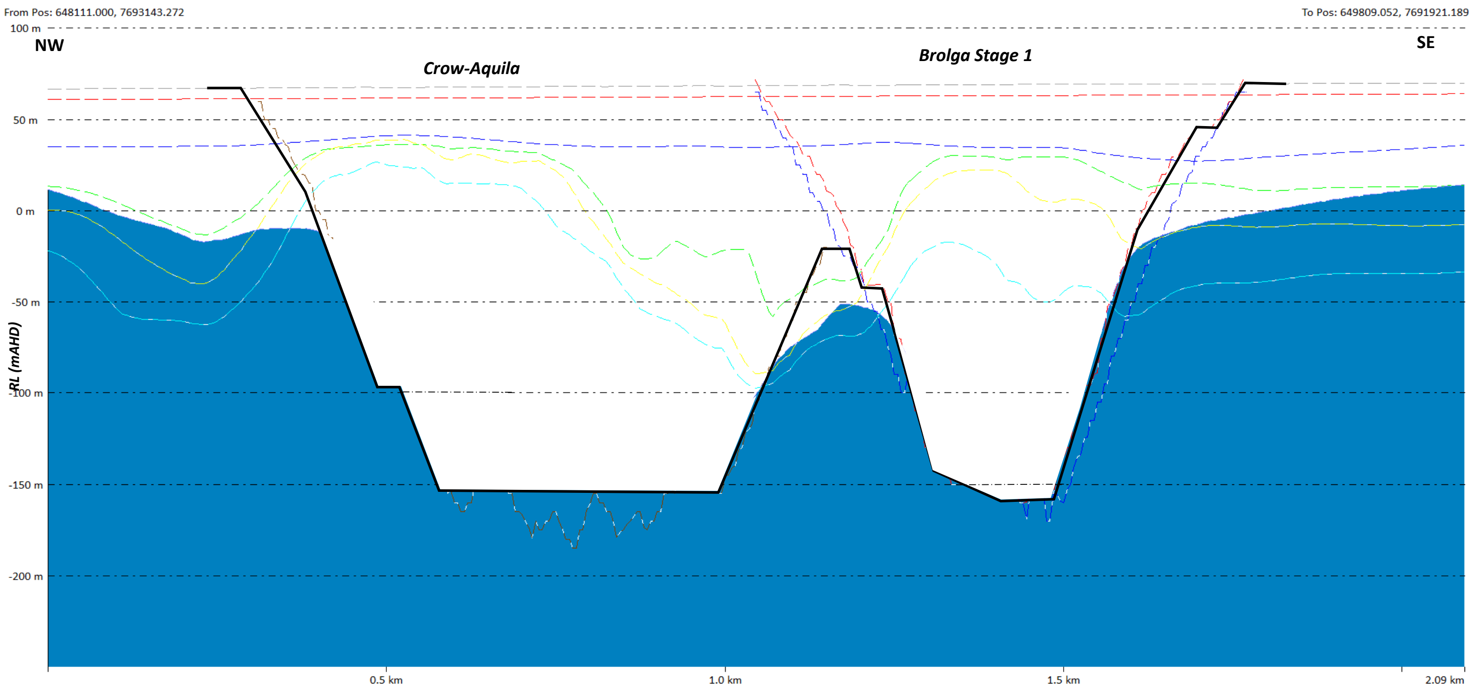
progressive pit outline | ground surface | base of saprolite
pre-dewatering water table | base of saprock
saturated zone | base of alluvium | base of slightly weathered (top of fresh) rock

Groundwater Level 5 years after start dewatering



Client	*DE GREY MINING LTD*	**Brolga Stage 1 - Crow Dewatering Sections Yr 3 & Yr 5**	Plan Title
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-2**	Plan Number
Geowater CONSULTING	A4P		
	Project # 1006-001		File reference

Groundwater Level 7 years after start dewatering



progressive pit outline

saturated zone

ground surface

pre-dewatering water table

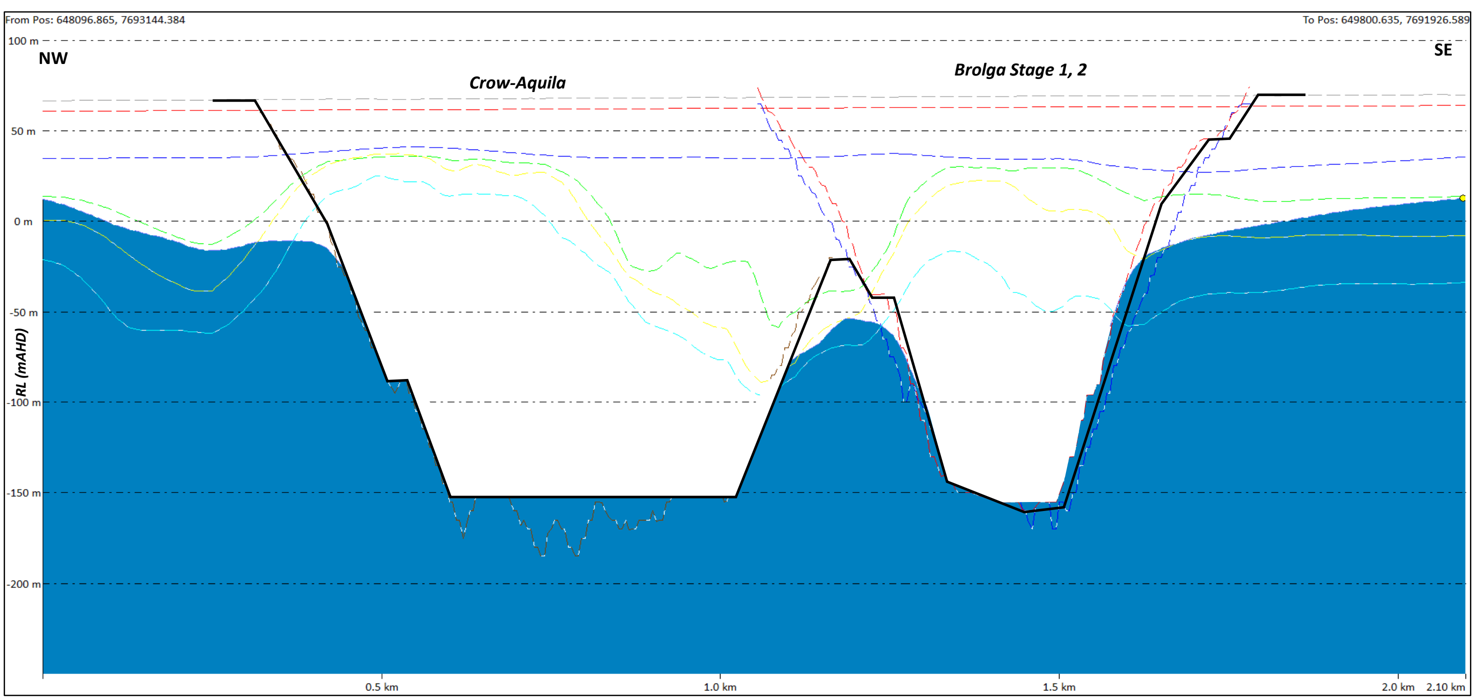
base of alluvium

base of saprolite

base of saprock

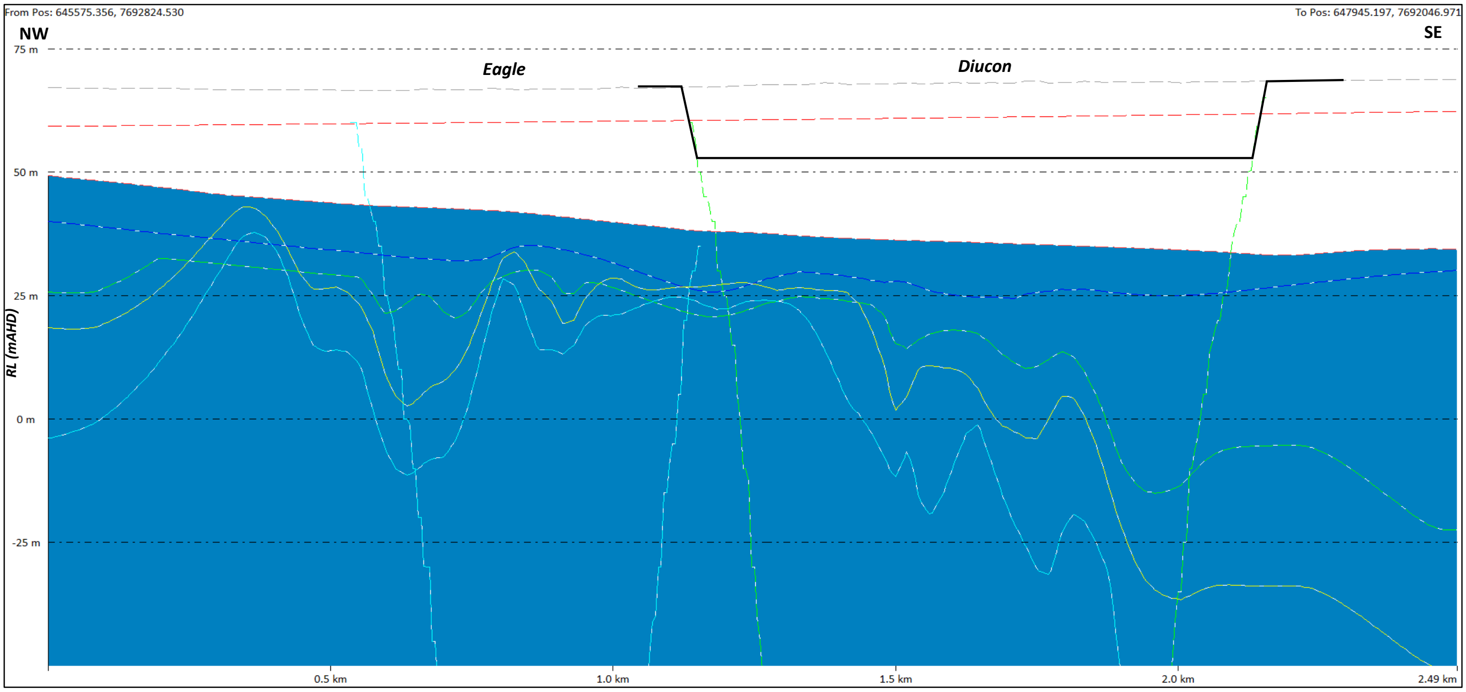
base of slightly weathered (top of fresh) rock

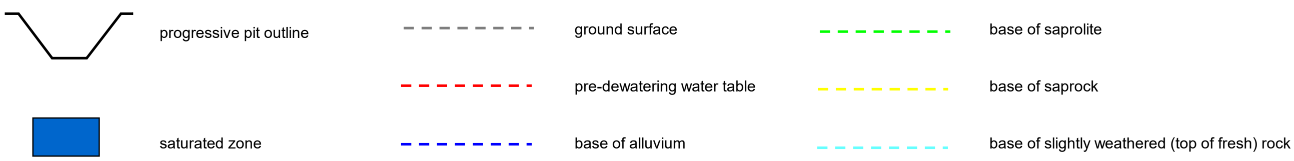
Groundwater Level 9 years after start dewatering



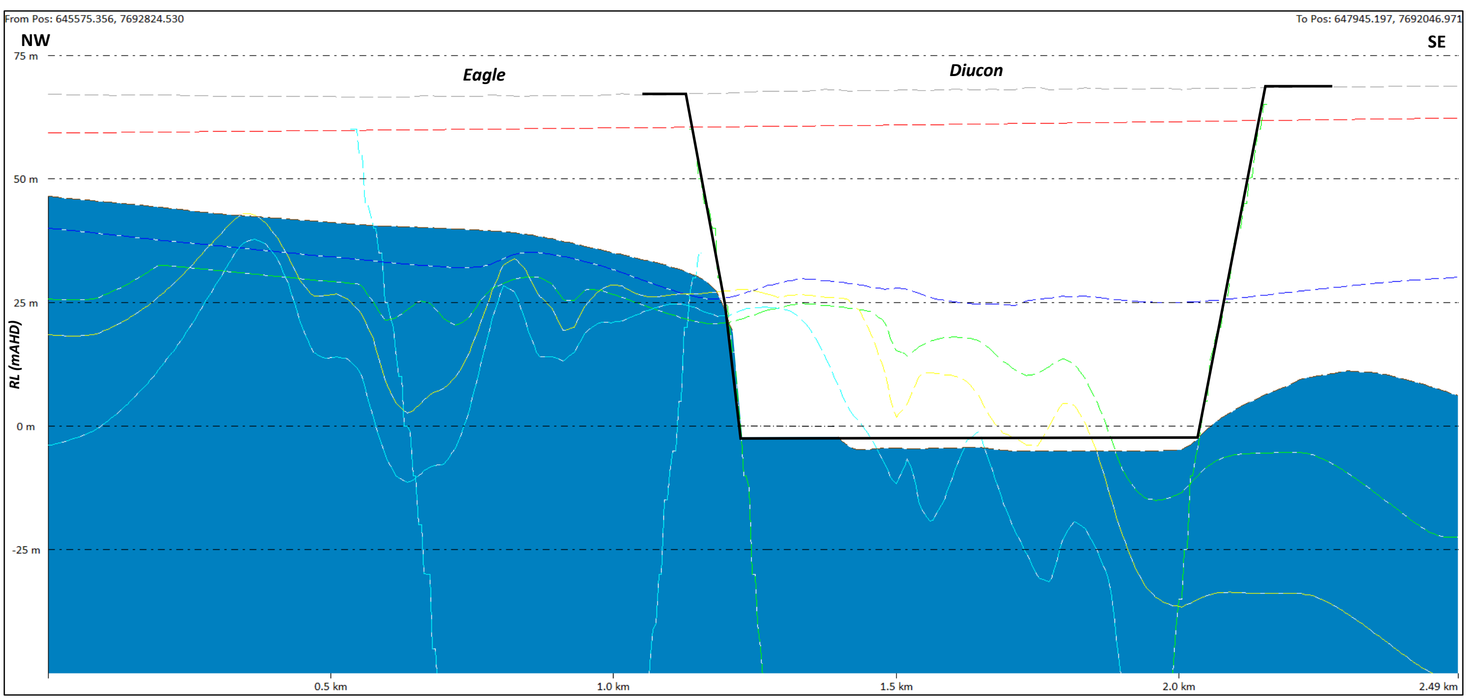
Client	*DE GREY MINING LTD*	**Brolga Stage 1 - Crow Dewatering Sections Yr 7 & Yr 9**	**Plan Title**
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-3**	**Plan Number**
Geowater CONSULTING	A4P		
	Project #	1006-001	File reference

Groundwater Level 2 years after start dewatering



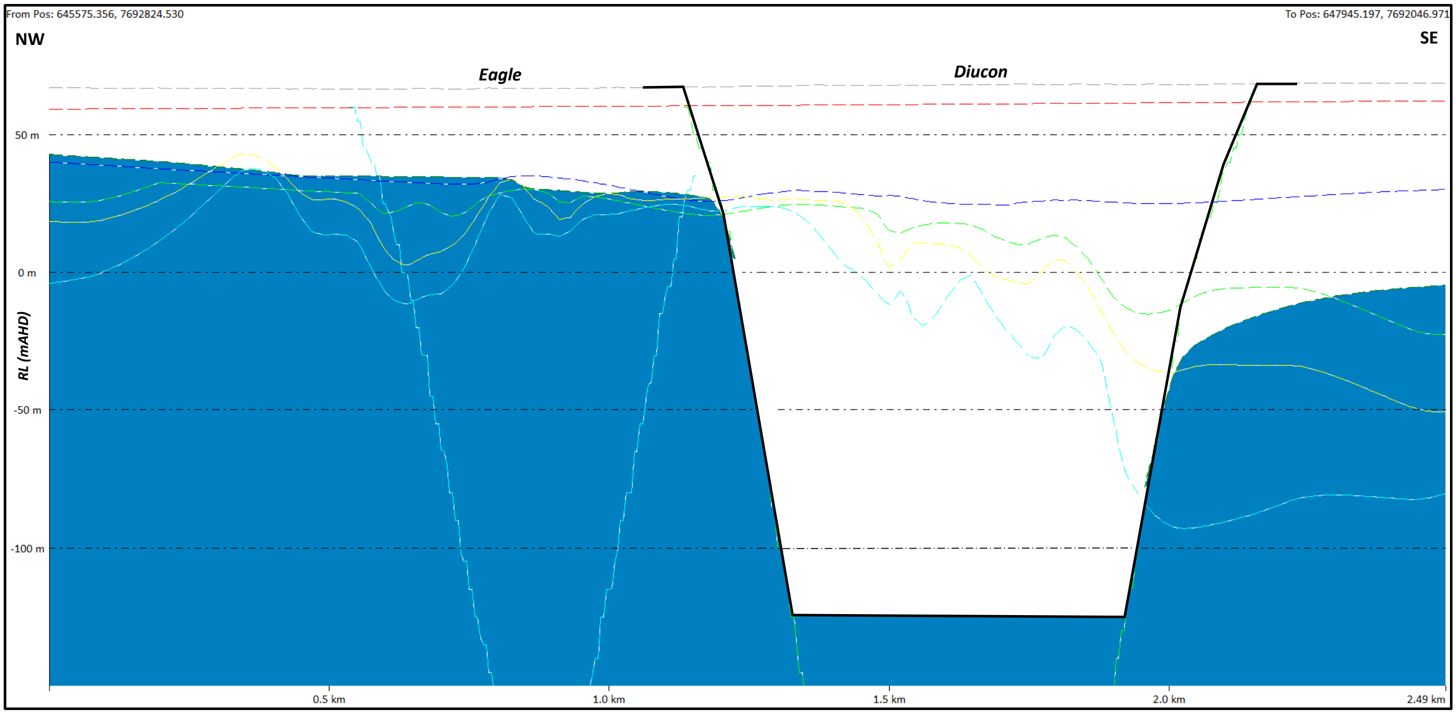


Groundwater Level 3 years after start dewatering



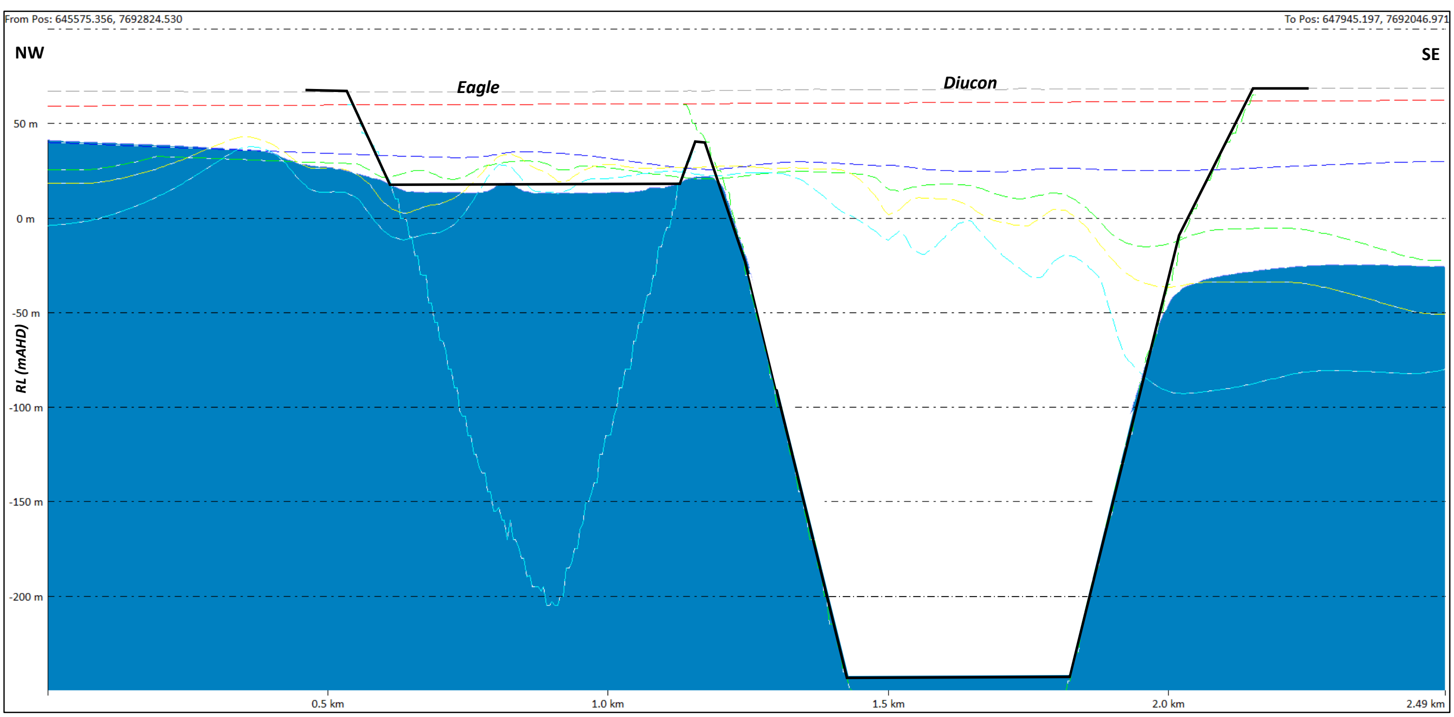
Client	DE GREY MINING LTD	Diucon - Eagle Dewatering Sections Yr 2 & Yr 3		Plan Title
Project	HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT		E-4	Plan Number
Geowater CONSULTING	A4P			
	Project #	1006-001		File reference

Groundwater Level 5 years after start dewatering



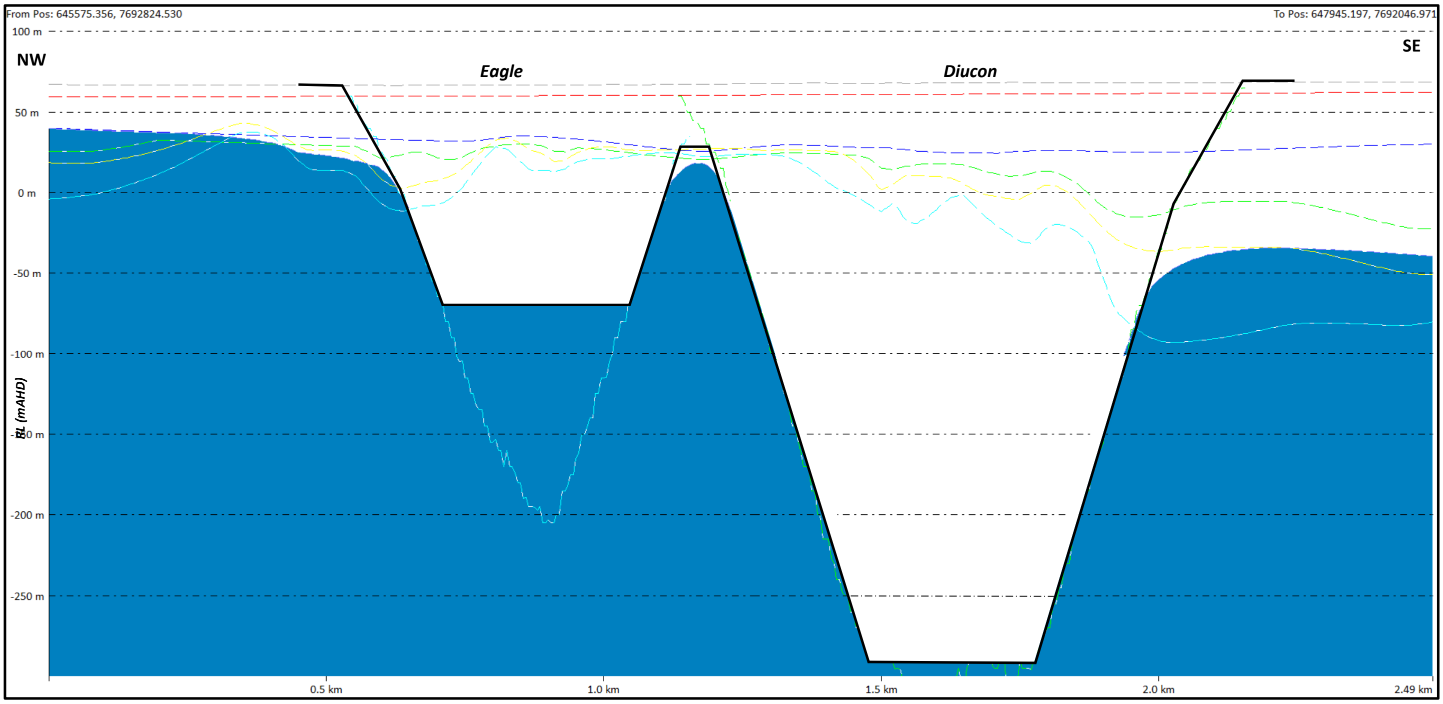
	progressive pit outline		ground surface		base of saprolite
			pre-dewatering water table		base of saprock
	saturated zone		base of alluvium		base of slightly weathered (top of fresh) rock

Groundwater Level 7 years after start dewatering



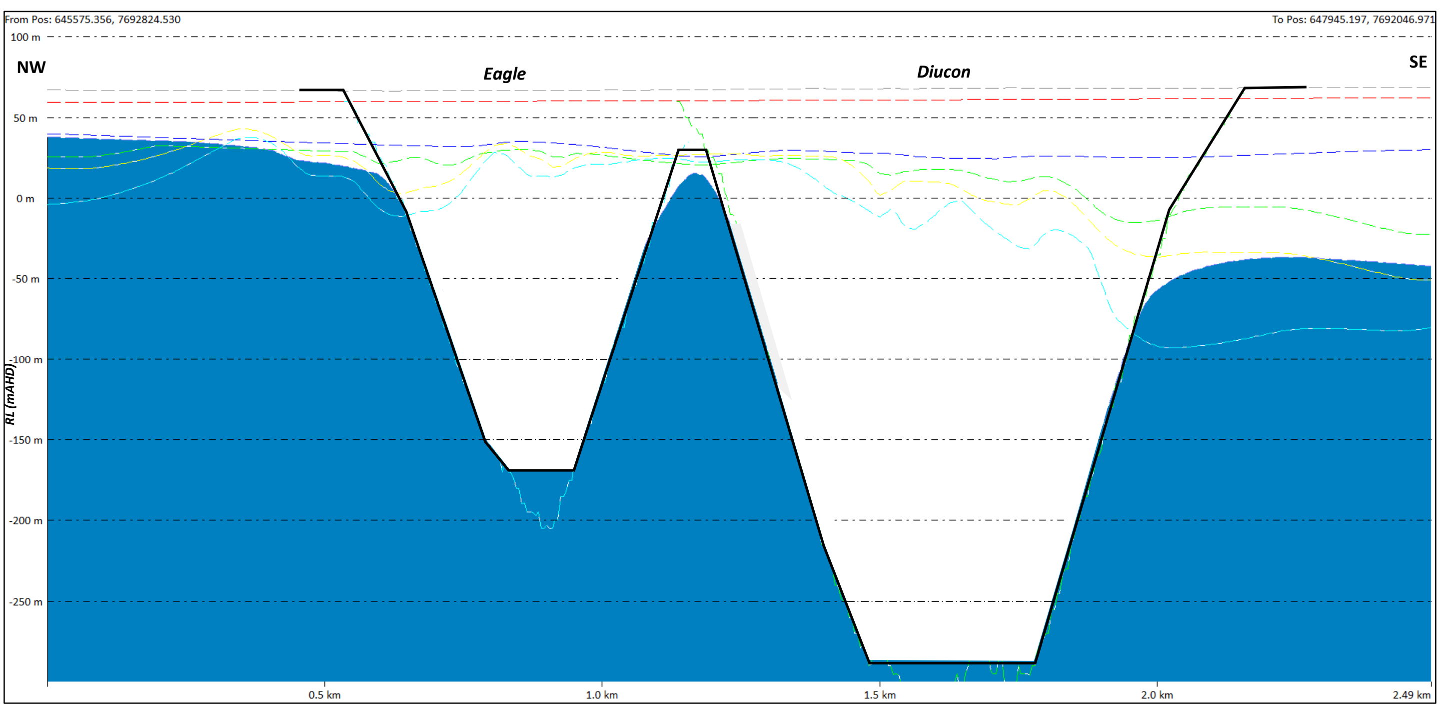
Client	*DE GREY MINING LTD*	Diucon - Eagle Dewatering Sections Yr 5 & Yr 7	Plan Title
Project	*HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT*	E-5	Plan Number
Geowater CONSULTING	A4P		
	Project # 1006-001		File reference

Groundwater Level 9 years after start dewatering



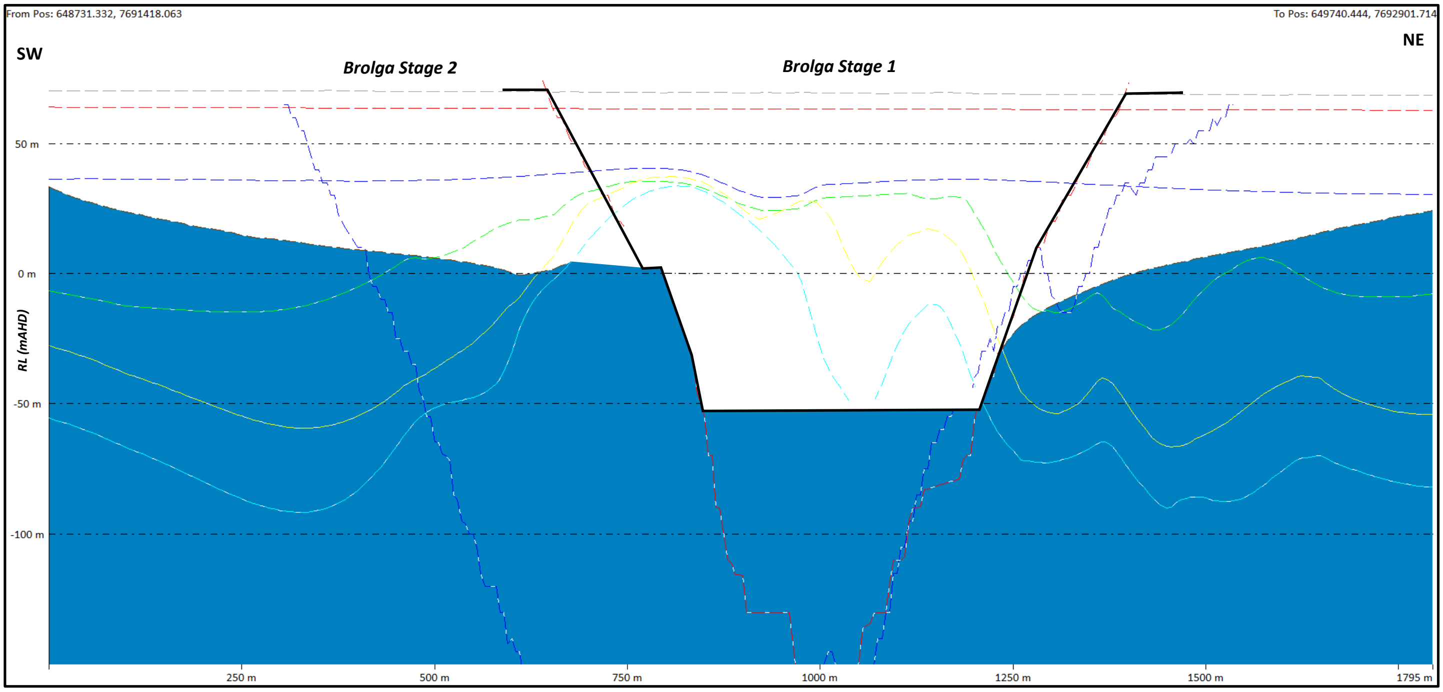
progressive pit outline	ground surface	base of saprolite
	pre-dewatering water table	base of saprock
saturated zone	base of alluvium	base of slightly weathered (top of fresh) rock

Groundwater Level 11 years after start dewatering



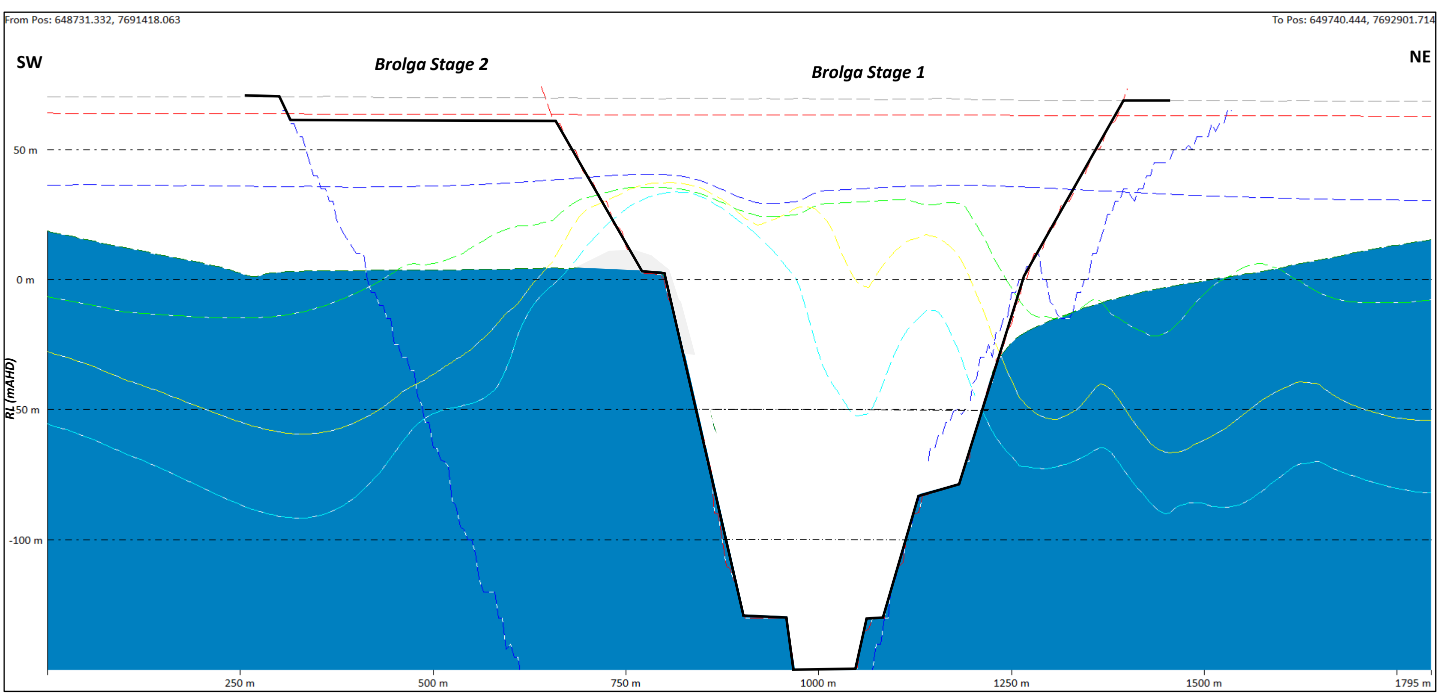
Client	*DE GREY MINING LTD*	**Diucon - Eagle Dewatering Sections Yr 9 & Yr 11**	Plan Title
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-6**	Plan Number
Geowater CONSULTING	A4P		
	Project # 1006-001		File reference

Groundwater Level 3 years after start dewatering



	progressive pit outline		ground surface		base of saprolite
			pre-dewatering water table		base of saprock
	saturated zone		base of alluvium		base of slightly weathered (top of fresh) rock

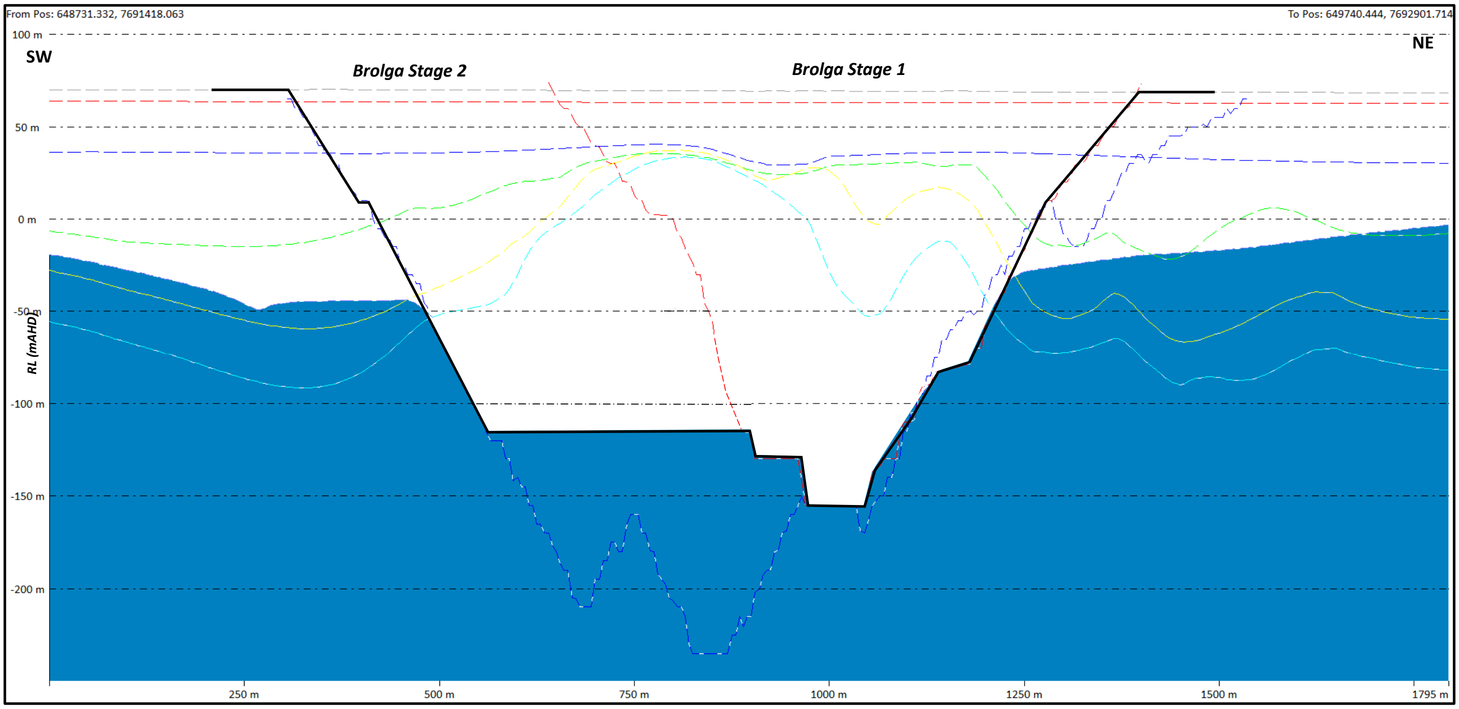
Groundwater Level 5 years after start dewatering



Client	*DE GREY MINING LTD*	**Brolga Stage 1 - Stage 2 Dewatering Sections Yr 3 & Yr 5**	Plan Title
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-7**	Plan Number

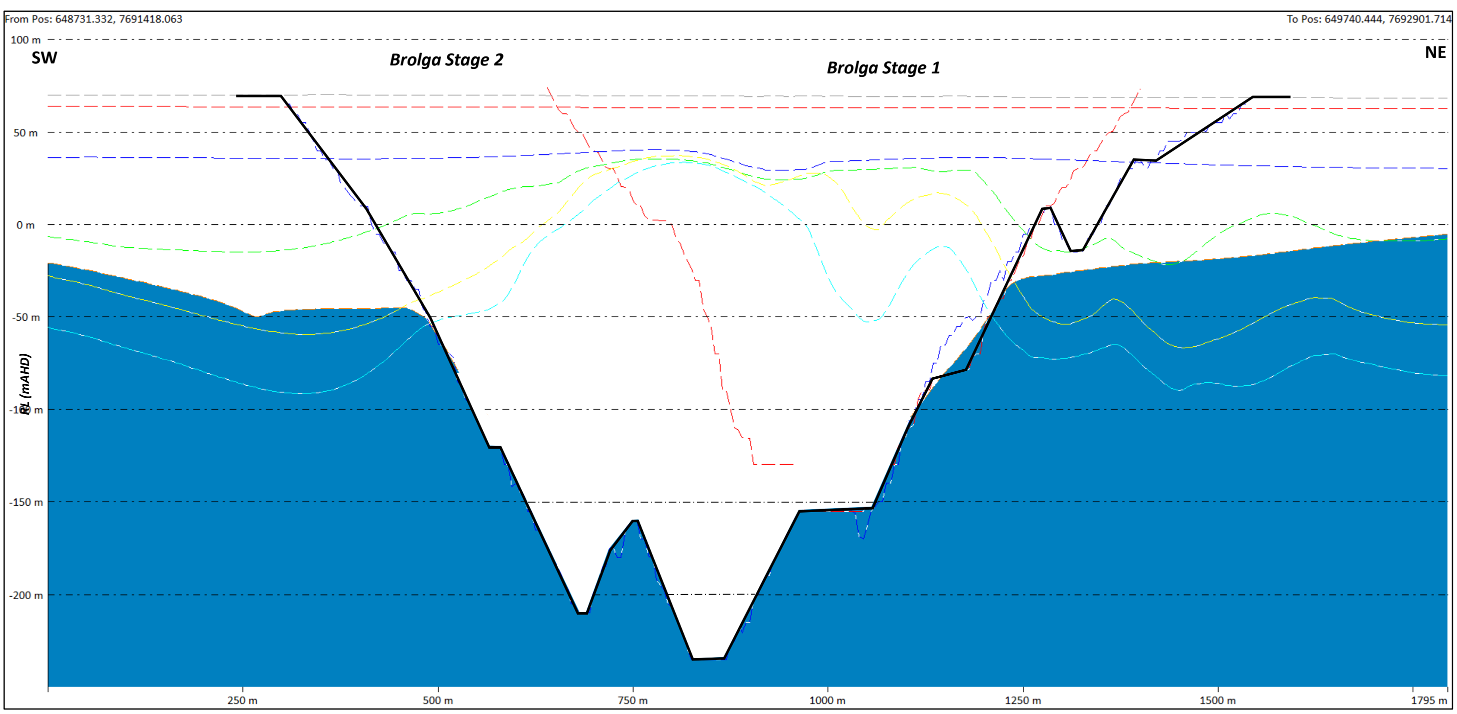
Geowater CONSULTING	A4P	
	Project #	1006-001	File reference

Groundwater Level 11 years after start dewatering



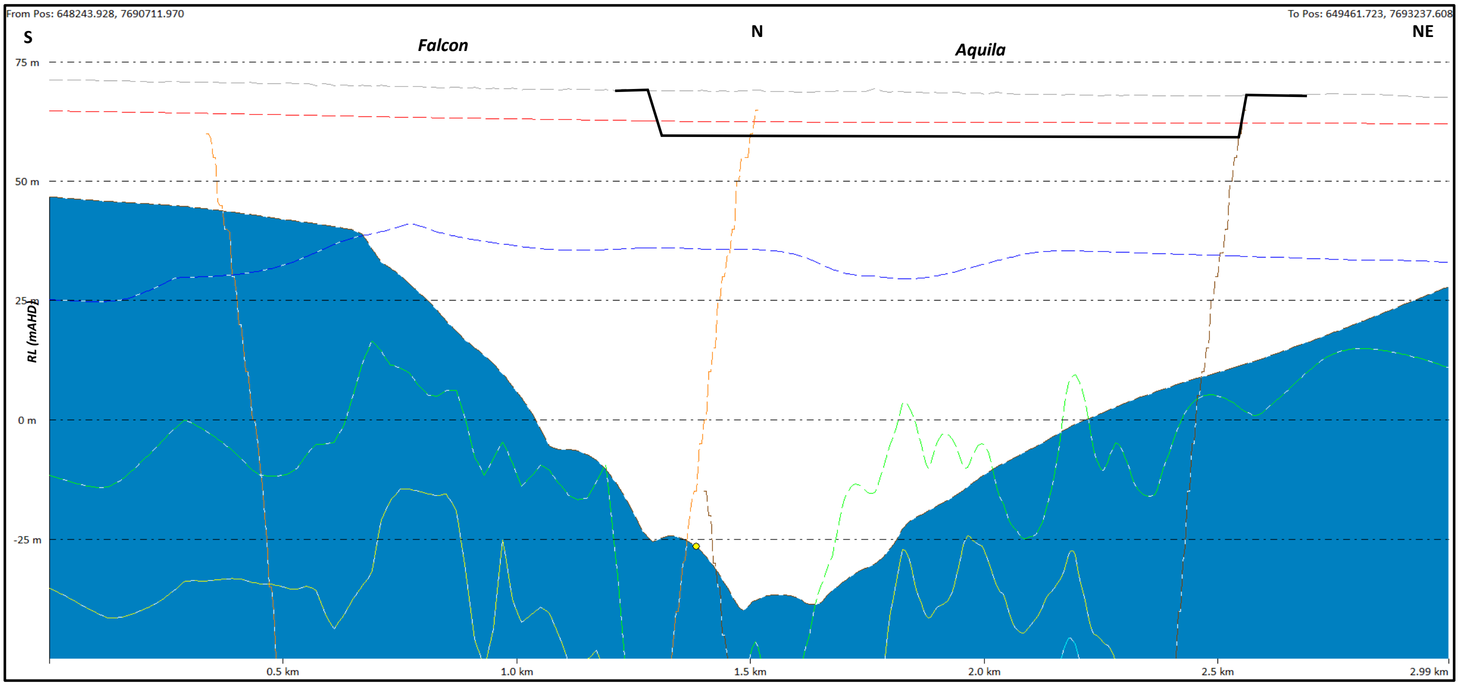
	progressive pit outline		ground surface		base of saprolite
			pre-dewatering water table		base of saprock
	saturated zone		base of alluvium		base of slightly weathered (top of fresh) rock

Groundwater Level 13 years after start dewatering



Client	*DE GREY MINING LTD*	**Brolga Stage 1 - Stage 2 Dewatering Sections Yr 11 & Yr 13**	Plan Title
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-8**	Plan Number
Geowater CONSULTING	A4P		
	Project # 1006-001		File reference

Groundwater Level 3 years after start dewatering



progressive pit outline

ground surface

base of saprolite

pre-dewatering water table

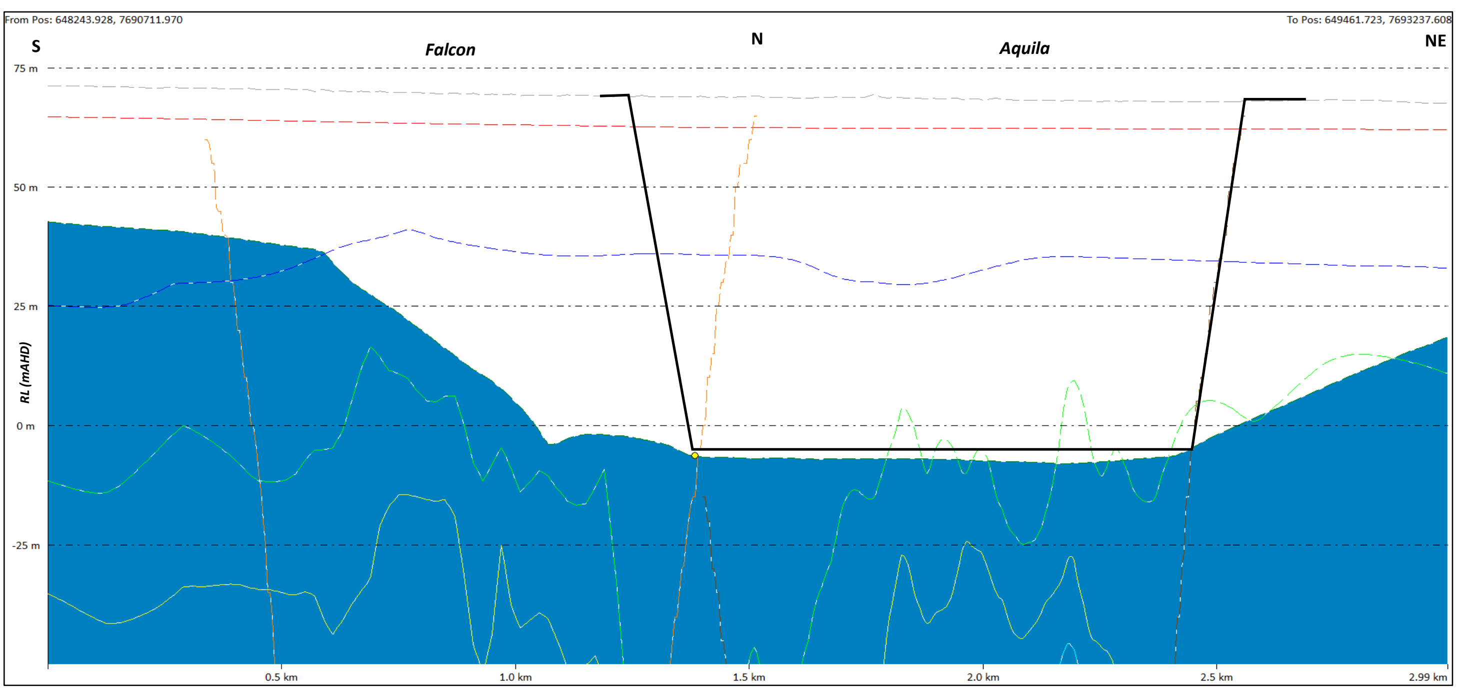
base of saprock

saturated zone

base of alluvium

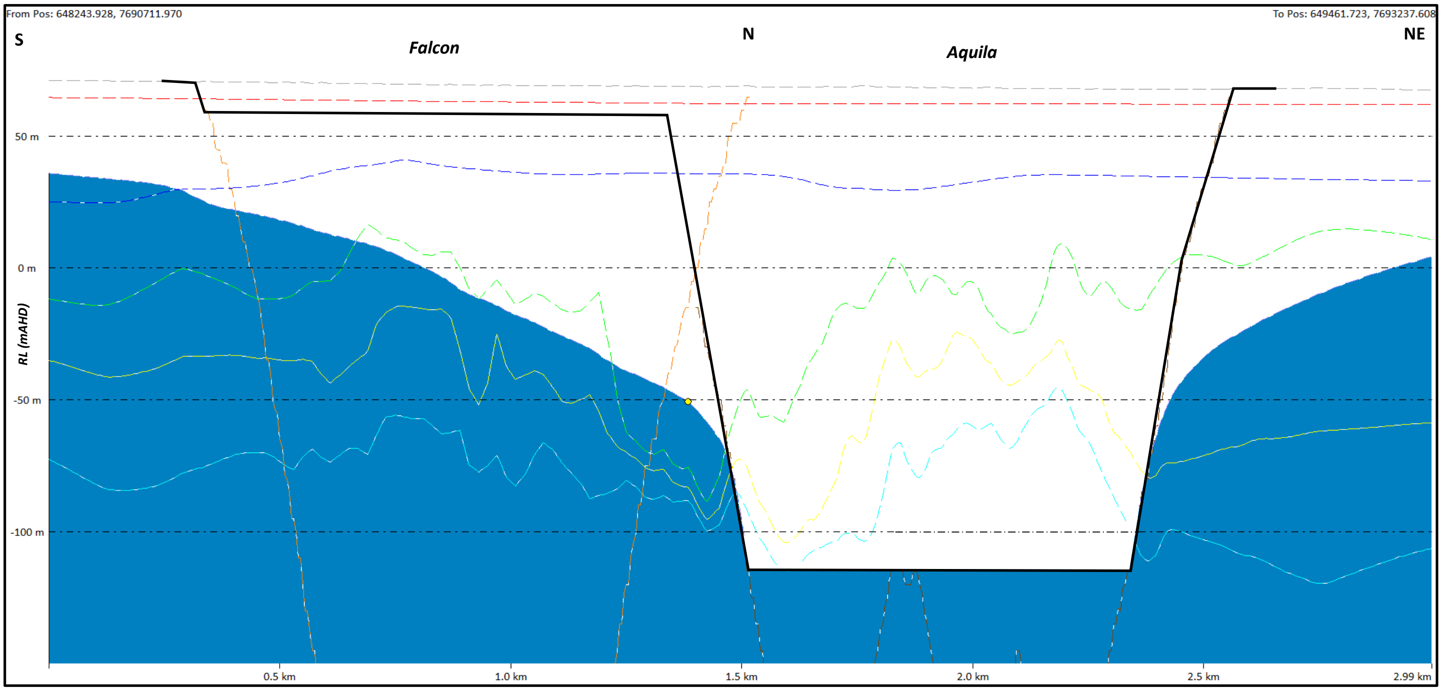
base of slightly weathered (top of fresh) rock

Groundwater Level 5 years after start dewatering



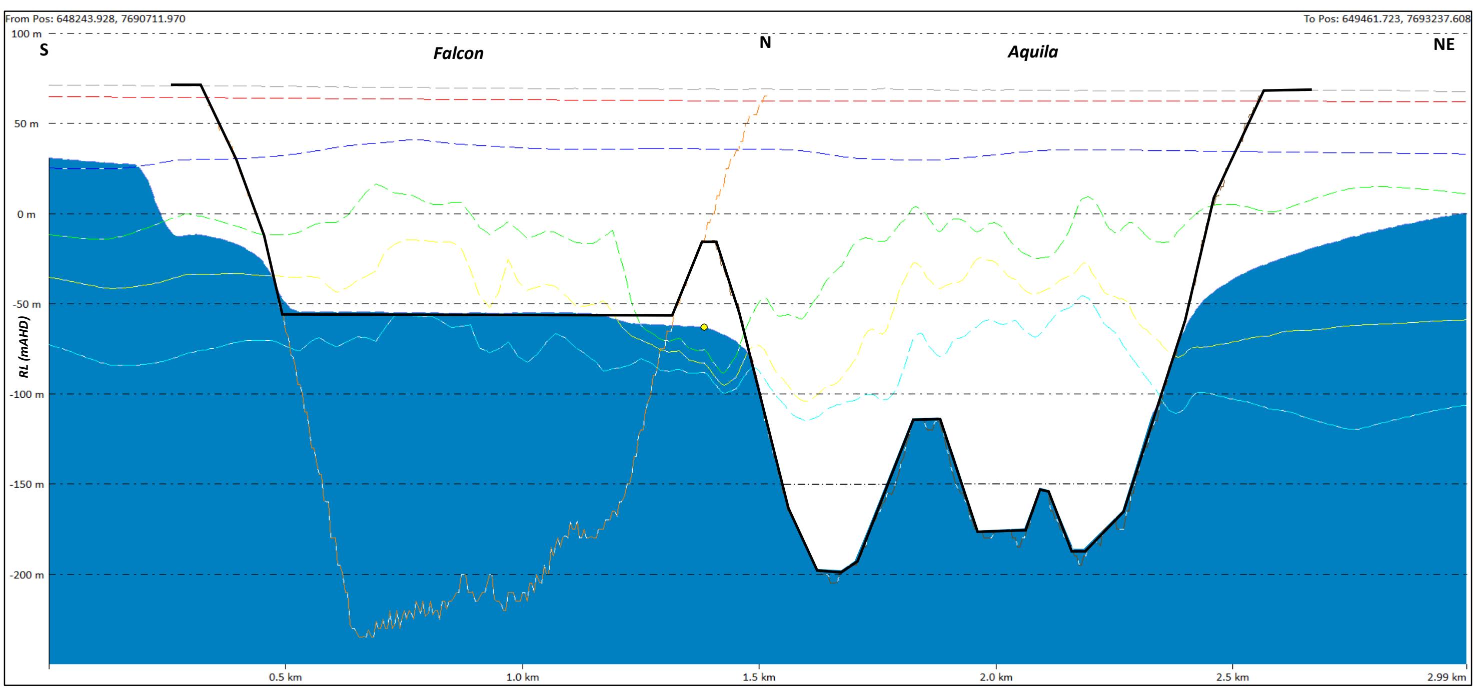
Client	*DE GREY MINING LTD*	**Falcon - Aquila Dewatering Sections Yr 3 & Yr 5**	Plan Title
Project	*HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT*	**E-9**	Plan Number
Geowater CONSULTING	A4P		
	Project # 1006-001		File reference

Groundwater Level 7 years after start dewatering



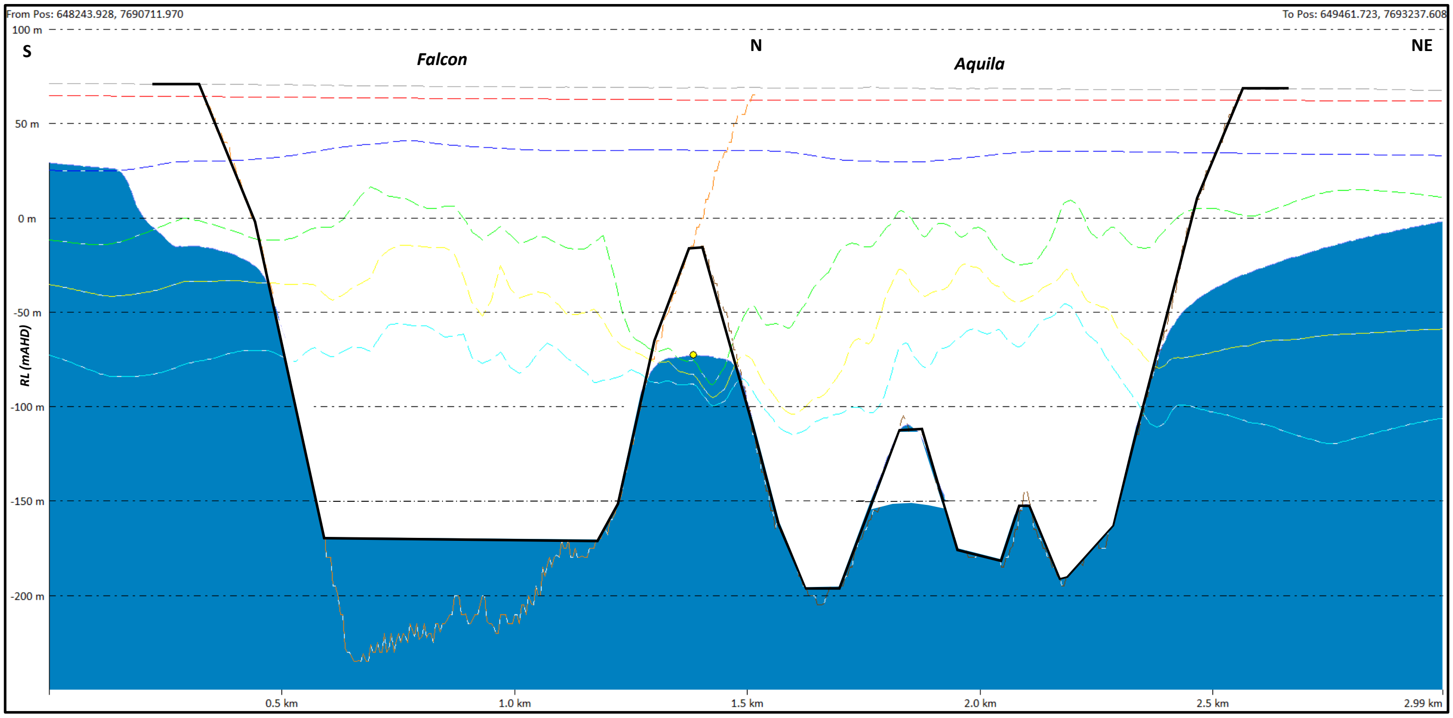
	progressive pit outline		ground surface		base of saprolite
			pre-dewatering water table		base of saprock
	saturated zone		base of alluvium		base of slightly weathered (top of fresh) rock

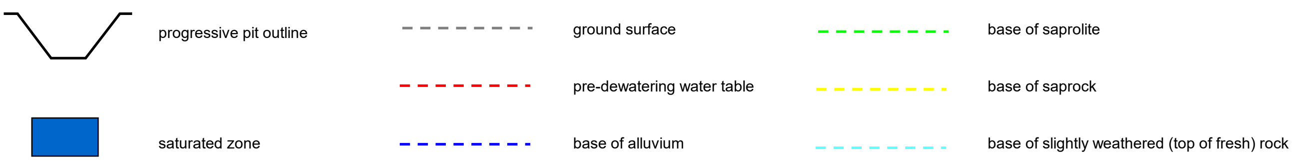
Groundwater Level 9 years after start dewatering



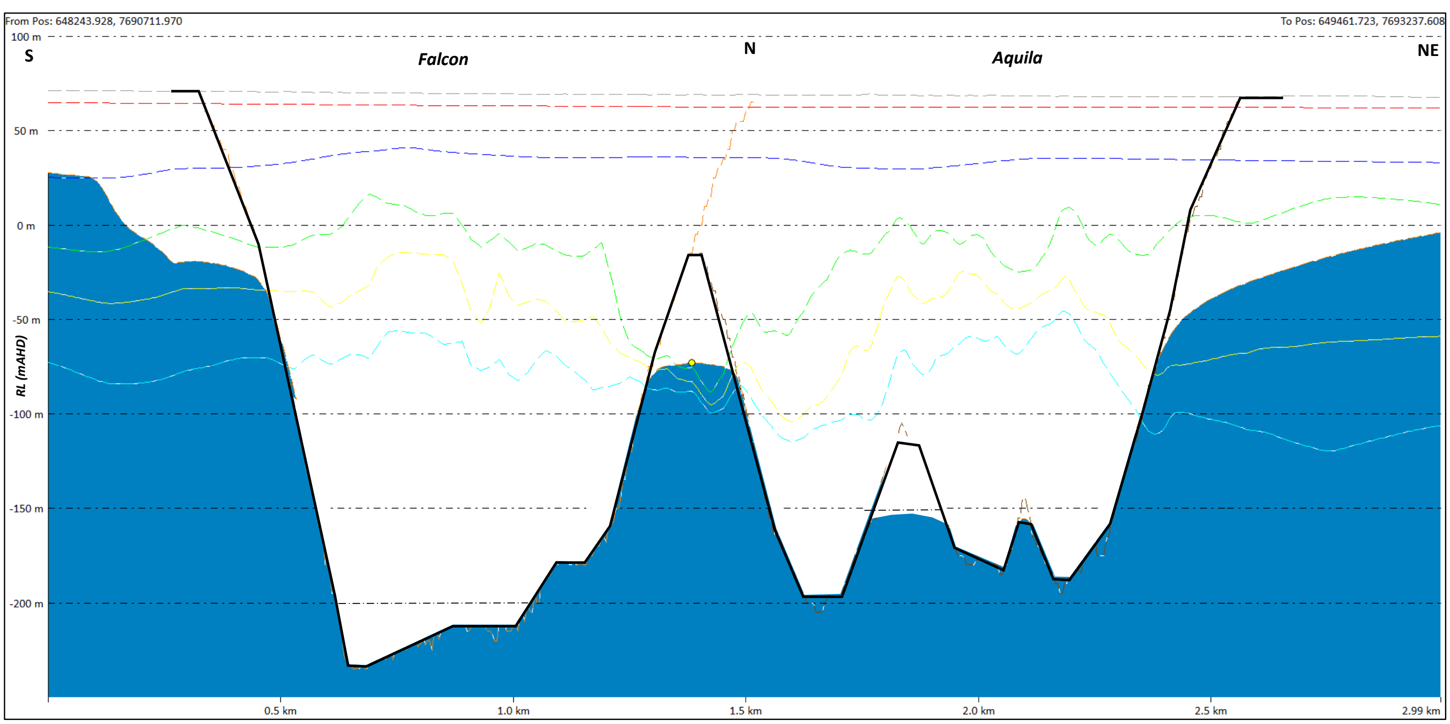
Client	*DE GREY MINING LTD*	**Falcon - Aquila Dewatering Sections Yr 7 & Yr 9**	Plan Title
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-10**	Plan Number
Geowater CONSULTING	A4P		
	Project # 1006-001		File reference

Groundwater Level 11 years after start dewatering





Groundwater Level 13 years after start dewatering



Client	*DE GREY MINING LTD*	**Falcon - Aquila Dewatering Sections Yr 11 & Yr 13**	**Plan Title**
Project	***HEMI GOLD PROJECT PFS - CONCEPTUAL AND NUMERICAL GROUNDWATER MODELLING REPORT***	**E-11**	**Plan Number**
Geowater CONSULTING	A4P		
	Project #	1006-001	File reference