

Final

H3 Hydrogeological Assessment

Sanjiv Ridge Project, Pilbara, Western Australia
Atlas Iron Pty Limited



SRK Consulting (Australasia) Pty Ltd ■ ATL009 ■ 27 August 2025

Disclaimer: The opinions expressed in this Report have been based on the information supplied to SRK Consulting (Australasia) Pty Ltd (SRK) by Atlas Iron Pty Limited (Atlas). The opinions in this Report are provided in response to a specific request from Atlas to do so. SRK has exercised all due care in reviewing the supplied information. While SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this Report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Contents

List of Abbreviations	vii
Executive Summary	viii
1 Introduction	1
1.1 Scope of work	1
1.2 Report structure	2
2 Background	3
2.1 Project description	3
2.2 Regulatory framework	5
2.3 Proclaimed groundwater management areas	5
2.4 Existing groundwater licence	5
2.5 Existing groundwater users	6
3 Supporting studies	7
3.1 Public datasets and site-specific data	7
3.2 Previous H3 report (2019) and addendum (2023)	7
3.3 2024 field report and pumping test	8
3.4 2014–2025 water quality	9
3.5 Surface water modelling and impact assessment	11
3.6 Geochemical assessment	12
3.7 Pit void water balance	12
3.8 Numerical groundwater modelling	13
4 Conceptual model	14
4.1 Climate and rainfall	14
4.2 Topography, drainage and hydrology	15
4.3 Geology	17
4.4 Hydrogeology	20
4.4.1 Fractured bedrock aquifer system	20
4.4.2 Alluvial groundwater system	23
4.5 Updates to hydrogeological conceptual model	23
4.5.1 Glen Herring Pit	23
4.5.2 Sparrow Lake and Razorback	24
4.5.3 Runway Pit	24
5 Groundwater modelling outcomes	26
5.1 Scenarios and predictions	26
5.2 Drawdown during Stage 5 operations	28
5.3 Dewatering requirements	31
5.4 Post-closure groundwater recovery	34
5.5 Rebound period between operation and post-closure equilibrium	37
6 Water balance outcomes	39
6.1 Runway South	39
6.2 Sparrow Lake	39
6.3 Shark Gully	40
6.4 Pit lake water quality	40

7	Surface water baseline and impact assessment outcomes	41
7.1	Model results	43
7.1.1	Baseline	43
7.1.2	Scenarios 2 and 3	43
7.1.3	Scenarios 4, 5 and 6	44
7.1.4	Impacts on the pools	44
7.1.5	Storm water management and flood mapping	45
7.2	Design runoff	45
7.2.1	Peak flows simulations in design runoff	45
7.3	Key outcomes of the surface water modelling.....	46
8	Impact assessment.....	47
8.1	Introduction	47
8.2	Basis of assessment.....	47
8.3	Environmental values	47
8.4	Heritage values.....	48
8.5	Groundwater-dependent ecosystems	48
8.5.1	Groundwater-dependent vegetation	49
8.5.2	Pools	49
8.6	Industrial use	49
8.7	Assessment of impacts.....	49
8.8	Ecological values.....	51
8.8.2	Impacts to pools	51
8.9	Industrial use EVs.....	57
8.9.1	Changes to groundwater dynamics	57
8.9.2	Impacts to interaction with surface water	58
8.9.3	Climate change	60
9	Recommendations.....	61
	References.....	64

Tables

Table 2.1:	Annual modelled historical abstraction volumes (m3) for Sanjiv Ridge	5
Table 3.1:	Hydraulic parameters calculated from the 2024 pumping test.....	9
Table 4.1:	Marble Bar weather data	14
Table 4.2:	Marble Bar evaporation data (1968–1988).....	15
Table 5.1:	Bore abstraction rates for predictive scenarios	27
Table 5.2:	Simulated drawdown at pools during operation	29
Table 5.3:	Annual predicted modelled abstraction volumes (m3) for Sanjiv Ridge	32
Table 5.4:	Pit lake water levels and evaporations.....	34
Table 5.5:	Drawdown at pools post closure	35
Table 5.6:	Maximum drawdown rates between operation and post-closure equilibrium (m/year).....	38
Table 6.1:	Summary of steady-state conditions – Runway South	39
Table 6.2:	Summary of steady-state conditions – Sparrow Lake.....	39
Table 6.3:	Summary of steady-state conditions – Shark Gully	40
Table 7.1:	Percentage reduction in catchment area	43
Table 8.1:	Simulated drawdown at pools	52

Figures

Figure 2.1:	Project location and Development Envelope	4
Figure 4.1:	Marble Bar mean monthly rainfall and temperature	14
Figure 4.2:	Sanjiv Ridge topography and drainage	16
Figure 4.3:	Sanjiv Ridge geology.....	18
Figure 4.4:	Sanjiv Ridge regolith areas	19
Figure 4.5:	Water levels from late 2024 across the Project area.	22
Figure 4.6:	Observed drawdown from water supply at Runway pit.....	25
Figure 4.7:	Observed drawdown south of Runway pit	25
Figure 5.1:	Drawdown extents at end of operations.....	30
Figure 5.2:	Simulated annual dewatering rates (L/s) across life of mine	33
Figure 5.3:	Drawdown extent post-closure.....	36
Figure 7.1:	Surface water monitoring locations	42
Figure 7.2:	Average peak flow and volume reduction in pools – Scenario 3	45
Figure 8.1:	Comparison of 1 m drawdown maximum extent at end of operations (8.1a) and post-closure (8.1b)	50
Figure 8.2:	Conceptual model at Pool 1	54
Figure 8.3:	Conceptual model at Pool 14	55

Appendices

Appendix A	Groundwater-Dependent Environmental Values
Appendix B	Drilling and Pumping Test Results
Appendix C	Groundwater Quality Report
Appendix D	Hydrographs
Appendix E	Surface Water Report
Appendix F	Water Balance Report
Appendix G	Numerical Groundwater Model Report
Appendix H	Preliminary Pit Lake Water Quality Assessment

List of Abbreviations

Atlas	Atlas Iron Limited Pty Ltd
BIF	banded iron formation
BOM	Bureau of Meteorology
CRT	constant rate test
CGM	Conceptual Groundwater Model
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation
EC	electrical conductivity
EV	Environmental Values
FBA	Fractured Bedrock Aquifer
GDE	Groundwater Dependent Ecosystem
GDV	Groundwater Dependent Vegetation
GIA	Groundwater Impact Assessment
GL/a	gigalitres per annum
GLOS	Groundwater Licence Operating Strategy
kL	kilolitres, equal to 1,000 litres or 1 m ³
kL/a	kilolitres per annum
L/s	litres per second
m	metres
m AHD	metres above Australian height datum
MB	monitoring bore
m bgl	metres below ground level
mbTOC	metres below top of casing
mg/L	milligrams per litre
µS/cm	microsiemens per centimetre
Mtpa	million tonnes per annum
PB	production bore
Project, the	the Sanjiv Ridge Project
SRK	SRK Consulting (Australasia) Pty Ltd
SWL	static water level
SWOP	Site Water Operating Plan
TDS	total dissolved solids
TSF	tailings storage facility
WIR	Water Information Reporting

Executive Summary

SRK Consulting (Australasia) Pty Ltd was engaged by Atlas Iron Pty Ltd to conduct an H3 hydrogeological assessment for the Sanjiv Ridge Project (the Project) in the Pilbara region of Western Australia. The study was undertaken to support the approvals required to transition from Stage 4 (above water table) to Stage 5 (below water table) mining operations. A previous H3 assessment was completed in 2019 to support Atlas' transition to Stage 4 mining. The primary objectives were to characterise the groundwater regime through field investigations and numerical modelling to assess potential impacts on groundwater-dependent ecosystems, in particular the identified permanent pools.

The assessment involved drilling and testing of additional 5 production and 13 monitoring bores (completed in 2024), as well as incorporation of groundwater and surface water quality sampling completed between 2020 and 2025. The conceptual groundwater model and numerical groundwater model were updated to incorporate new data and refine the understanding of the hydrogeological system. Surface water modelling and impact assessments were conducted to evaluate changes in runoff dynamics, while geochemical assessments and water balance modelling were undertaken to assess water quality and pit lake behaviour post-closure.

The updated conceptual groundwater model confirmed that groundwater occurs in a fractured bedrock aquifer (FBA) and ephemeral alluvial systems. The FBA was found to be highly anisotropic and compartmentalised, with recharge primarily occurring during episodic rainfall events.

Groundwater modelling for Stage 5 operations predicted lateral drawdown impacts extending up to 3,000 m in some areas but drawdown does not interact with the Coongan River or the associated riparian corridor and identified groundwater dependent ecosystems within. Simulated vertical drawdown shows potential for localised effects on some permanent pools, notably at Pool 1 and Pool 14. However, the geometry of current groundwater model is unable to accurately reflect some localised flow mechanisms observed in the field. The resulting simulated drawdowns, at some locations, may be overly conservative because the model parameters, while calibrated, were deliberately chosen to account for a wide range of uncertainties and variability. This cautious approach can result in overestimating drawdown impacts in certain areas, but model accuracy is expected to improve as more data are collected. Specific consideration is given to the site-specific conceptual model at Pool 1 and Pool 14 and commentary is given to further work that is intended to improve the flow mechanisms at these locations.

During operations, dewatering may be accomplished via a combination of existing ex-pit bore and sump pumping. The average annual dewatering rates is 51 L/s, with a range between 37 L/s and 71 L/s. Water demand for the mine site will, where possible, match this abstraction rate. Dewatering optimisation is currently being completed in an attempt to minimise periods of peak abstraction. Surplus volumes, where not possible to be used within the Project area, will require management by either storage or discharge.

Between 12 and 20 years post-closure, regardless of the dewatering strategy employed, pit lakes are expected to have reach 90% equilibrium. Steady state is simulated to occur 46 years (for Runway) and 71 years (for Sparrow Lake) post-closure with water levels stabilising 24–46 m below pre-mining levels. Pit lakes will act as evaporative sinks abstracting a net 1.1 L/s to 2.5 L/s from the system.

Surface water modelling indicated minor reductions in peak flows and runoff volumes (less than 15%) in local catchments due to mining activities – these reductions were classified as low to moderate impacts and are not expected to affect the seasonal filling or overtopping of the pools. However, climate change projections under the RCP8.5 scenario for 2090 suggest more significant impacts.

Groundwater quality has shown no significant changes over time, with most parameters remaining consistent when comparing results from 2014–2019 to those from 2020–2025, with some localised exceptions of elevated metals (notably iron, manganese and silica). It is anticipated that groundwater quality will remain relatively stable during operations, with any variations expected to fall within the ranges observed between 2020 and 2025. Groundwater inflows dominate pit lake chemistry, contributing approximately 60% of inflows, with pit wall runoff and rainfall accounting for the remainder. Preliminary geochemical modelling results indicate the Sparrow Lake pit lake is likely to remain circum-neutral, with limited influence from sulfur-rich wall rock due to its minor exposure (<1%). Ongoing kinetic testing, when complete, will provide more robust results which will refine these findings.

The study provides the following recommendations to help refine outstanding data gaps:

- In anticipation of the potential requirement to discharge excess water into the Coongan River, the following items should be considered:
 - an eco-hydrogeological assessment related to superficial aquifers and associated groundwater dependent ecosystems within the riparian corridor
 - installation and testing of groundwater monitoring bores in the Coongan River alluvial deposits to improve understanding of groundwater dynamics ahead of any potential excess water discharge.
- Assessment of Sparrow Lake dewatering effectiveness; there is potential to include additional model scenarios to predictive drawdown associated with in-pit dewatering bores (calibrated from existing in-pit bores) and/or couple with a further drill program to install and test new in-pit dewatering bores.
- Installation and testing of an additional monitoring location within the footprint of Razorback to assist in further characterisation of groundwater contributions to Pool 14.
- Tracer tests at the location Pool 14 (and potentially Pool 1) and to assess localised groundwater flow to key sensitive receptors which are poorly resolved in the existing numerical groundwater model.
- Continued surface water and rainfall monitoring to capture variability and incorporate climate change scenarios into future hydraulic modelling.
- Incorporation of laboratory kinetic data results into the pit lake water quality results to refine the modelling outcomes. Testwork is currently partially complete and due for completion in late 2025.
- Additional sample collection from Pool CO-WS-20 to assess if elevated hydrocarbon levels recorded in 2023 are continuing or anomalous.

1 Introduction

SRK Consulting (Australasia) Pty Ltd (SRK) was contracted by Atlas Iron Pty Ltd (Atlas) to undertake an H3 detailed hydrogeological assessment for the Sanjiv Ridge Project near Marble Bar in the Pilbara region of Western Australia.

As a minimum, an H3-level assessment requires a field hydrogeological assessment, including drilling and test pumping in order to characterise the groundwater regime, and numerical groundwater modelling to evaluate the potential for impacts on surrounding groundwater and surface water users and ecosystems.

1.1 Scope of work

Atlas is currently developing the Sanjiv Ridge Project (the Project), which involves the mining of iron ore from five open pits using conventional drill and blast methods.

As part of the current mine plan, the Project intends to transition from Phase 4, which operates above the water table, to Phase 5, where mining will extend to below the water table. Groundwater abstraction and dewatering from production bores will be required to facilitate the proposed mining activities, as well as to supply the raw water requirements for the Project.

A previous H3-level assessment was completed (SRK, 2019a) to support approvals to Stage 4 (above water table) mining. The report evaluated the potential impacts on local groundwater resources and receptors resulting from the development of the Project at that time – in particular, 13 identified groundwater-dependent water features.

As part of this updated 2025 H3 report, SRK completed additional investigations to refine the conceptual understanding and reassess potential impacts on any identified sensitive receptors. The investigations/scope of work included:

- drilling new 13 monitoring bores
- drilling and testing 5 new and existing production bores
- groundwater sampling of new and existing monitoring and production bores
- updated the conceptual groundwater model for the Project area
- update (Revision 3) of the numerical groundwater model developed as part of the previous (2019) H3 report
- surface water model and impact assessment
- pit void water balance
- geochemical assessment of pit wall lithology and pit lake quality
- a revised groundwater impact assessment
- recommendations for potential updates required for the groundwater and surface water monitoring program.

1.2 Report structure

This report is intended to meet the requirements of Operational Policy No. 5.12 – Hydrogeological reporting associated with a groundwater well licence (Department of Water, 2009).

To achieve this, the report is comprised of an overarching document which contains the key aspects of each study.

The specific study reports form the appendices of this document as listed below:

- Appendix A – Groundwater Dependent Environmental Values. This provides a list and description of the groundwater-dependent sensitive receptors identified across the project area.
- Appendix B – Field report. The 2024 field investigation report includes lithological and hydrogeological bore logs, construction details and pumping test data.
- Appendix C – Groundwater quality report. This presents all water quality data captured across the site between 2014 and 2025. Data are grouped by area of the mine for ease of comparison.
- Appendix D – Hydrographs of each bore compared to recorded monthly rainfall, grouped by area, covering the period 2014 to 2025.
- Appendix E – Surface water report and hydrological impact assessment.
- Appendix F – Pit void water balance. Following the cessation of dewatering it is anticipated that permanent lakes will form within the pit voids at Sparrow Lake and Runway. This water balance evaluates the final water level after closure.
- Appendix G – Groundwater modelling report. This provides detail on the updates and outcomes of the groundwater model.
- Appendix H – Preliminary pit lake water quality assessment. This evaluates the water quality of the pit lake water due to increased sulfur content and greater acid generation potential within the exposed wall rock of Stage 5 operations at Sparrow Lake.

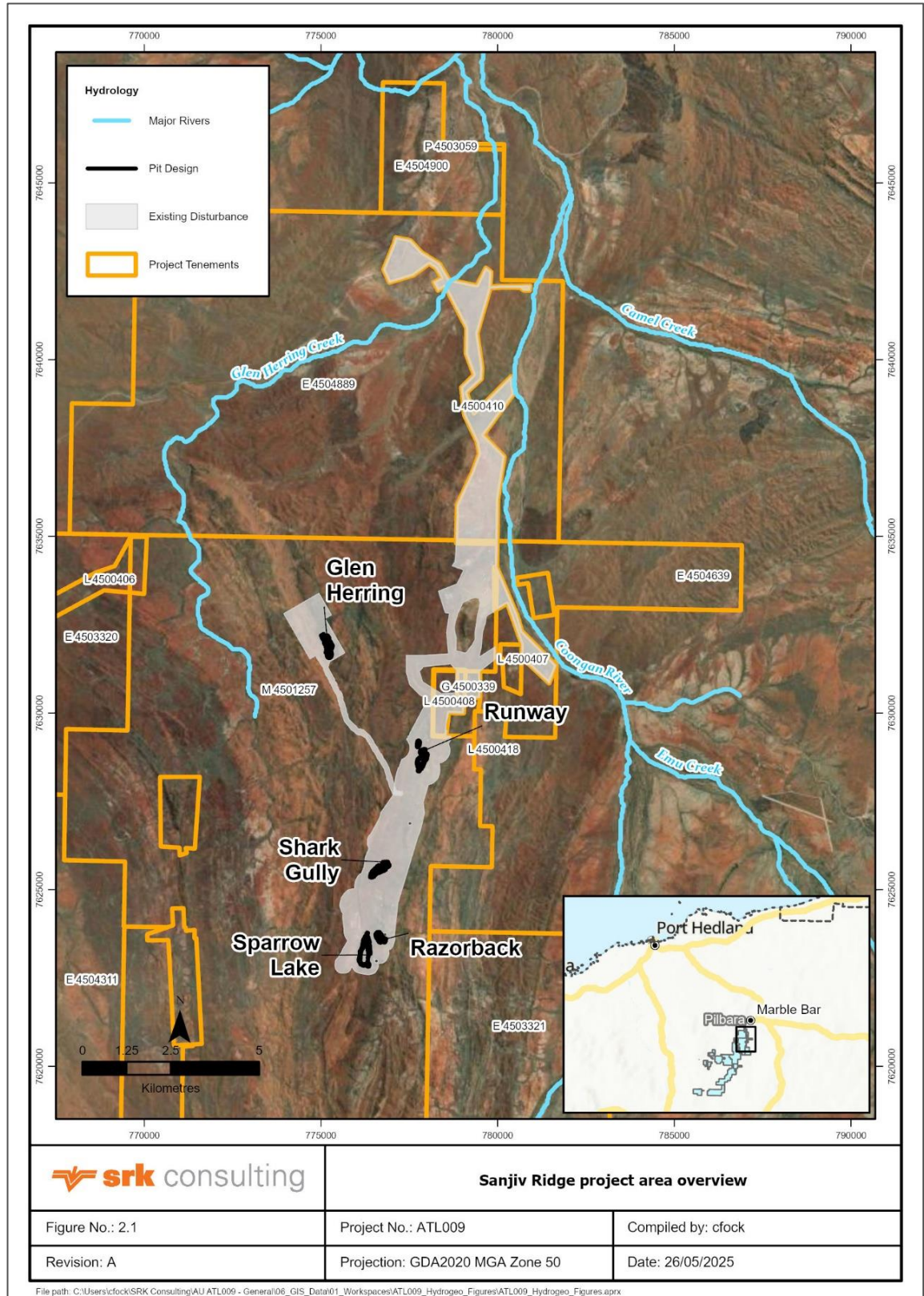
2 Background

2.1 Project description

The Project is located in the Pilbara region of Western Australia, approximately 240 km southeast of Port Hedland and 33 km south of Marble Bar. Stage 1 of the Project involved mining five open pits (Sparrow Lake (previously Split Rock), Razorback, Shark Gully, and Runway), using conventional drill and blast, load and haul methods to extract an iron ore resource of approximately 23.1 Mt over a mine life of approximately 6 years. Stage 2 of the Project included a further three open pits and five additional waste rock landforms to produce a further 10 Mt (Atlas, 2024) in the Glen Herring area. The location of the Project, with tenements, pits and the proposed Development Envelope, is provided in Figure 2.1.

The Project is currently developing from the Stage 4 (above the water table) to Stage 5 (below the water table). For this, the Glen Herring, Runway, Shark Gully and Sparrow Lake (formerly Split Rock) pits will be mined below water table, with a life of mine expected to expire in 2032.

Figure 2.1: Project location and Development Envelope



Source: SRK

2.2 Regulatory framework

Groundwater use must be licensed under the *Rights in Water and Irrigation Act 1914* (the Act) by the Department of Water and Environmental Regulation (DWER). Before a Licence to Take Water is issued to an applicant, the DWER undertakes an assessment of the potential impacts of the proposed groundwater abstraction. For applications where the proposed volume of water to be abstracted is large, the available data for the aquifer are limited, the demand for accessing a particular groundwater resource is high, or the potential impacts on the groundwater system and/or adjacent users because of abstraction are considered significant, the DWER may require additional information to complete its assessment.

Due to the known presence of several identified Environmental Values (EVs) in the vicinity of the Project, including water features such as perennial and ephemeral pools, a significant cave and identified areas of groundwater-dependent vegetation, an H3-level assessment was completed in 2019 for progression into Phase 4 operations. As the mine progresses into Phase 5 an updated H3 report is necessary.

2.3 Proclaimed groundwater management areas

The Project is situated within the East Pilbara subarea of the Pilbara Groundwater Area proclaimed under Western Australia's *Country Areas Water Supply Act (1947)*. Mining water supply is identified as an accepted water usage under the plan.

2.4 Existing groundwater licence

Atlas abstracts groundwater under the 5C Licence to Take Groundwater (GWL176960) to support mining activities at the Sanjiv Ridge operation (Atlas, 2024). The licence permits an annual abstraction limit of 1,100,000 kL (1.1 GL), with extraction volumes reported annually to the DWER. Annual abstraction volumes since 2020 have increased (Table 2.1) but are still below the abstraction limit. Groundwater management is governed by the Water Management Plan and Site Water Operating Plan (Atlas, 2019), which outline a robust monitoring program and establish triggers, thresholds, and contingencies to mitigate indirect impacts on sensitive receptors. Measures, such as adjusting abstraction rates or sourcing water from alternative locations, are applied as necessary to ensure compliance.

Table 2.1: Annual modelled historical abstraction volumes (m3) for Sanjiv Ridge

Year	Modelled abstraction volume (m3)	Average flow rate (L/s)
2020	580,492	18.4
2021	468,905	14.9
2022	566,236	18.0
2023	647,109	20.5
2024	730,533	23.2

Sources: SRK

Notes: Abstraction volumes are used for groundwater modelling. Annual volumes presented are taken from Atlas supplied water take records and are based on calendar year so may vary from reported abstraction volumes

In March 2025, Atlas submitted an application to update the licence (GWL176960(6)) to include recently constructed abstraction bores CRD0137 (Runway Pit) and CRD0143 (Sparrow Lake Pit, formerly Split Rock Pit). These bores will replace CRD0101 (Runway Pit) and CRD100 (Sparrow Lake Pit), which are expected to be lost to mining operations in the near future. The outcome of this application has not been determined at the time of writing this report, but the results of the numerical modelling that was incorporated into the application identified minimal changes to the drawdown and associated impacts.

2.5 Existing groundwater users

No surface water licences were identified within a 30 km radius of the Project area, and only two additional groundwater licences were located within this range since submission of the 2019 H3 assessment report:

- **Licence 204411:** Granted to Keras Gold Pty Ltd in September 2022, located 23 km northeast of the Project. This licence, valid for 10 years, has an annual allocation of 2,100,000 kL.
- **Licence 210644:** Granted to Fortescue Ltd in August 2024, located 30 km east of the Project. This licence, also valid for 10 years, has an annual allocation of 15,000 kL.

Additionally, a total of 152 wells or bores were identified within 30 km of the project area, based on information available from the DWER Water Information Reporting (WIR) database. The main findings regarding these bores are as follows:

- **Private ownership and status:**
 - Most bores are owned by private individuals and are located within or near Atlas' tenements, suggesting they are either inactive or abandoned.
- **Pastoral bores:**
 - No pastoral bores were identified within the 30 km radius.
- **Bore drilling history:**
 - The most recently drilled bores (outside of those constructed by Atlas) date back to 1999, located 30 km away in Marble Bar.
- **Bore depth and construction:**
 - The majority of identified bores (76 in total) are shallow (less than 20 mbgl) or have unknown depths, indicating they likely only penetrate the overburden. Furthermore, most bores were not constructed or installed, with only 33 showing installation details. Of these, four correspond to Atlas' installed bores.

These findings highlight a lack of significant competing water resources or infrastructure within the immediate vicinity of the Project, reinforcing the limited impact on external water users in the region.

3 Supporting studies

The following sources of information (public and private), including supporting technical studies, have been used to develop this H3 report. A brief summary of these supporting studies is given below.

3.1 Public datasets and site-specific data

Data and reports from public databases (DEMIRS, 2025) and previously completed geological and hydrogeological studies for the Sanjiv Ridge Project were reviewed for this assessment, including:

- Groundwater and surface water data:
 - Water level records for 152 production and monitoring bores and other open hole completions
 - Manual measurements and data logger water level records for 13 surface water pools for the period October 2017 to November 2024 (Atlas)
 - Water level data from regional bores available on the Water Information Reporting (WIR) government database
- Geological and elevation data:
 - Government geological mapping (GSWA)
 - Government digital elevation modelling (DEM) (30 m resolution) (GeoWA)
 - Local DEM of adequate resolution to inform surface water pool and gorge locations, relative to the groundwater table (Atlas)
 - Survey elevations for all pool locations (Atlas)
 - Photogrammetry surveys of Surface water monitoring locations (Atlas, 2024)
- Environmental and geochemical studies:
 - Below water table groundwater-dependent vegetation and aquatic ecology assessments conducted by Biologic Environmental Survey (Biologic, 2024)
 - Comprehensive geochemical characterisation undertaken by Mine Earth (Mine Earth, 2024, 2025a and 2025b)
- Atlas-supplied operational data:
 - Project data including water usage, pit shells, topography (including lidar photogrammetry), rainfall data, geological models, waste dump and backfill plans, and the mine schedule.

3.2 Previous H3 report (2019) and addendum (2023)

SRK previously conducted a detailed H3 assessment for the Sanjiv Ridge Project on behalf of Atlas Iron Ltd. The H3 was initially submitted in 2019, with a follow-up addendum submitted in 2023.

The key findings of these reports are:

- Mining and groundwater abstraction:
 - Mining was confined to areas above the water table, eliminating the need for dewatering.
 - Groundwater abstraction averages approximately 1 GL/year over the 6-year mine life, reducing the likelihood of long-term impacts.
 - Mining activities are limited to oxidised, low-sulfide zones, mitigating risks of acid generation.
 - All abstracted groundwater will be used on site, eliminating the need for discharge.
- Groundwater modelling and receptor impacts:
 - Groundwater-dependent water features are described and presented in Appendix A.
 - Modelling indicates no significant drawdowns in eight of the eleven features.
 - Pools CO-WS-01, CO-WS-03 and CO-WS-10 may experience minor impacts, but any effect on pool permanence is expected to be minimal.
 - Uncertainty remains regarding the soak area and deeper groundwater connections persist, but conservative assumptions were integrated into the study to account for potential risks.

3.3 2024 field report and pumping test

SRK conducted a fieldwork study between January and November 2024, which included hydrogeological drilling and a testing program. The study involved step rate tests and constant rate tests conducted at the Sparrow Lake, Runway and Glen Herring pits.

The full fieldwork report is presented in Appendix B, while the key findings are summarised below:

- Five production bores and 13 monitoring bores were drilled and installed during the study. Complete bore logs and installation details are presented in Appendix B. Bore construction forms for DWER records (Form 2) were completed for each bore and were delivered to Atlas Iron.
- Pumping tests were conducted across six production bores – one in Sparrow Lake, one in Razorback, one in Runway, and three in Glen Herring. Each production bore underwent a step rate test to determine the appropriate flow rates for the subsequent constant rate tests and to evaluate bore efficiency. A 72-hour constant rate test was completed on all production bores at varying flow rates to estimate aquifer parameters, which are summarised in Table 3.1.
- Ten packer tests were conducted in seven inclined geotechnical diamond bores within the Sparrow Lake and Runway pits. The calculated hydraulic conductivity (K) values of successful tests were compared with K values obtained from the 2024 pumping tests. Three of the ten tests were completed successfully. The remaining seven tests failed to maintain pressure due to excessive flow rates. The single successful test at Runway was calculated to be 1.21 m/d which closely aligns with the geometric mean K value of 0.76 m/d obtained from the pumping tests conducted at bore CRD0137. Results from the two successful tests at Sparrow Lake also gave results that were similar but lower than pumping test K values.

Table 3.1: Hydraulic parameters calculated from the 2024 pumping test

Bore	Area	Efficiency (%)	Transmissivity range (m ² /d)	Storativity	Geomean of storativity	Monitoring bore response
CRD0146	Glen Herring	56–81	205.2–783.4	2.67E-05 – 4.41E-03	6.39E-04	Observed in monitoring bore in the same pad
CRD0133	Glen Herring	13–171 ¹	16.66–420	3.87E-03 – 7.73E-03	4.95E-03	Observed in monitoring bore in the same pad
CRD0046	Glen Herring	51–66	384.5–1,215	Omitted ²	-	Not observed
CRD0143	Sparrow Lake	61–71	96.51–909.70	1.91E-08 – 6.15E-03	3.69E-04	Drawdown observed in multiple bores Recovery not observed in distant bores
CRD0141	Sparrow Lake/ Razorback	26–47	51.87–270.2	1.71E-06 – 2.19E-02	8.69E-04	Drawdown and recovery observed in multiple bores
CRD0137	Runway	4–7	14.82–510.3	1.47E-28 ³ – 1.32E-06	3.94E-7 ⁴	Observed in monitoring bore in the same pad

Source: SRK

Notes: Figures of production bores and associated monitoring bores are provided in Appendix C (Figure 4.3).

¹ Corrected by excluding last step.

² Omitted due to no monitoring bores showing response.

³ Value obtained using Cooper-Jacob method.

⁴ Values obtained using Cooper-Jacob method were omitted from Geomean.

3.4 2014–2025 water quality

Groundwater quality data, collected from 165 locations between 2014 and 2025, have been assessed to support an H3 report to support approval for Stage 5 mining operations at the Sanjiv Ridge Project.

To aid with data visualisation, the assessment monitoring locations were grouped into eight smaller subsets based on spatial distribution.

Figures of production bores and associated monitoring bores are presented in Appendix C. The eight subsets within the Project area are given below:

- Road Area – Appendix C; Figure 5.1
- Camp area – Appendix C; Figure 5.3
- Processing Plant – Appendix C; Figure 5.5
- Runway Pit – Appendix C; Figure 5.7
- Glen Herring Pit – Appendix C; Figure 5.9
- Shark Gully Pit – Appendix C; Figure 5.11
- Razorback Pit – Appendix C; Figure 5.13
- Sparrow Lake Pit – Appendix C; Figure 5.15.

The aim of the assessment was to identify major trends and changes over time, particularly between the 2014–2019 monitoring period (covered by the Stage 4 hydrogeological H3 report completed in 2019) and the more recent (2020–2025) monitoring period.

The complete report is presented in Appendix C and the main conclusions are:

- **General stability in water quality:**
 - Water quality parameters, including pH, EC (electrical conductivity), TDS (total dissolved solids), and water hardness, remained stable across most monitored locations and were within ANZECC and ADWG limits. The pH values generally ranged between 6.5 and 8.0 across the Project, with field pH data showing greater variability compared to laboratory results. Most sites were categorised as Very Hard Water, and ionic balance values were predominantly reliable (<10%), with minor uncertainties in isolated cases.
- **Localised exceptions:**
 - Larger variations in physico-chemical parameters (e.g. water hardness, TDS, chloride, sodium, and sulfate) were observed at bores CRD0086 and CRD0048 and surface pools CO-WS-10 and CO-WS-20. Surface pools exhibited greater variability than groundwater, likely due to evaporation and seasonal influences or potentially also the influence of livestock.
- **Metals and other relevant elements:**
 - Most metals were below laboratory detection limits, with detectable concentrations generally within ANZECC and ADWG thresholds. Elevated levels of iron, associated with banded iron formation (BIF) geology, exceeded the ADWG aesthetic threshold at some locations. Selenium and fluoride occasionally exceeded guidelines in specific bores, while elevated manganese levels were associated with pits areas. Silica concentrations were higher in the camp, processing plant, and road areas, likely due to silica dissolution under alkaline conditions.
- **Hydrocarbons and VOCs:**
 - Hydrocarbons and VOC levels were typically below detection limits, except for two samples from pool CO-WS-20, which recorded elevated hydrocarbons (C16–C34 range) in 2022–2023, potentially linked to diesel or oil range organics. No samples have been collected at CO-WS-20 since 2023 and the source of the hydrocarbons remains uncertain. Further monitoring and additional sampling is recommended.
- **Radiocarbon isotope analysis:**
 - Radiocarbon isotope data were inconclusive for groundwater flow delineation. However, the evidence indicates mixed groundwater and surface water contributions to pools, with CO-WS-14 (Razorback Pit) and CO-WS-16 (Glen Herring pit) dominated by groundwater inflows. Figures of sampled locations are given in Appendix C (Figure 4.4).
 - Management of identified potential impacts on pools will be detailed in the development of a planned surface water and groundwater management plan (expected later in 2025).

- **Comparison with pumping tests:**
 - Pools CO-WS-14 and CO-WS-16 are likely fed by groundwater, based on similarities with pumped bore water quality. In contrast, pool CO-WS-20 exhibited significant differences in water quality, likely in part due to the distance between the bore and pool. Limited data for pools CO-WS-11 and CO-WS-12 prevents any meaningful conclusions of a comparison to pumping test water quality.
- **Variability between monitoring periods:**
 - No significant continuous changes in water quality trends were observed between the two monitoring periods. Surface pools exhibited greater variability than bores, likely due to surficial processes, which requires ongoing monitoring and assessment.

3.5 Surface water modelling and impact assessment

The hydrological modelling and impact assessment report, detailed in Appendix E and key outcomes discussed in Section 7, evaluates the potential impacts of Stage 5 pit development on the local drainage system at the Sanjiv Ridge Project. The report provides a comprehensive characterisation of existing hydrological conditions, supported by local site-specific data and regional analyses, alongside an assessment of potential impacts associated with the proposed development. The report also includes an evaluation of the Project's location within the Coongan River catchment, incorporating regional climate characteristics as well as climate change considerations.

Streamflow monitoring, initiated by Atlas in 2023 at nine locations within the Project area, is supplemented by long-term regional hydrological data from the Coongan River at Marble Bar. Rating curves were developed at monitoring locations using topographic surveys, allowing flow time-series to be derived where sufficient data were available. The report also characterises ephemeral runoff behaviour within the Project area, influenced by steep gradients, shallow soils, and seasonal rainfall patterns.

As part of the study, a hydrological model was developed to simulate the runoff dynamics of the Project area. This model was calibrated using observed runoff events and long-term rainfall records (1998–2024), validated against both local and regional datasets. It was further used to simulate design runoff events using 24-hour intensity-frequency-duration (IFD) rainfall data for various annual exceedance probabilities (AEPs).

Additionally, an impact assessment model was developed to evaluate hydrological changes resulting from the planned pit expansions.

The models compared six different scenarios:

- Scenario 1: Baseline – a pre-mine natural catchment baseline.
- Scenario 2: Current (2025) – the calibrated model reflecting existing catchment modifications.
- Scenario 3: Stage 5 mining operations – modifications primarily limited to pit expansion areas and slight modifications to haul road and stockpile areas.
- Scenario 4: Baseline with climate change – the pre-mine natural catchment baseline with climate change effects for the RCP8.5 2090 scenario.

- Scenario 5: Current (2025) with climate change – the calibrated model reflecting existing catchment modifications, incorporating climate change effects for the RCP8.5 2090 scenario.
- Scenario 6: Stage 5 mining operations with climate change – modifications primarily limited to pit expansion areas and slight modifications to haul road and stockpile areas, including climate change effects for the RCP8.5 2090 scenario.

3.6 Geochemical assessment

Mine Earth has been engaged by Atlas to conduct a waste rock characterisation assessment on six geochemical drill holes targeting the Stage 4 and Stage 5 expansion areas of the Sanjiv Ridge Project.

Mine Earth conducted a geochemical assessment of the Sparrow Stage 4 and Stage 5 pit waste rock and reviewed the lithological and sulfur databases and preliminary analytical work.

The Stage 4 (above groundwater) material was shown to present low risks of acid and metalliferous drainage (AMD) due to low sulfur content, but the Stage 5 (below groundwater) material was shown to present a higher risk of AMD due to higher sulfur content, mostly in the shale.

To complement the work completed by Mine Earth, Atlas requested SRK to carry out a pit lake study to assess expected pit lake water balances and water quality for the Sanjiv Ridge Project. The outcomes of the water balance and pit lake water quality models are given in Section 6.4.

3.7 Pit void water balance

The technical memorandum on pit void water balance modelling, presented in Appendix F, focuses on predicting the post-closure water balance for pit lakes expected to form in the Sanjiv Ridge Project pits following mining activities below the water table. The pits included in the study are Runway South, Shark Gully and Sparrow Lake. The primary objectives of the modelling were to estimate long-term pit lake water levels, assess their behaviour as groundwater sinks, and evaluate the potential for surface water spillage.

The model estimates pit lake water volume as:

$$\Delta \text{ pit lake water volume} = P_{\text{precip}} + R_{\text{runoff}} + GW_{\text{inflow}} - E_{\text{pit}}$$

where:

- P_{precip} is the inflow from direct precipitation falling on the surface of the pit lake (m³/time-step).
- R_{runoff} is the inflow from pit wall runoff (the fraction of precipitation falling on the pit walls that ultimately reports to the pit lake).
- GW_{inflow} is the groundwater inflow to the pit lake (m³/time-step) and is positive when the water level of the lake is below the local water table, zero when it is at the same elevation, and becomes negative (i.e. outflow) if the level rises above the local water table.
- E_{pit} is the open water evaporation from the pit lake surface based on a modified pan evaporation rate applied to the pit lake surface area (m³/time-step).

To meet the model objective, a preliminary predictive pit lake water balance has been developed, using a dynamic system model in the GoldSim (v. 15) software platform. This platform can be used for probabilistic simulation (Monte Carlo) to evaluate the potential uncertainty and variability in model input parameters related to groundwater and surface water. Simulations were conducted on daily time-steps, with results reported monthly over a period of 400 years post closure.

Regarding climate inputs, daily precipitation, temperature, and solar radiation were generated using the WGEN weather simulator, which was informed by historical data from the Marble Bar weather station (1956–2025). This ensured the model accurately represented changing climatic conditions over the simulated period.

Evaporation was calculated through two specific methods. The Hargreaves-Samani equation was used to estimate evaporation from pit walls based on daily temperature data, while the Hamon Lake Evaporation method was applied to determine evaporation from pit lake surfaces, considering temporal changes in lake surface area.

Groundwater inflows were based on models that accounted for variable water levels due to lithological compartmentalisation. Specific elevations were defined for each pit to represent structural differences in the area accurately. Lastly, pit geometry was modelled using site-specific correlations that linked pit elevation, surface area, and water volume, ensuring precise representation of the physical characteristics of the pits.

The outcomes of the modelling are presented in Section 6.

3.8 Numerical groundwater modelling

An existing groundwater model of Sanjiv Ridge, initially developed for the 2019 H3 report, was updated for this 2025 H3 report.

The model revisions are:

- Revision 1 – *Corunna Downs Mine Water Supply H3 Hydrogeological Assessment* (SRK, 2019); this revision focused on above water table mining.
- Revision 2 – *Sanjiv Ridge Mine Water Supply H3 Hydrogeological Assessment Update* (updated H3 assessment) (SRK, 2023); this revision also focused on above water table mining but included additional data.
- Revision 3 – developed for this report. Refer to Appendix G for the full report including model log, details on scenarios and predicted drawdown extents for below water table mining during operations and post-closure.

The outcomes of the modelling are presented in Section 5.

4 Conceptual model

A conceptual mode for the site was previously developed for the 2019 H3 hydrogeological assessment (Atlas, 2019). Previous assessments were targeted on the impacts of water supply during above water table mining. Only minor changes to the conceptualisation have been incorporated for this updated H3 assessment. The most recent drilling and testing data have been used during the calibration to further refine the hydrostratigraphy and hydrogeologic connection within the project area (particularly at Sparrow Lake).

4.1 Climate and rainfall

The climate of the Pilbara region is classified as semi-arid to arid and is characterised by hot summers and warm winters. The area experiences a climate of extremes where severe droughts and major floods can occur at close intervals. Tropical cyclones can occur between January and April, bringing sporadic, high intensity rainfall events.

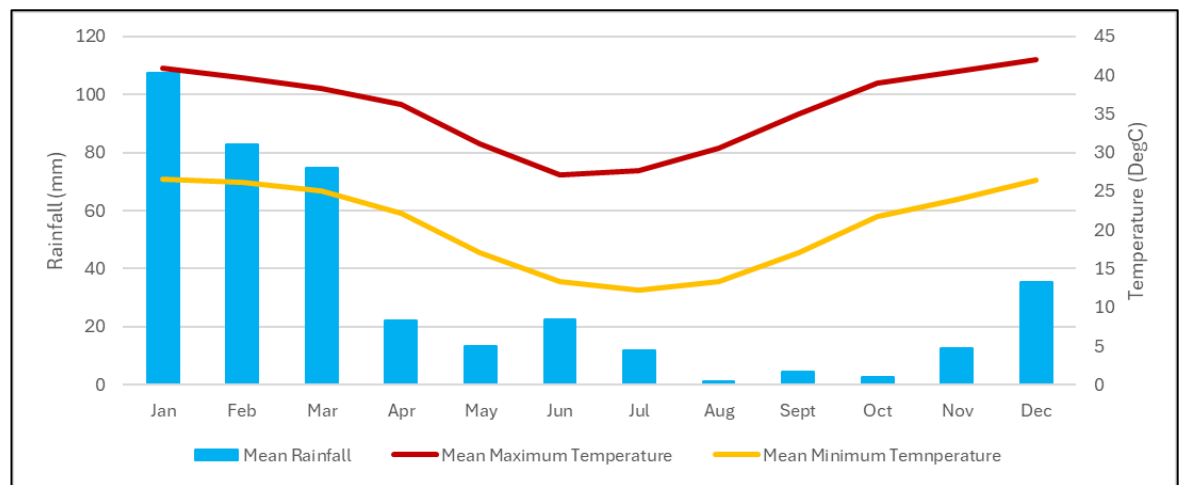
The closest Bureau of Meteorology (BOM) weather station to the Project is located at Marble Bar (Station Number 004106, previously Station Number 004020), approximately 65 km to the northeast (BOM, 2025). Summer in the Pilbara occurs from November to February when the mean maximum temperature for Marble Bar is 40.8°C and the mean minimum temperature is 25.7°C (Table 4.1 and Figure 4.1).

Table 4.1: Marble Bar weather data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mean maximum temperature (°C)	40.9	39.7	38.3	36.2	31.1	27.1	27.7	30.5	34.9	38.9	40.5	42
Mean minimum temperature (°C)	26.5	26.1	25.1	22.1	17	13.3	12.2	13.3	17.1	21.7	23.9	26.4
Mean rainfall (mm)	107.3	82.7	74.8	22.2	13.4	22.4	11.8	1.3	4.6	2.8	12.5	35.4

Source: BOM, 2025

Figure 4.1: Marble Bar mean monthly rainfall and temperature



Source: Marble Bar BOM meteorology station (#004106) for 1900–2025 (BOM, 2025)

Mean annual rainfall is 394 mm/year, with most rainfall occurring during the summer months (Table 4.1 and Figure 4.1), while annual evaporation is approximately 3,200 mm to 3,600 mm, almost 10-times greater than precipitation. Evaporation varies from a mean of 12.9 mm per day in summer (December) to 5.4 mm per day in winter (June/July). This trend is typically observed throughout the area, as indicated by regional maps provided by BOM (BOM, 2006). Evaporation records for Marble Bar are limited, with data only available between 1968 and 1988. Evaporation data are presented in Table 4.2.

Table 4.2: Marble Bar evaporation data (1968–1988)

Evaporation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean daily	11.4	10.4	9.7	8.6	6.5	5.4	5.4	6.3	8.7	11.0	12.7	12.9	9.1
Mean monthly	353	291	301	258	202	162	167	195	261	341	381	400	3322

Source: (BOM, 2006)

4.2 Topography, drainage and hydrology

The Project area is characterised by steep-sided ridges and hills dominated by outcrops of BIF, greenstone, chert, minor sandstone, dolomite and basalt. Mineralisation and proposed mining activities are centred on the site’s dominant landform – an elongated BIF ridge measuring approximately 9 km by 1.5 km and rising 90–110 m. The ridge features gentle slopes at the top and steep cliffs on its western and eastern sides (Figure 4.2). The topography of the ridge reflects the north-south striking, sub-vertical dipping stratigraphy of the Project area.

Drainage lines are well developed across the ridge areas and form gullies and gorges interpreted to have developed along east-west striking faults. Beyond the ridges, the topography transitions into gentle undulating slopes, alluvial valleys, and colluvial plains associated with regional rivers.

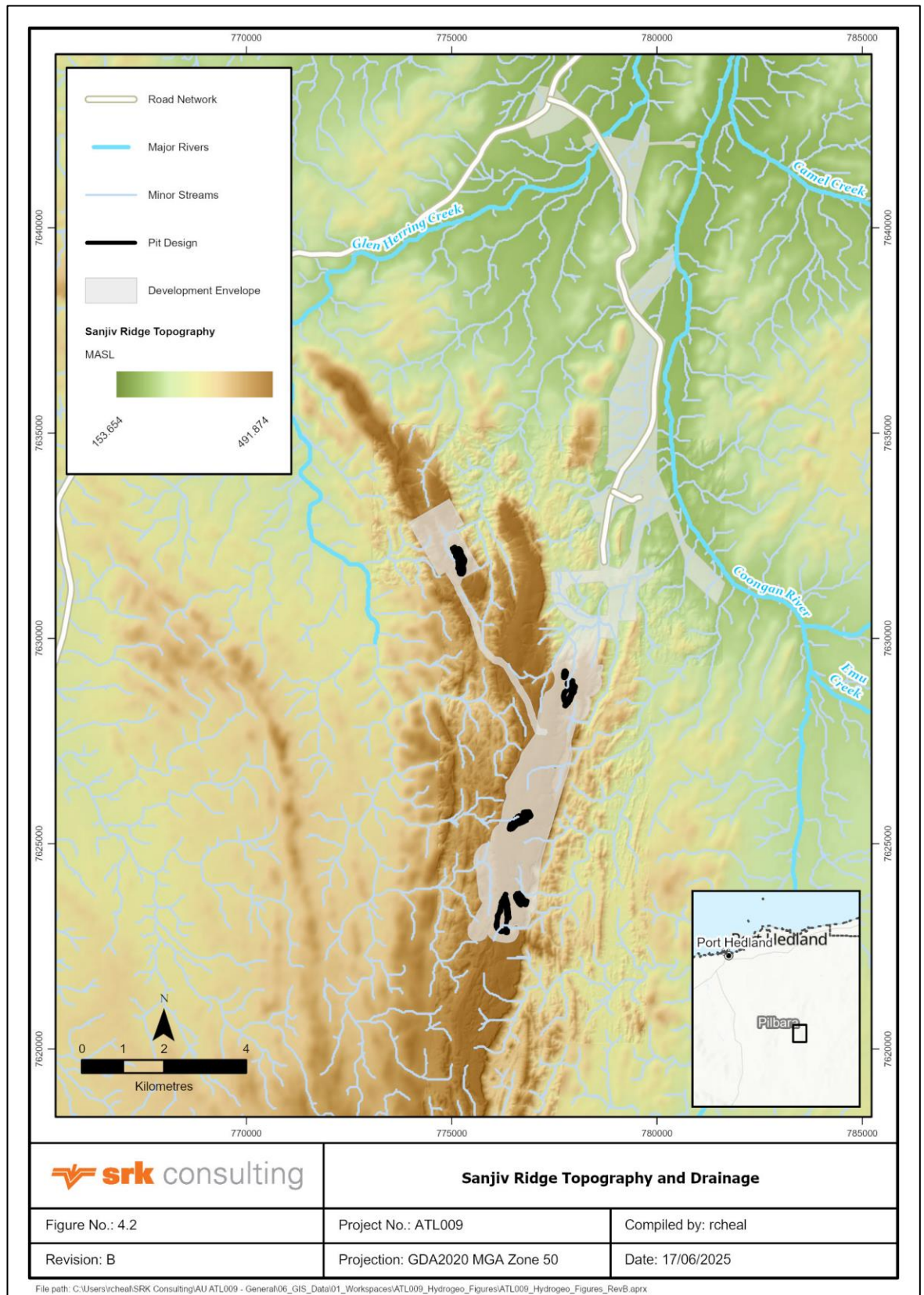
The Coongan River, which has a total catchment area of 7,090 km², lies east and north of the Project area and is fed by Glen Herring, Emu and Camel creeks, which drain the site. Minor drainage lines along gullies and incised ridges, as well as small creeks in the surrounding hills, direct surface water towards the Coongan River from both sides of the BIF ridge. The Shaw River, also ephemeral, is located 31 km west of the Project site, with the easternmost boundary of its catchment extending to within 6 km of the Project area. Both the Coongan and Shaw rivers are tributaries of the De Grey River, which has a total catchment area of approximately 56,890 km².

While the Coongan River itself is perennial, runoff within the Project area is ephemeral, driven by steep gradients and shallow soils. High-intensity rainfall events result in rapid overland flow, with only minor sustained flows occurring within shallow alluvial deposits exposed in depressions or bedrock outcrops during the wet season. No surface flows are evident during the dry season.

The MWH/Stantec H2 Hydrogeological study (2018) identified 13 water features (comprising pools, a cave and a soak) across the Project area (described in Appendix A). Assessments and ongoing monitoring suggest that pools are fed by both groundwater and surface water, with perennial pools receiving consistent groundwater inflows. Ephemeral pools are considered to rely primarily on surface water or occasional groundwater contributions during periods of higher groundwater levels.

Pools play an important ecological and cultural heritage role in the region. These water bodies are vital features within the Project area, reflecting the hydrological and geological characteristics of the region.

Figure 4.2: Sanjiv Ridge topography and drainage



4.3 Geology

The regional geology consists of metamorphosed and regionally deformed and faulted Archaean basement, overlain by thin deposits of alluvium and colluvium associated with rivers and creeks (Figure 4.3). BIF units, notably rich in iron, silica, sulfur and manganese (Bekele, 2013), are understood to be steeply inclined, generally striking northeast to southwest and are part of the Coongan Syncline (MWH, 2018b).

The main stratigraphic units in the Project area are:

- Cleaverville BIF
- Mount Roe Basalt
- Hardy Formation metasedimentary and metavolcanic units
- Duffer Formation felsic metavolcanics
- Wyman Formation metamorphosed sedimentary and felsic volcanic sequences which include the Euro Basalt Unit in the west and the Dalton Suite to the east.

The Cleaverville BIF is fault bound, with Mount Roe Basalt to the north, Euro Basalt to the west, and the Dalton Suite to the east. The Cleaverville BIF is the focus of mining and proposed water abstraction activities.

Some alluvial and colluvial deposits associated with surface water drainage channels occur in alluvial valleys in the northern part of the Project area and extend approximately 5 km east of the BIF ridge, running roughly parallel to the ridge. These alluvial and colluvial deposits generally overlie the Mount Roe Basalt and Hardy Formation within the Project area (Figure 4.4).

Figure 4.3: Sanjiv Ridge geology

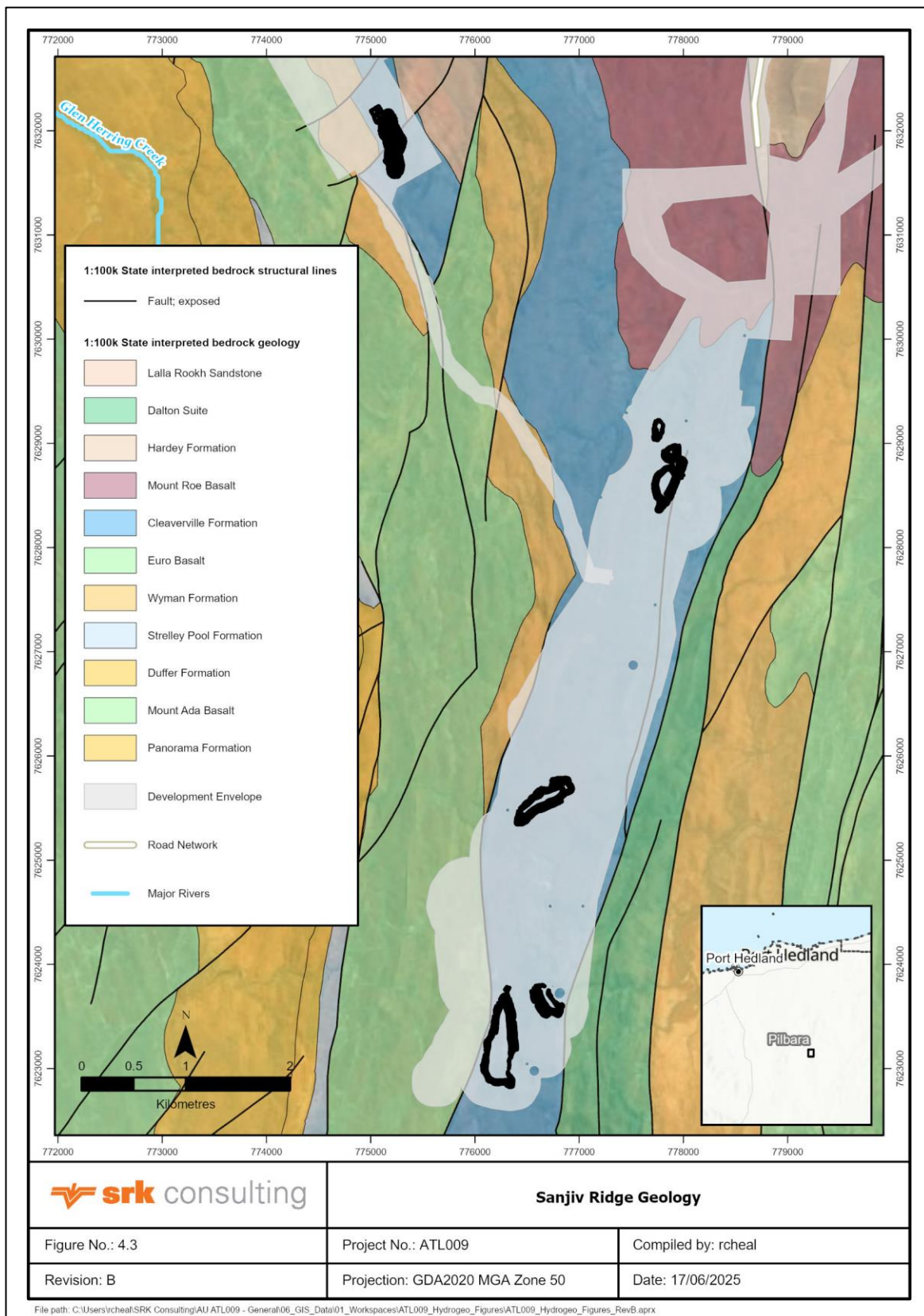
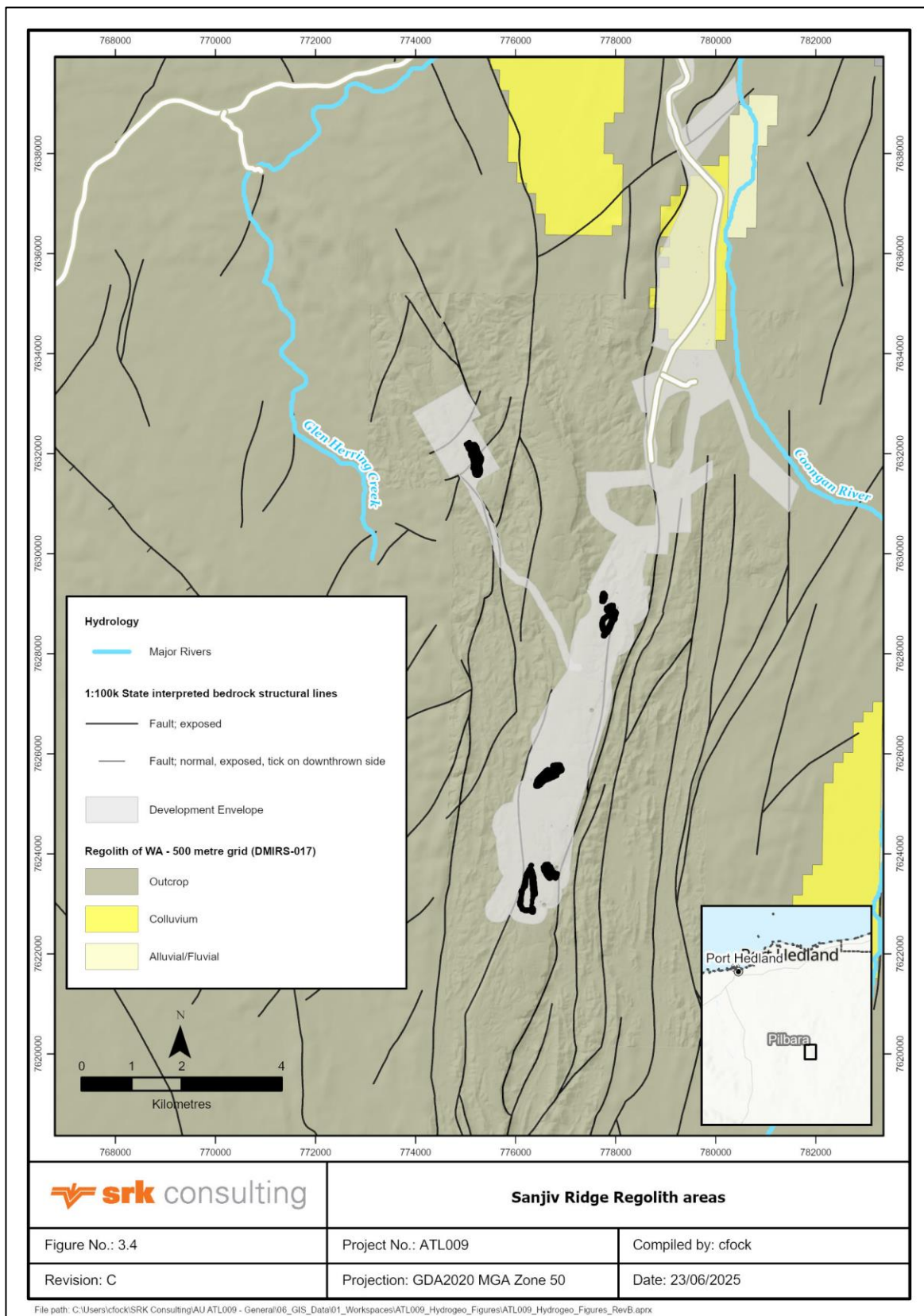


Figure 4.4: Sanjiv Ridge regolith areas



4.4 Hydrogeology

The Project lies within the Pilbara Groundwater Province of Western Australia. The geology of the province is typified by faulted granitoid rocks and associated folded Archaean greenstone rocks, resulting in structurally controlled permeability throughout the region.

The hydrostratigraphy of the Project area comprises a sequence of Quaternary and Archean units:

- **Quaternary units** (colluvium and alluvium) are thin and laterally discontinuous, primarily exposed across lowlands and stream valleys. These are generally unsaturated over the Project footprint, but can locally host perched groundwater and provide relatively high recharge rates where present.
- **Archean units** include:
 - **Banded Iron Formation:** Forms a moderately to highly permeable, unconfined aquifer locally. Yields are moderate to high; hydraulic properties are enhanced where extensive fracturing or weathering occurs.
 - **Shale:** Acts primarily as a confining unit; yields are poor and the shale restricts vertical groundwater movement.
 - **Mt Roe Basalt:** Where present, forms a fractured and locally permeable aquifer, but generally exhibits low yields except where highly fractured.

Groundwater occurs where secondary permeability and porosity have developed in fractures, weathered zones and along bedding planes, partings and joints. Therefore, groundwater occurrence tends to be compartmentalised.

Groundwater resources identified in the Project area are located in two aquifer systems:

- fractured bedrock aquifer (FBA)
- ephemeral alluvial groundwater system associated with surface water drainage lines.

4.4.1 Fractured bedrock aquifer system

The FBA is hosted within the Archean age BIF and Mount Roe Basalt covering an approximate extent across the Project area of 10 km².

The FBA is geologically constrained in extent, primarily following the outcropping BIF ridge. Laterally, the FBA is bounded by low-permeability shales and basalt units to the east and west of the BIF ridge. Groundwater gradients within the FBA are typically a subdued reflection of surface topography. The main groundwater flow within the BIF ridge is interpreted to be in a north–south direction, parallel to bedding planes (Figure 4.5). Gradients are locally influenced by the steeply dipping beds of chert, BIF and shales adding to the compartmentalising effect. This results in flow directions tending to converge towards local drainage channels and seepage points.

Hydraulic conductivities are expected to be significantly enhanced by fracture network development, and dissolution and weathering intensity, with some cases exhibiting localised zones of increased conductivity across strike, as is potentially observed at Sparrow Lake.

The FBA sits at or near the top of local catchments and is recharged primarily via direct infiltration from rainfall. The effective recharge is enhanced where the exposed bedrock is characterised by well-developed weathered zones, shallow fracture zones, or lithological contacts. Recharge may also occur via infiltration from the thin, discontinuous alluvial sediments. This potential recharge mechanism is enhanced where lithological contacts or fracture zones cross ephemeral watercourses. High evaporation rates in the area result in recharge being primarily limited to episodic, heavy rainfall events.

Field investigations suggest that the FBA is highly compartmentalised, with variable hydraulic properties within the compartments/host units, varying degrees of hydraulic connectivity between compartments, and variable responses to seasonal patterns. This is supported by monitoring at Runway which records large differences in drawdown associated with dewatering (section 4.5.3). The hydraulic connection between the BIF unit and the surrounding units (particularly the Mount Roe Basalt and Hardy Formation) are considered weak, based on the variability in water levels and the lack of response across formational contacts.

Discharge from the FBA occurs as:

- discharge from multiple low flow perennial seepages
- leakage into overlying colluvial/alluvial aquifers in creek beds
- potential on-site evapotranspiration from shallow groundwater in creek margins
- lateral outflows formed by faulting and anisotropy in the ridge. Flows preferentially move northwards along the more highly conductive units and/or faults to discharge into adjacent aquifer units or perennial watercourses

Discharge of the FBA may, at some locations within the Project area, be associated with shallow perched aquifer lenses that are disconnected from the deeper more regionally connected FBA aquifer. Uncertainty remains, specifically regarding CO-WS-14 (Pool 14), whether groundwater flow originates from these perched system or if flows are structurally controlled by other means. Further details are provided in Section 4.5.2. Recommendations on resolving this data gap are provided in Section 9.

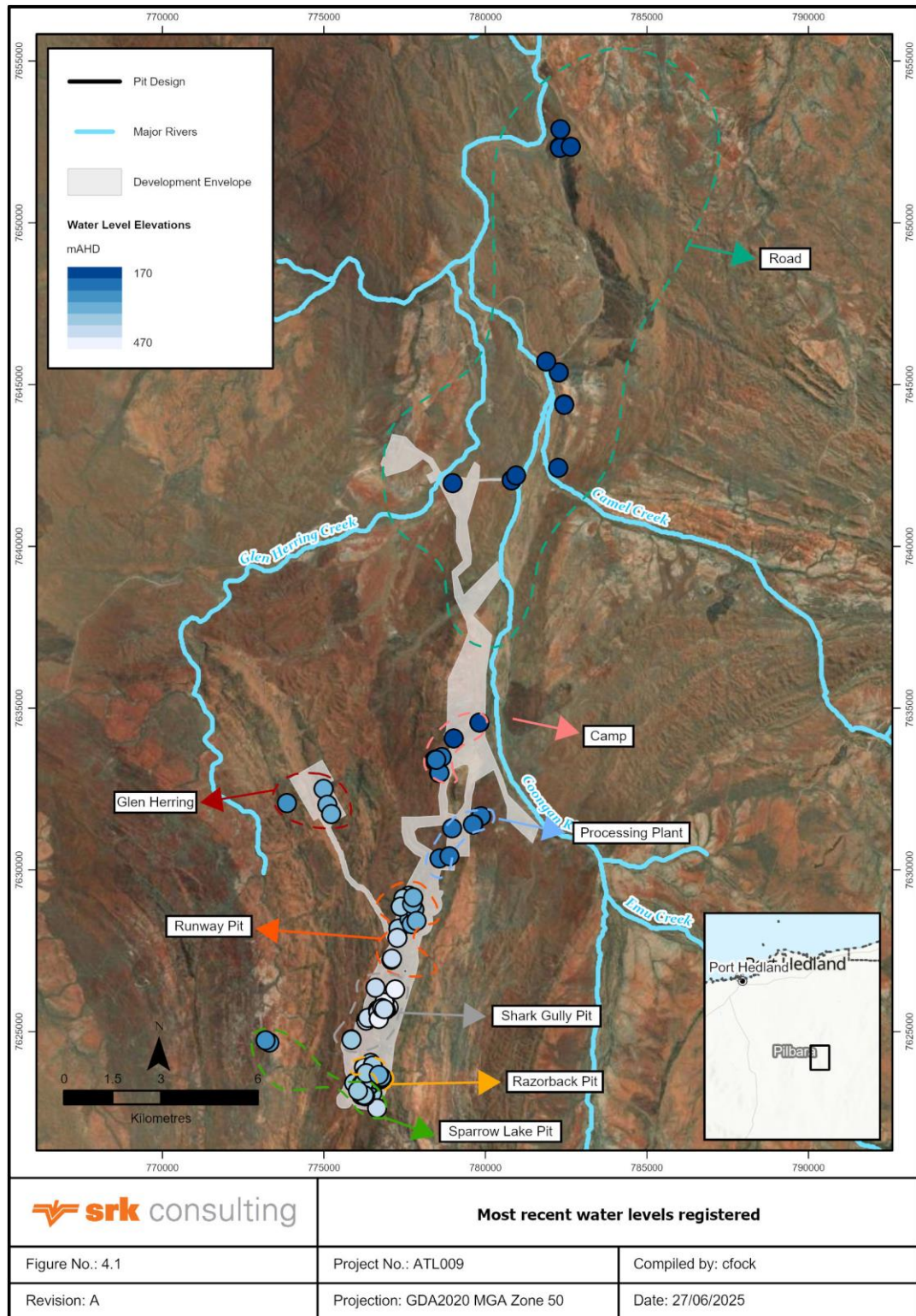
Water balance estimate for the FBA

Field observations and hydrometric assessments indicate a portion of groundwater is discharged from the FBA via perennial groundwater-fed pools. A high-level estimate of the proportion of the discharge is shown by a basic water balance. Thirteen identified pools, each discharging at an estimated average rate of 0.5 L/s, collectively account for a total groundwater outflow of approximately 6.5 L/s, equating to 205 ML/year (0.21 GL/year).

An aquifer recharge rate of 28 mm/year, which represents 10% of the mean annual rainfall (284 mm/year), has been applied over an FBA aquifer extent of approximately 10 km² (which covers the FBA extent influenced by identified pool locations). This corresponds to an annual recharge volume of 280 ML/year (0.28 GL/year).

The estimated annual recharge (280 ML/year) exceeds the combined observed groundwater discharge to pools (205 ML/year), indicating other groundwater losses (such as evapotranspiration, seepage, or lateral outflows) contribute to the discharge.

Figure 4.5: Water levels from late 2024 across the Project area.



Sources: SRK, Atlas

4.4.2 Alluvial groundwater system

The alluvial groundwater system is comprised of thin successions of unconsolidated colluvial and alluvial deposits associated with surface water drainage channels incised into the ridge, along valleys and including the Coongan River Valley system. The alluvium associated with these drainage systems forms unconfined aquifers of limited areal extent discontinuously overlying the FBA. The hydraulic connectivity between the thin, discontinuous alluvial groundwater system and the underlying FBA varies based on the composition of the alluvial and colluvial sediments and the extent of weathering and fracture development at the geological contact.

The thin unconsolidated alluvial and colluvial sediments in the Project area are ephemeral and are not considered to form a viable long-term water supply aquifer. When saturated and during periods of low relative evaporation, these unconsolidated sediments may provide a limited source of storage and recharge to the underlying FBA.

Recharge to the alluvial groundwater system occurs via infiltration from accumulated runoff during creek flows and via direct infiltration from rainfall. Groundwater occurrence and levels in the alluvial sediments are consequently highly variable and reflect short-term precipitation patterns.

The alluvial groundwater system is not present within the proposed Project area; however, it is spatially associated with the Coongan River, which runs parallel to the large north–south oriented ridge that hosts the proposed mining (Figure 4.2). Although the alluvial groundwater system is not considered to have significant influence on the proposed groundwater abstraction, recharge to the FBA by leakage may be an important process in local areas.

4.5 Updates to hydrogeological conceptual model

Data collected from 5 years of water supply abstraction have contributed to updating the conceptual model, primarily reinforcing the previous conceptualisation of a highly anisotropic and heterogeneous hydrogeological system. Additionally, new field studies conducted at Sanjiv Ridge in 2024 provided valuable inputs to further refine the model.

4.5.1 Glen Herring Pit

The Glen Herring pit is located northwest of the ongoing development at the Project and had not been studied from a hydrogeological perspective prior to the 2024 drilling program.

The geology of the Glen Herring pit is similar to the rest of the Sanjiv Ridge area. In the Glen Herring pit area, the expected aquifer type at the study area is an unconfined fractured system with the primary aquifer hosted in mineralised BIF. Groundwater flow in the study area is strongly controlled by local- and regional-scale stratigraphy and topography and may be enhanced or impeded along faults and discontinuities.

4.5.2 Sparrow Lake and Razorback

Located at the southern end of the linear arrangement of active pits, Sparrow Lake is the largest of the pits. Constant rate tests conducted at Sparrow Lake in 2024 provided additional insights to the local hydrogeology.

During the pumping test performed on CRD0143 (see Appendix B for more details), water level responses from two bores (CRD0091 and CRD0099), located 830 m to the east of CRD0143, did not record any recovery following the end of the pumping test.

The data suggest:

1. The pumping test is dewatering the storage of a compartmentalised high hydraulic conductivity fracture system within the aquifer.
2. There is connectivity across strike of the Cleaverville Formation BIF. This unit was previously conceptualised as highly anisotropic with higher hydraulic conductivity along strike.

4.5.3 Runway Pit

The Runway pit is located in the central part of the linear arrangement of active pits with similar geological and hydrogeological setting.

Water level data collected from an operational production bore (CRD0101) at Runway, over a period of 5 years, provide the most spatially and temporally extensive data within the Project area and serve to reinforce the conceptualisation of a highly anisotropic and heterogeneous hydrogeological system.

Monitoring bores at Runway Pit have recorded highly variable drawdowns (Figure 4.5) as listed below:

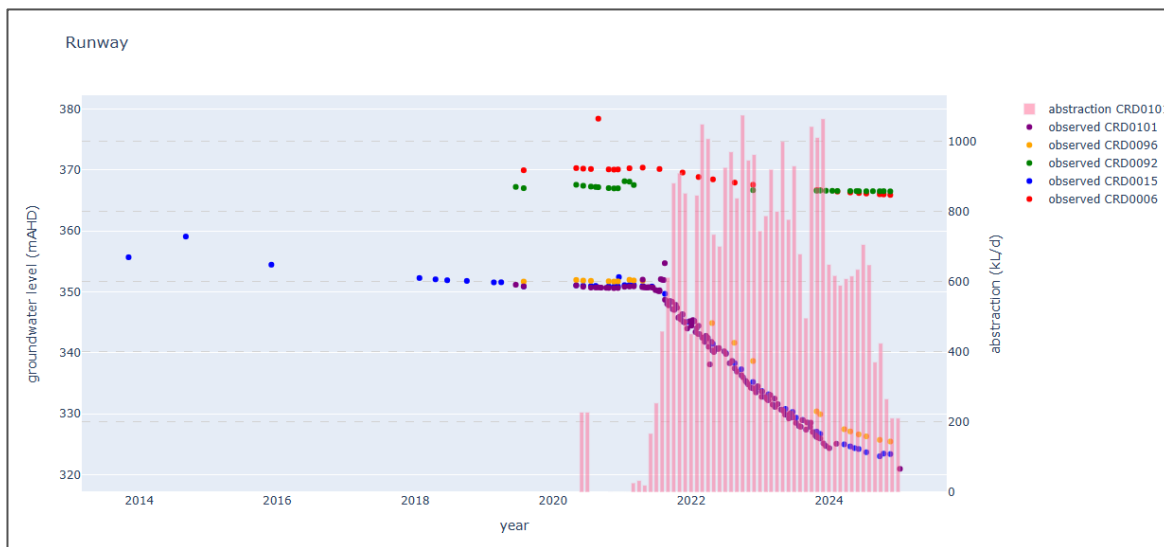
- CRD0015 (monitoring bore, 12 m northwest and across strike): drawdown is 25 m
- CRD0096 (monitoring bore, ~350 m south along strike): drawdown is 25 m
- CRD0092 and CRD0006 (Monitoring bores, ~430 m west and north-northwest respectively across strike): drawdown is 1–4 m.

The anisotropy of the area is also exemplified by a difference in static water levels of 25–40 m between the northern and southern extents of the Runway pit (CRD0014 at ~390 m and CRD0015 at ~350 m).

The slow, continuous rate of drawdown at CRD0006 suggests there is at least some connection between the low hydraulic conductivity of the aquifer matrix and the discrete high flow features.

To the south of Runway, another production bore (CRD0014) which has stopped pumping in 2023 recorded a large reduction (>200%) in abstraction rates between 2022 and 2023. Recovery of this bore has been slow (Figure 4.6), which supports the conceptual understanding that high flow features that have limited storage and a low hydraulic conductivity within the matrix of the aquifer unit.

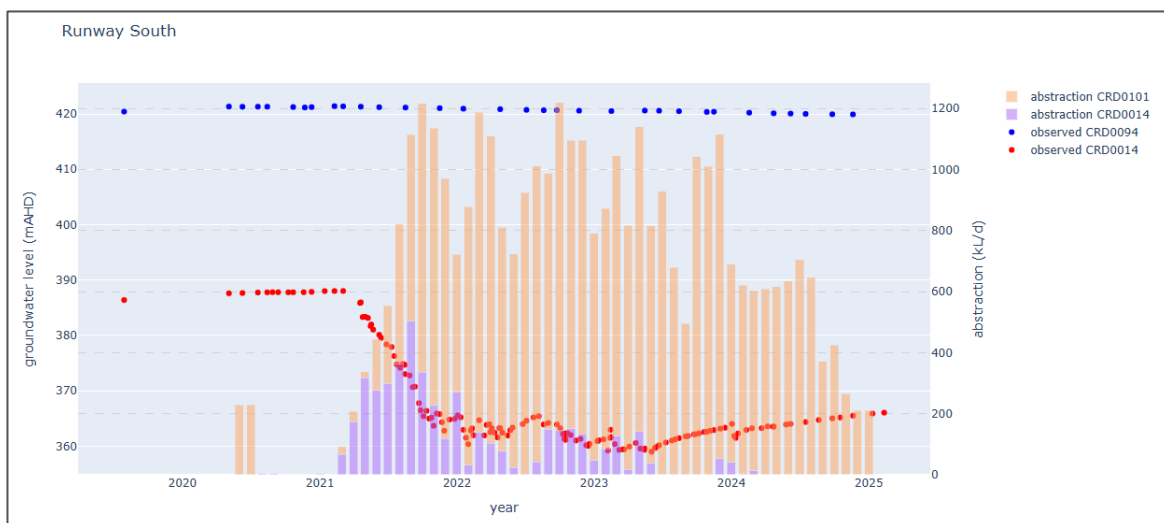
Figure 4.6: Observed drawdown from water supply at Runway pit



Source SRK

Notes: Bar chart denotes abstraction volumes (kL/d).

Figure 4.7: Observed drawdown south of Runway pit



Source: SRK

Notes: Bar chart denotes abstraction volumes (kL/d).

5 Groundwater modelling outcomes

The primary objective of the model was to simulate predictive scenarios for the Stage 5 mine plan at the Sanjiv Ridge Project.

The model also provided insight into the following:

- operational dewatering flow rates (see section 5.3)
- effectiveness of bore placement in dewatering pits via ex-pit bores and sump pumping
- drawdown impacts from active dewatering (see sections 5.2 and 5.4)
- long-term equilibrium pit lake level predictions (see section 6).

The complete modelling report is provided in Appendix G.

5.1 Scenarios and predictions

An existing groundwater model (Revision 2) of Sanjiv Ridge, initially developed for the 2019 H3 report, has been updated for this 2025 H3 report (Revision 3).

The calibration update between Revision 2 and Revision 3 of the model incorporated 2–3 additional years of operational data and six additional pumping tests completed in 2024. Revision 3 of the model was run for the remaining life of mine (2032), incorporating monthly pumping periods to reflect the nominated pumping schedule. The period between cessation of operations and equilibrium between groundwater level and the pit lake water levels was also modelled to assess drawdown rates at pools during this period. Refer to Appendix G for the model register and more information on scenario runs.

Initial parameters and zones from Revision 2 were transferred to the updated grid structure of Revision 3. Hydraulic conductivity values required adjustments during calibration to maintain consistent transmissivity due to changes in layer thickness and the addition of new model layer.

The updated model simulated three scenarios based on the mine plan:

- **Operational scenario:** The calibrated model was extended to 2032 to evaluate dewatering rates and drawdown impacts associated with dewatering and water supply operations. Water supply bores were assigned water requirement rates based on Revision 2 of the model and the 2025 updated abstraction regime (SRK, 2025). Abstraction rates are detailed in Table 5.1. The simulated annual dewatering rates are shown to increase from 2025 as advanced dewatering increases (Figure 5.2). Optimising the dewatering strategy (which is discussed further in section 5.3 and section 9) is anticipated to reduce peak volumes to those able to be used by the mine. However, the potential for the management of surplus water is being considered.

Table 5.1: Bore abstraction rates for predictive scenarios

Period	Average historical abstraction ¹	H3 assigned rate ²	Future assigned rate ³	Comments
Bore ID	Flow (L/s)			
CRD0083	1.7	2	2	ROM water supply
CRD0082	4.1	7	7	ROM water supply
CRD0014	1.2	0.5	0.5	Bore recorded reduced flow in 2022
CRD0101	7.1	10	–	To be replaced by CRD0137, original H3 assess impacts of 14 L/s until July 2026
CRD0121	–	2	2	ROM water supply
CRD0122	6.6	9	19	For water supply and advanced dewatering at Shark Gully
CRD0137	–	6	6	For water supply and advanced dewatering at Runway
CRD0143	–	15	15	For water supply and advanced dewatering at Sparrow Lake

Notes:

¹ Average operation rate for the bore.

² Combination of the updated H3 (SRK, 2023) and the 2025 updated abstraction regime (SRK, 2025).

³ Assigned rate for water supply and advanced dewatering. For dewatering bores, this rate decreases as aquifer is dewatered.

- **Post-closure scenario:** An iterative approach was adopted between the numerical groundwater model and the water balance to simulate groundwater and pit lake conditions at closure. The groundwater model simulated steady-state groundwater inflows at specified elevations using the drain boundary condition to represent inflows to the pit once the pit lake equilibrates.

Groundwater inflows were then imported into the water balance model to simulate the final resting pit lake water level. This final resting level was subsequently re-imported into the groundwater model and run in steady-state mode to simulate the drawdown impacts of all pits operating as permanent evaporative groundwater sinks.

Atlas is considering a partial backfill of material back into some of the pits (Runway, Shark Gully and Sparrow Lake). At this stage, the design and material composition of the backfill are not well understood. For the purposes of this H3 report, the numerical groundwater model, water balance and geochemical assessment have been completed without backfill.

- **Rebound period between operation and post-closure equilibrium:** The period between the cessation of mining operations and the equilibrium of groundwater and pit lake levels was modelled to evaluate drawdown rates at pools during this transitional phase. An iterative process between the groundwater and water balance models was employed to simulate water level rebound and drawdown dynamics. This rebound rate was subsequently re-input into the groundwater model to ensure consistency with the initial inflow rates. Once validated, the modelled pit lake rebound levels were used to assess the progression of groundwater drawdown at pools throughout the recovery period.

5.2 Drawdown during Stage 5 operations

To visually estimate areas of abstraction impacts, the extent of simulated 1 m drawdown was output from the model of the operational scenario (Figure 5.1). Key outputs are outlined below.

Processing Plant/ROM

Drawdown extending from the run-of-mine (ROM) bores (CRD0082 and CRD0083) is similar to previous assessments due to application of the same abstraction rates for the extended period. Drawdown extent from previous assessments had not eventuated in some bores further from the pumping wells (CRD0027) due to a lower actual rate being used than that used in the model.

Runway

The Runway pit is planned to progress another 35–40 m below the current water level by 2029, requiring sump pumping in addition to ex-pit dewatering at CRD0137. This will replace the current water supply bore, CRD0101, which is located within the planned pit area. Simulated drawdown from Stage 5 mining at Runway is estimated to extend up to 700 m northwest and up to 1,400 m south of the pit.

Drawdown from abstraction for water supply at CRD0101 is currently reported as being over 28 m along strike (25 m at CRD0096, 340 m to the south), and only 4 m across strike (4 m at CDR0006 and 1 m at CDR0092, 416 m and 436 m, respectively, to the northwest). Drawdown at these bores will continue with up to 40 m, 10 m and 10 m simulated at bores CRD0096, CDR0006 and CDR0092, respectively.

While drawdown is not simulated to reach CO-WS-10 and CO-WS-12 (Table 5.2) during operations due to the low permeability of the BIF matrix and high degree of compartmentalisation within the FBA represented in the model, the level of drawdown will ultimately depend on the extent of high flow pathways and their connection to the surficial FBA that cannot be predicted within the model.

Shark Gully

Mining is planned up to 50 m below the current water table. Due to dewatering at CRD0122 and additional sump pumping in areas of the pit, drawdown is simulated to be limited within the BIF ridge (to 200 m from the pit edge) but will propagate out up to 1,200 m towards the west (Figure 5.1).

CRD0122 is already dewatering the area (23 m in CRD0120 next to CRD0122, and 10 m in CRD0090, 80 m southwest of CRD0122) and planned mining represents a 6-year continuation of abstraction and drawdown from this bore.

The extent of drawdown has not increased from previous assessments as the pit level and sump abstraction would not represent a deeper point of water level than the simulated drawdown at CRD0122 from water supply.

Sparrow Lake

Mining at the Sparrow Lake pit is planned to extend approximately 115 m below the current water table. Simulated drawdown is expected to reach up to 600 m within the BIF ridge, 3,000 m east into

the Euro Basalt and Mt Roe Basalt, and 2,000 m west of the ridge. Drawdown is predicted to affect CO-WS-9 and CO-WS-14 during operations, with decreases of >10 m and 1–6 m at each pool, respectively, by the end of mining (Table 5.2).

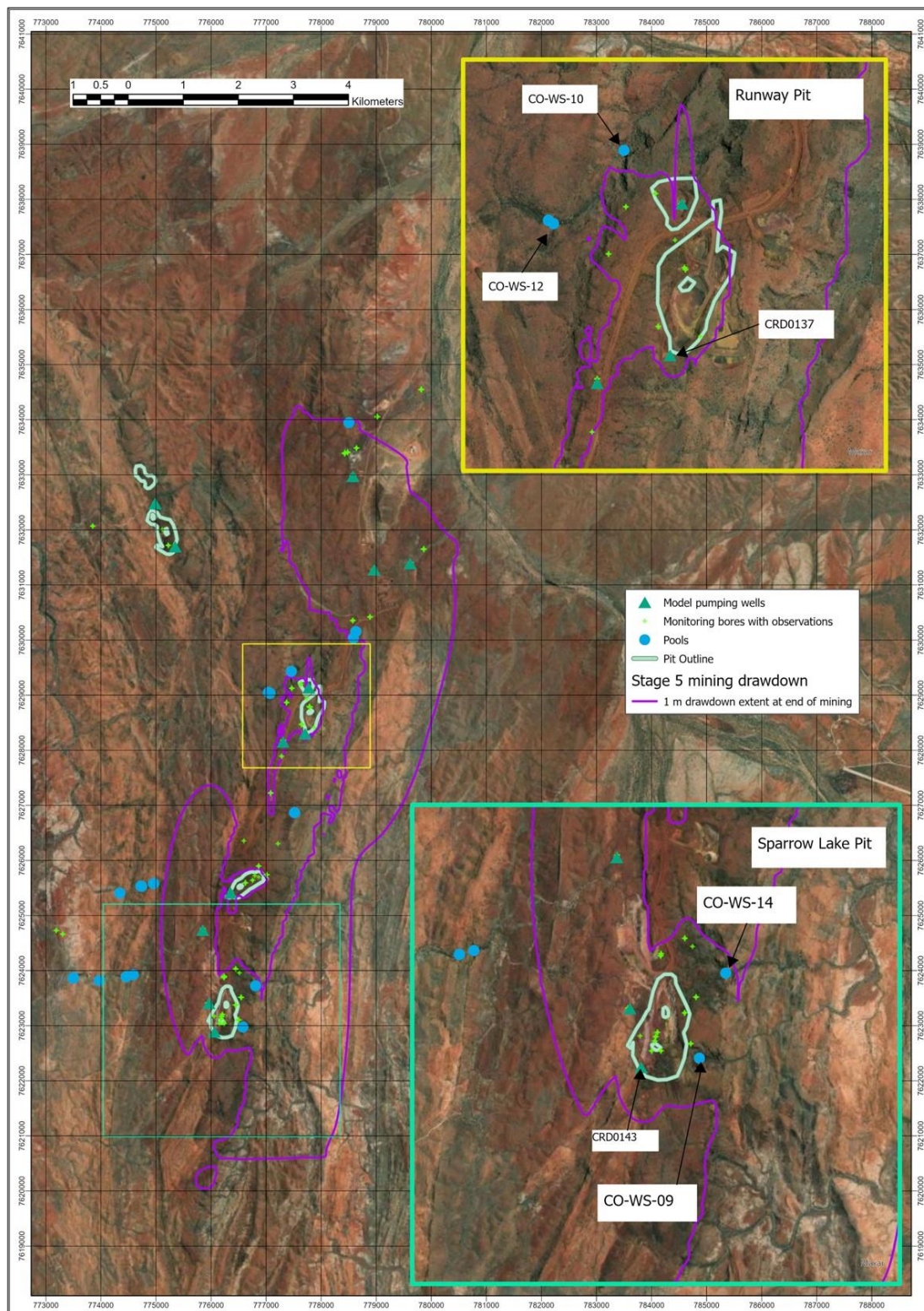
It is important to note that the drawdown extent is highly sensitive to the extent of higher flow zones that are currently informed by 3-day pumping tests only and not long-term abstraction. Additionally, the connection with depth between high flow features that were test pumped at Sparrow Lake and the surficial formations that feed CO-WS-14 is uncertain and has not been tested with test pumping (there is no bore at Pool 14). It is possible that the low hydraulic conductivity formations at surface will not be impacted by drawdown within the deeper aquifer

Drawdown extent at Sparrow Lake is significantly larger (1,000 m larger extent) than simulations in the previous assessment due to the deep progression of the pit and associated dewatering. The shape of the extent differs slightly from previous predictions (more drawdown towards the west and less drawdown towards the east) due to changes in hydraulic conductivities and extents of high hydraulic conductivity features during the calibration.

Table 5.2: Simulated drawdown at pools during operation

Pool	Simulated drawdown during operations (m)	Comment
CO-WS-14	1–6	Drawdown is highly sensitive to placement of moderate hydraulic conductivity. Range is indicative of different sensitivity scenarios.
CO-WS-9	>10	Pool has been identified as not groundwater dependent; high level of drawdown is due to high K zone placement and may be unrealistic.
CO-WS-10	<1	Drawdown not simulated to reach pool with the currently assigned hydraulic conductivities.
CO-WS-12	<1	Drawdown not simulated to reach pool with the currently assigned hydraulic conductivities.
CO-WS-1	5.5	From propagation of drawdown from CRD0082, bore does not usually operate at full flow and to date only seasonal fluctuation at monitoring bores near the pool (CRD0103) have been observed.

Figure 5.1: Drawdown extents at end of operations



Source: SRK

Notes: Does not represent the maximum drawdown extent in the low permeability formation in the ridge, as this does not consider drawdown during rebound and closure.

5.3 Dewatering requirements

The current groundwater abstraction licence permits an annual abstraction limit of 1,100,000 kL (1.1 GL). Historical abstraction data (Section 2.4) show a steady increase in abstraction volumes since 2020. As mining operations progress into Stage 5, the numerical model simulates groundwater abstraction volumes to increase further over the life of mine. Predicted modelled abstraction volumes are summarised by calendar year in Table 5.3.

The simulated dewatering rates increase in 2025 as advanced dewatering increases abstraction volumes ahead of mining below the water table. The magnitude of abstraction fluctuates over time as pit progression rates vary and the aquifer is dewatered (refer to Appendix G – Figure 5.7), but is averaged to have an annual range between 45 L/s and 70 L/s (Figure 5.2).

Uses of abstracted water will be covered in the Water Management Plan due in late 2025 but is likely to include raw water demand for processing, construction, camp supply and dust suppression. In addition, SRK has given a recommendation in this H3 to complete a dewatering optimisation study with the objective of reducing the simulated peak inflow periods between 2025 and 2030.

The simulated increase in abstraction volumes exceeds the current permitted abstraction licence for the remainder of the Stage 5 operations. It is therefore likely that an increase in the licence limit will be sought.

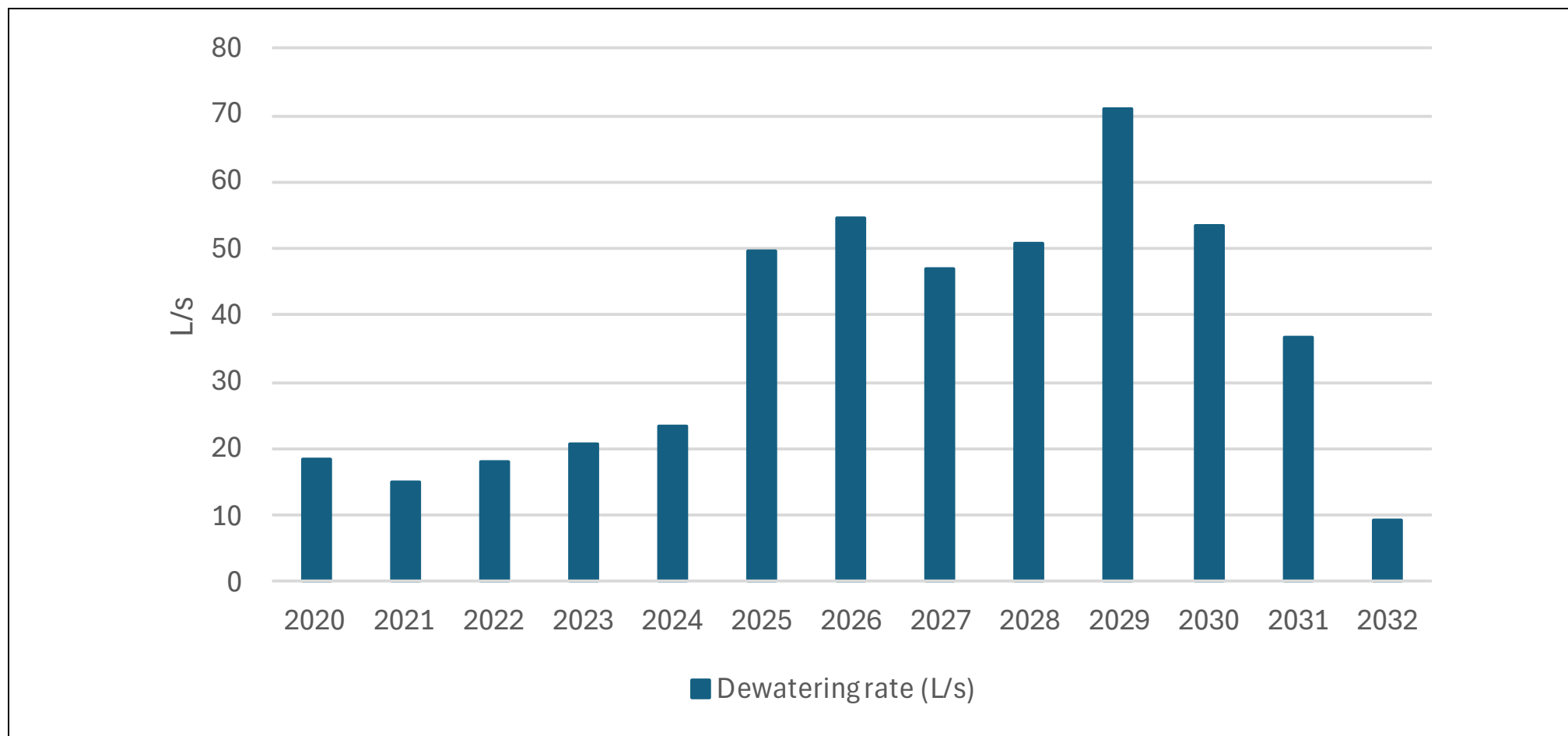
Table 5.3: Annual predicted modelled abstraction volumes (m3) for Sanjiv Ridge

Year	Total abstraction (kL/year)	Haul road construction (kL/year)	ROM (kL/year)	Runway (kL/year)		Shark Gully (kL/year)		Sparrow Lake (kL/year)		Comments
				Sumps	Bores	Sumps	Bores	Sumps	Bores	
2020	580,492	454,029	112,326	-	14,137	-	-	-	-	
2021	468,905	52,089	202,211	-	210,914	-	-	-	3,691	
2022	566,236	33,902	174,085	-	358,249	-	-	-	-	Historical abstraction
2023	647,109 ¹	64,045	172,498	-	327,634	-	82,052	-	-	
2024	730,533	74,773	192,363	-	195,196	-	268,201	-	-	
2025	1,567,875	1,639	276,468	-	204,836	-	555,206	957	528,768	
2026	1,717,757	-	283,824	-	236,520	-	584,364	306	612,743	
2027	1,484,380	-	283,824	-	236,520	-	452,244	-	511,791	
2028	1,596,389	-	284,602	4,958	237,168	207,408	377,277	36,910	448,066	Assumed increase in 2025 for advanced dewatering in simulation, but will likely to be less with full increase in abstraction in 2026
2029	2,241,865	-	283,824	847,757	235,788	127,818	333,156	9,587	403,935	
2030	1,691,273	-	283,824	-	236,093	495,390	296,895	5,600	373,471	
2031	1,157,209	-	283,824	-	236,520	-	267,672	23,315	345,879	
2032	297,856	-	72,317	-	60,264	-	65,955	64,778	34,543	Sparrow Lake active until February 2032
2033	-	-	-	-	-	-	-	-	-	

Notes: Abstraction volumes are used for groundwater modelling. Annual volumes presented are taken from Atlas supplied water take records and are based on calendar year so may vary from reported abstraction volumes.

¹ Includes minor (<1,000 kL) abstraction from Glen Herring.

Figure 5.2: Simulated annual dewatering rates (L/s) across life of mine



Sources: Atlas, SRK

Notes: Graphical representation of dewatering rates taken from total abstraction (kL/year) in Table 5.3.

5.4 Post-closure groundwater recovery

Combined outputs from the water balance and groundwater models indicate that pits will act as evaporative groundwater sinks, abstracting a net 1.1 L/s to 2.5 L/s and equilibrating to a pit lake level that is 24 m to 46 m lower than pre mining groundwater levels (Table 5.4).

Table 5.4: Pit lake water levels and evaporations

Pit	Resting pit lake water level (mAHD)	Net outflow ¹ (L/s)	Depth below pre-mining groundwater level ² (m)	Comment
Runway	327	1.6	24	
Shark Gully	380	1.1	41 to 47	Observed level is higher on the eastern side of the pit than on the western side
Sparrow Lake	305	2.5	46	

Notes:

¹ Surface water inflow minus evaporation.

² Groundwater level before all mining operations including water supply.

The resultant simulated drawdown from the permanent pit lakes (evaporation driven groundwater sinks) is presented in Figure 5.2 as drawdown from the simulated pre-mining water level.

Key outcomes are discussed below.

Glen Herring

It is unlikely that a pit lake will form at Glen Herring as the pit will be above water table and evaporation will exceed the direct rainfall and surface runoff from the pit.

Runway

Drawdown associated with the development of a lake at Runway Pit is comparable to the operation of bore CRD0101 in perpetuity. This bore has currently drawn down the aquifer ~28 m at the pumping well and yields have correspondingly reduced from 9.8 L/s to 2.4 L/s with the reduced saturated thickness. In comparison, groundwater inflow post closure is estimated to continue at an estimated rate of 1.6 L/s from the low permeability FBA.

Drawdown is simulated to propagate out towards Pools 10 and 12 (Table 5.5) and range from 2 m to 5 m as inflows from the low permeability FBA equilibrate over time. The model is likely overestimating drawdown propagation towards the west, as during calibration, drawdown at bore CRD0092 was over-simulated at 3 m compared to the ~1 m observed at the bore. The simulated post-closure drawdown at Pool 12 may therefore be too conservative (overestimated).

Shark Gully

The low hydraulic conductivity at Shark Gully Pit limits simulated drawdown impacts to within 400 m of the pit edge. Drawdown extends westward, influenced by combined effects with Sparrow Lake. The post-closure pit lake water level at Shark Gully is higher than nearby pools and is unlikely to cause direct drawdown impacts. Any drawdown affecting the pools is primarily linked to the evaporative sink at Sparrow Lake and may be influenced by reduced recharge and inflow from the ridge to the west due to the Shark Gully pit lake.

Sparrow Lake and Razorback

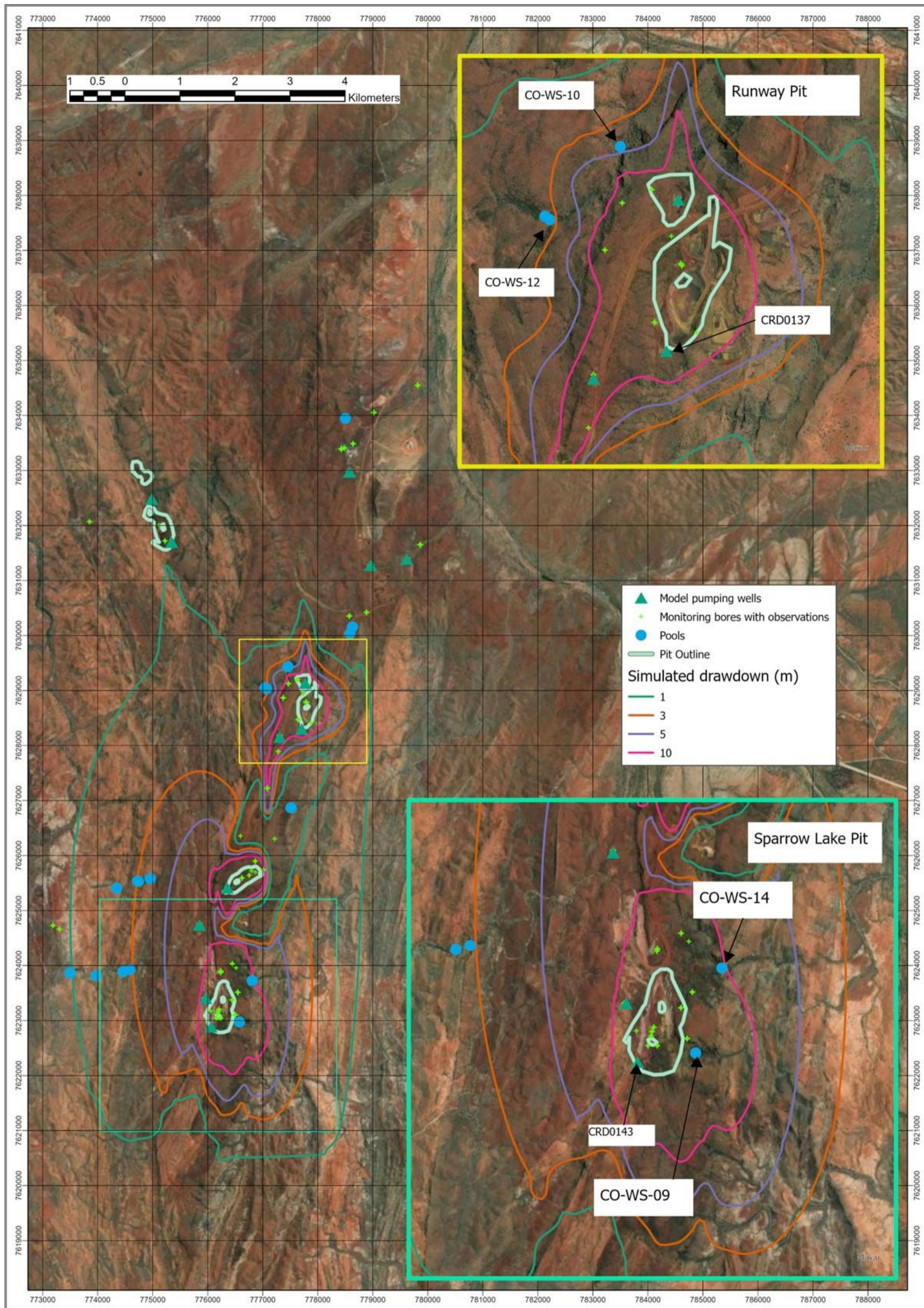
The simulated post-closure water level at Sparrow Lake pit (305 mAHD, 46 m below the pre-mining water table) indicates a drawdown that could extend beneath Pool 14 and potentially towards Pools 13 and 8 (Table 5.5). While local hydrogeological conditions might limit this drawdown, the generally lower water levels and gentler groundwater gradient at Sparrow Lake and Razorback suggest higher hydraulic conductivity in this area compared to other parts of the ridge. Pumping tests and airlift data from bores between the two pits support the presence of hydraulic connections, making the predicted drawdown patterns reasonable.

Zero drawdown at Pool 14 post closure could be possible if a continuous low conductivity aquitard (less than 5E-6 m/d) exists between Pool 14 and Razorback. While some data from bores north of the pit suggest the potential presence of such an aquitard (e.g. high water levels and lack of significant water yields in some bores), there is no direct drilling or testing evidence to confirm hydrogeological conditions between Razorback Pit and Pool 14. Recommendations to address this data gap have been considered and are presented in Section 9.

Table 5.5: Drawdown at pools post closure

	Drawdown (m)	Comment
CO-WS-14	2–14	Dependent on assigned hydraulic conductivity at Razorback pit. Zero drawdown is possible if a continuous aquitard of <5E-6 m/d is present between the pit and Pool 14, but this is not tested with pumping data. Additionally, the pool may be supported by a perched water system (similarly not tested).
CO-WS-12	0–3	No comment
CO-WS-10	2–5	No comment
CO-WS-8	2–4	No comment
CO-WS-13	2–3	No comment
CO-WS-9	>20 m	Identified as not groundwater dependent. Drawdown is sensitive to placement of high hydraulic conductivity features.

Figure 5.3: Drawdown extent post-closure



5.5 Rebound period between operation and post-closure equilibrium

Rebound in all pits is highest during the first 5–10 years due to a high hydraulic gradient and larger groundwater inflows. All three pits (Sparrow Lake, Runway and Shark Gully) are simulated to have equalised groundwater inflow with net evaporation by 2060, and water levels will fluctuate around a mean level from this time. Some change in groundwater levels will continue after this time due to the low hydraulic conductivity of the FBA. While this will have an impact on pit inflow rates, the changes are considered negligible and would not have a significant impact on pit lake water levels.

Drawdown rates were assessed and presented as the maximum rate in metres per annum (m/year) between the indicated period at pools that were identified as having impacts at closure (Table 5.6). Drawdown rates during the rebound period are below 0.5 m/year), with the highest rates observed at CO-WS-14 between 0.146 m/year and 0.192 m/year from 2039 to 2070. After this, the rate of drawdown starts to decrease, reaching negligible rates of less than 0.01 m/year by 2201 and further reducing to 0.001 m/year by 2401.

Drawdown rates at CO-WS-10 and CO-WS-12 are far lower than Pool 14, with a rate as high as 0.017 m/year at Pool 10 and 0.009 m/year at Pool 12. Additionally, the peak in rate of drawdown lags about 100 years after cessation of mining due to the low hydraulic conductivity assigned to the FBA in the area.

The cumulative drawdown in the rebound period approached, but did not reach, the total drawdown simulated by the closure scenario in steady state, by the end of the rebound period simulation (year 2500). While the drawdown rate is almost negligible, there is some change in water level suggesting that the system will not have achieved complete equilibrium until after 2500. However, the impact on the system after this date would be very small relative to the overall impacts (i.e. the system would be more than 80% recovered to final equilibrium by 2500).

Table 5.6: Maximum drawdown rates between operation and post-closure equilibrium (m/year)

Year from	Year to	CO-WS-10	CO-WS-12	CO-WS-13	CO-WS-14	CO-WS-8	CO-WS-9
2033	2040	-	0.000	0.001	0.168	-	-
2041	2050	0.001	0.003	0.002	0.192	0.002	-
2051	2060	0.005	0.006	0.003	0.186	0.004	-
2061	2070	0.009	0.007	0.003	0.146	0.004	0.031
2071	2080	0.012	0.008	0.003	0.113	0.005	0.130
2081	2090	0.015	0.008	0.004	0.075	0.005	0.117
2091	2100	0.016	0.008	0.004	0.057	0.005	0.116
2101	2150	0.017	0.008	0.004	0.046	0.005	0.002
2151	2200	0.015	0.007	0.004	0.017	0.005	0.002
2201	2250	0.012	0.007	0.004	0.010	0.006	0.001
2251	2300	0.008	0.004	0.004	0.005	0.005	0.001
2301	2350	0.006	0.003	0.003	0.003	0.004	0.000
2351	2400	0.004	0.003	0.003	0.002	0.004	0.000
2401	2450	0.004	0.002	0.003	0.001	0.003	0.000
2451	2500	0.003	0.002	0.003	0.001	0.003	0.000
Cumulative drawdown by 2500		3.47	2.06	1.68	11	2.22	34.5
Drawdown at equilibrium		4	2.5	2.5	14	3	35

Source: SRK

Notes: Drawdown is presented as the maximum rate (in m/year) between the indicated periods.

6 Water balance outcomes

The model was constructed to simulate the system on daily time-steps from a nominal start date of 1 January 2026 for a 400-year period post closure. The results are presented as statistical probabilities based on the results of 100 realisations of a Monte Carlo analysis. Probabilistic Monte Carlo statistical results are presented to allow assessment of uncertainty in model results to climatic (precipitation and evaporation) inputs.

6.1 Runway South

Results for the pit lake rebound include the minimum, maximum, median, 5th percentile and 95th percentile Monte Carlo statistical results and are summarised in Table 6.1.

Table 6.1: Summary of steady-state conditions – Runway South

Parameter	Unit	Minimum	5th percentile	Average	Median	95th percentile	Maximum
Water level	mRL	325.5	326.9	327.8	327.6	329.0	330.7

The median result shows that the steady-state water level in the Runway South pit occurs at 327 mRL after around 46 years post closure and with a maximum variation of around 5 m, indicating that the pit will remain a groundwater sink over the long term under the modelled conditions.

The long-term average of post-closure pit water level is expected to remain below the regional groundwater level recorded within the ridge, and therefore the pit lake water level is not expected to spill to the surface or contribute water to local aquifers.

6.2 Sparrow Lake

Results for the pit lake rebound include the minimum, maximum, median, 5th percentile and 95th percentile Monte Carlo statistical results and are summarised in Table 6.2.

Table 6.2: Summary of steady-state conditions – Sparrow Lake

Parameter	Unit	Minimum	5th percentile	Average	Median	95th percentile	Maximum
Water level	mAHD	303.0	305.3	306.9	307.0	308.4	310.5

The median result shows that the steady-state water level in the Sparrow Lake pit occurs at 307 mRL after around 71 years post closure and with a maximum variation of around 5 m, indicating that the pit will remain a groundwater sink over the long term under the modelled conditions.

The long-term average of post-closure pit water level is expected to remain below the regional groundwater level recorded within the ridge, and therefore the pit lake water level is not expected to spill to the surface or contribute water to local aquifers.

6.3 Shark Gully

Results for the pit lake rebound include the minimum, maximum, median, 5th percentile and 95th percentile Monte Carlo statistical results and are summarised in Table 6.3.

Table 6.3: Summary of steady-state conditions – Shark Gully

Parameter	Unit	Minimum	5th percentile	Average	Median	95th percentile	Maximum
Water level	mAHD	389.9	391.2	392.8	393.4	394	396.6

The median result shows that the steady state water level in the Shark Gully pit occurs at 393 mRL after around 31 years post closure and with a maximum variation of around 4 m, indicating that the pit will remain a groundwater sink over the long term under the modelled conditions.

The long-term average of post-closure pit water level is expected to remain below the regional groundwater level recorded within the ridge, and therefore the pit lake water level is not expected to spill to the surface or contribute water to local aquifers.

6.4 Pit lake water quality

A preliminary pit lake water quality study for the Sanjiv Ridge Project has been completed to assess the risk of acid generating material impacting groundwater. The preliminary modelling results (see Appendix H for full memorandum) are based on available data, supplemented by literature values where gaps exist. Ongoing kinetic testwork has limited the availability of site-specific data; however, further refinements to the model are expected to be made, complemented by an addendum to this H3 assessment, once more site-specific data become available.

The preliminary study prioritised the Sparrow Lake pit due to its higher sulfur content and acid generation potential compared to other pits. Eight samples from drill holes intersecting Sparrow Lake were selected for kinetic testing, with static testwork completed. Pending kinetic column leach data, analogue data from Mt McRae Shales were used for preliminary modelling.

The pit lake water quality model, developed in Excel, incorporates water balance outputs from GoldSim, groundwater chemistry, and literature-derived leaching rates for pit wall rock classified by sulfur content. Groundwater inflows dominate pit lake chemistry, contributing approximately 60% of inflows, with pit wall runoff and rainfall making up the remainder. Groundwater quality is near-neutral, low-salinity, and contains alkalinity, reducing the risk of acidification.

Preliminary results indicate the Sparrow Lake pit lake is likely to remain circum-neutral, with limited influence from sulfur-rich wall rock due to its minor exposure (<1%). However, uncertainties remain regarding groundwater flow rates, long-term quality, and the representativeness of analogue data. Contributions from the proposed in-pit waste rock dump were excluded due to insufficient data.

Recommendations include refining the model in GoldSim, incorporating laboratory data which will evaluate groundwater inflows over time, and assessing contributions from waste rock. These refinements will improve the accuracy of predictions and address uncertainties.

7 Surface water baseline and impact assessment outcomes

In late 2023, nine surface water monitoring sites were established during the dry season to monitor key catchments draining the Sanjiv Ridge mine. These monitoring sites included:

- seven sites monitoring eastward draining catchments that directly drain into the Coongan River
- two sites, SW007 and SW008, measuring runoff response in westward catchments that drain into a large tributary of the Coongan River, which in turn drains into the Coongan River just northeast of the Glen Herring pit.

The calibrated hydrological model used Global Precipitation Measurement rainfall data and evapotranspiration values to create a long-term record of streamflow responses across the Sanjiv Ridge drainage network. Surface water monitoring points are shown in Figure 7.1. As the model relates some impacts to pools identified as groundwater-dependent ecosystems (GDEs), the figure also includes these pools (described in Appendix A) for reference.

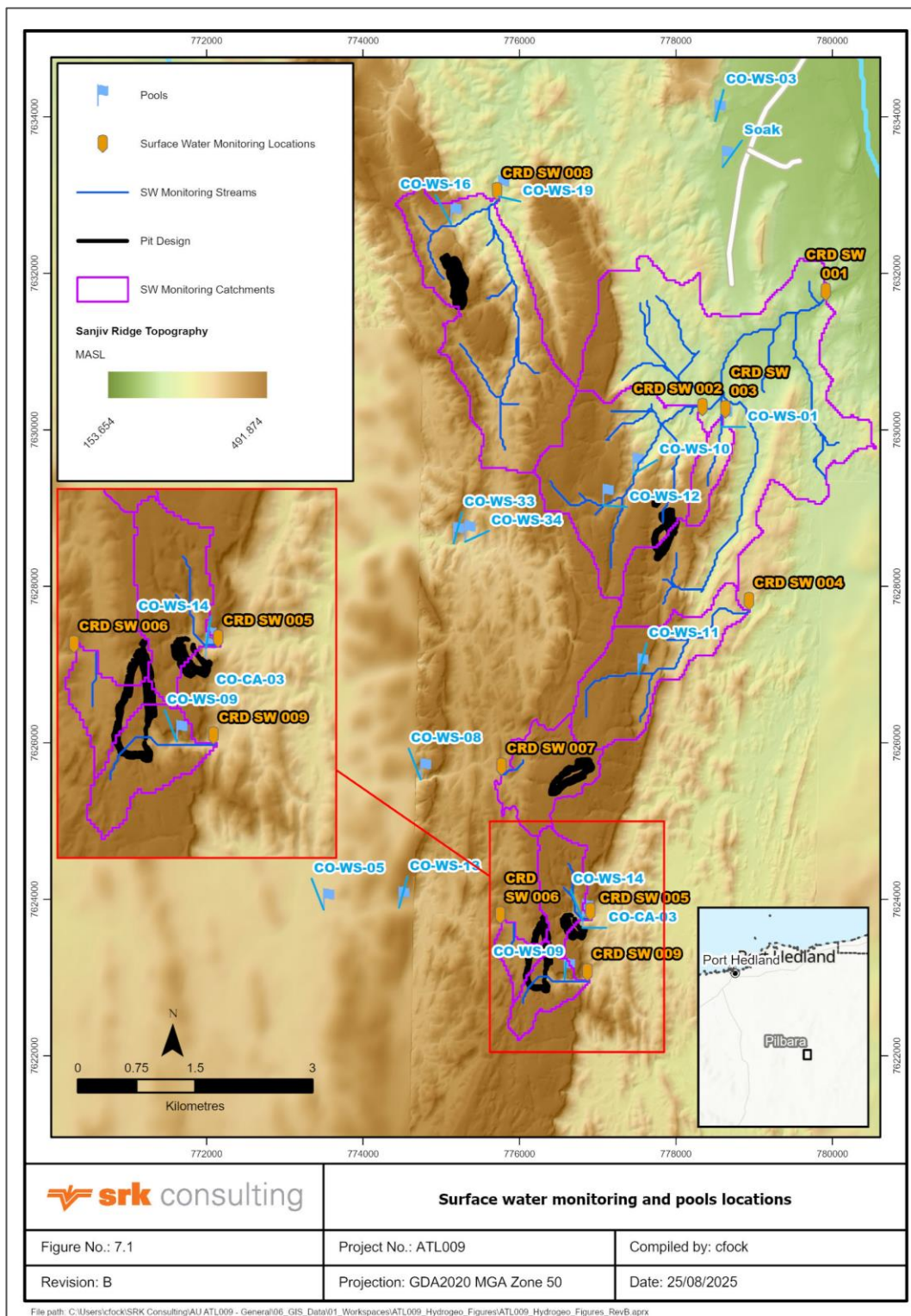
The results of the model are presented as an impact assessment, assessing changes in runoff responses across various scenarios. The scenarios are intended to reflect reductions in surface water catchments (due to increases in pit footprints) both with and without any influence of climate change using IPCC¹'s RCP8.5 scenario for the year 2090 (IPCC, 2014). The model also simulates the peak flows of design rainfall events.

The model was simulated under the following six scenarios:

- Scenario 1: Baseline – a pre-mine natural catchment baseline.
- Scenario 2: Current (2025) – the calibrated model reflecting existing catchment modifications.
- Scenario 3: Stage 5 mining operations – modifications primarily limited to pit expansion areas and slight modifications to haul road and stockpile areas.
- Scenario 4: Baseline with climate change – the pre-mine natural catchment baseline with climate change effects for the RCP8.5 2090 scenario.
- Scenario 5: Current (2025) with climate change – the calibrated model reflecting existing catchment modifications, incorporating climate change effects for the RCP8.5 2090 scenario.
- Scenario 6: Stage 5 mining operations with climate change – modifications primarily limited to pit expansion areas and slight modifications to haul road and stockpile areas, including climate change effects for the RCP8.5 2090 scenario.

¹ IPCC – Intergovernmental Panel on Climate Change

Figure 7.1: Surface water monitoring locations



Source: SRK

The comparison between baseline and the current ‘2025’ scenarios recorded a range of catchment reductions for individual sub-catchments across the Project area between ~0.5% and 13 %. Of the 11 identified pools in the Project area, five (Pools 1, 5, 8, 13 and 14) are situated within catchments potentially affected by changes to surface water runoff responses due to Stage 5 development (Table 7.1).

Table 7.1: Percentage reduction in catchment area

Site ID	Current	Stage 5	Comment
SW001	5.83%		Catchment influenced by Runway Pit
SW002	6.80%	7.17%	Catchment influenced by Runway Pit
SW003	12.62%		Catchment influenced by Runway Pit
SW004	0.46%		Catchment influenced by Shark Gully Pit
SW005		2.44%	Catchment influenced by Razorback Pit
SW006		36.73%	Catchment influenced by Sparrow Lake Pit
SW007		19.34%	Catchment influenced by Shark Gully Pit
SW008		3.62%	Catchment influenced by Glen Herring Pit
SW009	4.44%	66.76%	Catchment influenced by Sparrow Lake Pit
CO-WS-01	12.72%		Downstream of Runway Pit. Adjacent to SW003
CO-WS-05		2.10%	West of Sparrow Lake Pit. Downstream of SW006
CO-WS-08		7.05%	West of Shark Gully Pit
CO-WS-13		2.77%	West of Sparrow Lake Pit. Downstream of SW006
CO-WS-14		2.40%	East of Razorback Pit

Source: Smith Hydro

Notes: Blanks denotes no change.

7.1 Model results

7.1.1 Baseline

The simulation results for the baseline scenario demonstrate significant inter-annual variability, highlighting the model’s sensitivity to both dry and wet years. For example, limited runoff response was observed during low-rainfall years like 2016 and 2019, while substantial runoff occurred during wetter years, showcasing the model’s capability to capture varying climatic conditions. Runoff coefficients were highly variable and closely correlated with rainfall intensity.

7.1.2 Scenarios 2 and 3

Modelling results for Scenario 2 (‘2025’ which related to Stage 4 mining) and Scenario 3 (‘Stage 5’) indicate reductions in average peak flow and average annual volume at monitoring locations. The amount of reduction follows a similar trend to the catchment reduction values in Table 7.1.

In Scenario 2, four monitoring points (SW001, SW002, SW003 and SW009) show a reduction, with a maximum peak flow decrease of 13% at SW003.

Scenario 3 (Stage 5) results show peak flow reduction at all monitoring sites.

All locations recorded has having a <15% reduction with the exception of SW007 (20%) and SW009 (67%) due to their respective locations adjacent to Runway and Sparrow Lake pits. Reductions in average annual volume mirror the trends and percentage values above.

7.1.3 Scenarios 4, 5 and 6

The modelling for Scenarios 4, 5 and 6 integrate climate change projections under RCP8.5 for year 2090 to assess the combined impact of climate conditions and mining on average peak flow and annual runoff volume.

In Scenario 4, a 23% to 33% reduction in peak flow was observed, emphasising the substantial influence of changing climate conditions, even under baseline scenarios.

Scenario 5 showed an additional 1% to 9% reduction in peak flow at locations such as SW001, SW002, SW003 and SW004, indicating that the combined effects of mining activities and climate change further exacerbate reductions in peak flow at a local level.

In Scenario 6, reductions became more pronounced at locations like SW006, SW007 and SW009, with average peak flow reductions ranging from 38% to 57%. These results identify areas particularly vulnerable to the combined impacts of Stage 5 operations and climate change, while also demonstrating that the effects diminish with increasing distance downstream of mining operations.

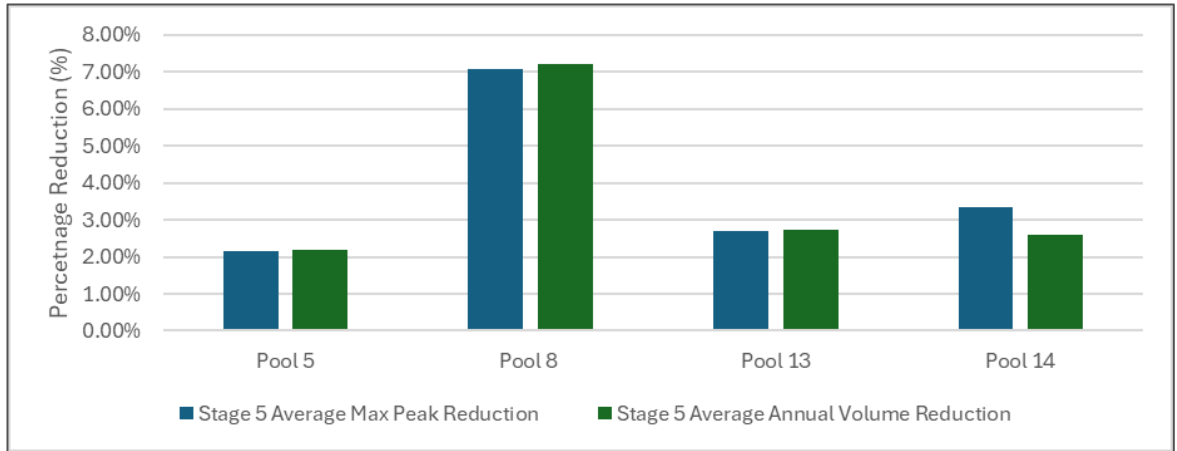
Reductions in runoff volume closely mirror the trend observed for peak flow reductions. Under Scenario 4, average annual runoff volumes declined by 36% to 38%. Scenario 5 showed an additional reduction of 3% to 10% in certain catchments, such as SW003. In Scenario 6, key catchments like SW006, SW007 and SW009 experienced further volume reductions, ranging from 7% to 44%.

7.1.4 Impacts on the pools

The hydrological modelling for Stage 5 operations evaluates the potential impacts on identified pools that receive a component of groundwater. The model shows average reductions in peak flows of 2–7% and annual volumes of 2–7.2% (Figure 7.2). Pool 8 (CS-WS-08) is identified as experiencing the most significant effects, though these reductions represent less than a 10% decrease in surface water volumetric yield flowing through the pool.

Under the climate change RCP8.5 projections for 2090, the impacts become significantly more pronounced, with reductions in average peak flow ranging from 32% to 35% and annual runoff volume decreasing by 38–41%. These projected changes underscore the dominant influence of climate change in shaping local flow regimes, far exceeding the hydrological impacts of Stage 5 mining alone.

Figure 7.2: Average peak flow and volume reduction in pools – Scenario 3



Source: Smith Hydro

7.1.5 Storm water management and flood mapping

Modelling flood inundation areas and associated storm water management will ensure that there will not be major mobilisation of sediment and/or peak discharge in excess of baseline flow regimes due to mining operations through the use of sediment retention ponds, etc. Modelling for these aspects is planned to be included in the Water Management Plan for the Sanjiv Ridge Project.

7.2 Design runoff

This section details the application of the calibrated model to simulate design runoff events, providing insights into hydrological responses under extreme conditions. The simulations focus on 1% (1 in 100 years), 2% (1 in 50 years), 20% (1 in 5 years), and 50% (1 in 2 years) annual exceedance probability (AEP) events, using 24-hour intensity-frequency-duration (IFD) data sourced from the Bureau of Meteorology (BOM).

7.2.1 Peak flows simulations in design runoff

The Baseline scenario, which simulates a pre-mine drainage system, climate change projections under RCP8.5 2090, sees a significant increase from 102.2 m³/s for the 1% AEP at SW001 to 193 m³/s.

For Stage 2: Current scenario, there is a reduction in extreme runoff peak flow for the current climate scenario of between 3% and 13%. Notably, SW003 experienced the most significant proportion of catchment changes. In Scenario 3: Stage 5, the reduction in peak flow increased at several locations, with SW007 and SW009 experiencing between 19% and 67% reduction in the 1% AEP peak flow.

The reductions observed are significantly offset under the RCP8.5 2090 climate change scenarios modelled in Scenarios 4 through 6. There is an increase in baseline 1% AEP peak flows of between 89% and 91% across all modelled catchments due to the projected climate change impacts. However, mining effects see this increase slightly reduced.

In Scenario 5: Current including climate change, the increase observed is between 64% and 89%. Scenario 6: Stage 5 including climate change sees further reductions at key locations such as SW007, with a 52% increase. The exception is SW009, which experienced a 38% reduction in the 1% AEP peak flow response.

7.3 Key outcomes of the surface water modelling

The combined impact of mining and climate change projections reveals that while mining operations have a localised effect on streamflow reduction, it is the climate change projections that potentially present a far more significant impact to the hydrological flow regime in the Project area.

The impacts of Stage 5 mining operations at the Sanjiv Ridge Project are unlikely to have more than a minor effect on streamflow within the local area, except for localised effects such as immediately downstream of locations such as SW009. The localised effects decrease rapidly with increasing distance from the mine, suggesting minimal long-term impact on the broader hydrological system, and no significant effects on identified pools within the Project area.

Overall, the total catchment reduction due to Stage 5 operations represents less than 0.016% of the total Coongan River catchment, as measured from the Marble Bar gauge. This is a very small percentage of the regional catchment, suggesting that although alterations to the surface water flow regime may have a localised effect, small catchment reductions in streamflow response will be insignificant within the regional catchment, and dissipate rapidly with distance downstream from the mine.

Storm water management and flood extent modelling are planned to be included in the Water Management Plan for the Sanjiv Ridge Project.

8 Impact assessment

8.1 Introduction

A Groundwater Impact Assessment (GIA) has been prepared to outline the potential impacts on Environmental Values (EVs) related to the progression into Stage 5 below water table mining at the Sanjiv Ridge Project.

8.2 Basis of assessment

The groundwater model report (SRK, 2025b) simulated the following two scenarios based on the current mine plan for the Sanjiv Ridge Project:

- **Operational:** Relates to the simulated drawdown at the proposed end of mine life (2032).
- **Post closure:** Relates to the simulated drawdown once the pit lake equilibrates with groundwater inflows, surface water inflows, and evaporation outflows, assuming the pit functions as a groundwater sink. These inflows represent long-term (>50 years) conditions after the low hydraulic conductivity aquifer has been dewatered through pit filling and evaporation.

The GIA will consider impacts to EVs at each of these stages.

The following documents/studies have been used to inform the GIA:

- Previous hydrogeological studies including:
 - SRK, 2019a. Corunna Downs Mine Water Supply H3 Assessment_Rev4
 - SRK, 2019b. Addendum to the H3 Hydrogeological Assessment Section 5.3
 - SRK, 2023. Sanjiv Ridge Mine Water Supply H3 Assessment_Update_Rev1.
- Ongoing site-wide water level and water quality monitoring completed by Atlas.
- Recent studies which form part of this H3 hydrogeological assessment:
 - SRK, 2024. Drilling and pumping test field report: H3 hydrogeological assessment, Sanjiv Ridge Iron Ore Mine, WA, Australia.
 - SRK, 2025a. Surface water modelling: H3 hydrogeological assessment, Sanjiv Ridge Iron Ore Mine, WA, Australia.
 - SRK, 2025b. Water quality report: H3 hydrogeological assessment, Sanjiv Ridge Iron Ore Mine, WA, Australia.
- Biologic Environmental Survey Pty Ltd (Biologic), 2024. Groundwater Dependent Vegetation (GDV) assessment.

8.3 Environmental values

The Department of Water and Environmental Regulation (DWER) outlines Groundwater Environmental Values (EVs) as part of its framework for managing water resources.

Groundwater Environmental Values are defined as the uses or values of groundwater that need to be protected to ensure sustainable management. The classification of Groundwater Environmental Values generally includes the following categories:

- **Groundwater-dependent ecosystems (GDEs):** Ecological habitats, such as wetlands, rivers, and vegetation that rely on groundwater for survival as well as the biodiversity that depend on groundwater.
- **Drinking Water Supply:** Groundwater used for public drinking water supply or private domestic use.
- **Agricultural and Irrigation Use:** Groundwater used for irrigation of crops, livestock watering, or other agricultural purposes.
- **Industrial Use:** Groundwater used for industrial processes, including mining operations.
- **Heritage Values:** Groundwater that holds cultural or spiritual significance, particularly for Aboriginal communities and includes protection of sites and practices associated with groundwater.
- **Recreational and Aesthetic Values:** Groundwater that contributes to recreational activities (e.g. swimming, fishing) or aesthetic enjoyment.

Due to Project's remote location, drinking water supply, agricultural use, and recreational and aesthetic values have been eliminated as being potential EVs of concern. No other mining activities are operating, and no significant population centres and/or agriculture are recorded within 20 km of the site.

From the categories above, Heritage Values, GDEs and Industrial Use are all considered to be relevant in the context of the Project area and are described more fully below.

8.4 Heritage values

Groundwater occurrences often carry cultural or spiritual significance for Traditional Owner communities. The EV is to protect these values through consultation and appropriate management.

Atlas has engaged with the Traditional Owners of the Sanjiv Ridge mine area, the Nyamal People, to consult on Aboriginal cultural heritage values associated with water in the area. Receptors which have identified heritage values associated with them are often related to water. If identified water features which have potential to be impacted are known to have Heritage values, these are highlighted in the GDE section.

8.5 Groundwater-dependent ecosystems

This EV is intended to maintain groundwater levels and flows to protect groundwater dependent ecosystems (GDEs).

The GDE Atlas national assessment (BOM, 2025) shows that the Project area contains several regions of low and moderate potential terrestrial GDEs. These areas are predominantly along the ridge containing the pit areas and the Coongan River flood plain. The national assessment identifies parts of the Coongan River with high potential to support aquatic GDEs. The GDE Atlas also marks several regional study locations with low potential GDE occurrence.

8.5.1 Groundwater-dependent vegetation

In late 2024, a Biologic Environmental Survey report (Biologic, 2024) highlighted the findings from its survey completed in June 2024. The report identifies areas within the Project area and surrounding catchments with potential for containing GDVs.

8.5.2 Pools

The MWH/Stantec H2 hydrogeological studies (2018 and 2019) identified 13 perennial water features (mostly pools) within the Project area. These features are mostly located at the toe of the ridge being mined and have at least a portion of their flow originating from groundwater and have been described as GDEs. Since 2018, regular water quality monitoring has been carried out at these features to further characterise the system. Between 2018 and 2025, 40 pools have been identified, some by helicopter survey only. Further details on the pools which are considered within the GIA are provided in Appendix A.

8.6 Industrial use

In the context on mining, industrial use EVs, focus on ensuring that groundwater resources are managed in a way that supports industrial activities while minimising environmental and social impacts.

Relevant standards for industrial EVs differ from those applying to potable water, stock watering, or ecosystem protection, and are based on what is required to safely facilitate industrial operations in accordance with state and national guidelines.

Within the Project area, the following issues are being considered that influence the industrial use EVs:

- changes to groundwater dynamics
- interactions with surface water
- long-term post-mining
- climate change.

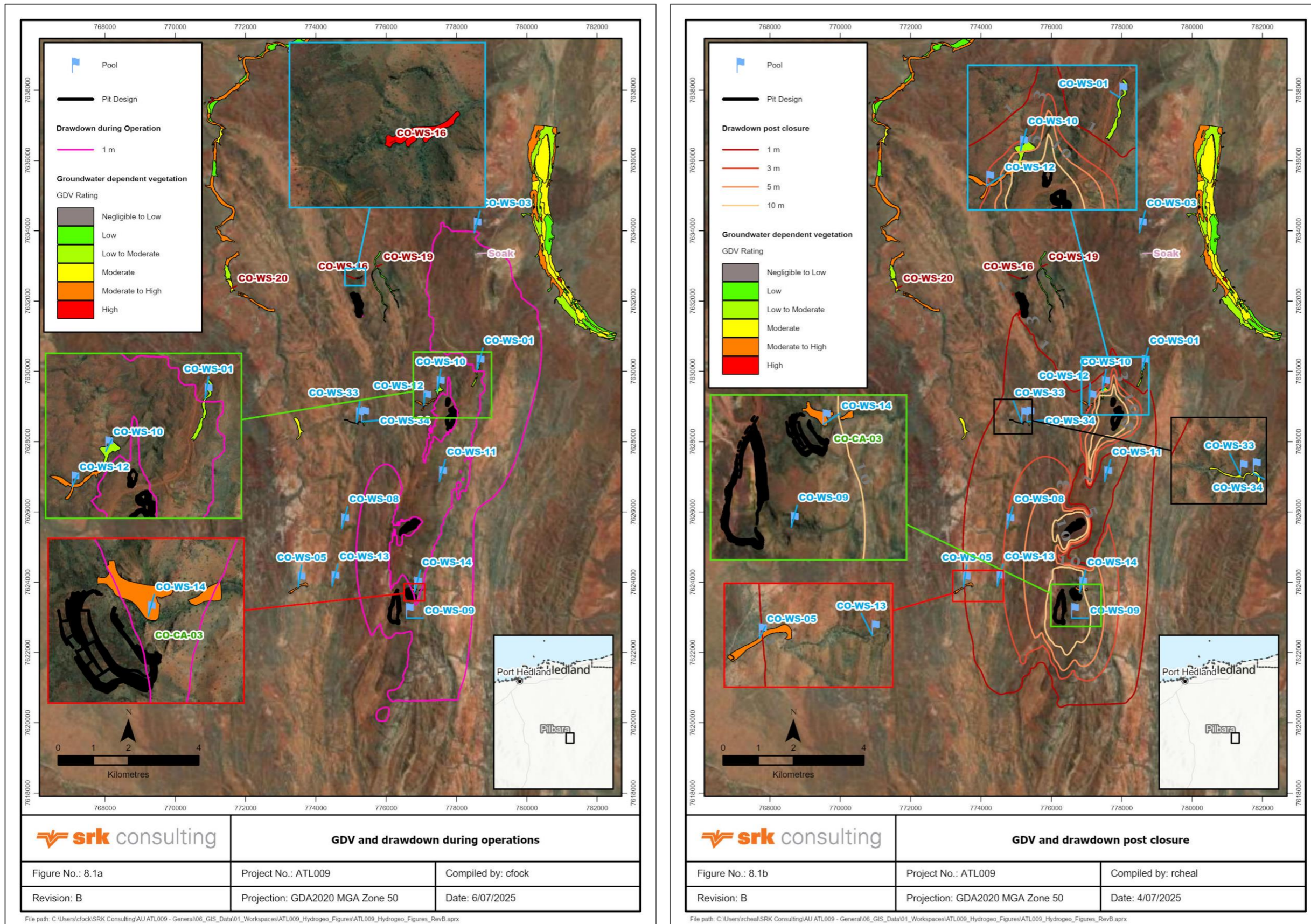
8.7 Assessment of impacts

The influence of mine dewatering on local groundwater levels is a key focus for the GIA. The groundwater model provides two scenarios that each simulate drawdown extent.

During operations, the abstraction of water for mining purposes and the dewatering of pits will result in a depletion of groundwater levels in the area. The maximum extent of drawdown is simulated to be at the end of mine life (Figure 8.1a).

After closure, groundwater levels will begin to recover; however, modelling indicates that equilibrium groundwater levels will not return to pre-mining conditions. Instead, water levels, particularly at Sparrow Lake, are projected to remain approximately 40 m lower than pre-mining levels, with the pit voids acting as permanent groundwater sinks (Figure 8.1b).

Figure 8.1: Comparison of 1 m drawdown maximum extent at end of operations (8.1a) and post-closure (8.1b)



Source: SRK
 Notes: GDV rating polygons taken from Biologic 2024 survey.

The extent of drawdown is different for each scenario. This assessment uses the 1 m drawdown extent for each scenario, along with other available information, to describe the impacts associated with each EV.

8.8 Ecological values

Impacts to groundwater-dependent vegetation

The Biologic Environmental Survey assessment (2024) identified several regions within the Project area that have groundwater-dependent vegetation (GDV) potential.

At the end of operations, the following areas are marked as having a GDV risk present within the simulated 1 m drawdown extent (Figure 8.1a):

- Upstream creeks of CO-WS-12 and CO-WS-10, with a GDV rating from Low to High. The GDV location is northwest of Runway pit. The GDV area extends just within the simulated 1 m drawdown extent. The specific pool locations are outside the drawdown extent.
- A narrow creek extending 200 m downstream from CO-WS-01 with a GDV rating of Low.
- The area located at CO-WS-14 with a GDV rating of High.

In the post-closure scenario, the 1 m drawdown area is different. The following areas are marked as having a GDV risk present within the simulated 1 m drawdown extent (Figure 8.1b):

- Upstream creeks of CO-WS-12 and CO-WS-10, with a GDV rating from Low to High. The GDV location is northwest of Runway pit. The GDV area extends within the simulated 1 m drawdown extent. The specific pool locations are inside the drawdown extent.
- Pool 14 (CO-WS-14) has a high GDV rating and is located within the simulated >10 m drawdown extent.
- A narrow creek extending 300 m upstream from pool CO-WS-05 with a GDV ranking of Moderate to High.
- A narrow channel within the same creek line as Pool 33 and pool 34 (west of Runway).

The riparian corridors of the Coongan River and Glen Herring Creek, where a significant number of GDVs are identified, do not fall within the operational or post-closure dewatering extent.

8.8.2 Impacts to pools

Table 8.1 summarises the simulated range of drawdown at environmental groundwater receptors (pools), taken from Revision 3 of the numerical groundwater modelling. Further discussion for these receptors is included below.

Table 8.1: Simulated drawdown at pools

Pool	Permanency	Simulated drawdown operations (m)	Simulated drawdown post closure (m)	Reduction in S5 max peak flow (%)	Revised potential for impact to GDEs	Comment
CO-WS-01	Perennial	5.5	<1	--	L	Located within a Heritage buffer area. Pool at edge of operational drawdown extent formed by propagation of processing area abstraction. Historical monitoring shows large difference in groundwater levels created by fault boundary between pool and abstraction. Simulated drawdown considered to be overly conservative and drawdown likely to be less than simulated.
CO-WS-03	Ephemeral	1	--	--	L	Negligible impact
CO-WS-05	Perennial	--	<1	2.1	L	Negligible impact
CO-WS-08	Ephemeral	<1	2-4	7.1	M	Medium risk given due to catchment reduction. Drawdown impact low as ephemeral and no GDVs.
CO-WS-09	Ephemeral	>10	>10	--	L	Pool has been identified as not groundwater dependent; high level of drawdown is due to high K zone placement and may be unrealistic.
CO-WS-10	Perennial	<1	2-5	--	M	Within an environmental exclusion area. Operational drawdown not simulated to reach pool. Closure drawdown impacts may warrant further considerations due to moderate GDV rating.
CO-WS-11	Ephemeral	--	<1	--	L	Negligible impact
CO-WS-12	Perennial	<1	0-3	--	L-M	Within an environmental exclusion area. Operational drawdown not simulated to reach pool with the currently assigned hydraulic conductivities. Closure drawdown impacts may warrant further considerations due to high GDV rating.
CO-WS-13	Ephemeral	<1	2-3	2.7	M	Medium risk given due to catchment reduction. Drawdown impact low as ephemeral and no GDVs.
CO-WS-14	Perennial	1-6	2-10	2.4	M-H	Located within a Heritage buffer area and environmental exclusion area. Conceptually, the location has potential for groundwater baseflow to be supplied by a shallow perched aquifer. Geometry of current groundwater model does not accurately reflect this flow mechanism. Current data gap.
CO-WS-16	Perennial	<1	--	--	L	Negligible impact. Location within a Heritage buffer area and close to environmental exclusion area.
CO-WS-19	Perennial	<1	--	--	L	Negligible impact. Location within a Heritage buffer area, but unaffected by drawdown.
CO-WS-20	Perennial	--	--	--	L	Negligible impact. Location within a Heritage buffer area, but unaffected by drawdown.
CO-WS-33	Ephemeral	--	2	--	L-M	Limited knowledge. Low to Medium risk as ephemeral, but GDV rating Moderate to High.
CO-WS-34	Ephemeral	--	2	--	L-M	Limited knowledge. Low to Medium risk as perennial, but GDV rating Moderate to High.

Potentially affected during operations

Pool CO-WS-01: Overall potential for impact to GDEs is Low

Pool 1 has been identified as a perennial pool and has Heritage Value environmental value significance.

The simulated drawdown for pool CO-WS-01, as shown in Figure 8.1, is attributed to the propagation of drawdown from bore CRD0082 (toward the northeast), located at the processing plant.

It is likely that the an over estimation of drawdown is presented in the Figure 8.1 and that the structural controls in the area (shown in cross section in Figure 8.2) will prevent the propagation of drawdown to reach pool CO-WS-01. Analysis of water quality samples supports this concept (Appendix A) by showing similar water quality markers for bores around Runway and CO-WS-01.

Operational (and post-closure) groundwater levels are not shown to extent to the point of pool CO-WS-01 therefore it is considered the likelihood of negative impacts to CO-WS-01 as a result of mining will be low.

Pool CO-WS-03: Overall potential for impact to GDEs is Low

Pool CO-WS-03 has been identified as ephemeral (i.e. not reliant on groundwater). No GDVs are recorded at the location. The predicted drawdown due to operations, which has been simulated to be close to 1 m, is therefore unlikely to impact the seasonal filling or draining of the pool.

Pool CO-WS-09: Overall potential for impact to GDEs is Low

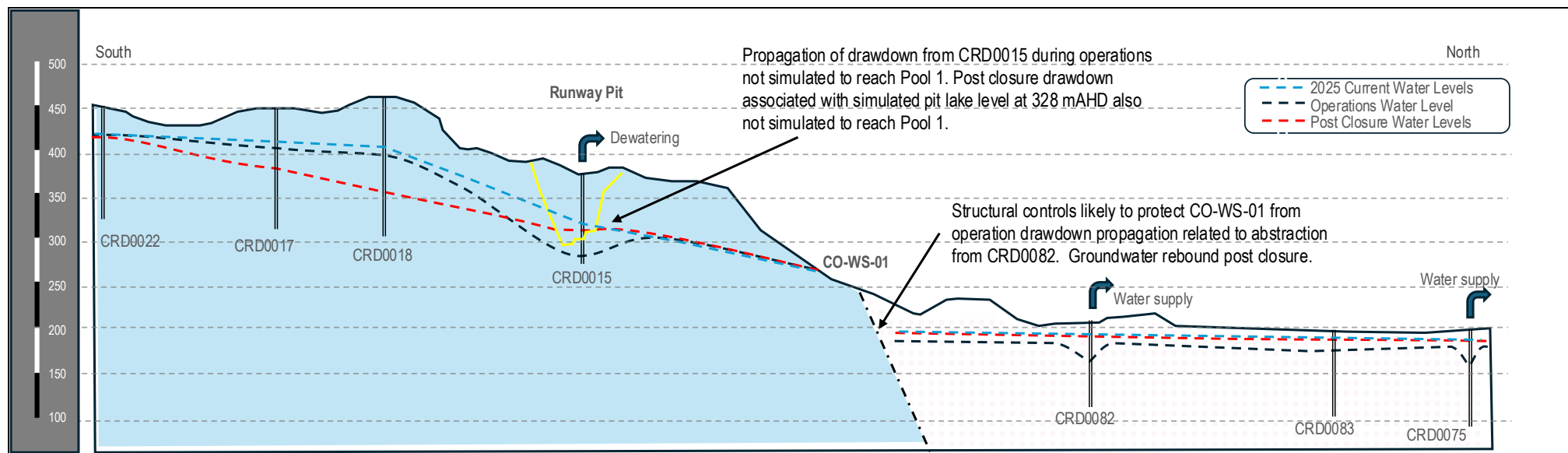
Pool CO-WS-09 has been identified as ephemeral (i.e. not reliant on groundwater) and has been observed to be dry. The predicted drawdown due to operations is simulated to be more than 10 m; the high level of drawdown is due to high K zone placement and may be unrealistic.

Pool CO-WS-14: Overall potential for impact to GDEs is Medium–High

Pool CO-WS-14 is located within an area of simulated drawdown of 1–6 m and is estimated to have a flow reduction of approximately 3%. This pool has been identified as perennial, primarily fed by groundwater and has Heritage Value EV significance.

Field observations record perennial groundwater seepages upgradient of CO-WS-14. The conceptual model presented in Figure 8.3 fits the recorded water levels from surrounding monitoring bores and field observations. However there is still uncertainty it the flow mechanisms at this location. Additional works are planned, potential from use of tracers, to provide more insight and refine this conceptual model.

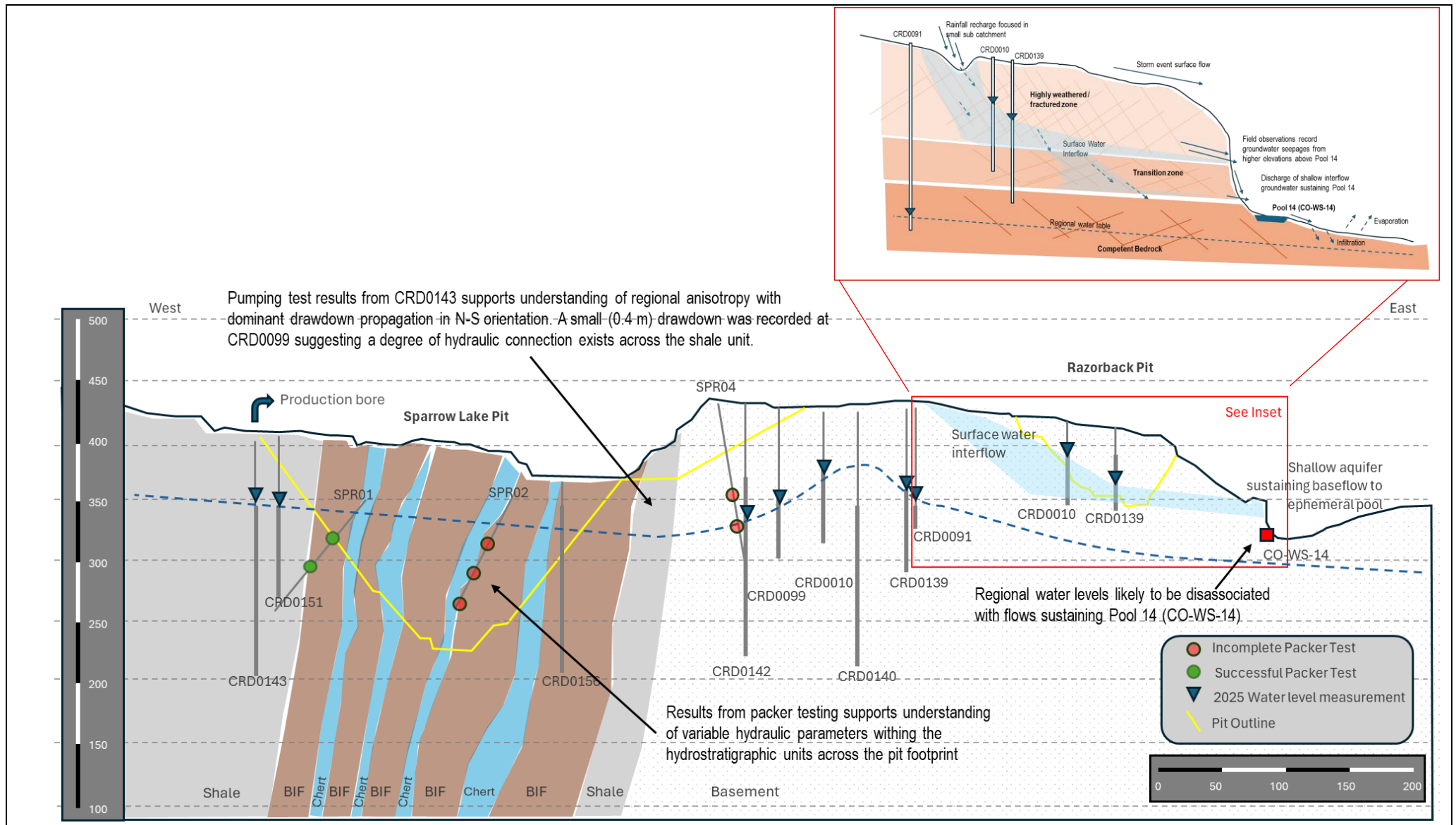
Figure 8.2: Conceptual model at Pool 1



Source: SRK. Adapted from MWH, 2018

Notes: Water levels associated with three periods: Current conditions (blue dotted), maximum drawdown at end of mine life in 2032 (black dotted) and post closure once pit lake stabilises in 2072 (red dotted).

Figure 8.3: Conceptual model at Pool 14



Pools potentially affected post-closure

Pool CO-WS-05: Overall potential for impact to GDEs is Low

Pool CO-WS-05 has been identified as a perennial pool with small reduction in catchment size. The predicted drawdown for this pool is expected to be less than 1 m. It is unlikely that the pool will be significantly impacted.

Pool CO-WS-08: Overall potential for impact to GDEs is Medium

Pool CO-WS-08 is located in an area characterised by a 2–4 m drawdown extent post closure. Although, the pool is ephemeral, it is modelled to have the largest reduction (7%) in the surface water peak flows.

Medium risk given to this pool predominantly due to catchment reduction. As no GDVs are noted within the creek, groundwater reduction is unlikely to have any impact on the ephemeral nature of the pool.

Pool CO-WS-09: Overall potential for impact to GDEs is Low

Pool CO-WS-09 has been identified as ephemeral, not reliant on groundwater and has been observed to be dry. The predicted drawdown at post closure is simulated to be more than 10 m; the high level of drawdown is due to high K zone placement and may be unrealistic.

Pool CO-WS-10: Overall potential for impact to GDEs is Medium

Pool CO-WS-10 is a perennial pool recording 2–5 m drawdown extent post closure. The source of water for CO-WS-10 is not well established, but it is known from field observations that it is partially supplied by overflow from pool CO-WS-12, which is located upstream within the same catchment as pool CO-WS-10 and is typically overflowing. A drawdown of 0–3 m is predicted in Pool 12.

In addition, 250 m from the pool, groundwater levels are approximately 60 m higher (monitored within the BIF) than water levels in CO-WS-10. This suggests that there is a strong hydraulic gradient between these two features which contributes to the baseflow entering the pool. As a result, an observable impact post closure to the permanence of the pool is simulated and may warrant further considerations due to the GDV rating (High).

Pool CO-WS-11: Overall potential for impact to GDEs is Low

Pool CO-WS-11 is an ephemeral pool with less than 1 m of drawdown. This suggests that the pool is fed by surface water and does not have any potential impact of reduction of flow. It is therefore unlikely to impact the seasonal filling or draining of the pool.

Pool CO-WS-12: Overall potential for impact to GDEs is Low–Medium

Pool CO-WS-12 is a perennial pool modelled to have 3 m drawdown extent. The surface water flow reduction is not significant, and the pool is perennial, suggesting a Low to Medium impact on to the permanence of the pool. Closure drawdown impacts may warrant further considerations due to GDV rating (High).

Pool CO-WS-13: Overall potential for impact to GDEs is Medium

Pool CO-WS-13 has a simulated drawdown of 3 m and a potential surface water peak flow reduction of approximately 3%. This reduction is moderate for an ephemeral pool and could moderately affect the pool's seasonal filling and draining patterns.

Pool CO-WS-14: Overall potential for impact to GDEs is Medium–High

Pool CO-WS-14 is located within an area of simulated drawdown exceeding 10 m and is estimated to have a flow reduction of approximately 3%. This pool has been identified as perennial, primarily fed by groundwater and has Heritage Value EV significance.

However, a data gap exists due to the absence of bores in the vicinity of the pool. This raises the possibility of a perched aquifer connection (Figure 8.3) or the presence of a low hydraulic conductivity (K) unit between the Razorback Pit and the pool. As a result, there is uncertainty regarding the actual impact of drawdown on the pool.

Pools CO-WS-33 and CO-WS-34: Overall potential for impact to GDEs is Low–Medium

These pools are located close to each other within the same creek and within an area of simulated drawdown of 2 m. These pools also noted to be ephemeral but are recorded to have GDVs present of Moderate to High rating and has Heritage Value EV significance. There is an no anticipated catchment flow reduction. The impact risk rating is Low to Medium as very little is known about the nature and dynamics of these features.

Locations are understood to only have been viewed via helicopter survey and assessed once on foot during the survey by Biologic Environmental Survey in 2024.

8.9 Industrial use EVs

8.9.1 Changes to groundwater dynamics

Impacts to groundwater levels

Within the range of uncertainty and sensitivity, the proposed groundwater abstraction is expected to cause localised depletion of aquifer storage, specifically around the below water table pits and water supply abstraction bores. The anisotropic nature of the aquifer is predicted to elongate drawdown extents toward the northeast.

Pit dewatering during Stage 5 operations will result in a more pronounced groundwater cone of depression associated with sustained dewatering activities. However, no operational challenges, such as dry bores, are anticipated during the Project's operational phase.

Impacts to alluvial aquifers

During operations, dewatering associated with pit excavations will modify groundwater flow directions. Groundwater modelling simulations for operational drawdown indicate that the extent of dewatering remains outside the riparian corridors of the Coongan River and Glen Herring Creek. The resulting drawdown and associated reduction in baseflow to these surface water catchments are considered minimal.

Simulated post-closure simulated drawdowns are predicted to be even less significant, with no anticipated impacts on the alluvial aquifer.

Impacts to groundwater quality

During the operational phase of Stage 5 mining, blasting and excavations, among other activities, can alter the groundwater quality. The Water Quality Report (Appendix C) does not report any significant changes to trends in physico-chemical parameters, major ions, and metals between the 2014–2019 data and the 2020–2025 data. This suggests natural variation in aquifer composition are not likely to be significant.

Preliminary results of a pit lake water quality model indicate the Sparrow Lake pit lake is likely to remain circum-neutral, with limited influence from sulfur-rich wall rock due to its minor exposure (<1%). However, uncertainties remain regarding groundwater flow rates, long-term quality, and the representativeness of analogue data. Contributions from the proposed in-pit waste rock dump were excluded due to insufficient data.

Pit dewatering volumes

The simulated dewatering rates presented in Appendix G in Figure 5.7 show notable peaks of large inflows during 2029. Higher inflows are caused when pit progression is quicker than ex-pit dewatering rates and additional in-pit dewatering is required. The volumes of these short-term elevated inflows can more than be more than twice the cumulative monthly yields across the rest of the Project area. Work is being completed to optimise the dewatering strategy to reduce these peaks. Long-term management of this water, and any surplus, will be part of a Water Management Plan due for completion in late 2025.

8.9.2 Impacts to interaction with surface water

The impact of groundwater interacting with surface water comprises the specific issues outlined below.

Change to surface water catchment area

Increasing the surface footprint of a mine has the potential to reduce the extent of surface water catchments and flow to downstream receptors.

The expansion of the Sparrow Lake pit as part of Stage 5 operations results in localised reductions in surface water catchment areas.

Overall, the total catchment reduction due to Stage 5 operations accounts for less than 0.016% of the Coongan River catchment, as measured at the Marble Bar gauge. This minimal percentage suggests that while localised alterations to the surface water flow regime may occur, their impacts will be negligible at the regional scale, and they will dissipate quickly downstream from the mine.

Further detail on the hydraulic modelling and catchment analysis completed is provided in the Surface Water Report (Appendix E).

Potential discharge of surplus water

Deposits of alluvial and colluvial material along the Coongan River floodplain act as a permeable shallow unconfined aquifer. The lateral extent and hydraulic connection with deeper fractured bedrock systems is uncertain.

If surplus water is planned to be discharged into the Coongan River, impacts to the groundwater environment may arise. If water has a different chemical composition to the receiving surface water or shallow aquifer, water quality can degrade. In addition, additional discharge may cause localised mounding of the water table, and an increase in surface flooding or surface runoff. The EV is intended to ensure that mining activities do not cause unintended negative impacts to the receiving shallow aquifer unit.

Currently, the Coongan River does not have a systematic water quality monitoring network in place, making it unclear whether differences in water quality exist between the surface water and the groundwater. To address this, a Water Management Plan will be developed to implement monitoring downstream, establish baseline conditions, and ensure mining operations do not cause unintended adverse impacts. Further detail on the additional monitoring is provided in Section 9.

The Water Quality Report (Appendix C) provides more detail on the aquifer extent and water quality.

Surface water diversions

Surface water diversions may also be considered a potential impact, as they could influence surface water recharge. The EV aims to ensure that mining activities do not cause unintended negative impacts on surface water recharge. While diversions are not currently planned, they remain a potential strategy to manage and minimise contact water volumes. Implementing diversions would reduce the volume of water coming into contact with mining activities, particularly at Sparrow Lake, which is the only pit containing shale and potentially acid forming (PAF) material. Minimising the need for sump pumping in this area would lower risks and improve operational efficiency.

A potential benefit from not creating, or reinstating, the surface water diversions could become apparent post closure. Additional volumes of catchment rainfall flowing into the pit would help raise pit lake levels which are currently simulated to become sustained groundwater sinks post closure.

Flooding

As part of the ongoing development of the Water Management Plan for the Project area, the flood inundation map for the site will be updated to reflect the latest hydrological data and modelling. This updated mapping will ensure that all flood scenarios, including those associated with extreme rainfall events, are comprehensively assessed to inform effective planning and mitigation strategies. The updated flood inundation map will incorporate enhanced modelling techniques to account for topographical, climatic and hydrogeological factors specific to the Pilbara region.

The revised flood inundation map will play a critical role in identifying areas at risk of inundation, enabling proactive measures to minimise flood impacts on mine infrastructure, operations and surrounding environmental receptors. This initiative aligns with the mine's commitment to sustainable water management and environmental stewardship.

The completion of the Water Management Plan, including the updated flood inundation map, is scheduled for late 2025. This timeline allows for thorough analysis and integration of the latest hydrological insights to ensure the mine's operational resilience and compliance with regulatory requirements. Regular reviews and updates of the flood mapping will be incorporated into the Water Management Plan to maintain adaptability to evolving conditions over the life of the Project.

Long-term post mining

Open pits that were dewatered during operations will gradually fill with groundwater, forming pit lakes. Numerical groundwater modelling and water balance modelling have been used to simulate the long-term dynamics of pit lake levels and their stabilisation over time.

Water balance and groundwater modelling predicts that the lakes at Sparrow Lake and Runway will equilibrate 15–40 m below pre-mine levels, with lakes acting as groundwater sink in the post-closure period.

8.9.3 Climate change

Climate change can alter precipitation patterns, evaporation rates and temperature, affecting groundwater recharge and availability: this happened by reduced recharge as well as increased evaporation. However, intense rainfall events may lead to rapid infiltration, potentially carrying contaminants into the groundwater system.

Under the climate change RCP8.5 projections for 2090, the impacts become significantly more pronounced, with reductions in average peak flow ranging from 32% to 35% and annual runoff volume decreasing by 38–41%. These projected changes underscore the dominant influence of climate change in shaping local flow regimes, far exceeding the hydrological impacts of Stage 5 mining alone.

9 Recommendations

The following recommendations are based on the outcomes of the GIA:

1. **Additional groundwater and surface water studies of the alluvial deposits of the Coongan River:** Should surplus water need to be discharged directly into the Coongan River, further studies should include:
 - a. Undertake installation of a minimum of three sets of twin bores (one shallow and one deep on the same pad): one upstream of the planned discharge location and at least two locations set progressive downstream of the discharge location. The shallow bore should be screened within the alluvial deposits and the deep bore should be screened within the FBA.
 - b. Undertake a short (24 h) period of test pumping of the deep bore at each location to determine the vertical hydraulic gradient between the shallow alluvial deposits and deeper FBA. Test results will also allow for aquifer parameters to be calculated.
 - c. Continue the water level and water quality monitoring within the shallow and deep bores to capture baseline data.
2. **Conceptualisation of Pool 14 (CO-WS-14):** The groundwater model does not include perched aquifers (and no calibration data are available to include such a feature). Monitoring of groundwater upgradient of Pool 14 would allow clarification of these uncertainties. The proximity of Razorback Pit and local topography of the area upgradient of Pool 14 prohibits the installation over any additional permanent monitoring bores. However, Razorback is not planned to progress mining until August 2027 which leaves opportunity for a temporary monitoring bore to be installed within the pit footprint. It is recommended that a deep and shallow monitoring bore be installed and the following testing completed:
 - a. Pumping tests: An additional pumping test, pumping from bore CRD0141 and monitored at the proposed new monitoring bores within the razorback footprint. Installation in 2025 would provide a good period of baseline of monitoring before razorback operations start. The proposed monitoring bore location would also provide some early indication of groundwater dynamics immediately upgradient of Pool 14 as advanced dewatering at Sparrow lake starts in February 2026.
 - b. Tracer tests. A series of tracer tests to determine the influence of groundwater at Pool 14. Injection of a measured quantity of fluorescent tracer dye(s) into the new monitoring bore(s) and, if required, nearby bores CRD0139, CRD0140 and CRD0150, would allow empirical data to be collected, which relate to the proportion of flow (if any) and preferential direction of groundwater flow discharging from Pool 14. Using a quantitative logger installed within the pool, the concentration of fluorescence would be recorded over a period of 2–3 weeks. The data can provide insight into the proportion of tracer recovered and the velocity of groundwater movement.

To the northeast of Runway Pit, Pool 01 (CO-WS-01), known to have heritage significance and GDVs, has been also identified as having a simulated drawdown >1 m. Clarification of groundwater flow contributions to Pool 1 would aid in clarification to understanding (and potentially de-risking) potential impacts to the pool.

3. **Pit dewatering optimisation:** The objective of the study would be to take the peaks of the sump pump volumes. SRK recommends the following three-step approach:
 - a. **Model.** Include additional scenarios in Revision 3 of the groundwater model that simulate the effectiveness of in-pit bores (possibly at the location of CRD0100 where good calibration exists) at smoothing out abstraction volume peaks.
 - b. **Monitor.** Observations during early progression into Stage 5 would allow for assessment of monitoring data compared against modelled data.
 - c. **Drill.** Use the results of modelling and monitoring, to prepare a scope of works to design, drill and install in-pit bores for testing purposes as these are likely necessary to optimise dewatering, reduce peak pumping rates, and minimise the requirement for discharge.
4. **Revision to isotope analysis.** As set out as further work in the radiocarbon isotope study (Chmierlarski, 2024), Radon-222 (^{222}Rn) is often considered a reliable method for detecting ongoing groundwater input into surface waters. MWH (2018) conducted some isotope analysis using Radon-222. An assessment of this usefulness of these data to provide a more robust isotope assessment would be valuable. If collection of new isotope samples is planned, Chmierlarski also recommends the analysis of stable isotopes of water – deuterium ($\delta^2\text{H}$) and oxygen-18 ($\delta^{18}\text{O}$).
5. **Surface water data collection.** Incorporating more years of monitoring data would enhance the accuracy of the model, allowing for calibration across both wet and dry years would help capture the variability in hydrological responses and improve the robustness of the predictions.
6. **Water Management Plan and flood mapping.** This is intended to update the existing Water Management Plan and revise water monitoring thresholds/limits for Stage 5 operations. It will also include updated flood inundation modelling to help define storm water management infrastructure required.
7. **Input kinetic column leach testing results.** With data for use in pit lake water quality modelling pending (likely available in Q3 of 2025), a refined pit lake water quality model should be developed once sufficient laboratory data are available to populate it.

Closure

This report, H3 Hydrogeological Assessment, was prepared by

Cris Fock
Consultant (Hydrogeology)

and reviewed by

Richard Cheal
Senior Consultant (Hydrogeology)

and

Brian Luinstra
Principal Consultant (Hydrogeology)

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

References

- Atlas, 2019. Corunna Downs Project Supplementary Report – EPA Referral. Doc No: 179-LAH-EN-REP-0006.
- Atlas, 2024. MS1125 Compliance Assessment Report 2023-2024. Sanjiv Ridge Direct Shipping Ore (DSO) Project – Stage 1.
- Bekele, B, & Gray, D J, 2013. Geochemical characteristics of banded iron formations and their implications for water quality. *Australian Journal of Earth Sciences*, 60(5), 567-578.
- BOM – Groundwater Dependent Ecosystems (GDEs) Atlas [Accessed: May 2025].
- Chmierlarski, M, 2024. SRK_CorunnaDowns_radiocarbon_RevA. University of Western Australia.
- Department of Mines, Industry Regulation and Safety (DMIRS), 2024a. Geoview – 1:100 000 Interpreted bedrock geology. <https://geoview.dmp.wa.gov.au/geoview> [Accessed May 2025].
- Department of Mines, Industry Regulation and Safety (DMIRS), 2024b. Geoview – 1:100 000 Regolith geology regimes of Western Australia <https://geoview.dmp.wa.gov.au/geoview>. Accessed May 2025].
- IPCC, 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [Intergovernmental Panel on Climate Change \(IPCC\)](https://www.ipcc.org/)
- Smith Hydro, 2025. Surface water report (Appendix E).
- Mine Earth, 2024. Sanjiv Stage 4 – Waste Rock Assessment. Detailed Geochemical Characterisation.
- Mine Earth, 2025a. Sanjiv Ridge Stage 5 - Waste Rock Geochemical Characterisation – Sparrow Pit Update.
- Mine Earth, 2025b. Sanjiv Ridge Stage 5 – Interim Report – Preliminary Geochemical Characterisation.
- MWH, 2018. Corunna Downs H2 Hydrogeological Study (No. 052617_Corunna_H2 FINAL).
- Smith, F, 2025. Hydrology Impact Assessment (Appendix E).
- SRK, 2019a. Corunna Downs Mine Water Supply H3 Hydrogeological Assessment.
- SRK, 2019b. ATL004_H3 Appendix A Corunna Downs – Water Supply Drilling Site Investigation Report (No. ATL004).
- SRK, 2019b. ATL004_H3_Appendix B Corunna Downs - Numerical Model Report.
- SRK, 2023. Corunna Downs Mine Water Supply H3 Hydrogeological Assessment Addendum.
- SRK, 2025a. Drilling and testing (2024) Report: Sanjiv Ridge Stage 5 Below Water Table Mining Hydrogeology Study, WA, Australia (Appendix B).
- SRK, 2025b. Water Quality Report: Sanjiv Ridge Stage 5 Below Water Table Mining Hydrogeology Study, WA, Australia (Appendix C).
- SRK, 2025c. Numerical groundwater model report: Sanjiv Ridge Stage 5 Below Water Table Mining Hydrogeology Study, WA, Australia (Appendix G).
- SRK, 2025d. Sanjiv Ridge Pit Lake (Appendix F).
- SRK, 2025e. Preliminary pit lake water quality assessment (Appendix H).

**Appendix A Groundwater-Dependent Environmental
Values**

1 Groundwater dependent environmental values

Environmental Values (EVs) in the context of a groundwater impact assessment are features (receptors) which are considered to have some reliance on groundwater or which may provide resource and/ or refuge for groundwater reliant fauna.

Groundwater Dependent Ecosystems (GDEs) are ecosystems that require access to groundwater to meet all of some of their water requirements. Changes to groundwater beyond natural variation can impact these ecosystems. The three key GDEs include (BoM, 2024):

1. Aquatic ecosystems: flora and fauna reliant on surface expression of groundwater – such as rivers, wetlands, lakes and springs (excludes fringing vegetation).
2. Terrestrial ecosystems: flora and fauna reliant on the presence of subsurface groundwater to meet all or some of its water requirements; and
3. Subterranean ecosystems: water-dependent ecosystems occurring below the ground surface, including cave and aquifer systems.

1.1 GDEs at Sanjiv Ridge: Pools

The MWH/Stantec H2 Hydrogeological study (2018) of Sanjiv Ridge identified 13 GDEs (comprising 11 pools, a cave and a 'soak') within the Project area (Figure A.1). Descriptions of the pool settings and outcomes of recent studies are presented below.

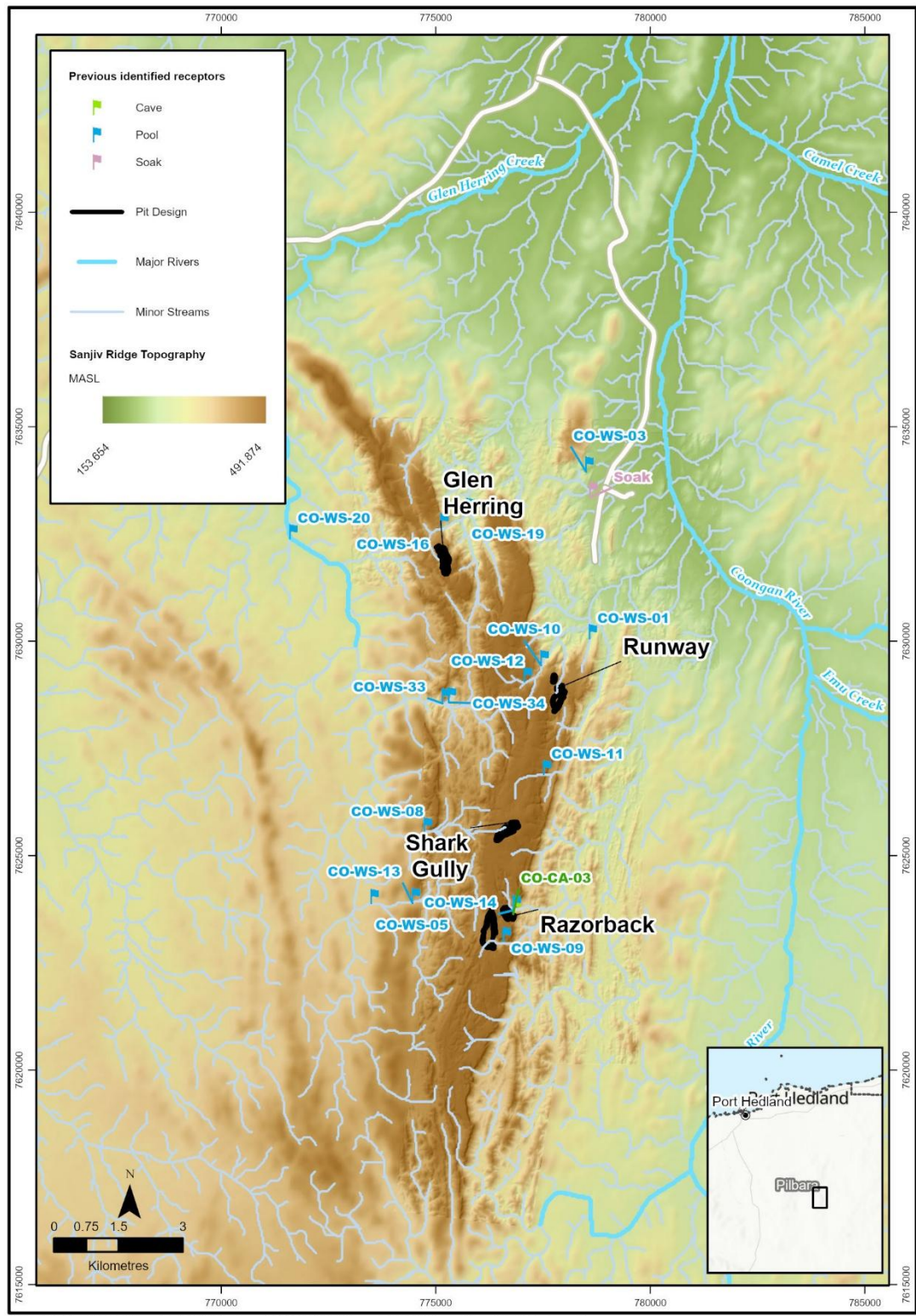
Continued water quality monitoring since 2019 has been used to further characterise the system. Further work related to the pools completed in 2024 and 2025 have included:

- radiocarbon isotope analysis to determine groundwater flow patterns and provenance of water within a selection of these features (Appendix C - Water Quality Report)
- Surface water catchment analysis assessing the impacts to the pools of catchment reductions and climate change (Appendix E – Surface Water report)
- Numerical groundwater model report assessing the impacts of groundwater drawdown on the pools (Appendix G – Numerical groundwater model report)

The results of the assessments and ongoing monitoring suggest that the pools are likely fed via both groundwater and surface water, with perennial pools located in areas with a more consistent groundwater contribution. Ephemeral pools are considered to be reliant exclusively on surface water or having limited groundwater contribution only during periods of higher groundwater levels.

A summary of each GDE location is given below in Table A.1.

Figure A.1: Pool locations



Sources: SRK

1.1.1 Pool CO-WS-01

Pool CO-WS-01 is located along the eastern flank of the BIF Ridge and approximately 1.5 km north of, and in a separate catchment to, the Runway pits. Field observations confirm that the pool is perennial based on the observation of active seepage feeding the pool and maintenance of pool depth year-round (~0.55–0.65 m). This conclusion is also supported by the interpolated water table at the pool which suggests that it is being supplied by discharge from the groundwater system (within 5 m of pool water level).

Analysis of water quality sampling from the pool suggest it is bicarbonate and magnesium dominant recharged water, mirroring that of bores installed within the BIF near to the Runway pit and has stable TDS levels over time (suggesting constant throughflow and no concentration of analytes due to evapoconcentration). This data further supports an interpretation that the pool is dependent on groundwater and is likely being sourced from the BIF groundwater system.

Radiocarbon isotope analysis (Section 1.3) shows the location to have a likely groundwater inflow. The Biologic Survey (2024) shows the area to have a Low to Moderate GDV rating.

1.1.2 Pool CO-WS-02

Pool CO-WS-02 is located along the eastern flank of the BIF Ridge and approximately 2 km south of the Sparrow Lake pit, and within a catchment that is completely outside the proposed Development Envelope. No field observations are available for this pool given the absence of safe access; however, based on comparison of interpolated water level and estimated elevation of the pool using local LiDAR data (more than 5 m), this pool is likely to be ephemeral and not reliant on groundwater.

1.1.3 Pool CO-WS-03

Pool CO-WS-03 is located 5 km north of, and in a separate catchment to, the Runway pits along the eastern flank of the ridge. Field observations report the pool as drying completely with no evidence of active seepage, suggesting that the pool is likely ephemeral. The interpolated water table lies more than 5 m below the pool elevation, further suggesting an unlikely reliance on groundwater.

Water quality results are inconsistent with the nearest groundwater monitoring points in the most likely aquifer system, suggesting that the pool is unlikely to be reliant on groundwater and supporting the interpretation that this pool is ephemeral, distinct from groundwater and dominated by surface water processes.

The Biologic Survey (2024) shows the area to have no GDV rating.

1.1.4 Pool CO-WS-05

Pool CO-WS-05 is located within a creek line draining a large catchment area approximately 3.5 km west of the BIF Ridge and Sparrow Lake pit. Field observations suggest that the pool is perennial based on the observed persistence of water/ wet soils in the area almost year-round. The pool is located in an area of alluvial cover and is thought to be maintained by discharge from the ephemeral alluvial groundwater system.

Analysis of water quality sampling from the pool is consistent with groundwater in the area, but has fluctuating TDS levels over time, indicating some concentration of analytes due to evaporation. This data supports the interpretation that the pool is fed by surface water during recharge events and is maintained by discharge from the ephemeral alluvial groundwater system.

The Biologic Survey (2024) shows the area to have a Moderate to High GDV rating.

1.1.5 Pool CO-WS-08

Pool CO-WS-08 is located within a creek line draining a large catchment area approximately 1.7 km west of the BIF Ridge and Shark Gully pit. Field observations confirm that the pool is ephemeral, with reports of the pool being dry for large periods of the year (i.e. May 2018 to January 2019). This conclusion is also supported by the interpolated water table at the pool which is more than 5 m below the pool elevation, suggesting that it is unlikely to be reliant on groundwater.

Analysis of water quality sampling from the pool is consistent with groundwater derived from the BIF unit in the area, but has fluctuating TDS levels over time, indicating concentration of analytes due to evaporation. This data along with observed seepage supports the interpretation that the pool is likely dependent on surface water but may be supplied by groundwater/ interflow discharge intermittently following major rainfall (and recharge) events.

The Biologic Survey (2024) shows the area to have no GDV rating.

1.1.6 Pool CO-WS-09

Pool CO-WS-09 is located along the eastern flank of the BIF Ridge and less than 1 km east of, and in a separate catchment to, the Sparrow Lake pit. Field observations confirm that the pool is ephemeral, with reports of the pool being dry and no evidence of active seepage noted. This conclusion is also supported by the interpolated water table at the pool which is more than 5 m below the pool elevation, suggesting that it is unlikely to be reliant on groundwater.

Analysis of water quality sampling from the pool is not consistent with groundwater in the area and has fluctuating TDS levels over time, indicating concentration of analytes due to evaporation. This data further supports the interpretation that the pool is ephemeral and not dependent on groundwater.

The Biologic Survey (2024) shows the area to have a no GDV rating.

1.1.7 Pool CO-WS-10

Pool CO-WS-10 (Photo P.1) is located along the eastern flank of the ridge and less than 1 km north of, and in a separate catchment to, the Runway pits. The pool is located in a steep gully downstream of Pool CO-WS-12 and is known to have a rock bottom and is protected on three sides by steep terrain. It is these physical features that may support the persistence of this pool year-round, as no seepage has been observed. Conceptually, it is thought that the primary source of water for the pool is derived from overflowing water from Pool CO-WS-12, which is identified as being groundwater dependent.

Analysis of water quality sampling from the pool, is not consistent with groundwater in the area and fluctuating TDS levels are observed over time. This data supports an interpretation that the pool is

likely fed by surface water, but it may be supplied by groundwater discharge intermittently immediately following major rainfall (and recharge) events.

Radiocarbon isotope analysis (Section 1.3) shows the location to have a minimal influence of groundwater inflows. The Biologic Survey (2024) shows the area to have a Low to Moderate GDV rating.

Photo P.1 Pool 10 (image taken in March 2024)



1.1.8 Pool CO-WS-11

Pool CO-WS-11 is located along the eastern flank of the ridge over 1 km south of, and in a separate catchment to the Runway pits. Field observations confirm that the pool is ephemeral, with reports of the pool being dry (i.e. October 2018 to January 2019) and no evidence of active seepage noted. This conclusion is supported by the interpolated water table which is more than 5 m below the pool elevation, suggesting that it is unlikely to be reliant on groundwater.

Analysis of water quality sampling from the pool is not consistent with groundwater in the area, but has fluctuating TDS levels over time, suggesting that the pool may be fed intermittently by infiltrating meteoric water via fractures (i.e. interflow). This data supports the interpretation that the pool is ephemeral and dependent on surface water, but it may be supplied by groundwater discharge intermittently following major rainfall (and recharge) events.

The Biologic Survey (2024) shows the area to have no GDV rating.

1.1.9 Pool CO-WS-12

Pool CO-WS-12 is located along the eastern flank of the BIF Ridge and less than 1 km west of, and in a separate catchment to the Runway pits. Pool CO-WS-12 is situated within the same catchment and upstream of Pool CO-WS-10. Field observations confirm that the pool is perennial based on the observation of active seepage feeding the pool and its persistence year-round. This

conclusion is also supported by the interpolated water table at the pool, which suggests that it is likely being supported by discharge from the groundwater system (within 5 m). Pool CO-WS-12 is interpreted to be a source of water for Pool CO-WS-10.

Analysis of water quality sampling from the pool suggest it is bicarbonate- and magnesium-dominant recharged water and has stable TDS levels over time, indicating persistent throughflow. This data further supports the interpretation that the pool is dependent on groundwater and is likely being recharged from the groundwater system.

The Biologic Survey (2024) shows the area to have a Moderate to High GDV rating.

1.1.10 Pool CO-WS-13

Pool CO-WS-13 is located along the western flank of the BIF Ridge within a deep gully and approximately 2.5 km west of, and in a separate catchment to, Sparrow Lake pit. Field observations confirm that the pool is ephemeral, with reports of the pool being dry for large periods of the year (i.e. August 2018 to January 2019). The pool is in an area of thin alluvial cover in the upper reach of the catchment and upstream of Pool CO-WS-05 and is thought to be partially maintained by discharge from the ephemeral alluvial groundwater system.

Analysis of water quality sampling from the pool is consistent with groundwater in the area but has fluctuating TDS levels over time. This data supports the interpretation that the pool is primarily dependent on surface water but may be supplied by discharge from the alluvial groundwater system and persist for a period of time following major rainfall (and recharge) events.

The Biologic Survey (2024) shows the area to have no GDV rating.

1.1.11 Pool CO-WS-14 and Cave CO-CA-03

Pool CO-WS-14 (Photo P.2 and Photo P.3) is located along the eastern flank of the BIF Ridge within the Razorback pit catchment and less than 1 km north of the Razorback pit. The pool is located adjacent to the entrance to cave CO-CA-03, both of which have been identified as potentially important fauna habitat. Field observations suggest that the pool is perennial based on the observation of surface flow into the pool from upstream and maintenance of pool depth year-round (~0.9–1 m). Seepage internal to the cave has also been observed year-round. The interpolated water table elevation at the location of the cave/ pool is consistent with the surveyed elevation of pool CO-WS-14, suggesting that this pool and the cave seepage are connected to the local groundwater system.

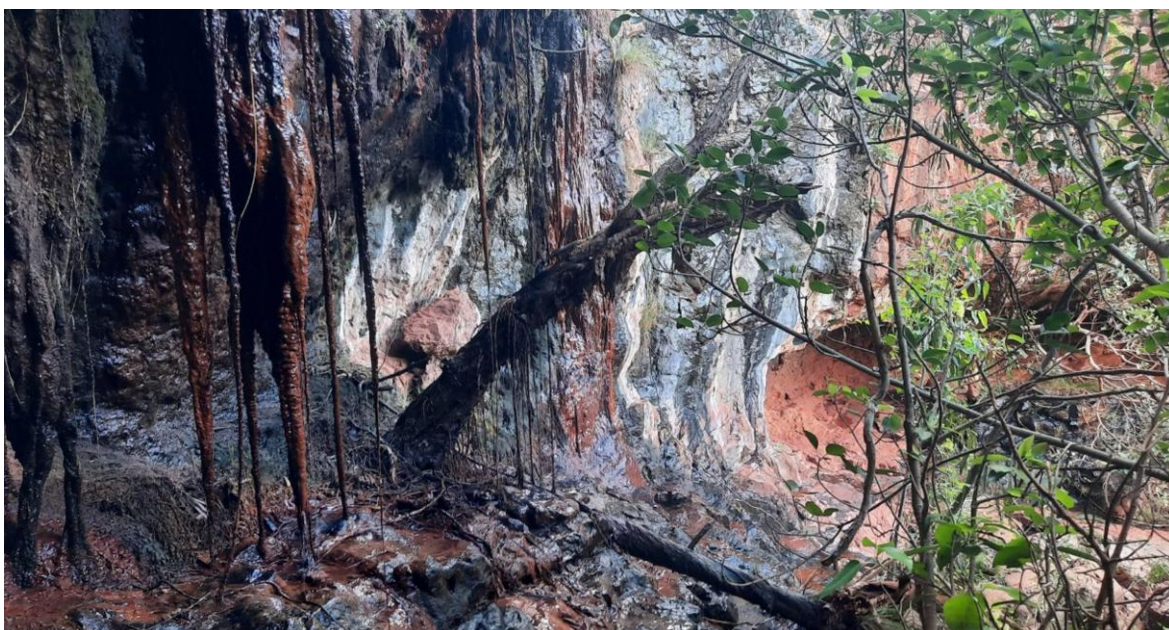
Analysis of water quality sampling from the pool suggest it is bicarbonate- and magnesium-dominant recharged water and has stable TDS levels over time. This data further supports the interpretation that the pool and cave are dependent on groundwater. However, the water quality signature of CO-WS-14 does differ from bores intersecting high flow zones in the FBA (CRD0100 located 750m to the southwest).

Radiocarbon isotope analysis (Section 1.3) shows the location to be dominated by groundwater inflows. The Biologic Survey (2024) shows the area to have a Moderate to High GDV rating.

Photo P.2 Pool 14 (image taken in March 2024)



Photo P.3 Cave (CO-CA-03) (image taken in March 2024)



1.1.12 'Soak'

Field investigations identified an area of shallow groundwater, termed the 'soak' approximately 5 km north of the Runway pits along the eastern flank of the BIF Ridge. The soak is a small pan at the upper reaches of a minor catchment, interpreted to be an ephemeral, perched alluvial water bearing unit based on the observation of residual encrusted evaporates and the presence of

stratified sands and clays, and is likely only recharged during major rainfall events. The high clay content of the soils in this area likely means water persists in the soil profile for a significant period of time, which is supported by the presence of sedge species *Scheuchzeria palustris* and *Cyperus vaginatus* (Woodman, 2019).

While no active groundwater discharge or standing water has been observed at the soak, groundwater data in vicinity of the soak also suggests that the underlying water table in this area is shallow (e.g. in monitoring bores CRD0083 located 150 m south of the soak and CRD0075 50 m northeast are within 3–5 m of the surface). The reliance of the soak and connectivity with the deeper groundwater system is not well understood.

1.2 Additional pools monitored since the 2019 H3 report

As operations have progressed in the Glen Herring area, three new perennial pools are monitored which were not part of the original 2019 H3 report.

1.2.1 Pool CO-WS-16

Eastern side of Glen Herring Pit area located upstream of CRD-SW-008. CO-WS-16 (Photo P.4) is found in a steep incised ravine with difficult access. Radiocarbon isotope analysis (Section 1.3) shows the location to be dominated by groundwater inflows. The Biologic Survey (2024) shows the area to have a High GDV rating.

Photo P.4 Pool 16 (image taken in March 2024)



1.2.2 Pool CO-WS-19

Eastern side of Glen Herring Pit area located downstream of CRD-SW-008. Pool Co-WS-19 is situated at the confluence of two creeks (Photo P.5). Flood flow markers on tree show debris 1.5-

1.7m above channel bed. Radiocarbon isotope analysis (Section 1.3) shows the location to have minimal groundwater inflow. The Biologic Survey (2024) shows the area to have a Low GDV rating.

The Biologic report identified more than 10 locations along the same channel, both upstream and downstream of the creek, containing flora species with potential groundwater requirements. These locations are situated outside the 1 m drawdown extent during both the mine life and post-closure.

Photo P.5 Pool 19 (image taken in March 2024)



1.2.3 Pool CO-WS-20

Western side of Glen Herring Pit area. CO-WS-20 (Photo P.6) is found at a lower elevation off the ridge and lies within the main channel of the Glen Herring creek. The Biologic Survey (2024) shows the area to have a Moderate GDV rating.

The Biologic report identified more than 20 locations downstream of Glen Herring Creek with flora species potentially reliant on groundwater. These locations are situated outside the 1 m drawdown extent during both the mine life and post-closure.

Photo P.6 Pool 20 (image taken in March 2024)



1.2.4 Additional Biologic pools

The Biologic report identified three locations in a small unnamed creek with potential for groundwater-dependent vegetation (GDVs), which Atlas has designated with Pool IDs CO-WS-33

and CO-WS-34. These locations are west of Runway pit and have been assigned a Moderate GDV rating (Figure A.1). However, no monitoring data has been provided to SRK for review or impact assessment. These locations fall within the 1 m drawdown extent during post-closure only.

1.2.5 Groundwater quality of the Glen Herring Pools

Water quality data collected from pumping tests at three bores (CRD0046, CRD0133, and CRD0146) were compared to data from three surface pools (CO-WS-16, CO-WS-19, and CO-WS-20). Refer to Appendix C – Groundwater Quality Report for more detail.

The comparison used the most recent data from the surface pools alongside data collected from the bores during the pumping tests. As the data collection periods do not overlap, this introduces some uncertainty; however, the surface pool data has remained stable over time. The key findings from this comparison, based on the time series are summarised below:

- Physical parameters
 - EC
 - EC values observed in bores during the pumping tests ranged from 246 to 446 $\mu\text{S}/\text{cm}$, while surface pools showed higher concentrations, ranging from 486 to 3,080 $\mu\text{S}/\text{cm}$. The elevated EC levels in surface pools, particularly in CO-WS-19 and CO-WS-20 (both exceeding 1,390 $\mu\text{S}/\text{cm}$), are likely due to exposure to atmospheric conditions.
 - pH and alkalinity
 - Pools CO-WS-19 and CO-WS-20 exhibited higher pH values (above 8.13) and elevated alkalinity levels (>220 mg/L of CaCO_3), whereas pool CO-WS-16 had pH values closer to those of the pumped bores, ranging from slightly acidic to neutral (6.36–7.05).
- Major Ions
 - Water Facies
 - Pool CO-WS-20 exhibited a distinct chemistry compared to the bores, positioned near the boundary between magnesium sulfate and sodium bicarbonate water facies. This pool also displayed higher concentrations of chloride and sodium.
 - Pools CO-WS-16 and CO-WS-19 tended to fall within the same water facies category as the pumped groundwater.
- Metals
 - Most metals were below the laboratory detection limit in both surface pools and bore samples.
 - An exception was Iron, which was consistently detected in all samples and exceeded the ADWG aesthetic threshold in pool CO-WS-16, as well as in bores CRD0046 and CRD0133.
- Other analytes
 - Two samples have been taken at Pool CO-WS-20 between November 2022 and November 2023. Both samples have recorded elevated values for the hydrocarbons in the C16–C34 faction.

Table A.1 Pool Locations and sampling counts

Location ID	Sample Type	Bore type	Area	Easting	Northing	Elevation	Date Range	Labs counts 2014-2019	Labs counts 2020-2025	Field counts 2020-2025
CO-WS-01	Field and Laboratory Sample	Surface Pool	Processing Plant	778,585.5	7,630,036.1	245.781	Jul-2017 - Nov-2024	10	9	1
CO-WS-03	Only Laboratory sample	Surface Pool	Camp	778,502.8	7,633,945.9		Jul-2017	1		1
CO-WS-05	Only Laboratory sample	Surface Pool	Sparrow Lake	773,497.2	7,623,864.3		Jul-2017 - Feb-2019	9		1
CO-WS-08	Only Laboratory sample	Surface Pool	Shark Gully	774,737.3	7,625,528.5		Aug-2017 - Feb-2019	8		
CO-WS-09	Only Laboratory sample	Surface Pool	Sparrow Lake	776,575.5	7,622,976.9		Jul-2017	1		1
CO-WS-10	Field and Laboratory Sample	Surface Pool	Runway	777,454.7	7,629,433.6	297.225	Oct-2017 - May-2023	11	5	19
CO-WS-11	Only Laboratory sample	Surface Pool	Runway	777,516.0	7,626,869.5		Jul-2017 - Feb-2019	9		1
CO-WS-12	Field and Laboratory Sample	Surface Pool	Runway	777,069.5	7,629,034.2		Aug-2017 - Feb-2019	11		
CO-WS-13	Only Laboratory sample	Surface Pool	Sparrow Lake	774,459.5	7,623,889.6		Jul-2017 - Feb-2019	7		1
CO-WS-14	Field and Laboratory Sample	Surface Pool	Razorback	776,807.7	7,623,724.5	320.99	Aug-2017 - Nov-2024	13	9	
CO-WS-16	Field and Laboratory Sample	Surface Pool	Glen Herring	775,125.0	7,632,628.0		Nov-2022 - Nov-2023			2
CO-WS-19	Field and Laboratory Sample	Surface Pool	Glen Herring	775,735.0	7,632,980.0		Nov-2022 - Nov-2023			2
CO-WS-20	Field and Laboratory Sample	Surface Pool	Glen Herring	771,602.0	7,632,367.0		Nov-2022 - Nov-2023			2
CO-WS-33	No sample collected	Surface Pool	Runway	775,158.0	7,628,548.0		N/A			
CO-WS-34	No sample collected	Surface Pool	Runway	775,305.0	7,628,569.0		N/A			

1.3 Radiocarbon isotope analysis

A radiocarbon isotope analysis was conducted by the University of Western Australia (UWA) on behalf of Atlas. The resulting report provided insights related to groundwater age determination and the characterisation of groundwater-surface water interactions in the Sanjiv Ridge area.

Isotope analysis was completed on five previous identify sensitive receptors and six groundwater locations, most of them adjacent to the sampled sensitive receptors, from five different areas at Sanjiv Ridge. Refer to Appendix C – Groundwater Quality Report for more detail.

Sensitive receptors are known to be points of discharge from the aquifer units.

The premise of the report was to assess the age of the groundwater from bores to determine groundwater flow patterns and to characterise the surface pools for relative proportions of surface water and groundwater. The main conclusions of the report and summary tables (Table A.2) are given below.

The report conclusions of groundwater age:

- Groundwater samples exhibit signatures dominated by carbonate dissolution, creating uncertainty in the dating for groundwater age.
- The spatial and depth relationships of these results are inconclusive in terms of delineating groundwater flow patterns using age.
- No clear distinctions in the ages seen between these groups to indicate a north-south trend in proximity to recharge.
- Spatially close bores demonstrate very different groundwater ages.

Table A.2 Radioisotope conclusions

Surface water pools	Area	Contact lithology ¹	Likely GW contributions ²
CO-WS-01	Processing Plant	Mount Roe Basalt/Cleaverville	Likely GW input
CO-WS-10	Runway	Cleaverville Formation	Minimal GW input
CO-WS-14	Razorback	Cleaverville Formation	Dominated by GW input
CO-WS-16	Glen Herring	Cleaverville Formation	Dominated by GW input
CO-WS-19	Glen Herring	Lalla Rookh Sandstone	Minimal GW input

Sources: UWA

Notes: GW = Groundwater.

¹ As per DMIRS.

² Compared to the carbon signatures within the Clearville Formation

Appendix B Drilling and Pumping Test Results

Final

Drilling and Pumping Test Results

Sanjiv Ridge Below Water Table Mining Hydrogeology WA, Australia
Study,
Atlas Iron Pty Ltd



SRK Consulting (Australasia) Pty Ltd ■ ATL009 ■ July 2025

Final

Drilling and Pumping Test Results

Sanjiv Ridge Below Water Table Mining Hydrogeology Study, WA, Australia

Prepared for:

Atlas Iron Pty Ltd
1314 Hay Street
West Perth, WA, 6005
Australia

+61 8 6228 8000
www.atlasiron.com.au



Prepared by:

SRK Consulting (Australasia) Pty Ltd
Level 3, 18–32 Parliament Place
West Perth, WA, 6005
Australia

+61 8 9288 2000
www.srk.com

ABN. 56 074 271 720

Lead Author: Pedro Di Liscia/Cris Fock **Initials:** PdL&CF
Reviewer: Julie Trembleau/Richard Cheal **Initials:** JT&RC

File Name:

ATL009_SMR Field Report_Rev3.docx

Suggested Citation:

SRK Consulting (Australasia) Pty Ltd. 2025. Drilling and Pumping Test Results. Final. Prepared for Atlas Iron Pty Ltd: West Perth, WA. Project number: ATL009. Issued July. 2025.

Copyright © 2025

SRK Consulting (Australasia) Pty Ltd ■ ATL009 ■ July 2025

Disclaimer: The opinions expressed in this Report have been based on the information supplied to SRK Consulting (Australasia) Pty Ltd (SRK) by Atlas Iron Pty Ltd. The opinions in this Report are provided in response to a specific request from Atlas Iron Pty Ltd to do so. SRK has exercised all due care in reviewing the supplied information. While SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this Report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Contents

Useful Definitions	vii
1 Introduction	1
2 Field program methodology	2
2.1 Drilling program	2
2.2 Pumping test program	2
2.3 Approvals and ground disturbances	3
3 Water bore drilling and construction	6
3.1 Bore details	6
3.1.1 Sparrow Lake Pit and Razorback Pit	6
3.1.2 Runway Pit	15
3.1.3 Glen Herring	18
4 Pumping tests	26
4.1 Methodology	26
4.2 Pumping test analysis	29
4.2.1 Glen Herring area	29
4.2.2 Sparrow Lake / Razorback area	35
4.2.3 Runway area	43
5 Summary	48

Tables

Table 2.1:	Summary of the locations for the 2024 drilling program	4
Table 3.1:	CRDTA0143 geology	8
Table 3.2:	CRD0144 geology	9
Table 3.3:	CRD0145 geology	9
Table 3.4:	CRD0139 geology	10
Table 3.5:	CRDTA0141 geology	11
Table 3.6:	CRD0143 geology	12
Table 3.7:	CRD0151 geology	13
Table 3.8:	CRD0140 geology	13
Table 3.9:	CRD0142 geology	14
Table 3.10:	CRD0150 geology	14
Table 3.11:	CRD0141 geology	15
Table 3.12:	CRD0137 geology	17
Table 3.13:	CRD0149 geology	18
Table 3.14:	CRD0132 geology	20
Table 3.15:	CRD0130 geology	21
Table 3.16:	CRD0146 geology	22
Table 3.17:	CRD0131 geology	22
Table 3.18:	CRD0154 geology	23
Table 3.19:	CRD0133 geology	24
Table 3.20:	CRD0147 geology	25
Table 3.21:	CRD0148 geology	25
Table 4.1:	Production bore test flow rates and set up	26
Table 4.2:	Bore CRD0146 pumping test parameters	29
Table 4.3:	Distance to pumping bore and maximum drawdown during pumping test for bore CRD0146	31
Table 4.4:	Inferred hydraulic parameters for bore CRD0146	31
Table 4.5:	Bore CRD0046 pumping test parameters	32
Table 4.6:	Distance to pumping bore and maximum drawdown during pumping test for bore CRD0046	32
Table 4.7:	Inferred hydraulic parameters for bore CRD0046	33
Table 4.8:	Bore CRD0133 pumping test parameters	34
Table 4.9:	Distance to pumping bore and maximum drawdown during the pumping test for bore CRD0133	34
Table 4.10:	Inferred hydraulic parameters for bore CRD0133	35
Table 4.11:	Bore CRD0143 pumping test parameters	36
Table 4.12:	Distance to pumping bore and maximum drawdown during pumping test for bore CRD0143	38
Table 4.13:	Inferred hydraulic parameters for bore CRD0143	39
Table 4.14:	Bore CRD0141 pumping test parameters	40
Table 4.15:	Distance to pumping bore and maximum drawdown during pumping test for bore CRD0141	40
Table 4.16:	Inferred hydraulic parameters for bore CRD0141	41
Table 4.17:	Summary of Sparrow Lake geotechnical bores details and Packer test configuration	43
Table 4.18:	Bore CRD0137 pumping test parameters	45
Table 4.19:	Distance to pumping bore and maximum drawdown during pumping test for bore CRD0137	45
Table 4.20:	Inferred hydraulic parameters for bore CRD0137	46
Table 4.21:	Summary of Runway geotechnical bores details and Packer test configuration	47
Table 5.1:	Summary of hydraulic parameters calculated in the Glen Herring Pit area	48
Table 5.2:	Summary of hydraulic parameters calculated in the Sparrow Lake Pit area	49
Table 5.3:	Summary of hydraulic parameters calculated in the Runway Pit area	49

Figures

Figure 2.1: Locations of bores drilled at the Project	5
Figure 3.1: Locations of bores in the Sparrow Lake Pit and Razorback Pit areas	7
Figure 3.2: Location of bores in Runway Pit area	16
Figure 3.3: Location of bores in the Glen Herring area	19
Figure 4.1: Glen Herring tested bores and monitoring bores	30
Figure 4.2: Sparrow Lake tested bores and monitoring bores	37
Figure 4.3: Corrected water levels in bores CRD0091 and CRD0099 before and after the pumping tests.....	42
Figure 4.4: Runway tested bores and monitoring bores	44

Appendices

Appendix A	Borehole logs
Appendix B	Chip tray photographs
Appendix C	Pumping test analytical report
Appendix D	Borehole completion photographs
Appendix E	Packer Test data

Useful Definitions

This list contains the list of geology acronyms used in the logs and tables.

Atlas	Atlas Iron Pty Ltd
BIF	banded iron formation
CLY	clay
cm	centimetres
CRT	constant rate test
EC	electrical conductivity
EOH	end of hole
GOH	hard, dense, massive goethite
GOM	moderate hardness, bedded goethite
HEH	hard, dense, massive hematite
HEM	moderate hardness, bedded hematite
HES	siliceous hematite
HGF	friable, porous, faint bedding goethitic-hematite
HGH	hard, dense, massive goethitic-hematite
HGM	moderate hardness, bedded goethitic-hematite
LMF	friable, porous, faint bedding limonite
LMH	hard, dense, massive limonite
LMM	moderate hardness, bedded limonite
L/s	litres per second
mbgl	metres below ground level
mbTOC	metres below top of casing
mm	millimetres
m/day	metres per day
m ² /day	square metres per day
mRL	reduced level in metres
OVERBURDEN	the layer of soil, rock, or sediment that sits on top of the area
PAF	potentially acid forming
QTZ	quartz
SRK	SRK Consulting (Australasia) Pty Ltd
SRT	step rate test
SWL	standing water level
µS/cm	micro siemens per centimetre
%	per cent

1 Introduction

Atlas Iron Pty Ltd (Atlas) is currently developing the Sanjiv Ridge (formally Corunna Downs) project (the Project) located in the Pilbara Region of Western Australia from Phase 4 (above the water table) into Phase 5 (below the water table). The Project involves the mining of iron ore from five open pits using conventional drill and blast methods. Atlas previously engaged SRK Consulting (Australasia) Pty Ltd (SRK) to complete hydrogeological drilling, testing and modelling during the Phase 4 mining studies that were completed in 2019. Atlas further engaged with SRK during 2023 and 2024 on the following Phase 5 studies:

- hydrogeological drilling and testing
- surface water catchment characterisation and flood modelling
- pit void water balance modelling
- geochemical review, assessment and analysis.

This report focuses on the hydrogeological drilling and testing program completed between January and October 2024. The program initially planned for the drilling of 19 DN 8" (200 mm) diameter pilot holes, but ultimately included 21 bores, as 2 had to be redrilled. Based on the encountered lithology and airlift yields, the pilot bores were completed with different designs that comprised:

- reaming 5 pilot bores to DN 12" (300 mm) diameter to allow the installation of DN 8" (200 mm) production bore casing. Each of the 5 production bores were complemented with a 3-day pumping test to characterise the identified aquifers.
- construction of 13 monitoring bores completed with either DN 2" (50 mm) or DN 4" (100 mm)
- 3 of the pilot bores collapsed due to unstable lithological conditions.

2 Field program methodology

2.1 Drilling program

The drilling program commenced on 9 January 2024. Drilling was undertaken with the objectives of developing dewatering targets, water supply targets, expanding the existing monitoring network and providing additional aquifer characterisation to support approvals for below water table development. Atlas appointed SRK to provide technical oversight of the drilling and construction of all bores and pumping tests.

All drilling was conducted by the contractor FORACO Australia Pty Ltd predominantly using air rotary drilling. Occasionally shallow sections of bores needed to be drilled with mud rotary to mitigate against unstable ground conditions.

Holes were drilled to the planned depth, or deeper in cases where the yield was insufficient or where yield was increasing. Drill cuttings were collected every 2 m, and geological characteristics were logged throughout the drilling process. Airlift yield and water quality parameters were recorded during drilling, after the first water strike, during rod changes, and during the development of each bore or during the pumping test.

Monitoring bores were constructed using DN 2" (50 mm) or DN 4" (100 mm) diameter class 18 PVC casing, while production bores were constructed using DN 8" (200 mm) diameter class 18 PVC casing. After completion, bores were developed using airlift methods until clear of fines, foam or mud. During this period, physiochemical parameters (electrical conductivity – EC, temperature and pH) were recorded as development of the hole progressed; water samples collected at the end of the development were sent to the laboratory for analysis.

Drilling of the first pilot bore (CRDTA0143) began on 11 January 2024, and the final monitoring bore (CRD0148) was installed on 6 July 2024. The program was based on the 2023 SMR Drilling Scope provided by Atlas, comprising the drilling of 21 bores, including pilot, monitoring, and production bores.

Yields and water quality results are summarised in Table 2.1 and locations are shown in Figure 2.1.

In Q2 2025, 13 geotechnical bores commissioned by Atlas were drilled across the Sanjiv Ridge pits. Of these bores, 5 were selected by SRK to undergo packer testing. At the time of writing, three tests had been completed in 2 bores at Runway Pit – the outcomes are described in section 4.2.3.

2.2 Pumping test program

Following completion of the drilling program, a pumping test program was conducted in two stages due to the pumping test contractors' availability. The first testing stage took place from 19 September 2024 to 8 October 2024 and was located in Glen Herring and was performed by Flow Water Services. The second testing stage occurred from 24 October 2024 to 15 November 2024 and was located in the Sparrow Lake and Runway areas and was carried out by Airwell Group. Technical oversight for both pumping test stages was completed by SRK.

The program consisted of six pumping tests – five pumping tests were in bores drilled during the drilling program and one additional test was conducted at a pre-existing bore (CRD0046 – also

known as Dingo Bore). Each pumping test started with a step test comprised of four 1-hour steps, followed by a 3-day constant rate test and a recovery test.

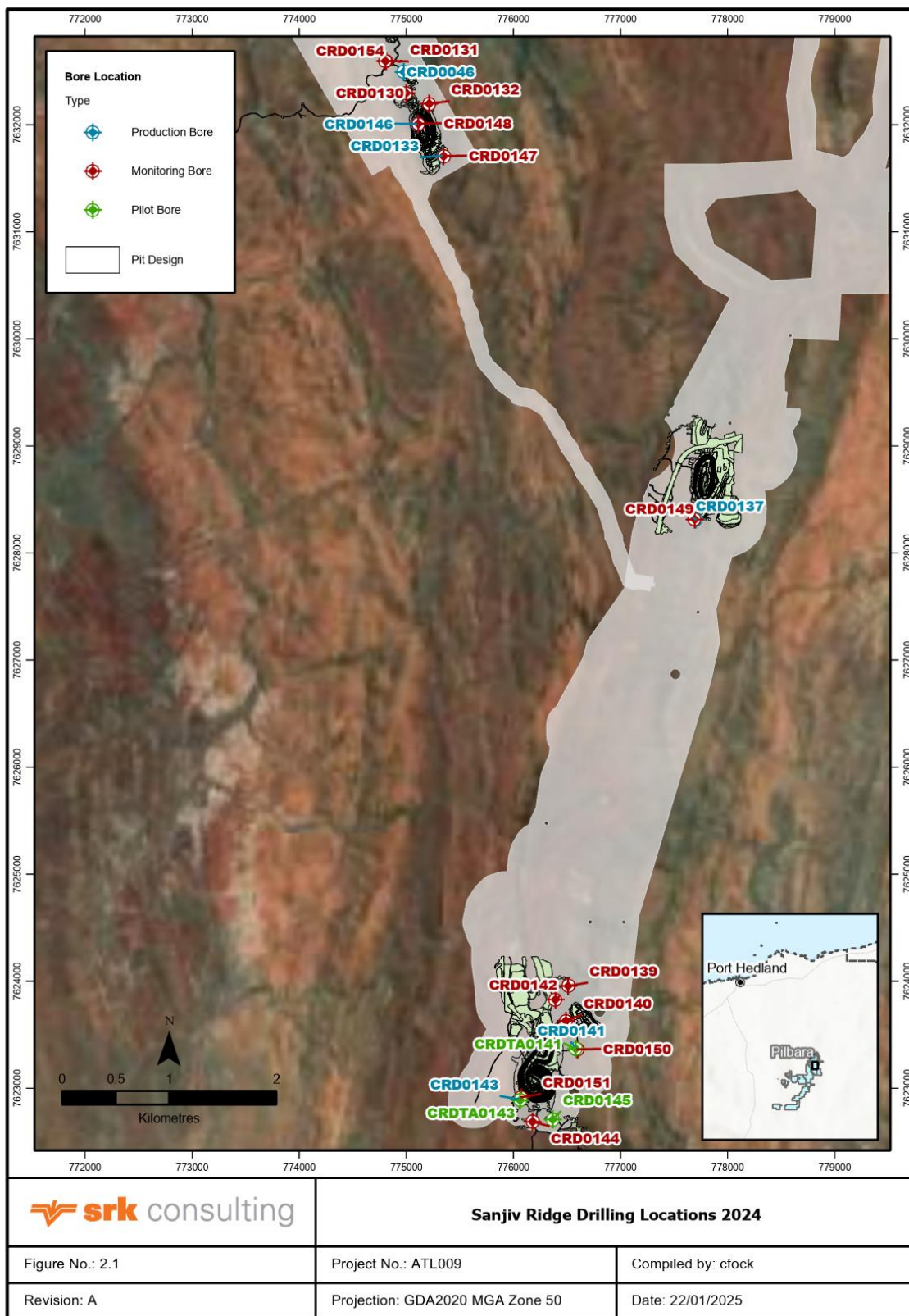
2.3 Approvals and ground disturbances

1. 26d (CAW209548) approved on 19 January 2024 for as many exploration, monitoring and supply bores as required on M45/1257.
2. POW (120471) approved on 22 September 2023 for tenement M45/1257.

Table 2.1: Summary of the locations for the 2024 drilling program

Hole ID	Bore location	Purpose	East (GDA2020 MGA Zone 50)	North (GDA2020 MGA Zone 50)	Elevation (mRL)	Start date	End date	EOH depth (mbgl)	Hole diameter (mm)	Screen diameter (mm)	Screened section (mbgl)	First water strike (mbgl)	Final EC (µS/cm)	Final pH	Estimated flow (L/s)	Comments
CRDTA0143	Sparrow Lake	Pilot hole	776068.0	7622893.0	-	11/01/2024	13/01/2024	186	203.2	-	-	62	574	7.63	20	Pilot bore collapsed and was abandoned (now under haul road). Pilot bore was at the same pad as CRD0143 and CRD0150.
CRD0144	Sparrow Lake	Monitoring	776183.8	7622692.4	439.3	14/01/2024	18/01/2024	186	203.2	101.6	89–185	84	303	-	1	Non-artesian monitoring bore
CRD0145	Sparrow Lake	Pilot hole	776372.4	7622713.3	434.6	18/01/2024	22/01/2024	192	203.2	-	-	96	624.8	7.68	22	Pilot bore collapsed and was abandoned (the hole is still open); decommissioning pending.
CRD0139	Sparrow Lake / Razorback	Monitoring	776515.2	7623959.6	424.8	01/02/2024	02/02/2024	126	203.2	101.6	34–126	Dry	-	-	-	Non-artesian monitoring bore
CRDTA0141	Sparrow Lake / Razorback	Pilot hole	776587.0	7623373.0	-	04/02/2024	10/02/2024	198	203.2	-	-	96	667.2	8.05	20	Pilot bore collapsed and was abandoned and decommissioned. Pilot bore was at the same pad as CRD0141 and CRD0151.
CRD0143	Sparrow Lake	Production	776061.9	7622901.2	404.5	16/02/2024	07/03/2024	186	304.8	203.2	73–183.6	53	-	-	-	Non-artesian production bore
CRD0151	Sparrow Lake	Monitoring	776078.5	7622920.9	404.0	08/03/2024	10/03/2024	122	203.2	101.6	44–122	62	-	-	-	Non-artesian, monitoring bore next to production bore CRD0143.
CRD0140	Sparrow Lake / Razorback	Monitoring	776494.5	7623633.6	423.3	13/03/2024	16/03/2024	198	203.2	101.6	66–198	86	960.3	8.13	10	Non-artesian monitoring bore
CRD0142	Sparrow Lake / Razorback	Monitoring	776397.3	7623833.4	429.6	17/03/2024	20/03/2024	198	203.2	101.6	66–198	98	567.6	9.23	0.43	Non-artesian monitoring bore
CRD0150	Sparrow Lake / Razorback	Monitoring	776604.6	7623368.0	429.4	31/03/2024	03/04/2024	198	203.2	101.6	96–198	110	2890	9.03	1	Non-artesian, monitoring bore next to production bore CRD0141.
CRD0141	Sparrow Lake / Razorback	Production	776597.3	7623367.1	429.6	05/04/2024	20/04/2024	198	304.8	203.2	84–198	90	1050	8.27	7	Non-artesian production bore
CRD0137	Runway	Production	777708.4	7628315.5	398.8	22/04/2024	29/04/2024	208	304.8	203.2	82–208	82	453.4	8.47	4.6	Non-artesian production bore
CRD0149	Runway	Monitoring	777696.9	7628315.4	399.1	02/05/2024	08/05/2024	212	203.2	101.6	84–210	80	588	7.77	1	Non-artesian, monitoring bore next to production bore CRD0137.
CRD0132	Glen Herring	Monitoring	775219.1	7632196.1	401.7	13/05/2024	16/05/2024	158	203.2	101.6	106–136	116	789	8.44	4.6	Non-artesian monitoring bore
CRD0130	Glen Herring	Monitoring	775003.7	7632293.8	395.5	19/05/2024	23/05/2024	198	203.2	101.6	101–197	114	769	7.7	6	Non-artesian monitoring bore
CRD0146	Glen Herring	Production	775113.0	7632005.2	405.1	24/05/2024	31/05/2024	164	304.8	203.2	108.5–162.5	122	793	6.45	7	Non-artesian production bore
CRD0131	Glen Herring	Monitoring	774818.0	7632595.4	356.4	01/06/2024	03/06/2024	186	203.2	101.6	75.2–87.2	150	630	6.95	5	Non-artesian monitoring bore on the same pad as CRD0154 (deep monitoring bore).
CRD0154	Glen Herring	Monitoring	774810.2	7632594.4	356.8	08/06/2024	08/06/2024	64.5	203.2	101.6	58.5–64.5	Dry	-	-	-	Non-artesian monitoring bore on the same pad as CRD0131 (shallow monitoring bore).
CRD0133	Glen Herring	Production	775346.9	7631708.6	420.8	13/06/2024	19/06/2024	176	304.8	203.2	116–176	104	497	8.32	4	Non-artesian production bore
CRD0147	Glen Herring	Monitoring	775353.8	7631706.6	420.6	22/06/2024	24/06/2024	174	203.2	101.6	114–172.5	108	-	-	-	Non-artesian, monitoring bore next to production bore CRD0133.
CRD0148	Glen Herring	Monitoring	775117.3	7632009.5	405.1	04/07/2024	06/07/2024	164	203.2	101.6	107–161	108	-	-	-	Non-artesian, monitoring bore next to production bore CRD0146.

Figure 2.1: Locations of bores drilled at the Project



File path: C:\Users\cfock\OneDrive - SRK Consulting\Documents\000_Cristobal\SRK_Projects_Local\ATL009_Local\GIS\Hydrogeology\ATL009_Hydrogeo_Figures\ATL009_Hydrogeo_Figures.aprx

3 Water bore drilling and construction

3.1 Bore details

Of the 21 bores drilled, 5 were selected to be converted to production bores and 13 were selected to be converted to monitoring bores. The 3 remaining bores were pilot bores and were abandoned due to collapse. The three areas where drilling occurred were the:

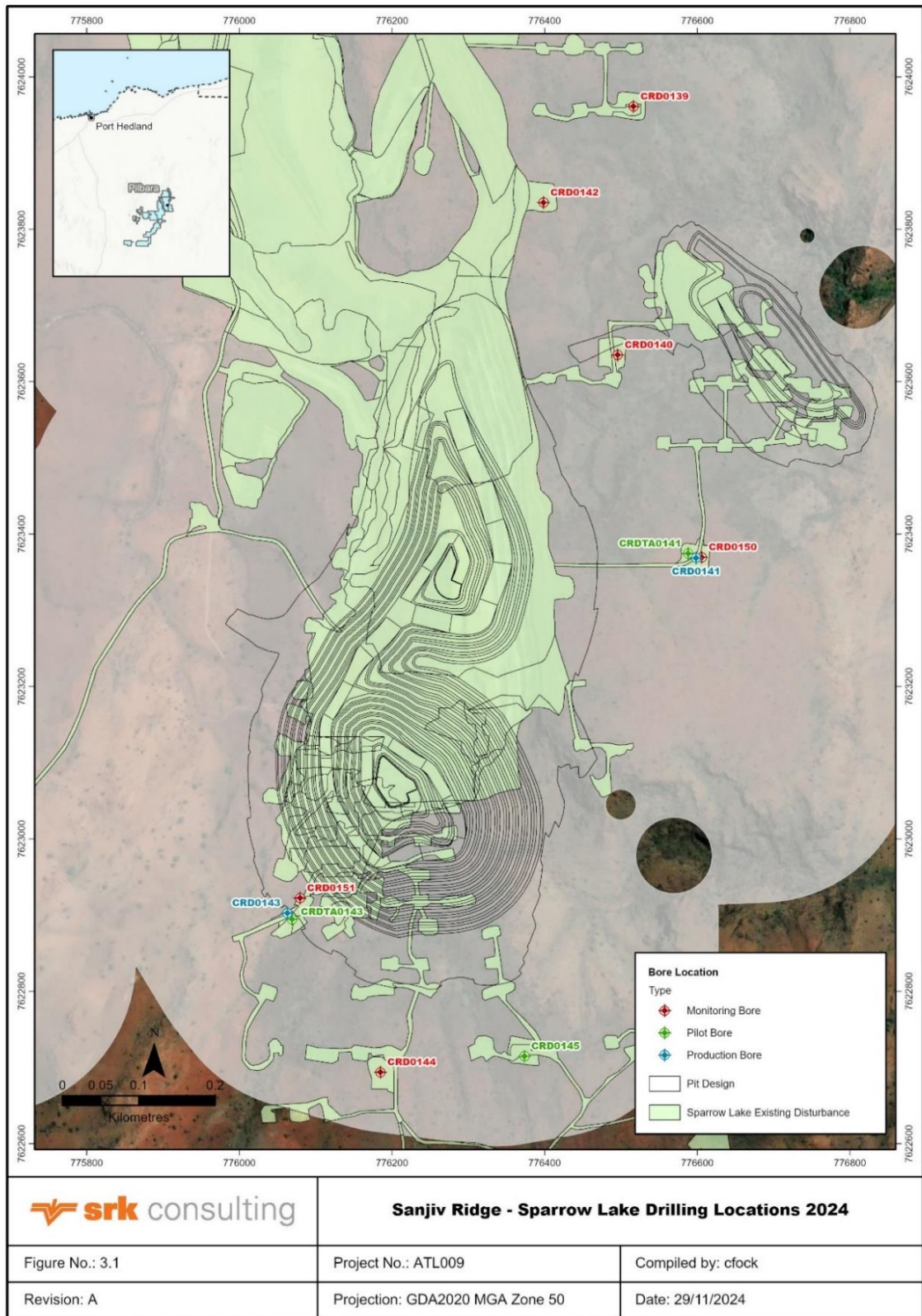
- Sparrow Lake Pit and Razorback Pit
- Runway Pit
- Glen Herring area.

The following sections present a summary of the lithology and construction designs of the bores. The complete logs are presented in Appendix A, and chip tray photographs are presented in Appendix B.

3.1.1 Sparrow Lake Pit and Razorback Pit

Drilling in the Sparrow Lake Pit area began on 11 January 2024 and ended on 20 April 2024. Three pilot holes, two production bores and six monitoring bores were drilled and constructed. The locations are represented in Figure 3.1.

Figure 3.1: Locations of bores in the Sparrow Lake Pit and Razorback Pit areas



Pilot hole CRDTA0143

Drilling operations for borehole CRDTA0143 commenced on 11 January 2024 and concluded on 13 January 2024. The borehole was drilled using air rotary to a depth of 186 mbgl but collapsed the following day due to soft ground conditions. The initial water strike occurred at 72 mbgl, with a yield of 0.45 L/s. Water yields increased with depth and reached a maximum of 20 L/s at the final depth. The water encountered was classified as fresh, with EC values ranging between 290 µS/cm and 594 µS/cm. The pH levels varied between 7.3 and 8.08, indicating slightly basic conditions. A summary of the geological findings is presented in Table 3.1.

Table 3.1: CRDTA0143 geology

Metres	Description	Hydrostratigraphic unit
0–4	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, strongly weathered, yellow-brown, sub-angular, non-foliated.	Cover
4–34	Goethite, dense and massive, brown-yellow, soft to drill. Main lithology: GOH 100%, moderately weathered, yellow-brown, sub-angular, non-foliated.	Aquitard
34–72	Goethitic-hematite, brown-grey, 2 cm quartz crystals. Main lithology: HGH 95%, moderately weathered, grey-brown, sub-angular, non-foliated.	Aquitard
72–160	Chert (BIF), high silica, steel grey, concave fracture. Main lithology: CHERT 90%, weakly weathered, grey, angular, slight foliation.	Aquifer
160–186	Black shale, presence of small crystals of pyrite. During drilling: foam turned grey, smell like sulfur, soft rock to drill. Slightly foliated. Presence of powdery nodules (some kind of clay?). Main lithology: SHALE 97%, weakly weathered, black, angular, foliated.	Aquifer

This bore was not installed due to the hole collapsing post-drilling. Consequently, it was abandoned after the drilling, necessitating a redrill a few metres away from the initial attempt. This hole was decommissioned, backfilled and is now located under the recently constructed haul road.

Monitoring bore CRD0144

Drilling operations for borehole CRD0144 commenced on 14 January 2024 and concluded on 18 January 2024. The borehole was drilled to a depth of 186 mbgl using air rotary drilling. The initial water strike occurred at 84 mbgl, and water yields varied with depth but did not exceed 1.25 L/s. The water encountered was classified as fresh, with EC values ranging from 268 µS/cm to 580 µS/cm, and an EC value of 303 µS/cm at the end of the borehole. Only two pH levels were measured – at 84 mbgl and 90 mbgl – because the field pH equipment was uncalibrated. The pH values were 7.51 and 7.81, indicating slightly basic conditions. A summary of the geological findings is presented in Table 3.2.

Table 3.2: CRD0144 geology

Metres	Description	Hydrostratigraphic unit
0–2	Goethitic-hematite, brown-grey. Main lithology: OVERBURDEN 95%, moderately weathered, khaki brown, sub-angular, non-foliated.	Cover
2–86	Main lithology: HGH 95%, moderately weathered, khaki brown, sub-angular, non-foliated.	Aquitard
86–186	Chert (BIF), high silica, steel grey, concave fracture, bands of silica and hematite. Main lithology: CHERT 90%, weakly weathered, grey, angular, slight foliation.	Aquifer

Pilot hole CRD0145

Drilling at borehole CRD0145 began on 18 January 2024 and concluded on 22 January 2024. The borehole was drilled to a depth of 192 mbgl. The first water strike occurred at 96 mbgl and yielded 2.5 L/s. The water exhibited freshwater conditions with an EC value ranging between 598.4 $\mu\text{S/cm}$ and 745.5 $\mu\text{S/cm}$, and a pH between 6.94 and 8.5, indicating basic to slightly basic conditions. Towards the end of the borehole, the yield increased significantly to be close to 21 L/s. The geology is summarised in Table 3.3.

Table 3.3: CRD0145 geology

Metres	Description	Hydrostratigraphic unit
0–8	Dark red brown, very hard. Main lithology: OVERBURDEN 100%, moderately weathered, red-brown, sub-angular, non-foliated.	Cover
8–30	Main lithology: GOH 100%, moderately weathered, red-brown, sub-angular, non-foliated.	Aquitard
30–50	Main lithology: HGH 100%, moderately weathered, red-brown, angular, non-foliated.	Aquitard
50–54	Main lithology: GOH 100%, moderately weathered, yellow-brown, angular, non-foliated.	Aquitard
54–96	Water strike at approximately 96 m. Main lithology: HEH 95%, weakly weathered, purple, sub-angular, non-foliated.	Aquitard
96–160	Hematite, red and grey. Main lithology: HGH 100%, weakly weathered, red-brown, angular, non-foliated.	Aquifer
160–192	Main lithology: BASALT 100%, weakly weathered, grey, angular, non-foliated.	Aquifer

Note: HEH – hard, dense, massive hematite.

Although the yield was high in this bore, unstable ground conditions (that started at 156 mbgl) made the hole collapsed at around 30 m. CRD0145 was abandoned and remains open at approximately 30 m.

Monitoring bore CRD0139

Drilling at CRD0139 began on 1 February 2024 and ended on 2 February 2024. The hole was drilled and installed to 126 mbgl. No significant water strike was encountered and this bore was declared dry. The geology is summarised in Table 3.4.

Table 3.4: CRD0139 geology

Metres	Description	Hydrostratigraphic unit
0–10	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, moderately weathered, red-brown, sub-angular, non-foliated.	Cover
10–44	Goethite, dense and massive, brown-yellow, soft to drill. Main lithology: GOH 100%, moderately weathered, yellow-brown, sub-angular, non-foliated.	Aquitard
44–76	Massive, steel grey with red brown. Main lithology: HGH 100%, moderately weathered, grey-brown, sub-angular, non-foliated.	Aquitard
76–90	Main lithology: CHERT 100%, weakly weathered, grey-black, angular, slight foliation.	Aquitard
90–96	Black Shale, presence of small crystal of pyrite. Main lithology: SHALE 97%, weakly weathered, black, angular, slight foliation.	Aquitard
96–126	Main lithology: CHERT 100%, weakly weathered, grey-black, angular, slight foliation.	Aquitard

Notes: GOH – hard, dense, massive goethite; HGH – hard, dense, massive goethitic-hematite.

Pilot hole CRDTA0141

Drilling operations for CRDTA0141 commenced on 4 February 2024, and concluded on 10 February 2024. The borehole was drilled to a depth of 198 mbgl using air rotatory but collapsed the following day, due to soft ground conditions. The initial water strike occurred at 96 mbgl, and had a yield of 3.33 L/s. Water yields increased with depth and reached a maximum of 20 L/s at the final depth. The water encountered was classified as fresh, with EC values ranging between 651.2 $\mu\text{S}/\text{cm}$ and 723.4 $\mu\text{S}/\text{cm}$, and having a value of 667.3 $\mu\text{S}/\text{cm}$ at the end of the hole. The pH levels varied between 7.87 and 8.05, indicating slightly basic conditions. A summary of the geological findings is presented in Table 3.5.

Table 3.5: CRDTA0141 geology

Metres	Description	Hydrostratigraphic unit
0–18	Main lithology: HGH 100%, weakly weathered, red-brown, angular, non-foliated.	Cover
18–34	Very meteorised, presence of powdery nodules (clay?). Main lithology: HGF 95%, strongly weathered, grey, sub-rounded, non-foliated.	Aquitard
34–62	Main lithology: HGM 100%, moderately weathered, brown, sub-angular, very slight foliation.	Aquitard
62–96	Presence of powdery nodules probably from 18–34 m depth (chip tray 80–82 m). Main lithology: HGH 95%, moderately weathered, brown, sub-angular, non-foliated.	Aquitard
96–158	Also presence of powdery nodules. Main lithology: CHERT 100%, fresh rock, grey, angular, non-foliated.	Aquifer
158–198	Presence of glassy green crystals (quartz and chlorite). Sample of powdery nodules in the last tray. Main lithology: CHERT 85%, fresh rock, grey, angular, foliated.	Aquifer

This bore was not installed due to the hole collapsing post-drilling. Consequently, it was abandoned and backfilled during the earthworks required to redrill the bore a few metres away from the initial attempt.

Production bore CRD0143

Drilling operations for borehole CRD0143 commenced on 16 February 2024 and concluded on 7 March 2024. The borehole was drilled to a depth of 186 mbgl, using mud rotary for the first 72 m of drilling. Once the casing was successfully installed, drilling continued using air rotary to total depth. No airlifts were performed due to the instabilities encountered during the first attempt to drill bore CRDTA0143 located 10 m away. As a result, no EC or pH data were collected. A summary of the geological findings is presented in Table 3.6.

Table 3.6: CRD0143 geology

Metres	Description	Hydrostratigraphic unit
0–4	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, strongly weathered, yellow-brown, sub-angular, non-foliated.	Cover
4–18	Goethite, dense and massive, brown-yellow, some QTZ of up to 2 cm. Main lithology: GOH 98%, strongly weathered, yellow-brown, sub-angular, non-foliated.	Aquitard
18–22	Goethitic-hematite, dense and massive, hard, brown-grey. Main lithology: HGH 100%, strongly weathered, grey-brown, angular, non-foliated.	Aquitard
22–28	Goethite, dense and massive, brown-yellow, some QTZ of up to 2 cm. Main lithology: GOH 100%, strongly weathered, yellow-brown, sub-angular, non-foliated.	Aquitard
28–46	Goethitic-hematite, dense and massive, hard, brown-grey. Main lithology: HGH 100%, moderately weathered, grey-brown, angular, non-foliated.	Aquitard
46–70	Goethite, sub-angular chips. Main lithology: GOH 95%, strongly weathered, yellow-brown, sub-angular, non-foliated.	Aquitard
70–122	High silica, steel grey, some goethite, banded. Main lithology: CHERT 97%, weakly weathered, grey, angular, banded (BIF).	Aquifer
122–146	Black to grey shale. Slightly foliated, angular chips. Main lithology: SHALE 100%, weakly weathered, black, angular, slight foliation.	Aquifer
146–164	High silica, steel grey, some goethite. Main lithology: CHERT 97%, weakly weathered, grey, angular, banded (BIF).	Aquifer
164–186	Black to grey shale, slightly foliated, angular chips. Main lithology: SHALE 100%, weakly weathered, black, angular, slight foliation.	Aquifer

This bore was constructed as a production bore due to the high yield. The final yield of the bore after construction was close to 14 L/s.

Monitoring bore CRD0151

Drilling at CRD0151 began on 8 March 2024 and ended on 10 March 2024. This borehole was drilled in the same pad as the production bore CRD0143, and was drilled up to 122 mbgl and installed as a monitoring bore. The first water strike occurred at 62 mbgl. In agreement with Atlas, EC, pH and yield were not recorded due to the proximity of production bore CRD0143. The geology is summarised in Table 3.7.

Table 3.7: CRD0151 geology

Metres	Description	Hydrostratigraphic unit
0–14	Main lithology: GOH 100%, strongly weathered, yellow-brown, sub-angular, non-foliated.	Cover
14–16	Main lithology: GOH 100%, moderately weathered, pink, sub-angular, non-foliated.	Aquitard
16–24	Main lithology: GOH 100%, moderately weathered, yellow-brown, sub-angular, non-foliated.	Aquitard
24–46	Main lithology: HGH 100%, moderately weathered, grey-brown, angular, non-foliated.	Aquitard
46–82	Main lithology: CHERT 80%, fresh rock, grey-brown, angular, non-foliated.	Aquitard
82–122	High silica, steel grey, quartz crystals. Main lithology: CHERT 80%, fresh rock, grey, angular, non-foliated.	Aquifer

Monitoring bore CRD0140

Drilling operations for borehole CRD0140 commenced on 13 March 2024, and concluded on 16 March 2024. The borehole was drilled to a depth of 198 mbgl using air rotatory. The initial water strike occurred at 86 mbgl, with water yields increasing with depth and reaching a maximum of 10 L/s at the final depth of 198 mbgl. The water encountered was classified as fresh, with EC values ranging from 136.5 $\mu\text{S}/\text{cm}$ to 960.3 $\mu\text{S}/\text{cm}$. The pH levels varied between 8.13 and 8.52, with a final pH value during drilling of 8.13 at the bottom of the borehole, indicating slightly basic conditions. A summary of the geological findings is presented in Table 3.8.

Table 3.8: CRD0140 geology

Metres	Description	Hydrostratigraphic unit
0–12	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, strongly weathered, yellow-brown, sub-angular, slight foliation.	Cover
12–24	Goethitic-hematite, dense and massive, hard, red to brown. Main lithology: HGH 100%, strongly weathered, red-brown, sub-angular, non-foliated.	Aquitard
24–58	Main lithology: GOH 90%, moderately weathered, yellow-brown, sub-angular, slight foliation.	Aquitard
58–82	Main lithology: HGH 100%, moderately weathered, red-brown, angular, non-foliated.	Aquitard
82–164	Grey, QTZ of up to 1 cm, some goethite (yellow-brown), could be some fall back from 40 m depth. Main lithology: CHERT 80%, fresh rock, grey, angular, banded (BIF).	Aquifer
164–184	Grey chert, HGM yellow-brown, red powdery (ferric clays?), could be some fall back from 40 m depth. Main lithology: CHERT 70%, fresh rock, grey, angular, banded (BIF).	Aquifer
184–198	Grey, QTZ of up to 1 cm, some goethite (yellow-brown), could be some fall back from 40 m depth. Main lithology: CHERT 80%, fresh rock, grey, angular, banded (BIF).	Aquifer

Notes: BIF – banded iron formation; HGM – moderate hardness, bedded goethitic-hematite; QTZ – quartz.

Monitoring bore CRD0142

Drilling operations for borehole CRD0142 commenced on 17 March 2024, and concluded on 20 March 2024. The borehole was drilled to a depth of 198 mbgl, using air rotatory. The initial water strike occurred at 98 mbgl, with water varying with depth but values less than 1 L/s. The water encountered was classified as fresh, with EC ranging from 260 µS/cm to 1,124 µS/cm, with a value at the end of the hole of 567.6 µS/cm. The pH levels varied between 7.88 and 9.23 indicating basic conditions. A summary of the geological findings is presented in Table 3.9.

Table 3.9: CRD0142 geology

Metres	Description	Hydrostratigraphic unit
0–10	Main lithology: HGH 98%, strongly weathered, red-brown, sub-angular, non-foliated.	Cover
10–70	Main lithology: HGH 100%, moderately weathered, red-brown, sub-angular, non-foliated.	Aquitard
70–122	Main lithology: CHERT 100%, fresh rock, grey, angular, slight foliation.	Aquifer (from 98 m – first water strike)
122–130	Presence of pyrite micro crystals; PAF sample taken. Main lithology: CHERT 97%, fresh rock, grey, angular, slight foliation.	Aquifer
130–150	Main lithology: CHERT 100%, fresh rock, grey, angular, slight foliation.	Aquifer
150–160	Presence of pyrite micro crystals. Main lithology: CHERT 97%, fresh rock, grey, angular, slight foliation.	Aquifer
160–198	Main lithology: CHERT 100%, fresh rock, grey, angular, slight foliation.	Aquifer

Note: PAF – potentially acid forming.

Monitoring bore CRD0150

Drilling at CRD0150 began on 31 March 2024 and ended on 3 April 2024. This borehole was drilled in the same pad as production bore CRD0141, and was drilled to a depth of 198 mbgl and installed as a monitoring bore. The first water strike was at 110 mbgl, and had a yield of 1 L/s, an EC of 2,890 µS/cm and a pH of 9.03. The geology is summarised in Table 3.10.

Table 3.10: CRD0150 geology

Metres	Description	Hydrostratigraphic unit
0–10	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, strongly weathered, brown, angular, non-foliated.	Cover
10–44	Some powdery nodules. Main lithology: HGM 100%, moderately weathered, brown, sub-angular, non-foliated.	Aquitard
44–92	Main lithology: HGH 100%, moderately weathered, red-brown, sub-angular, very slight foliation.	Aquitard
92–160	Less than 1% pyrite. Main lithology: CHERT 94%, weakly weathered, grey, angular, slight foliation.	Aquifer (from 110 m, First Water Strike)
160–198	Presence of glassy green crystals (quartz and chlorite), less than 1% pyrite. Main lithology: CHERT 85%, weathered, grey, angular, foliated, BIF.	Aquifer

Note: HGM – moderate hardness, bedded goethitic-hematite.

Production bore CRD0141

Drilling operations for borehole CRD0141 commenced on 5 April 2024, and concluded on 20 April 2024. The borehole was drilled to a depth of 198 mbgl, using mud rotary for the first 30 m of drilling (until the pre-collar casing was installed) and then continued to total depth with air rotary. This bore was located 11 m away from the pilot hole CRDTA0141. One airlift measurement was performed at 183.6 mbgl, EC was 1,050 $\mu\text{S}/\text{cm}$, pH was 8.3 and the yield was close to 20 L/s. A summary of the geological findings is presented in Table 3.11.

Table 3.11: CRD0141 geology

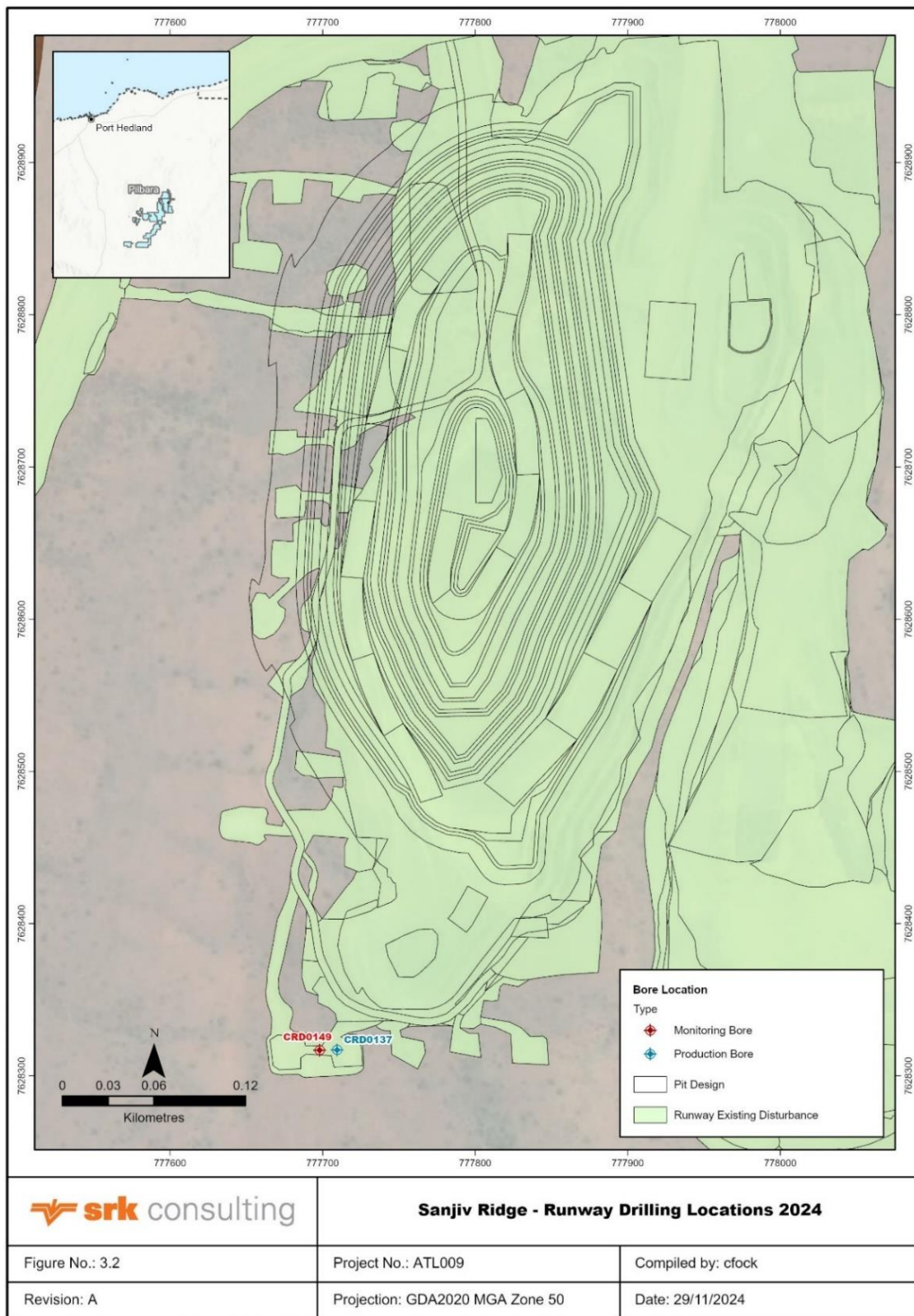
Metres	Description	Hydrostratigraphic unit
0–14	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, moderately weathered, brown, sub-angular, non-foliated.	Cover
14–24	Altered area; presence of clay and powdery nodules. Main lithology: GOH 100%, strongly weathered, grey, sub-angular, non-foliated.	Aquitard
24–58	Main lithology: GOH 100%, moderately weathered, red-brown, angular, non-foliated.	Aquitard
58–82	Main lithology: HGM 100%, strongly weathered, red-brown, angular, non-foliated.	Aquitard
82–198	Presence of glassy green crystals (quartz and chlorite). Main lithology: CHERT 90%, fresh rock, grey, angular, slight foliation.	Aquifer

This bore was constructed as a production bore due to the high yield. The final yield of the bore after construction was close to 7 L/s. This relatively low yield could be attributed to a significant loss of mud during drilling, specifically between 30 m and 35 m, where a cavity was encountered.

3.1.2 Runway Pit

Drilling in the Runway Pit area began on 22 April 2024 and ended on 8 May 2024. The work in this area comprised the drilling and construction of one production bore and one monitoring bore. Locations are represented in Figure 3.2.

Figure 3.2: Location of bores in Runway Pit area



Production bore CRD0137

Drilling of CRD0137 commenced on 22 April 2024 and concluded on 29 April 2024. The borehole was drilled to a depth of 208 mbgl using air rotary drilling for the entire depth. The first water strike occurred at 82 mbgl, and initially had flow rates lower than 1 L/s. However, the yield increased with depth, reaching flow rates of up to 11 L/s at 202 mbgl, with a final yield of 7 L/s at the end of the borehole.

EC values show a higher range, from 703 µS/cm to 4,190 µS/cm between depths of 88 mbgl and 130 mbgl, but became stable below 130 mbgl with a smaller range of between 528 µS/cm and 453.4 µS/cm. pH also decreased with depth from 88 mbgl to 130 mbgl from a maximum of 11.7 down to 8.8. pH values became stable below 130 mbgl with a range between 8.6 and 8.8.

A summary of the geological findings is presented in Table 3.12.

Table 3.12: CRD0137 geology

Metres	Description	Hydrostratigraphic unit
0–4	Overburden, sediments and rocks. Main lithology: OVERBURDEN 100%, strongly weathered, brown, angular.	Cover
4–18	Limonite. Main lithology: LMF 100%, strongly weathered, yellow, sub-angular	Aquitard
18–46	Main lithology: HGH 100%, strongly weathered, red-brown, angular.	Aquitard
46–70	Main lithology: HEH 100%, strongly weathered, red, angular	Aquitard
70–84	Intercalation between chert and hematite. Main lithology: CHERT 90%, weakly weathered, grey, angular, banded (BIF).	Aquifer (from approximately 82m, First Water Strike)
84–194	Some levels with some pyrite and chlorite. Main lithology: CHERT 85%, weakly weathered, grey, angular, banded (BIF).	Aquifer
194–208	Dark water at 208 m, presence of pyrite starting at 192 m. Getting darker with depth, could be a 'mix' with chert. Main lithology: SHALE 97%, fresh rock, black, angular, slight foliation.	Aquifer

Note: LMF – friable, porous, faint bedding limonite.

Monitoring bore CRD0149

Drilling at borehole CRD0149 began on 2 May 2024, and concluded on 8 May 2024. This borehole was drilled on the same pad as the production bore CRD0137, located just 11 m away. Drilling reached a depth of 212 mbgl and the borehole was installed as a monitoring bore. The first water strike occurred at 80 mbgl, and initially yielded a very low flow rate. Subsequent sporadic airlifts indicated yields of up to 1 L/s at the end of the borehole. The water was slightly basic and fresh, with an EC value of 588 µS/cm and a pH of 7.77. The geology is summarised in Table 3.13.

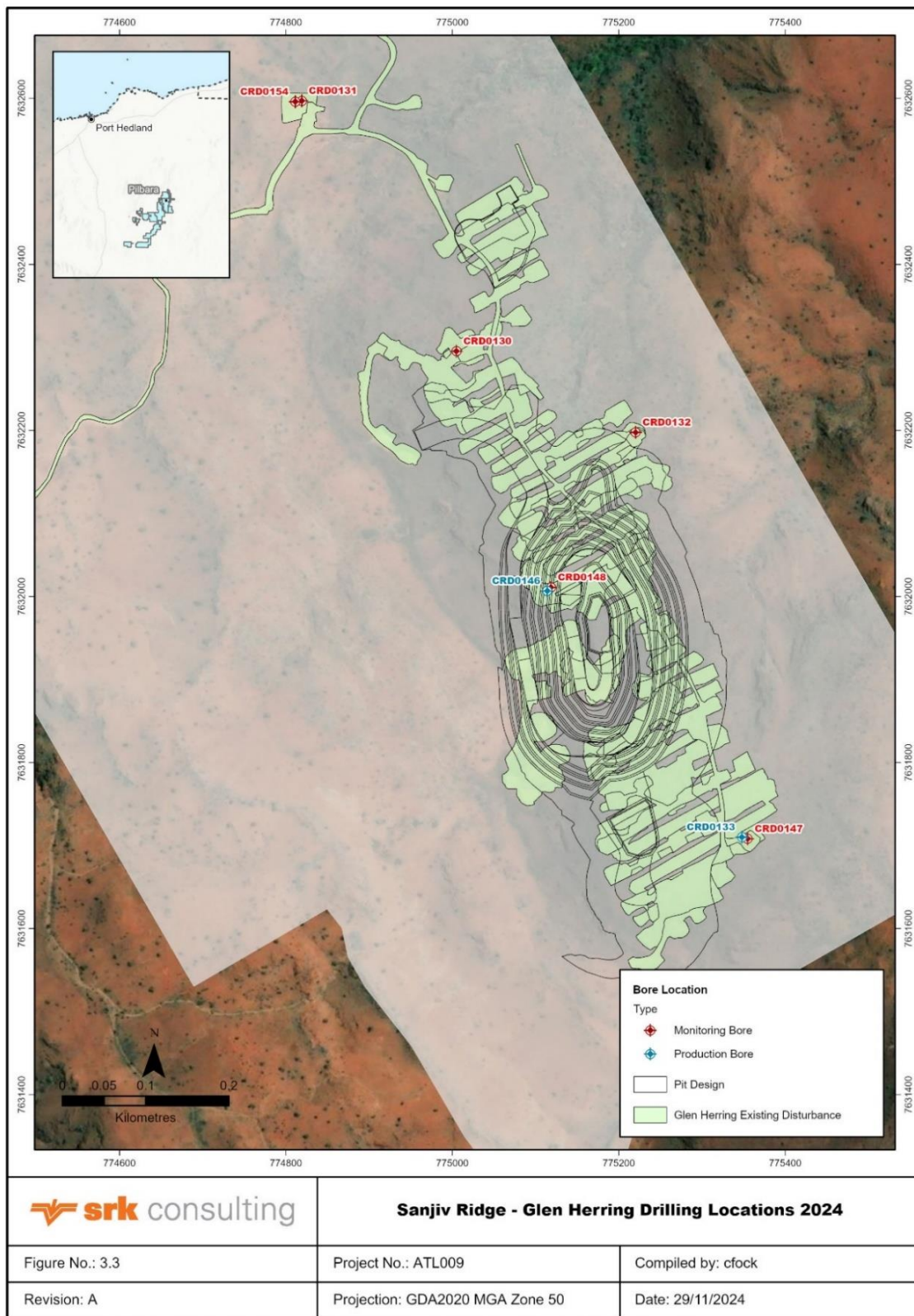
Table 3.13: CRD0149 geology

Metres	Description	Hydrostratigraphic unit
0–2	Main lithology: OVERBURDEN 100%, strongly weathered, red-brown, angular.	Cover
2–18	Main lithology: LMF 100%, strongly weathered, yellow, sub-angular.	Aquitard
18–48	Main lithology: HGH 100%, strongly weathered, brown, angular.	Aquitard
48–70	Main lithology: HEH 100%, strongly weathered, red-brown, angular.	Aquitard
70–188	Main lithology: CHERT 100%, weakly weathered, grey, angular, banded (BIF).	Aquifer (from approximately 80 m – first water strike)
188–206	Gradual transition from chert to shale. Main lithology: CHERT 85%, fresh rock, grey, angular, banded (BIF).	Aquifer
206–212	Dark water at 212 m. Main lithology: SHALE 90%, fresh rock, black, angular, slight foliation.	Aquifer

3.1.3 Glen Herring

Drilling in the Glen Herring Pit area began on 13 May 2024 and ended on 6 July 2024. The program comprised the drilling and construction of two production bores and six monitoring bores. Locations are represented in Figure 3.3.

Figure 3.3: Location of bores in the Glen Herring area



Monitoring bore CRD0132

Drilling operations for borehole CRD0132 commenced on 13 May 2024 and concluded on 16 May 2024. The borehole was drilled to a depth of 158 mbgl using air rotary drilling and was installed as a monitoring bore to a depth of 136 mbgl. The initial water strike occurred at 116 mbgl, with yields varying between 1.81 L/s and 2.5 L/s from 116–134 mbgl, increasing to 4.6 L/s at 140 mbgl. The water encountered was classified as fresh, with EC values ranging from 789 $\mu\text{S}/\text{cm}$ to 996.4 $\mu\text{S}/\text{cm}$. The pH levels indicated slightly basic water, varying between 8.44 and 9.09. A summary of the geological findings is presented in Table 3.14.

Table 3.14: CRD0132 geology

Metres	Description	Hydrostratigraphic unit
0–6	Main lithology: OVERBURDEN 100%, strongly weathered, red-brown, angular.	Cover
6–18	Soft to drill. Main lithology: LMF 90%, strongly weathered, yellow-brown, angular.	Aquitard
18–38	Main lithology: HEM 90%, strongly weathered, red-brown, angular.	Aquitard
38–52	Main lithology: HEH 100%, moderately weathered, red-brown, angular, slight foliation (BIF?).	Aquitard
52–62	Yellow and some red. Main lithology: LMM 90%, moderately weathered, yellow, angular.	Aquitard
62–82	Main lithology: HEH 100%, moderately weathered, red-brown, angular.	Aquitard
82–90	Main lithology: HGH 100%, moderately weathered, red-purple, angular.	Aquitard
90–98	Main lithology: LMH 98%, moderately weathered, yellow, angular.	Aquitard
98–104	Main lithology: HEH 100%, moderately weathered, red, angular.	Aquitard
104–116	Main lithology: HGH 90%, moderately weathered, red-purple, angular.	Aquitard
116–122	Main lithology: HEH 100%, moderately weathered, red, angular.	Aquifer
122–140	Light grey. Main lithology: CHERT 100%, moderately weathered, grey, angular.	Aquifer
140–158	Dark grey. Main lithology: CHERT 100%, moderately weathered, grey, angular.	Aquifer

Notes: LMH – hard, dense, massive limonite; LMM – moderate hardness, bedded limonite.

Monitoring bore CRD0130

Drilling operations for borehole CRD0130 commenced on 19 May 2024 and concluded on 23 May 2024. The borehole was drilled to a depth of 198 mbgl using air rotary. The initial water strike occurred at 114 mbgl; water yields increased with depth and reached a maximum of 9.5 L/s at 192 mbgl and a yield of 6 L/s at the final depth of 198 mbgl. The water encountered was classified as fresh, with EC values ranging from 652 $\mu\text{S}/\text{cm}$ to 775 $\mu\text{S}/\text{cm}$. pH varied between 7.4 and 7.8, with a final pH value of 7.7 at the bottom of the borehole, indicating slightly basic conditions. A summary of the geological findings is presented in Table 3.15.

Table 3.15: CRD0130 geology

Metres	Description	Hydrostratigraphic unit
0–6	Main lithology: HGM 100%, strongly weathered, brown, sub-angular, plate-like.	Cover
6–20	Main lithology: LMF 90%, strongly weathered, yellow-brown, sub-rounded, basal contact to hematite unit at ~19 m.	Aquitard
20–42	Main lithology: HEM 100%, strongly weathered, red, sub-angular, foliated.	Aquitard
42–60	Main lithology: HEH 100%, moderately weathered, red-grey, angular, foliated.	Aquitard
60–96	Main lithology: HEH 100%, weakly weathered, grey-red, angular, foliated.	Aquitard
96–124	Tiger iron (layered red jaspilite, black hematite and yellow quartz with former amphibole fibres turned into limonite). Driller's comment: 'Broken from 101 m onwards'. Main lithology: HES 100%, fresh rock, yellow-red-grey, angular.	Aquifer (from approximately 114 m – first water strike)
124–166	Similar to the overlying unit but almost no yellow tiger's eye, only grey hematite and red jaspilite; recrystallised transparent quartz veins cross-cutting the primary layering. Main lithology: HEH 100%, fresh rock, red-grey, angular.	Aquifer
166–186	Tiger iron (layered red jaspilite, black hematite and yellow quartz with former amphibole fibres turned into limonite). Main lithology: HES 100%, fresh rock, yellow-red-grey, angular.	Aquifer
186–198	Similar to the overlying unit but almost no yellow tiger's eye, only grey hematite and red jaspilite. Main lithology: HEH 100%, fresh rock, red-grey, angular.	Aquifer

Notes: HEM – moderate hardness, bedded hematite; HES – siliceous hematite.

Production bore CRD0146

Drilling operations for borehole CRD0146 commenced on 24 May 2024, and concluded on 31 May 2024. The borehole was drilled to a depth of 164 mbgl using air rotary drilling and was installed as a production bore to a depth of 162.5 mbgl. The initial water strike occurred at 122 mbgl, with a water yield of 1.2 L/s, increasing to 7 L/s at 152 mbgl and remaining stable until the end of the borehole. The water encountered was classified as fresh, with EC values ranging from 740 µS/cm to 1,000 µS/cm. pH varied with depth, starting at approximately 10.2 at the first water strike and ranging between 6.1 and 6.45 at the end of the borehole. A summary of the geological findings is presented in Table 3.16.

Table 3.16: CRD0146 geology

Metres	Description	Hydrostratigraphic unit
0–4	Rubble from heaped up drill pad. Main lithology: OVERBURDEN 100%, strongly weathered, red-brown, sub-angular.	Cover
4–26	Goethite and coated with friable limonite, poor sample return due to numerous cavities while drilling. Main lithology: GOM 80%, strongly weathered, yellow-brown, sub-angular.	Aquitard
26–130	Goethite, sporadic yellow silicified limonite, poor sample return due to numerous cavities while drilling. Main lithology: GOM 100%, moderately weathered, brown, sub-angular.	Aquifer (from approximately 122 m – first water strike)
130–132	High presence of quartz, potential presence of a quartz vein. Main lithology: QTZ 50%, moderately weathered, white-brown, angular.	Aquifer
132–164	Main lithology: HGH 100%, moderately weathered, brown, sub-angular, slight foliation reaching the bottom.	Aquifer

Note: GOM – moderate hardness, bedded goethite.

Monitoring bore CRD0131

Drilling operations for borehole CRD0131 commenced on 1 June 2024 and concluded on 3 June 2024. The borehole was drilled to a depth of 186 mbgl using air rotary. The initial water strike occurred at 150 mbgl, and water yields increased with depth, reaching a maximum of 5 L/s at 168 mbgl and remaining stable until the end of the hole. The water encountered was classified as fresh, with EC values ranging from 478 µS/cm to 667 µS/cm. pH varied between 5.8 and 7.21, with a final pH value of 7.0 at the bottom of the borehole. A summary of the geological findings is presented in Table 3.17.

Table 3.17: CRD0131 geology

Metres	Description	Hydrostratigraphic Unit
0–2	Main lithology: OVERBURDEN 100%, moderately weathered, brown, sub-angular.	Cover
2–26	Main lithology: CLY 100%, strongly weathered, white.	Confining layer
26–40	Main lithology: CLY 80%, strongly weathered, white-brown, sub-angular.	Confining layer
40–76	The clay present in this samples is probably a result of contamination from the upper unit. Main lithology: CLY 60%, strongly weathered, grey, sub-angular.	Confining layer
76–162	The clay in this sample is probably a result of contamination from the upper unit. Main lithology: CHERT 90%, moderately weathered, grey, sub-angular	Aquifer (from approximately 150 m – first water strike)
162–186	Not as foliated as the shale from previous bores. Also a bit weathered. Main lithology: SHALE 100%, weakly weathered, dark grey, sub-angular.	Aquifer

Note: CLY – clay.

Monitoring bore CRD0154

Bore CRD0154 was drilled as a shallow monitoring bore at the same pad as CRD0131. The drilling began on 8 June 2024 and ended on the same day. The hole was drilled and installed to 64.5 mbgl, intercepting mainly clays. No significant water strike was encountered and this bore was declared dry. The geology is summarised in Table 3.18.

Table 3.18: CRD0154 geology

Metres	Description	Hydrostratigraphic unit
0–2	Main lithology: OVERBURDEN 100%, moderately weathered, brown, sub-angular.	Cover
2–22	Main lithology: CLY 100%, strongly weathered, white.	Confining layer
22–48	Main lithology: CLY 90%, strongly weathered, white-brown.	Confining layer
48–60	Main lithology: CLY 75%, strongly weathered, brown-red, sub-angular.	Confining layer
60–64.5	Main lithology: CLY 80%, strongly weathered, grey, sub-angular.	Confining layer

Production bore CRD0133

Drilling operations for borehole CRD0133 commenced on 13 June 2024 and concluded on 19 June 2024. The borehole was drilled using air rotary drilling and installed as a production bore to a depth of 176 mbgl. The initial water strike occurred at 104 mbgl with a very low water yield, and increased to 4 L/s at 158 mbgl. The water encountered was classified as fresh, with EC values ranging from 460 µS/cm to 505 µS/cm. The pH levels indicated slightly basic water, varying between 7.7 and 8.39. A summary of the geological findings is presented in Table 3.19.

Table 3.19: CRD0133 geology

Metres	Description	Hydrostratigraphic unit
0–22	Main lithology: GOH 60%, weakly weathered, brown, angular.	Cover/aquitard
22–30	Main lithology: GOH 90%, weakly weathered, dark brown, angular.	Aquitard
30–32	Main lithology: HGH 100%, fresh rock, red-brown, angular, BIF.	Aquitard
32–36	Main lithology: GOH 90%, fresh rock, dark brown, angular.	Aquitard
36–50	Main lithology: HGH 100%, fresh rock, red-brown, angular, BIF.	Aquitard
50–70	Main lithology: HGH 70%, fresh rock, grey-brown-yellow, sub-angular.	Aquitard
70–86	Main lithology: HGH 100%, fresh rock, red-brown, sub-angular.	Aquitard
86–90	Main lithology: HGH 100%, fresh rock, brown, sub-angular.	Aquitard
90–152	Main lithology: HEH 100%, fresh rock, red-brown, sub-angular, foliation reaching to the bottom area.	Aquifer? (Moisture detected at 104 m)
152–174	More chert and jasperite. Main lithology: Cherty BIF 100%, fresh rock, grey-red, sub-angular, BIF.	Aquifer
174–176	Main lithology: CHERT 100%, fresh rock, grey, angular.	Aquifer

Monitoring bore CRD0147

Drilling at borehole CRD0147 began on 22 June 2024 and concluded on 24 June 2024. This borehole was drilled on the same pad as the production bore CRD0133, located just 7 m away, reaching a depth of 174 mbgl and was installed as a monitoring bore. The first water strike occurred at 108 mbgl, and just one airlift was performed at the end of the bore due to its proximity to production bore CRD0133. The flow rate at the bottom was 4.4 L/s, EC was 527.5 μ S/cm and pH was 8.2. A summary of the geological findings is presented in Table 3.20.

Table 3.20: CRD0147 geology

Metres	Description	Hydrostratigraphic unit
0–2	Main lithology: OVERBURDEN 100%, strongly weathered, brown, angular.	Cover
2–22	Main lithology: GOH 60%, weakly weathered, brown, angular.	Aquitard
22–30	Main lithology: GOH 90%, weakly weathered, dark brown, angular.	Aquitard
30–32	Main lithology: HGH 100%, fresh rock, red-brown, angular, BIF.	Aquitard
32–38	Main lithology: GOH 90%, fresh rock, dark brown, angular.	Aquitard
38–48	Main lithology: HGH 100%, fresh rock, red-brown, angular, BIF.	Aquitard
48–58	Main lithology: HGH 100%, fresh rock, red-grey, angular, BIF.	Aquitard
58–66	Main lithology: HGH 70%, fresh rock, grey-brown-yellow, sub-angular.	Aquitard
66–98	Main lithology: HGH 100%, fresh rock, red-grey, angular, BIF.	Aquitard
98–102	Main lithology: HGH 100%, fresh rock, brown, sub-angular.	Aquitard
102–158	Some hematized shale, slightly shiny hematite layered with red jasperite. Appears close to the bottom. Main lithology: HGH 90%, fresh rock, red-brown, sub-angular, BIF.	Aquifer
158–166	More chert and jasperite. Main lithology: Cherty BIF 100%, fresh rock, grey-red, sub-angular, BIF.	Aquifer
166–174	Main lithology: CHERT 100%, fresh rock, grey, sub-angular.	Aquifer

Monitoring bore CRD0148

Drilling at borehole CRD0148 began on 4 July 2024 and concluded on 6 July 2024. This borehole was drilled on the same pad as the production bore CRD0146, located just 6 m away, reached a depth of 164 mbgl and was installed as a monitoring bore. The first water strike occurred at 108 mbgl, and no airlifts were performed during drilling due to its proximity to CRD0146. A summary of the geological findings is presented in Table 3.21.

Table 3.21: CRD0148 geology

Metres	Description	Hydrostratigraphic unit
0–6	Rubble from heaped up drill pad. Main lithology: OVERBURDEN 100%, strongly weathered, red-brown, sub-angular.	Cover
6–60	Goethite and coated with friable limonite. Main Lithology: GOM 80%, strongly weathered, yellow-brown, sub-angular.	Aquitard
60–102	Goethite, sporadic yellow silicified limonite. Main Lithology: GOM 100%, moderately weathered, brown, sub-angular.	Aquitard
102–132	BIF with slightly shiny hematite layered with red jasperite, presence of yellow silicified limonite, some levels with quartz. Main lithology: HGH 70%, moderately weathered, brown, angular, BIF.	Aquifer (from approximately 122 m – first water strike)
132–168	Slightly shiny hematite layered with red jasperite, some levels with presence of quartz. Main lithology: HGH 100%, moderately weathered, red-brown, sub-angular, BIF.	Aquifer

4 Pumping tests

4.1 Methodology

To obtain aquifer parameters for the constructed production bores, six pumping tests were completed. At Glen Herring, the tests were conducted by Flow Water Services (FWS) from 19 September 2024 to 8 October 2024, while the pumping tests in Runway Pit and Sparrow Lake Pit were performed by Airwell Group from 24 October 2024 to 15 November 2024. FWS and Airwell set up and monitored the testing, and SRK personnel provided technical guidance over the course of the testing.

The pumping test program included the testing of the six production bores, as summarised in Table 4.1, with the following methodology:

- A step rate test (SRT), consisting of four 1-hour steps, conducted to calculate specific capacity and efficiency of the bores.
- A constant rate test (CRT) of at least 72 hours, undertaken to assess aquifer behaviour and estimate properties such as transmissivity and storage.
- A recovery test, conducted immediately after the CRT to complement the knowledge of the hydraulic behaviour of the bore.

Table 4.1: Production bore test flow rates and set up

Pumped bore	Observation bore in pad	Pump depth (mbTOC)	Slotted interval for the pumped bore	SWL (mbTOC)	Flow rate (L/s)	
					SRT	CRT
CRD0146	CRD0148	150	108.5–162.5	103.85	3 – 6 – 8 – 10	10
CRD0046 ¹	-	75	83.85–105	58.7	1.5 – 2.0 – 2.4 – 2.8	2.8
CRD0133	CRD0147	170	116–176	119.56	6 – 7 – 8 – 9	8
CRD0143	CRD0151	130 ²	73–183.6	57.73	12.5 – 15 – 17.5 – 20	20
CRD0141	CRD0150	150	95–197	79.51	4 – 6 – 8 – 10	8
CRD0137	CRD0149	150	82–208	76.39	5 – 6 – 7 – 8	6.5

Notes: CRT – constant rate test; mbTOC – metres below top of casing; SRT – step rate test; SWL – standing water level.

¹ Also known as Dingo Bore

² For the SRT the pump was located at 145 mbTOC

Data were collected using aqua troll loggers provided by Atlas and manual water level measurements in the production and monitoring bores.

Aquifer characteristics and parameters were estimated from drawdown and recovery data collected during the CRTs using AQTESOLV (HydroSOLVE, 2019), an industry standard software package. In addition, the Flow Characteristic (FC) Program for Aquifer Test Analysis¹ and manual calculations were also used to increase confidence in the aquifer parameters output from

¹ FC program for Aquifer Test Analysis (2013 version). Prof. Gerrit van Tonder, Fanie de Lange and Modreck Gomo. Institute for Groundwater Studies, University of the Free State.

AQTESOLV. The results from both AQTESOLV and FC are provided in Appendix C. The analysis was performed on pumped and monitoring bores, but calculated storativity values are derived only from the monitoring bores. For all tests, anisotropy was assumed to be 1:1 (K_z/K_r).

The pumping test analysis consisted of the following:

- review of the raw hydrograph to assess overall test completion
- aquifer and well response trends
- diagnostic plots and derivative analysis
- identification of analytical solutions and derivation of inferred aquifer parameters.

Key well and aquifer parameters inferred from this analysis include:

- well effects (wellbore storage, skin effects, etc.)
- flow regime type (radial, linear, recharge, no-flow boundaries, etc.)
- hydraulic conductivity (K) and transmissivity (T)
- storage parameters, storativity (S)
- anisotropy.

Aquifer and well response trends

Prior to the analysis to identify aquifer parameters, drawdown and recovery data were reviewed to identify flow trends, check for stable drawdown and evaluate any boundary effects.

Diagnostic plots and derivative analysis

Diagnostic plots are a scatter plot of both drawdown and its logarithmic derivative versus time and is usually plotted on a log–log scale. The use of both the drawdown and the logarithmic derivative allows the flow regimes to be identified and highlights any well effects or subtle boundary conditions. Smoothing functions are used to improve interpretation. Diagnostic plots were used for bores in the same pads only and not in bores located on different pads and are presented in Appendix C.

Diagnostic plots have many advantages:

- The logarithmic derivative is highly sensitive to subtle variations in the shape of the drawdown curve.
- The analysis of diagnostic plots facilitates the selection of a conceptual model.
- The values of the derivatives can aid in refining the conceptual model of groundwater flow surrounding the pumped bore.

The average logarithmic derivative value was calculated for bores in the same drill pad, giving an indication of the connectivity of the fracture network – the smaller the value, the better the aquifer (van Tonder et al., 2001). The guidelines used were:

- Log derivative = 0.5 ~ single fracture (limited fracture network)
- Log derivative = 0.25 ~ good fracture network

- Log derivative ≤ 0.10 ~ radial flow homogenous aquifer (very good fracture network).

Identification of analytical solutions

The trend and derivative analyses were integrated with the hydrogeological conceptual model to select representative analytical solutions. This process accounted for well effects (e.g. bore construction, penetration type, wellbore storage, and skin effects), aquifer characteristics (e.g. fracture flow, confined/unconfined, or leaky systems), and boundary conditions (e.g. constant head or recharge boundaries). Based on the characteristics of the Sanjiv Ridge aquifer, four primary solutions were used to analyse the pumping test results: Moench (1984)², Cooper-Jacob (1946)³, Theis (1935)⁴, and Dougherty-Babu (1984).⁵

The drawdown and derivative responses from constant rate tests confirm a fractured bedrock aquifer, with some bores indicating double-porosity behaviour. Early time to mid-time (time <100 min) responses tended to imply a transition from wellbore storage effects to radial flow. At later times (time >100 min), tests within the Sanjiv Ridge area showed a temporary transition to linear flow in flow patterns, likely reflecting boundary effects, fracture dewatering, or increasing secondary porosity dominance.

To capture these dynamics, the Moench (1984) solution was widely applied. This model, designed for isotropic fractured aquifers with wellbore storage and skin effects, assumes dual porosity and estimates hydraulic conductivity and storativity for both fractures and the matrix. Early-time drawdown data reflected preferential fracture flow, while late-time data revealed slower matrix contributions.

Due to the non-uniqueness of Moench (1984) solutions, complementary methods – including Cooper-Jacob, Theis, Dougherty-Babu, and the FC program for fractured aquifers – were used to refine the parameter estimates.

Production bores intersected multiple fracture zones along screened intervals, suggesting that flow may have been influenced by compartmentalised fracture networks. This could introduce uncertainty in storage parameter estimation, as transmissivity values represent a composite of contributions from various fractures. Nevertheless, the most reliable results were obtained using the equivalent porous media approach. SRK considers this method the most appropriate given the aquifer's conditions and available data.

² Moench, A F, 1984. Double-porosity models for a fissured groundwater reservoir with fracture skin, *Water Resources Research*, 20(7):831–846. [pdf]

³ Jacob, C E, 1947. Drawdown test to determine effective radius of artesian well, *Trans. Amer. Soc. of Civil Engrs.*, v112, paper 2321, pp 1047–1064.

⁴ Theis, C V, 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, *Am. Geophys. Union Trans.*, 16:519–524.

⁵ Dougherty, D E and Babu, D K, 1984. Flow to a partially penetrating well in a double-porosity reservoir, *Water Resources Research*, 20(8):1116–1122.

4.2 Pumping test analysis

4.2.1 Glen Herring area

Three bores were tested at Glen Herring: CRD0146, CRD0046 and CRD0133. Locations of the pumped bores and the bores used to monitor the test are presented in Figure 4.1.

Bore CRD0146

Bore CRD0146 is a production bore located in the central area of the designed pit. The SRT started on 22 September 2024 at 09:55 and finished on 22 September 2024 at 13:55 – each step was 1 hour long, and the yields selected for each step were 3, 6, 8 and 10 L/s. The CRT lasted 72 hours, starting on 22 September 2024 at 15:00 and finishing on 25 September 2024 at 15:00. The recovery test started on 25 September 2024 at 15:00 and last for 80 minutes until reaching 95% of recovery. Complete analysis report and plots are presented in Appendix C.

This bore has a total depth of 162.5 mbgl and is screened from 108.5 mbgl to the end of the bore, intercepting goethite and hematite, typical of a BIF. The aquifer thickness (b) was considered equal to the screened section for the analysis (b = 54 m). The parameters used in the analysis are summarised in Table 4.2.

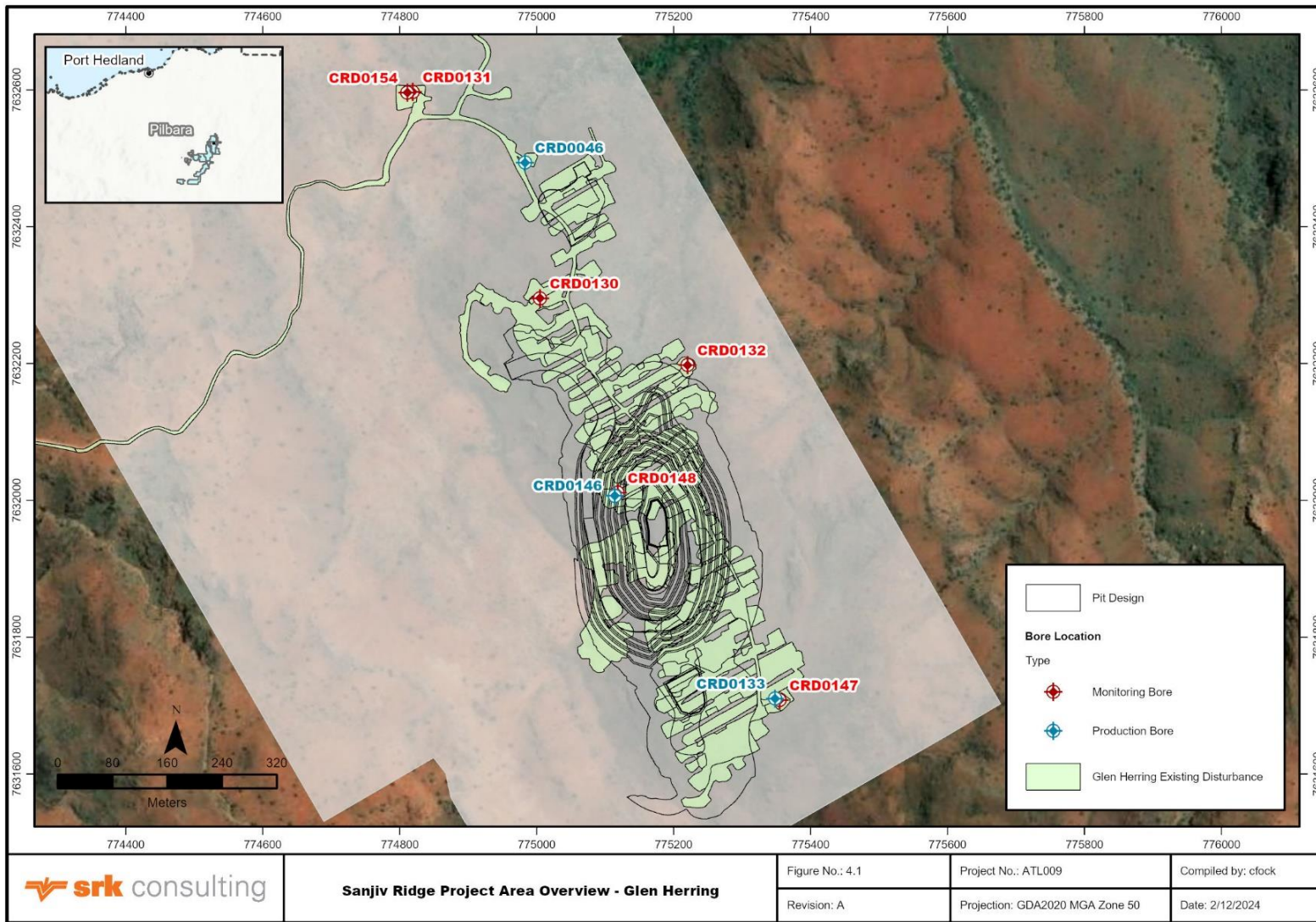
Table 4.2: Bore CRD0146 pumping test parameters

Parameter	CRD0146
Depth of hole (m)	162.5
Hole diameter (m)	0.3
Hole diameter (m)	0.2
Screened section (m)	54
Water level (mbTOC)	103.88
Maximum drawdown (m)	5.22
Pump depth (mbTOC)	150
Flow rate (L/s)	10

The SRT is used to evaluate the apparent efficiency of the bore, which means, the proportion of drawdown caused by laminar flow. In this case, the production bore has an apparent efficiency between 56% and 81 % for flow rates between 3 L/s and 10 L/s (the higher the flow rate, the lower the efficiency).

For the CRT, the monitoring network included the following bores: CRD0130, CRD0131, CRD0132, CRD0154, CRD0147 and CRD0148. Bore CRD0148 is located on the same pad and has a screened section from 107–161 mbgl. Monitoring bore distance to the pumping bore (radius) and maximum drawdown are summarised in Table 4.3.

Figure 4.1: Glen Herring tested bores and monitoring bores



File path: P:\ATL009 - Sanjiv Ridge Below Water Table Mining Hydrogeology study\06_GIS_Data\Hydrogeology\ATL009_Hydrogeo_Figures\ATL009_Hydrogeo_Figures.aprx

Table 4.3: Distance to pumping bore and maximum drawdown during pumping test for bore CRD0146

Monitoring bore ID	Distance to pumping bore (m)	Maximum drawdown (m)
CRD0130	309	0.0
CRD0131	660	0.0
CRD0132	218	0.0
CRD0147	384	0.0
CRD0154	662	0.0
CRD0148	6	1.01

Three different solutions were used to analyse drawdown results and applied in both production and monitoring bores. Storativity (S), transmissivity (T) and hydraulic conductivity (K) results are summarised in Table 4.4.

Table 4.4: Inferred hydraulic parameters for bore CRD0146

Pumping bore	Observation bore	Solution type	S	T (m ² /day)	K (m/day)
CRD0146	CRD0146	Moench (Fracture)	-	205.20	3.80
		Cooper-Jacob (AQ _t)	-	424.00	7.85
		Cooper-Jacob (FC)	-	335.10	6.21
CRD0146	CRD0148	Moench (Fracture)	2.67E-05	276.37	5.12
		Cooper-Jacob (AQ _t)	2.22E-03	783.40	14.51
		Cooper-Jacob (FC)	4.41E-03	729.90	13.52
Geomean			6.39E-04	408	7.55

Note: Minor difference with Appendix C is due to rounding.

Only monitoring bore CRD0148 responded to the pumping test conducted at bore CRD0146. The hydraulic parameters for both bores are comparable, indicating a likely hydraulic connection between them. The observed values align with those expected for crystalline fractured bedrock, characterised by high hydraulic conductivity (0.01–10 m/day) and low storativity, typically ranging from 10E-05 to 10E-03.

Using the drawdown data from the CRT, the average logarithmic derivative of drawdown calculated for CRD0146 was 0.03, while for CRD0148 it was 0.10, both indicative of a very good fracture network.

The final depth of the pump during the CRT was 150 mbTOC. Based on observations during the test, this pump depth is likely to be appropriate for long-term abstraction at this location.

Bore CRD0046

Bore CRD0046 (Dingo Bore) is a production bore located in the northern area of the designed Glen Herring Pit. The SRT started on 29 September 2024 at 10:51 and finished on 29 September 2024 at 14:51 – each step was 1 hour long, and the yields selected for each step were 1.5, 2, 2.4 and 2.8 L/s. The CRT lasted 72 hours, starting on 29 September 2024 at 15:43 and finishing on

2 October 2024 at 15:48. The recovery test started immediately after the CRT and was monitored for 60 minutes, during which 95% recovery was achieved within 18 minutes. The complete analysis report and plots are presented in Appendix C.

This bore has a total depth of 105 mbgl and is screened from 83.85 mbgl to the end of the bore. The aquifer thickness (b) was considered equal to the screened section for the analysis (b = 21.15 m). The parameters used for analysis are summarised in Table 4.5.

Table 4.5: Bore CRD0046 pumping test parameters

Parameter	CRD0046
Depth of hole (m)	105
Hole diameter (m)	0.2
Casing diameter (m)	0.1
Screened section (m)	21.15
Water level (mbTOC)	58.7
Maximum drawdown (m)	0.81
Pump depth (mbTOC)	75
Flow rate (L/s)	2.8

In this case, the production bore has an apparent efficiency between 51% and 66% for flow rates between 1.5 L/s and 2.8 L/s (the higher the flow rate, the lower the efficiency).

For the CRT, the monitoring network included the following bores: CRD0130, CRD0131, CRD0132, CRD0147, CRD0148 and CRD0154. None of the wells mentioned are located on the same pad. Monitoring bore distance to pumping bore (radius) and maximum drawdown are summarised in Table 4.6.

Table 4.6: Distance to pumping bore and maximum drawdown during pumping test for bore CRD0046

Monitoring bore ID	Distance to pumping bore (m)	Maximum drawdown
CRD0130	201	0.0
CRD0131	193	0.0
CRD0132	381	0.0
CRD0147	871	0.0
CRD0148	503	0.0
CRD0154	199	0.0

Solutions and results are summarised in Table 4.7.

Table 4.7: Inferred hydraulic parameters for bore CRD0046

Pumping bore	Observation bore	Solution type	S	T (m ² /day)	K (m/day)
CRD0046	CRD0046	Moench (Fracture)	-	378.59	17.90
		Theis	-	1160.60	54.87
		Cooper-Jacob (AQ _t)	-	1215.00	57.45
		Cooper-Jacob (FC)	-	831.90	39.33
Geomean			-	816.34	38.60

Notes: Minor difference with Appendix C is due to rounding.

No additional monitoring bores showed any response during the pumping test, suggesting either no connection between the bores or an insufficient flow rate during the test. The hydraulic values calculated include transmissivity and hydraulic conductivity, with values falling within the expected range for crystalline fractured bedrock. Storativity values were omitted, as no monitoring bores exhibited a response.

The final depth of the pump during the CRT was 75 mbTOC. Based on observations during the test, this pump depth is likely to be appropriate for long-term abstraction at this location.

Bore CRD0133

Bore CRD0133 is a production bore located to the southeast of the designed pit. The SRT started on 4 October 2024 at 07:30 and finished on 4 October 2024 at 11:30 – each step was 1 hour long, and the yields selected for each step were 6, 7, 8 and 9 L/s. The CRT lasted 72 hours, starting on 4 October 2024 at 13:30 and finishing on 7 October 2024 at 13:30. The recovery test started immediately after the CRT and lasted for 160 minutes until reaching 97% of recovery. The complete analysis report and plots are presented in Appendix C.

This bore has a total depth of 176 mbgl and is screened from 116 mbgl to the end of the bore, intercepting a zone of hard hematite, cherty BIF and chert to the bottom. The aquifer thickness (b) was considered equal to the screened section for the analysis (b = 60 m). Parameters used in the analysis are summarised in Table 4.8.

Table 4.8: Bore CRD0133 pumping test parameters

Parameter	CRD0133
Depth of hole (m)	176
Hole diameter (m)	0.3
Hole diameter (m)	0.2
Screened section (m)	60
Water level (mbTOC)	119.87
Maximum drawdown (m)	18.43
Pump depth (mbTOC)	170
Flow rate (L/s)	8

The step test is used to evaluate the apparent efficiency of the bore. During the SRT at CRD0133 instability in drawdown was recorded during the final step of the test (at 9 L/s). This instability has created an anomaly in the s/Q versus Q plot (Appendix C) and calculated a negative well efficiency. If this last step is excluded from the calculation, the apparent efficiency of the bore is estimated to be approximately 13–17% for flow rates between 6 L/s and 8 L/s.

For the CRT, the monitoring network included the following bores: CRD0130, CRD0131, CRD0132, CRD0147 and CRD0148. Bore CRD0147 is located in the same pad and has a screened section from 114–172.5 mbgl. Monitoring bore distance to pumping bore (radius) and maximum drawdown are summarised in Table 4.9.

Table 4.9: Distance to pumping bore and maximum drawdown during the pumping test for bore CRD0133

Monitoring bore ID	Distance to pumping bore (m)	Maximum drawdown
CRD0130	678	0.0
CRD0131	1033	0.0
CRD0132	504	0.0
CRD0148	378	0.0
CRD0154	1036	0.0
CRD0147	7	1.18

Solutions and results are summarised in Table 4.10.

Table 4.10: Inferred hydraulic parameters for bore CRD0133

Pumping bore	Observation bore	Solution type	S	T (m ² /day)	K (m/day)
CRD0133	CRD0133	Moench (Fracture)	-	15.66	0.26
		Cooper-Jacob (AQ _t)	-	62.00	1.03
		Theis	-	49.29	0.82
		Cooper-Jacob (FC)	-	59.00	0.98
CRD0133	CRD0147	Cooper-Jacob (AQ _t)	4.07E-03	420.00	7.00
		Dougherty-Babu	3.87E-03	401.30	6.69
		Cooper-Jacob (FC)	7.73E-03	404.40	6.74
Geomean			4.95E-03	110	1.83

Only the monitoring bore CRD0147 showed a response to the pumping test in CRD0133. The hydraulic parameters for the monitoring bore are higher than those calculated for the pumping bore, possibly reflecting the low efficiency of production bore CRD0133 compared with the monitoring bore. However, the K and T values are similar and indicate relatively high conductivity and transmissivity values for both bores. The hydraulic values fall within the expected range for crystalline fractured bedrock, with high conductivity values and low storativity values.

Using the drawdown data from the CRT, the average logarithmic derivative of drawdown calculated for CRD0133 was 0.14 – this is the same value as CRD0147, and indicates a good fracture network.

The final depth of the pump during the CRT was 170 mbTOC. Based on observations during the test, this pump depth is likely to be appropriate for long-term abstraction at this location.

4.2.2 Sparrow Lake / Razorback area

Two bores were tested in the Sparrow Lake area: CRD0143 and CRD0141. Locations of the pumped bores and the bores used to monitor the test are presented in Figure 4.2.

Bore CRD0143

Bore CRD0143 is a production bore located to the south of the designed pit. The SRT started on 28 October 2024 at 07:28 and finished on 28 October 2024 at 11:28 – each step was 1 hour long, and the yields selected for each step were 12.5, 15, 17.5 and 20 L/s. The CRT lasted 72 hours, starting on 28 October 2024 at 14:00 and finishing on 31 October 2024 at 14:00. The recovery test started 31 October 2024 at 14:00 and lasted for 60 minutes until reaching 98% of recovery. The complete analysis report and plots are presented in Appendix C.

This bore has a total depth of 183.6 mbgl and is screened from 73 mbgl to the end of the bore, intercepting a chert unit. The aquifer thickness (b) was considered equal to the screened section for the analysis (b = 110.6 m). The parameters used in the analysis are summarised in Table 4.11.

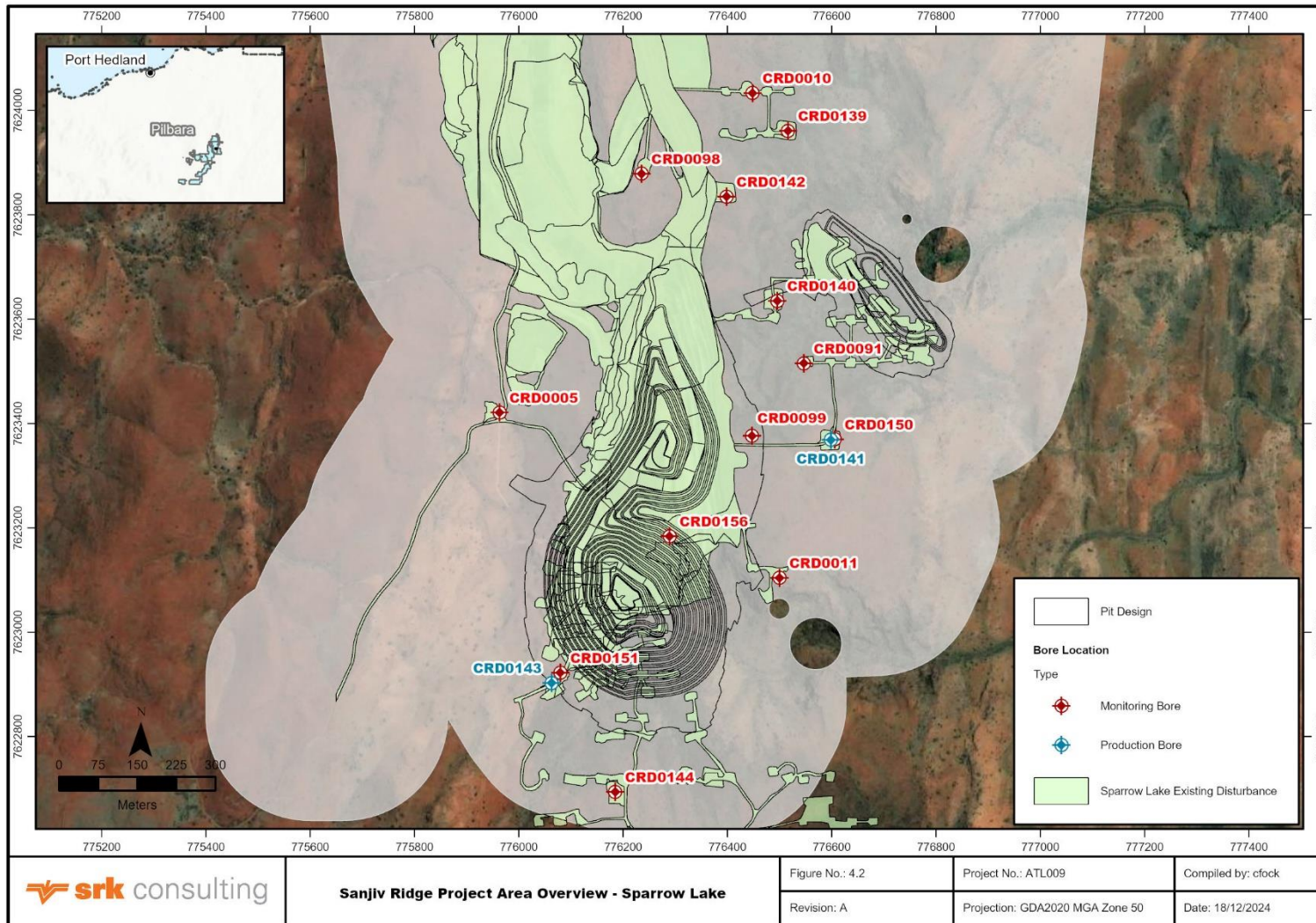
Table 4.11: Bore CRD0143 pumping test parameters

Parameter	CRD0143
Depth of hole (m)	183.6
Hole diameter (m)	0.3
Casing diameter (m)	0.2
Screened section (m)	110.6
Pre-test Water level (mbTOC)	53.73
Maximum drawdown (m)	38.81
Pump depth (mbTOC)	130
Flow rate (L/s)	20

In this case, the production bore has an apparent efficiency between 61% and 71% for flow rates between 12.5 L/s and 20 L/s (the higher the flow rate, the lower the efficiency).

For the CRT, the monitoring network included the following bores: CRD0139, CRD0140, CRD0142, CRD0144, CRD0150, CRD0151 and CRD0156. Bore CRD0151 is located on the same pad and has a screened section from 44–122 mbgl. This bore had to be drilled shallower than CRD0143 due to stability problems. Monitoring bore distance to pumping bore (radius) and maximum drawdown are summarised in Table 4.12.

Figure 4.2: Sparrow Lake tested bores and monitoring bores



File path: P:\ATL009 - Sanjiv Ridge Below Water Table Mining Hydrogeology study\06_GIS_Data\Hydrogeology\ATL009_Hydrogeo_Figures\ATL009_Hydrogeo_Figures.aprx

Table 4.12: Distance to pumping bore and maximum drawdown during pumping test for bore CRD0143

Monitoring bore ID	Distance to pumping bore (m)	Maximum drawdown
CRD0005	528	0
CRD0010	1194	0
CRD0011	481	0
CRD0098	991	0
CRD0139	1151	0
CRD0142	991	0
CRD0144	242	0
CRD0150	716	0.22
CRD0140	851	0.23
CRD0099	610	0.30
CRD0091	780	0.31
CRD0151	26	4.14
CRD0156	361	0.48

Solutions and results are summarised in Table 4.13.

During the pumping test, several distant monitoring bores (CRD0140, CRD0156, CRD0099, CRD0091 and CRD0150) exhibited measurable drawdown. However, CRD0140, CRD0099, CRD0091 and CRD0150 showed no signs of recovery afterwards. The hydraulic parameters for most observation bores are consistent with storativity values in the order of 10E-03. Notably, storativity values for CRD0151 fall at the extreme end of the typical range for crystalline fractured rock (10E-03 to 10E-05). In contrast, the hydraulic parameters for the remaining bores align with the expected range for transmissivity (0.01–10 m/day).

Using the drawdown data from the CRT, the average logarithmic derivative of drawdown calculated for CRD0143 was 0.01, while for CRD0151 it was 0.10, indicating a very good and good fracture network, respectively.

The pump for this test was initially installed at a depth of 145 mbTOC but was raised by 15 m after the SRT due to difficulties in maintaining a stable flow rate of 20 L/s for 72 hours. The final depth of the pump during the CRT was 130 mbTOC. Based on observations during the test, this pump depth is likely to be appropriate for long-term abstraction at this location.

Table 4.13: Inferred hydraulic parameters for bore CRD0143

Pumping bore	Observation bore	Solution type	S	T (m ² /day)	K (m/day)
CRD0143	CRD0143	Moench (Fracture)	-	96.51	0.83
		Cooper-Jacob (AQ _t)	-	391.50	3.38
		Cooper-Jacob (FC)	-	338.70	2.92
CRD0143	CRD0151	Moench (Fracture)	1.91E-08	124.87	1.13
		Dougherty-Babu	4.60E-07	383.40	3.47
		Cooper-Jacob (AQ _t)	1.00E-06	367.00	3.32
CRD0143	CRD0140	Cooper-Jacob (FC)	2.96E-04	431.80	3.90
		Theis	3.35E-03	327.20	2.96
		Cooper-Jacob (AQ _t)	2.35E-03	721.90	6.53
CRD0143	CRD0156	Dougherty-Babu	3.23E-03	388.80	3.52
		Theis	6.15E-03	412.50	3.73
		Cooper-Jacob (AQ _t)	5.12E-03	345.50	3.12
CRD0143	CRD0099	Dougherty-Babu	5.36E-03	519.00	4.69
		Theis	3.37E-03	858.80	7.76
		Cooper-Jacob (AQ _t)	3.13E-03	909.70	8.23
CRD0143	CRD0091	Dougherty-Babu	3.50E-03	621.00	5.61
		Theis	3.43E-03	272.20	2.46
		Cooper-Jacob (AQ _t)	2.49E-03	668.30	6.04
CRD0143	CRD0150	Dougherty-Babu	2.92E-03	203.90	1.84
		Moench (Fracture)	1.16E-07	274.73	2.48
		Cooper-Jacob (AQ _t)	1.87E-03	373.40	3.38
		Theis	2.58E-03	202.30	1.83
Geomean			3.69E-04	365.80	3.31

Notes: Minor differences with Appendix C are due to rounding.

Bore CRD0141

Bore CRD0141 is a production bore located to the west of the designed pit. The SRT started on 3 November 2024 at 08:00 and finished on 3 November 2024 at 12:00 – each step was 1 hour long, and the yields selected for each step were 4, 6, 8 and 10 L/s. The CRT lasted 72 hours, starting on 3 November 2024 at 14:00 and finishing on 6 November 2024 at 14:00. The recovery test started on 6 November 2024 at 14:00 and lasted for 17 hours until reaching 97% of recovery. The complete analysis report and plots are presented in Appendix C.

This bore has a total depth of 198 mbgl and is screened from 84 mbgl to the end of the bore, intercepting a chert unit. The aquifer thickness (b) was considered equal to the screened section for the analysis (b = 114 m). Parameters used in the analysis are summarised in Table 4.14.

Table 4.14: Bore CRD0141 pumping test parameters

Parameter	CRD0141
Depth of hole (m)	197
Hole diameter (m)	0.3
Hole diameter (m)	0.2
Screened section (m)	114
Water level (mbTOC)	79.51
Maximum drawdown (m)	30.4
Pump depth (mbTOC)	150
Flow rate (L/s)	8

In this case, the production bore has an apparent efficiency between 26% and 47% for flow rates between 4 L/s and 10 L/s (the higher the flow rate, the lower the efficiency).

For the CRT, the monitoring network included the following bores: CRD0139, CRD0140, CRD0142, CRD0144, CRD0150, CRD0151 and CRD0156. Bore CRD0150 is located on the same pad and has a screened section from 96–198 mbgl. Monitoring bore distance to pumping bore (radius) and maximum drawdown are summarised in Table 4.15.

Table 4.15: Distance to pumping bore and maximum drawdown during pumping test for bore CRD0141

Monitoring bore ID	Distance to pumping bore (m)	Maximum drawdown
CRD0005	638	0
CRD0010	681	0
CRD0011	282	0
CRD0098	616	0
CRD0139	598	0
CRD0142	507	0
CRD0144	791	0
CRD0151	684	0
CRD0156	360	0
CRD0099	151	0.57
CRD0140	286	0.59
CRD0091	156	0.76
CRD0150	7	4.47

Solutions and results are summarised in Table 4.16.

Table 4.16: Inferred hydraulic parameters for bore CRD0141

Pumping bore	Observation bore	Solution type	S	T (m ² /day)	K (m/day)
CRD0141	CRD0141	Moench (Fracture)	-	51.87	0.46
		Cooper-Jacob (AQ _t)	-	82.98	0.73
		Cooper-Jacob (FC)	-	91.60	0.80
CRD0141	CRD0150	Moench	7.31E-05	102.87	0.90
		Cooper-Jacob (AQ _t)	4.94E-03	104.20	0.91
		Dougherty-Babu	5.82E-04	141.80	1.24
		Cooper-Jacob (FC)	2.19E-02	116.20	1.02
CRD0141	CRD0091	Moench (Fracture)	1.71E-06	121.98	1.07
		Cooper-Jacob (AQ _t)	4.77E-03	164.00	1.44
		Dougherty-Babu	3.50E-03	204.30	1.79
CRD0141	CRD0099	Theis	6.16E-03	255.30	2.24
		Cooper-Jacob (AQ _t)	6.75E-03	212.30	1.86
		Dougherty-Babu	6.46E-03	218.5	1.92
CRD0141	CRD0140	Moench (Fracture)	2.50E-06	247.04	2.17
		Cooper-Jacob (AQ _t)	1.47E-03	222.50	1.95
		Dougherty-Babu	1.25E-03	270.2	2.37
Geomean			8.69E-04	147.47	1.29

Note: Minor differences with Appendix C are due to rounding.

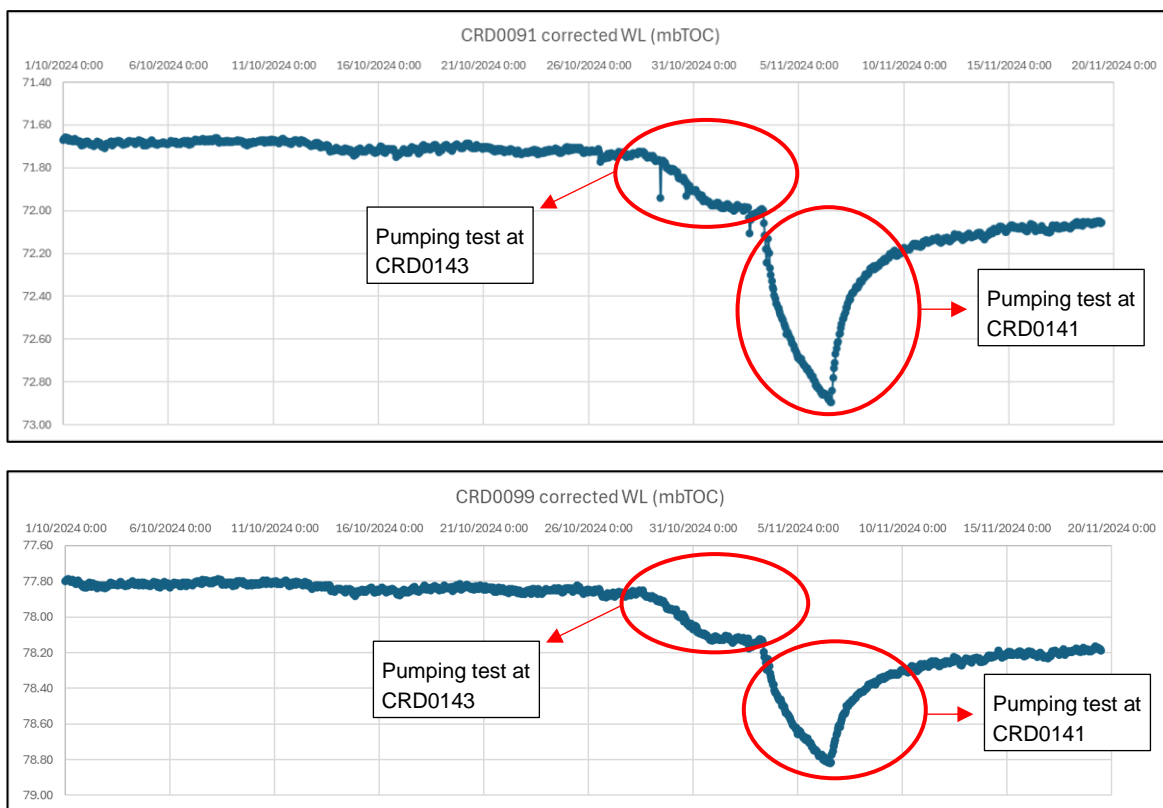
Several monitoring bores showed a clear response during the pumping test on bore CRD0141. Bores CRD0091, CRD0099 and CRD0140 recovered to levels close to their pre-test conditions, although they did not fully return to the values recorded before pumping in bore CRD0143. The hydraulic parameters align with expectations for crystalline fractured bedrock, displaying high conductivity (typically from 0.01–10 m/day) and low storativity (ranging between 10E-03 and 10E-05).

The average logarithmic derivative of drawdown calculated for CRD0141 was 0.03, while for CRD0150 it was 0.21, indicating a very good and good fracture network, respectively.

The final depth of the pump during the CRT was 150 mbTOC. Based on observations during the test, this pump depth is likely to be appropriate for long-term abstraction at this location.

Figure 4.3 shows the corrected water levels in bores CRD0091 and CRD0099 between 1 October 2024 and 19 November 2024. The graphs for both bores display the drawdown during the pumping of bore CRD0143, followed by a flat line indicating no recovery after the test concluded. When the pumping test at CRD0141 started, the drawdown and recovery were clearly identified. However, even after 10 days following the completion of the pumping tests at Sparrow Lake Pit, the water level did not recover to the levels observed prior to the start of pumping at CRD0143. This is the only location where drawdown was recorded at distances greater than 10 m. The cause of this behaviour is currently unknown but is likely related to a compartmentalised fracture system through the aquifer and dewatering of the local saturated fracture network.

Figure 4.3: Corrected water levels in bores CRD0091 and CRD0099 before and after the pumping tests



Packer testing at Sparrow Lake

Five geotechnical bores were drilled at Sparrow Lake Pit in 2025, three of which (SPR01, SPR02 and SPR04) were selected for Packer testing.

A total of seven Packer tests were conducted: two in bore SPR01, three in SPR02 and two in SPR04. All tests in SPR02 and SPR04 were incomplete. The reason was not specified within the raw data but it is assumed it is due to the inability to generate downhole pressure (similar to the incomplete tests at Runway). All tests in SPR01 were successful. All tests used a single-packer configuration with a pressure sequence of 150 kPa, 300 kPa, 450 kPa, 300 kPa, and 150 kPa. Table 4.17 provides a summary of the borehole details and Packer test configuration.

Table 4.17: Summary of Sparrow Lake geotechnical bores details and Packer test configuration

Bore ID	Easting	Northing	Depth (mb TOC)	Azi-muth	Dip	Test date	Test interval (mbTOC)	True vertical depth (mAHD)	Test status
SPR01a	776165.1	7622992	146	255	-50	27/05/25	111.5-114.2	294.6–292.5	Successful
SPR01b						27/05/25	71.9-73.9	324.9–323.4	Successful
SPR02	776271.7	7623072	138	65	-65	26/05/25	69.3-72.6	314.1–311.1	Incomplete
						26/05/25	108.5-111.8	278.6–275.6	Incomplete
						26/05/25	129.5-132.8	259.5–256.5	Incomplete
SPR04	776402	7623316	130	130	-80	25/05/25	72.3-75.3	357.8–355.1	Incomplete
						25/05/25	98.3-101.3	332.2–329.2	Incomplete

Sources: Atlas

Notes: True vertical depth is the vertical distance from ground level to the test interval, taking into account the bore's deviation from vertical. Used to relate to water level.

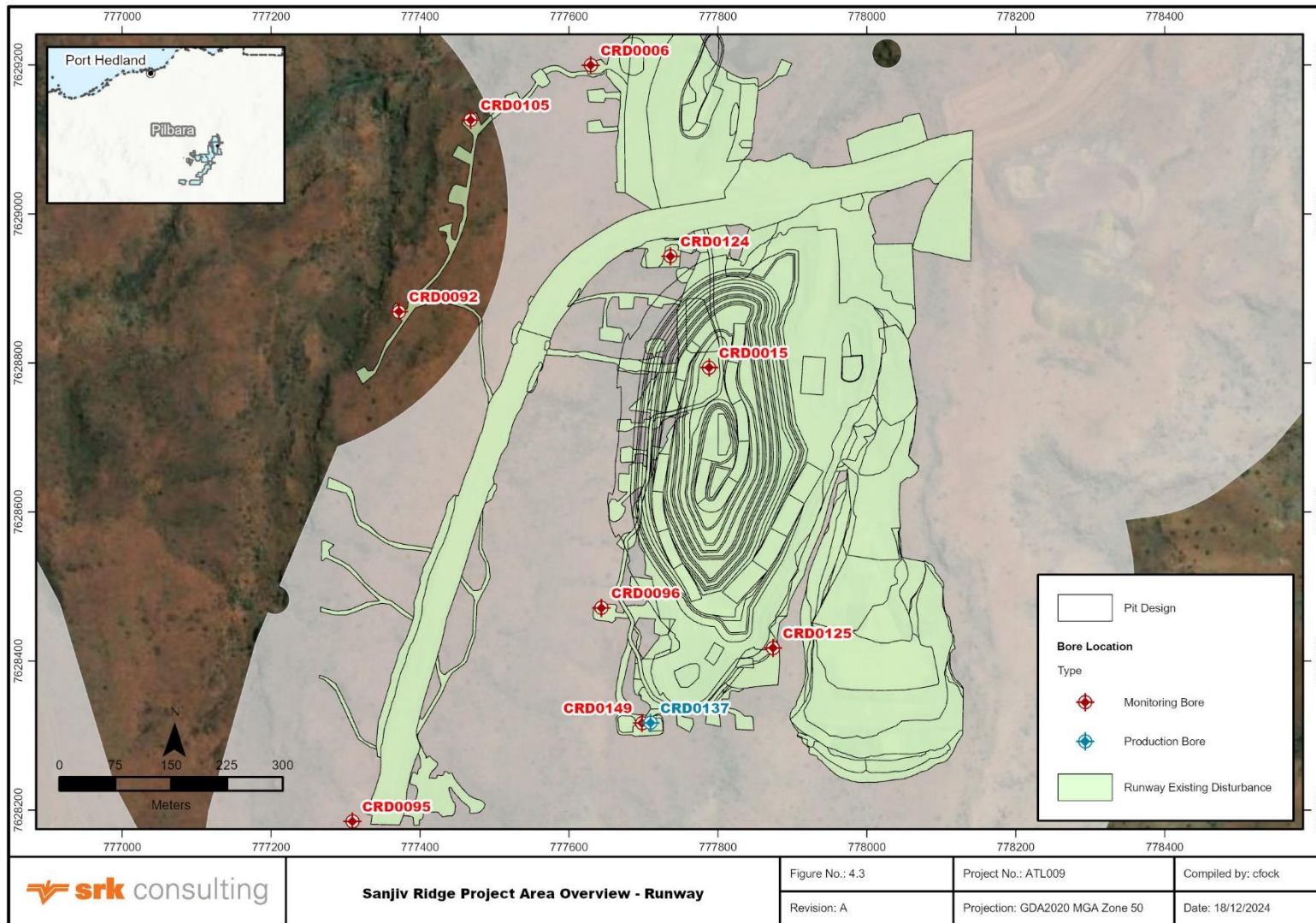
The results from the successful Packer tests conducted in bore SPR01 are presented in Appendix E, with the key findings summarised below:

- Water levels within the pit footprint are approximately ~350 mAHD. Below water table mining has not yet commenced; as such, water levels have been stable for the duration of monitoring (see the H3 report appendix D). The test depths for all Packer tests are below recorded water levels.
- Using the data generated by the Packer test, SRK calculated the K value to be 0.15 m/d at SPR01a and 0.37 m/d at SPR01b. This is similar to, but lower than, the pumping test geomean K values of 1.297 m/d at CRD0141 (Table 4.16) and 3.31 m/d at CRD0143 (Table 4.13).
- The tests performed at bores SPR02 and SPR04, though incomplete, provided qualitative insights suggesting significant variability in conductivities around the pit and higher K values recorded during the pumping tests of CRD0141.
- The results aligned with the heterogeneities proposed in the conceptual groundwater model. (refer to the numerical groundwater model report, contained within the H3 report appendix G for more information).

4.2.3 Runway area

One bore was tested in the Runway area: CRD0137. Locations of the pumped bore and the bores used to monitor the test are presented in Figure 4.4.

Figure 4.4: Runway tested bores and monitoring bores



File path: P:\ATL009 - Sanjiv Ridge Below Water Table Mining Hydrogeology study\06_GIS_Data\Hydrogeology\ATL009_Hydrogeo_Figures\ATL009_Hydrogeo_Figures.aprx

Bore CRD0137

Bore CRD0137 is a production bore located to the south of the designed pit. The SRT started on 11 November 2024 at 07:30 and finished on 11 November 2024 at 11:30 – each step was 1 hour long, and the yields selected for each step were 5, 6, 7 and 8 L/s. The CRT lasted 72 hours, starting on 11 November 2024 at 13:00 and finishing on 14 November 2024 at 13:00. The recovery test started on 14 November 2024 at 13:00 and lasted for 90 minutes until reaching 99% of recovery. The complete analysis report and plots are presented in Appendix C.

This bore has a total depth of 208 mbgl and is screened from 82 m to the end of the bore, intercepting a chert unit. The aquifer thickness (b) was considered equal to the screened section for the analysis (b = 126 m). The parameters used in the analysis are summarised in Table 4.18.

Table 4.18: Bore CRD0137 pumping test parameters

Parameter	CRD0137
Depth of hole (m)	208
Hole diameter (m/)	0.3
Hole diameter (m)	0.2
Screened section (m)	126
Water level (mbTOC)	76.39
Maximum drawdown (m)	45.7
Pump depth (mbTOC)	150
Flow rate (L/s)	6.5

In this case, the production bore has an apparent efficiency between 4% and 7% for flow rates between 5 L/s and 8 L/s (the higher the flow rate, the lower the efficiency).

For the CRT, the monitoring network included the following bores: CRD0006, CRD0015, CRD0092, CRD0095, CRD0096, CRD0105, CRD0124, CRD0125 and CRD0149. Bore CRD0149 is located in the same pad and has a screened section from 84–210 mbgl. Monitoring bore distance to pumping bore (radius) and maximum drawdown are summarised in Table 4.19.

Table 4.19: Distance to pumping bore and maximum drawdown during pumping test for bore CRD0137

Monitoring bore ID	Distance to pumping bore	Maximum drawdown
CRD0006	886	0
CRD0015	483	0
CRD0092	647	0
CRD0095	422	0
CRD0096	168	0
CRD0105	844	0
CRD0124	627	0
CRD0125	193	0
CRD0149	11	7.34

Solutions and results are summarised in Table 4.20.

Table 4.20: Inferred hydraulic parameters for bore CRD0137

Pumping bore	Observation bore	Solution type	S	T (m ² /day)	K (m/day)
CRD0137	CRD0137	Moench (Fracture)	-	14.82	0.12
		Cooper-Jacob (AQ _t)	-	84.81	0.67
		Cooper-Jacob (FC)	-	133.00	1.06
CRD0137	CRD0149	Moench (Fracture)	1.32E-06	20.46	0.16
		Dougherty-Babu	1.18E-07	99.50	0.79
		Cooper-Jacob (AQ _t)	1.47E-28	420.60	3.34
		Cooper-Jacob (FC)	4.60E-22	510.30	4.05
Geomean			3.93E-07	95.61	0.76

Notes: Minor difference with Appendix C is due to rounding. Geomeans does not include Cooper-Jacob outliers.

Only the monitoring bore CRD0149 showed a response to the pumping test of bore CRD0137. The hydraulic parameters for the monitoring bore are higher than those calculated for the pumping bore possibly reflecting the low efficiency of production bore CRD0137 compared with the monitoring bore. However, both values suggest high transmissivity and hydraulic conductivity values, falling within the expected range for a crystalline fracture rock (typically from 0.01–10 m/day). Storativity values calculated using Moench and Daugherty-Babu are in the extreme end of the range expected for a fracture rock aquifer (ranging from 10E-03 to 10E-05), while storativity values calculated using Cooper-Jacob are outside the range and are not considered to be within the geomean value in Table 4.20.

Using the drawdown data from the CRT, the average logarithmic derivative of drawdown calculated for CRD0137 was 0.01, while for CRD0149 it was 0.02, both indicative of a very good fracture network.

The final depth of the pump during the CRT was 150 mbTOC. Based on observations during the test, this pump depth is likely to be appropriate for long-term abstraction at this location.

Packer testing at Runway

Four geotechnical bores were drilled at Runway Pit in 2025, two of which (RS03 and RS04) were selected for Packer testing.

A total of three Packer tests were conducted: two in bore RS03, both of which failed due to the inability to generate downhole pressure; and one in bore RS04, which was successful. All tests used a single-packer configuration with a pressure sequence of 150 kPa, 300 kPa, 450 kPa, 300 kPa, and 150 kPa. Table 4.21 provides a summary of the borehole details and Packer test configuration.

Table 4.21: Summary of Runway geotechnical bores details and Packer test configuration

Bore ID	Easting	Northing	Depth (mbTOC)	Azi-muth	Dip	Test date	Test interval (mbTOC)	True vertical depth (mAHD)	Test status
RS03	777750	7628782	80	265	-65	25/03/25	76.1 – 80	323.85–327.08	Successful
RS04	777823	7628783	90	85	-65	13/03/25	45.7 – 50.1	342.58–346.21	Incomplete
RS04	777823	7628783	90	85	-65	14/03/25	63.2 – 66.0	329.43–331.74	Incomplete

Sources: Atlas

Notes: True vertical depth is the vertical distance from ground level to the test interval, taking into account the bore's deviation from vertical. Used to relate to water level.

The results from the successful Packer test conducted in bore RS03 are presented in Appendix E, with the key findings summarised below:

- Water levels were approximately ~350 mAHD until 2021 but have since decreased by around 30 m, reaching ~320 mAHD due to pumping. While the test depths for all Packer tests were below historical water levels, only the successfully completed test (RS03) was conducted below the current water level.
- Using the of 0.76 m/d conducted in CRD0137 (Table 4.20).
- The shallower tests performed at bore RS04, though incomplete, provided qualitative insights suggesting higher conductivities at shallower depths.
- The results aligned with the heterogeneities proposed in the conceptual groundwater model. (refer to the numerical groundwater model report, contained within the H3 report appendix G for more information).

5 Summary

The summary for the drilling program at Sanjiv Ridge is as follows:

- Five production bores and thirteen monitoring bores were drilled and installed. Additionally, three pilot bores were drilled but not constructed due to ground instability. When yields were sufficient and the hole did not remain open, these pilot bores were redrilled near the original locations and installed as production bores. If the hole remained open and the yield was sufficient, it was reamed and installed as a production bore. Monitoring bores were drilled and installed on the same pads as the production bores, and most of the pilot holes, with only one exception, were installed as monitoring bores.
- A step rate test was conducted on six production bores and was used to determine the flow rate for the constant rate test and the efficiency of the bore. A 72-hour constant rate pumping test was conducted on all the production bores at different flow rates to estimate aquifer parameters.
- Three production bores were tested at Glen Herring and all exhibited high hydraulic conductivity and low storativity, characteristic of fractured bedrock formations. The hydraulic parameters calculated are summarised in Table 5.1.

Table 5.1: Summary of hydraulic parameters calculated in the Glen Herring Pit area

Bore	Efficiency (%)	Transmissivity range (m ² /day)	Storativity	Geomean of Storativity	Monitoring bore response
CRD0146	56–81	205.2–783.4	2.67E-05 – 4.41E-03	6.39E-04	Observed in monitoring bore in the same pad
CRD0133	13–171 ¹	16.66–420	3.87E-03 – 7.73E-03	4.95E-03	Observed in monitoring bore in the same pad
CRD0046	51–66	384.5–1,215	Omitted ²	-	Not observed

Notes:

¹ Corrected by excluding last step

² Omitted due to no monitoring bores showing a response.

- Two production bores were tested at Sparrow Lake. Both intercepted a chert fractured unit, exhibiting high hydraulic conductivity and low storativity values, typical of fractured rock. The hydraulic parameters are summarised in Table 5.2.
- Successfully completed packer test data from this area recorded similar to, but lower than, hydraulic conductivity (K) values than the results obtained from pumping tests. Several incomplete packer tests are indicative of significant variability in K values within the pit footprint which supports the current conceptual model.

Table 5.2: Summary of hydraulic parameters calculated in the Sparrow Lake Pit area

Bore	Efficiency (%)	Transmissivity range (m ² /day)	Storativity	Geomean of Storativity	Monitoring bore response
CRD0143	61–71	96.51–909.70	1.91E-08 – 6.15E-03	3.69E-04	Drawdown observed in multiple bores. Recovery not observed in distant bores
CRD0141	26–47	51.87–270.2	1.71E-06 – 2.19E-02	8.69E-04	Drawdown and recovery observed in multiple bores

- The bore tested at Runway showed high conductivity and low storativity values, consistent with fractured rock formations and Packer test data. During the pumping test, only the bore located on the same pad exhibited a response. The hydraulic parameters are summarised in Table 5.3. Storativity values derived from the Cooper-Jacob solutions are unrealistically low and should be disregarded.

Table 5.3: Summary of hydraulic parameters calculated in the Runway Pit area

Bore	Efficiency (%)	Transmissivity (m ² /day)	Storativity	Geomean of Storativity	Monitoring bore response
CRD0137	4–7	14.82–510.3	1.47E-28 ¹ – 1.32E-06	3.94E-07 ²	Observed in monitoring bore in the same pad

Notes:

- ¹ Value obtained using the Cooper-Jacob method.
- ² Values obtained using the Cooper-Jacob method were omitted from the Geomean.

Closure

This report, Drilling and Pumping Test Results, was prepared by

Pedro Di Liscia
Consultant (Hydrogeology)

and

Cris Fock
Graduate Consultant (Hydrogeology)

and reviewed by



Julie Trembleau
Consultant (Hydrogeology)

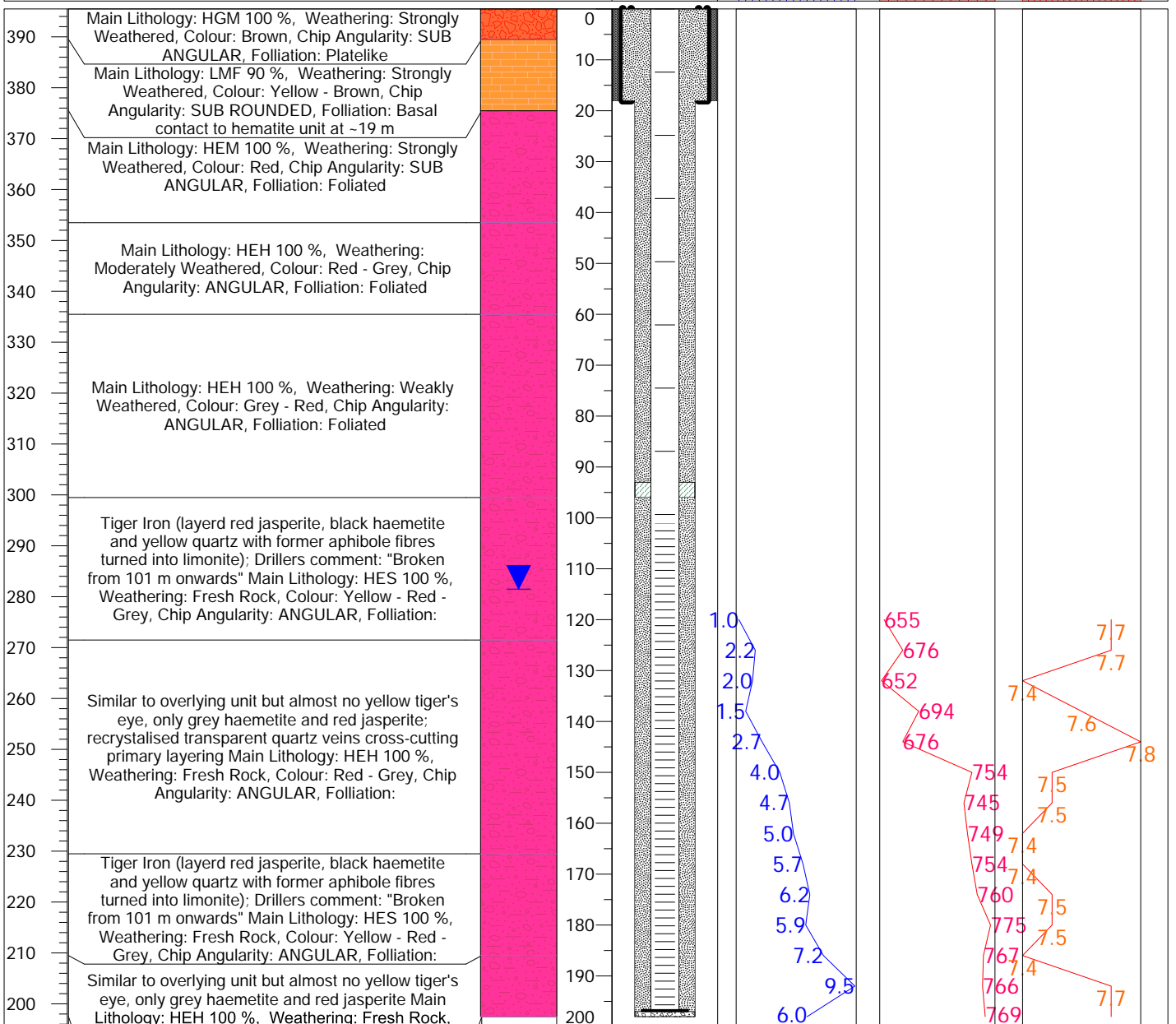
and




























Richard Cheal
Senior Consultant (Hydrogeology)



All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

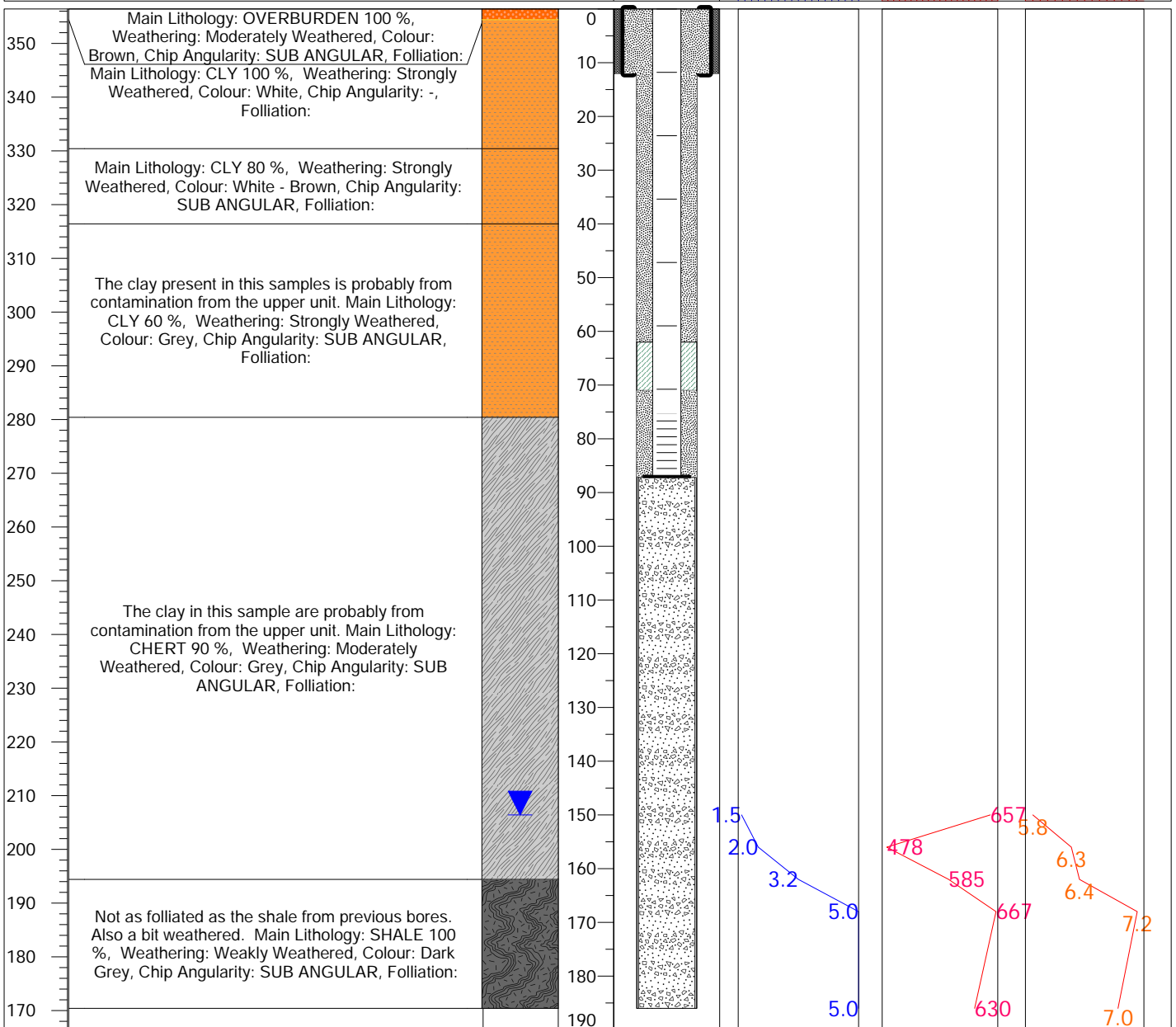
Appendix A Borehole logs

HOLE NO.: CRD0130		CLIENT: 	
LOCATION: Glen Herring	PROJECT. NO.: ATL009	EASTING: 775,003.78	TOTAL DEPTH (m): 198
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,632,293.86	GROUND ELEVATION (mAHD): 395.5
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 396.14	
START DATE: 19/05/2024	FINISH DATE: 23/05/2024	TOP OF CONCRETE PLINTH (mAHD): 395.70	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Monitoring Bore	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH)			





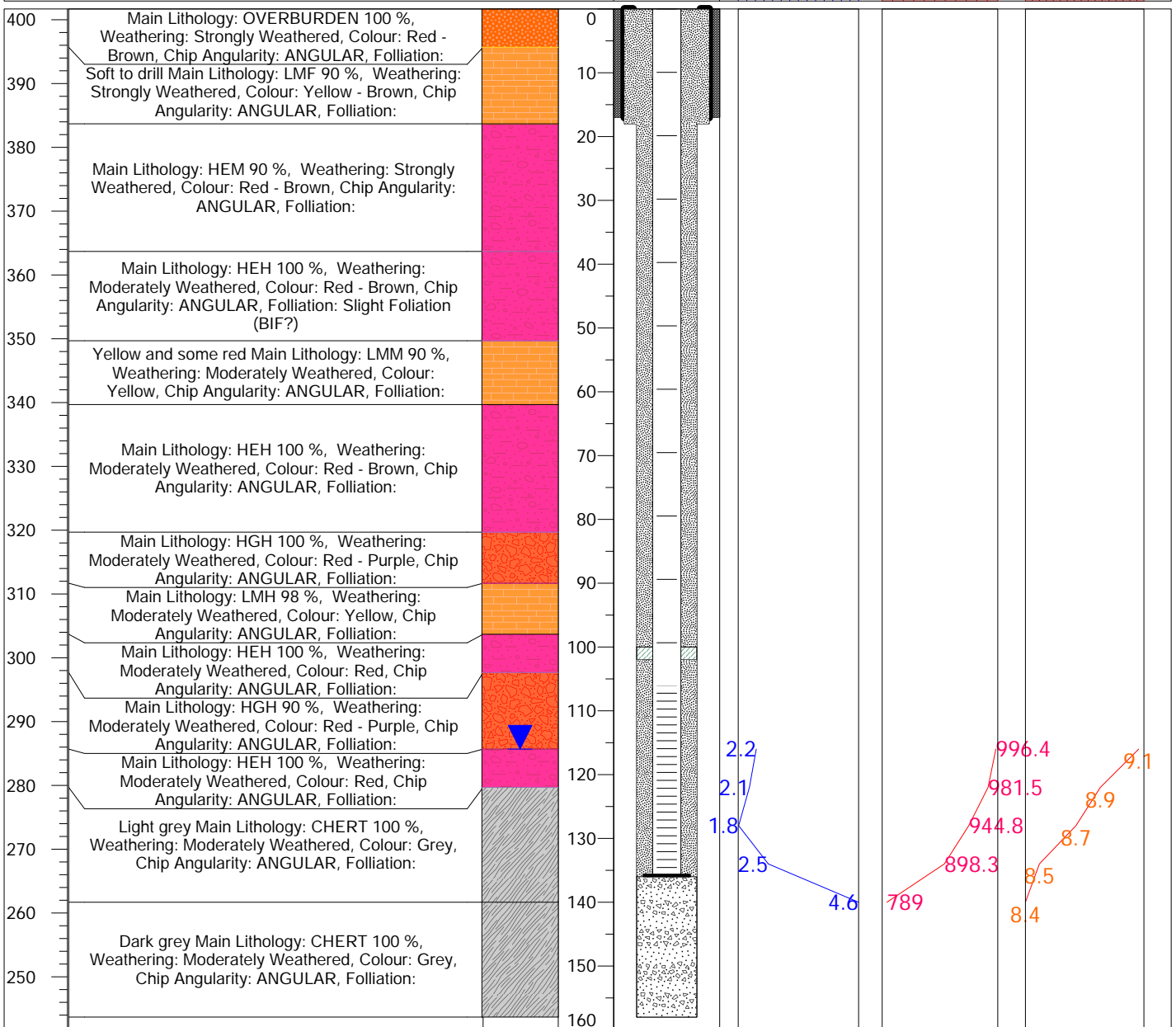
Geology Key				Well Construction Key			
	BASALT		GOM		HGM		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF				
	Open Hole		PVC Casing		Steel Casing		PVC Screen
	Grout		End Cap		Gravel Pack		Fall Back
	Bentonite						

HOLE NO.: CRD0131		CLIENT: 	
LOCATION: Glen Herring	PROJECT. NO.: ATL009	EASTING: 774,818.02	TOTAL DEPTH (m): 186
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,632,595.49	GROUND ELEVATION (mAHD): 356.4
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 357.09	
START DATE: 01/06/2024	FINISH DATE: 03/06/2024	TOP OF CONCRETE PLINTH (mAHD): 356.65	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Monitoring Bore, same pad than CRD0154, deep monitoring bore	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH)			





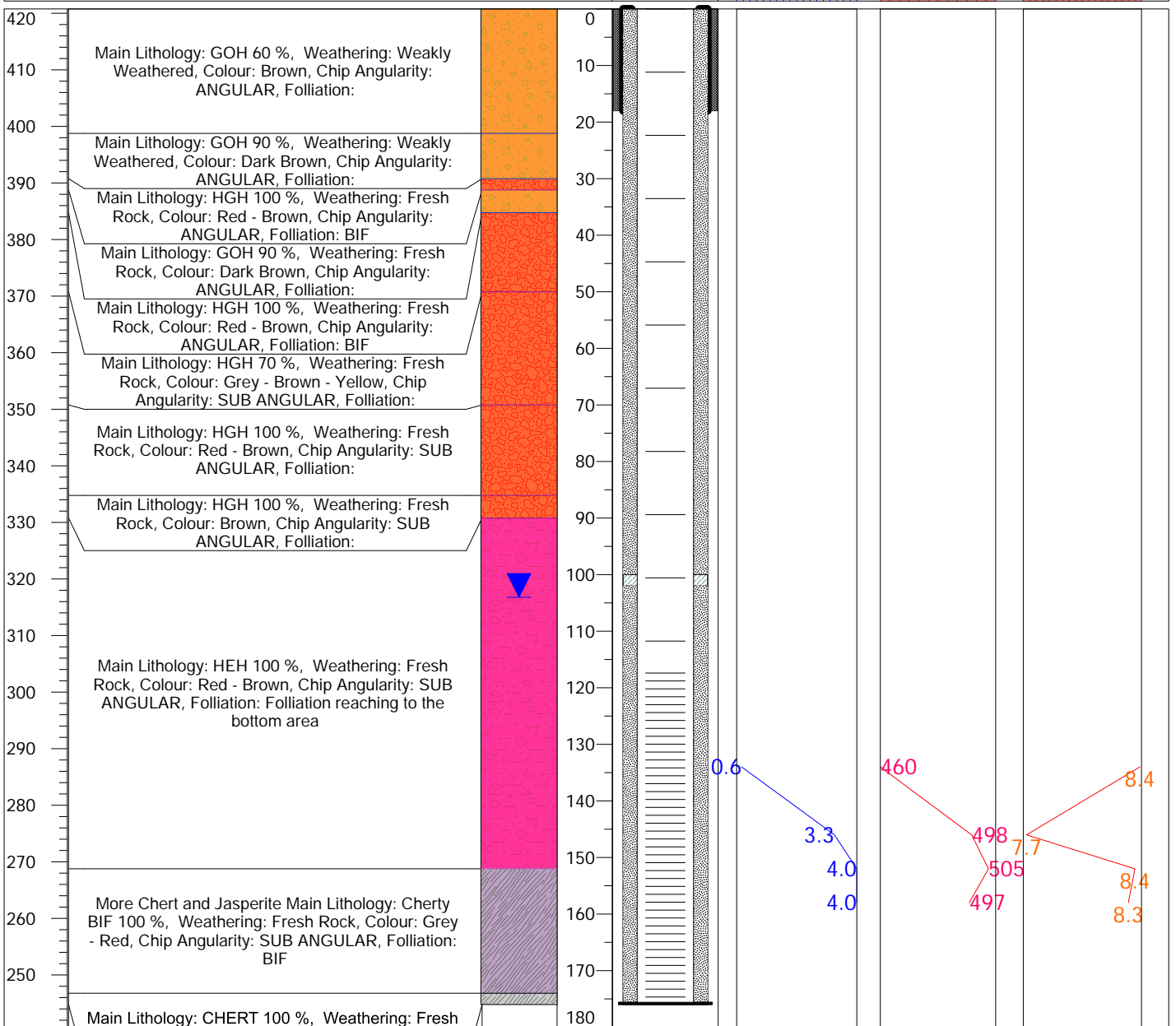
Geology Key				Well Construction Key			
	BASALT		GOM		HGH		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF		Open Hole		PVC Casing
					Steel Casing		PVC Screen
					Grout		End Cap
					Gravel Pack		Fall Back
					Bentonite		




























HOLE NO.: CRD0132		CLIENT: 	
LOCATION: Glen Herring	PROJECT. NO.: ATL009	EASTING: 775,219.18	TOTAL DEPTH (m): 158
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,632,196.11	GROUND ELEVATION (mAHD): 401.7
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 402.38	
START DATE: 13/05/2024	FINISH DATE: 16/05/2024	TOP OF CONCRETE PLINTH (mAHD): 401.89	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Monitoring Bore	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH)			





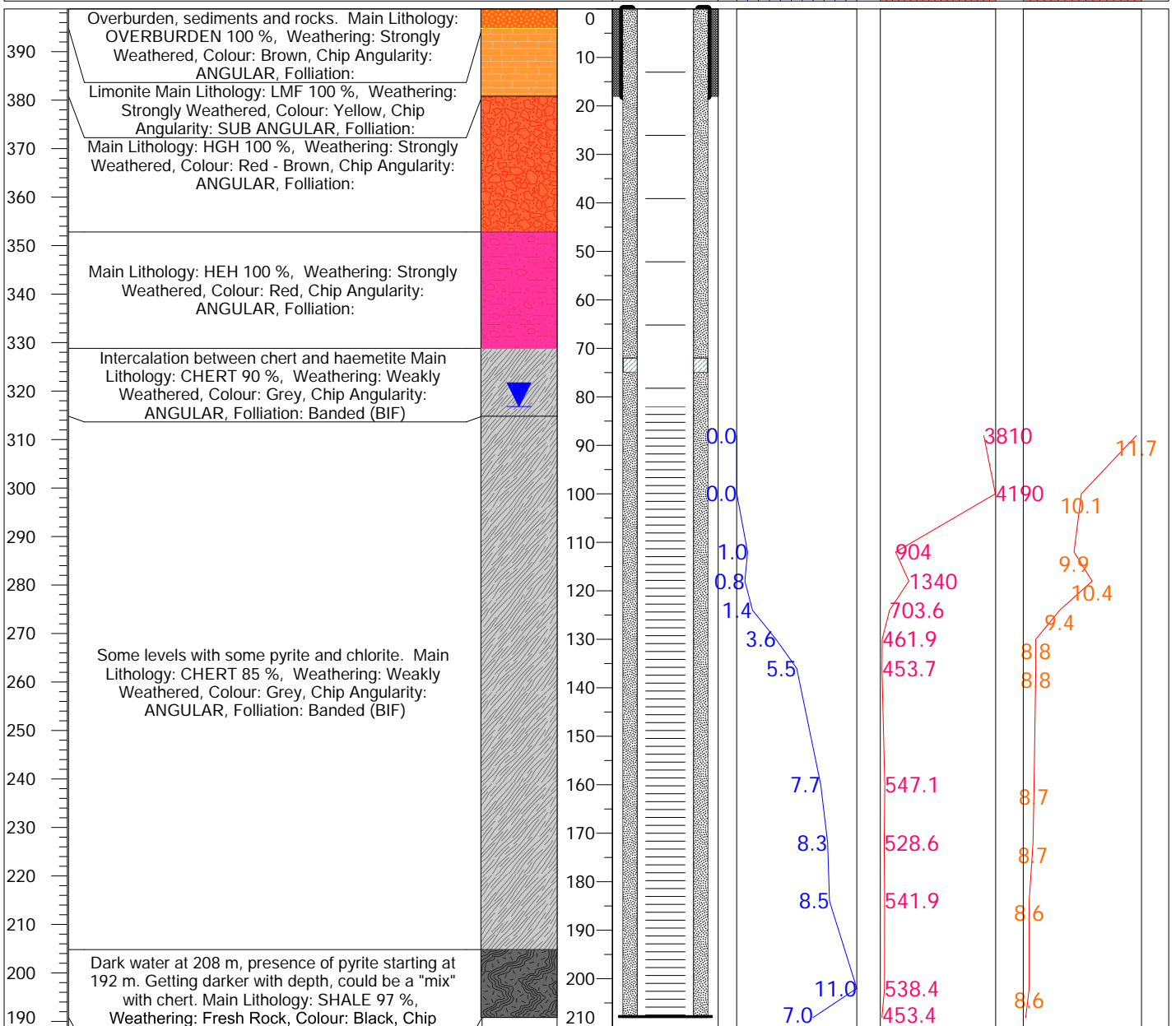
Geology Key				Well Construction Key			
	BASALT		GOM		HGH		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF		Open Hole		PVC Casing
					Steel Casing		PVC Screen
					Grout		End Cap
					Gravel Pack		Fall Back
					Bentonite		

HOLE NO.: CRD0133		CLIENT: 	
LOCATION: Glen Herring	PROJECT. NO.: ATL009	EASTING: 775,346.97	TOTAL DEPTH (m): 176
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,631,708.68	GROUND ELEVATION (mAHD): 420.8
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 421.39	
START DATE: 13/06/2024	FINISH DATE: 19/06/2024	TOP OF CONCRETE PLINTH (mAHD): 420.95	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Production Bore (4 l/s)	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH)			





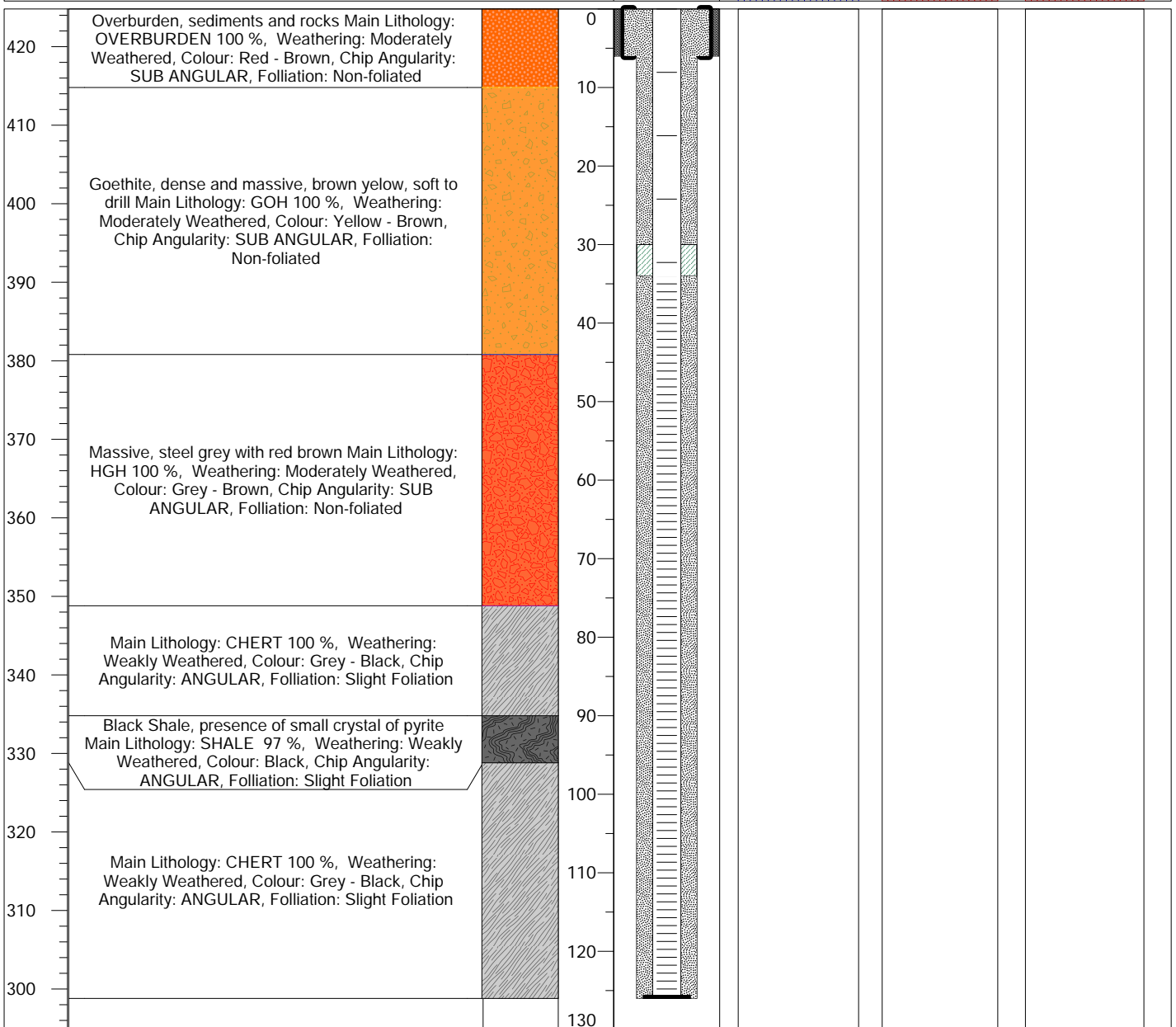
Geology Key				Well Construction Key			
	BASALT		GOM		HGH		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF				
	Open Hole		PVC Casing		Steel Casing		PVC Screen
	Grout		End Cap		Gravel Pack		Fall Back
	Bentonite						

HOLE NO.: CRD0137		CLIENT: 	
LOCATION: Runway	PROJECT. NO.: ATL009	EASTING: 777,708.45	TOTAL DEPTH (m): 208
DRILLING CONTRACTOR: FORACO	LOGGED BY: AL/CFK	NORTHING: 7,628,315.53	GROUND ELEVATION (mAHD): 398.8
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 399.33	
START DATE: 22/04/2024	FINISH DATE: 29/04/2024	TOP OF CONCRETE PLINTH (mAHD): 399.10	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Production Bore (5.2 l/s)	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH)			





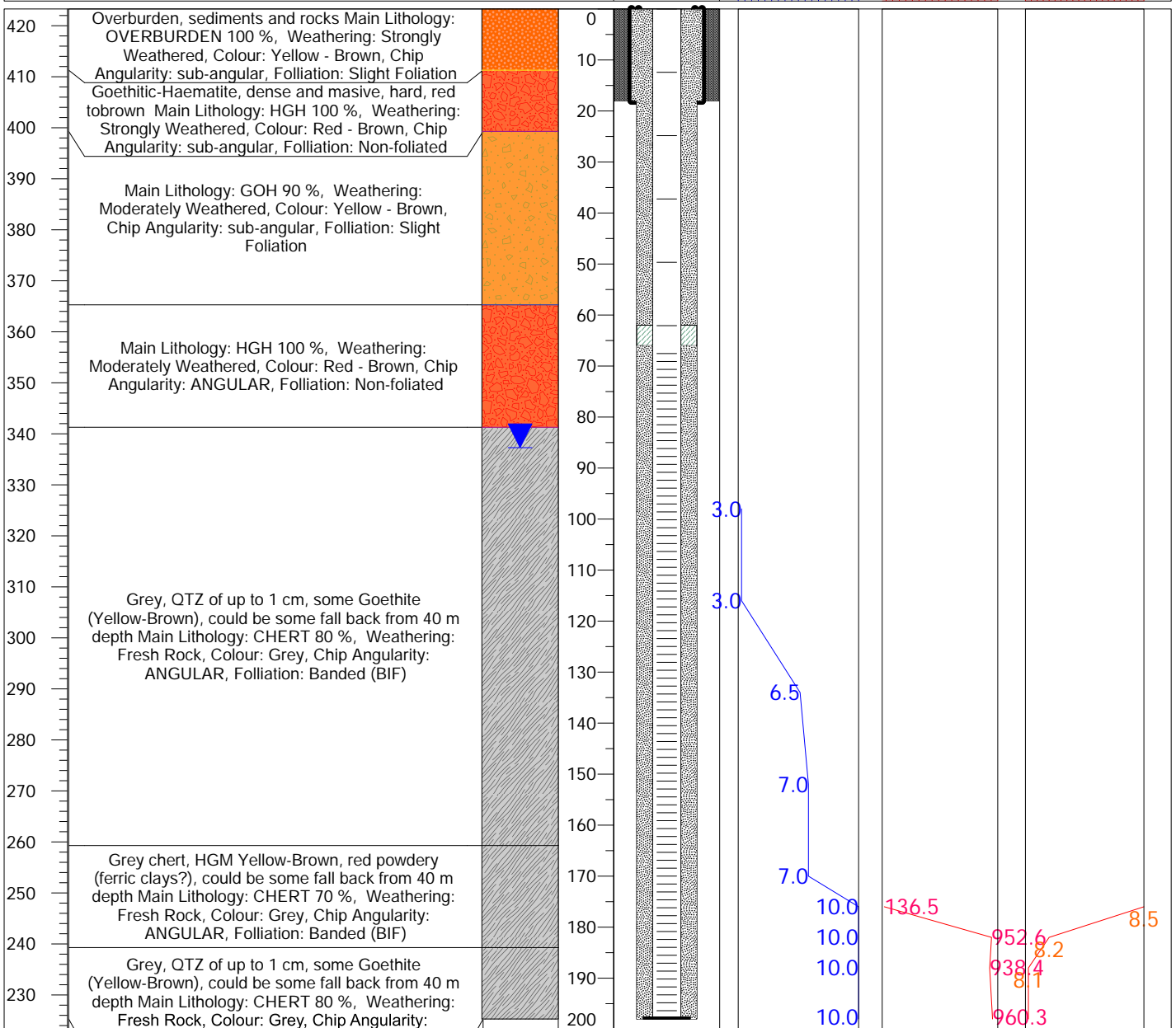
Geology Key				Well Construction Key			
	BASALT		GOM		HGH		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF		Open Hole		PVC Casing
					Steel Casing		PVC Screen
					Grout		End Cap
					Gravel Pack		Fall Back
					Bentonite		

HOLE NO.: CRD0139		CLIENT: 	
LOCATION: Sparrow Lake / Razorback	PROJECT. NO.: ATL009	EASTING: 776,515.28	TOTAL DEPTH (m): 126
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,623,959.63	GROUND ELEVATION (mAHD): 424.8
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 425.31	
START DATE: 01/02/2024	FINISH DATE: 02/02/2024	TOP OF CONCRETE PLINTH (mAHD): 424.86	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Monitoring Bore	
NOTE: Data collected during pilot hole (8") drilling. No significant water strikes encountered.			





Geology Key				Well Construction Key			
	BASALT		GOM		HGH		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF				
					Open Hole		PVC Casing
					Steel Casing		PVC Screen
					Grout		End Cap
					Gravel Pack		Fall Back
					Bentonite		

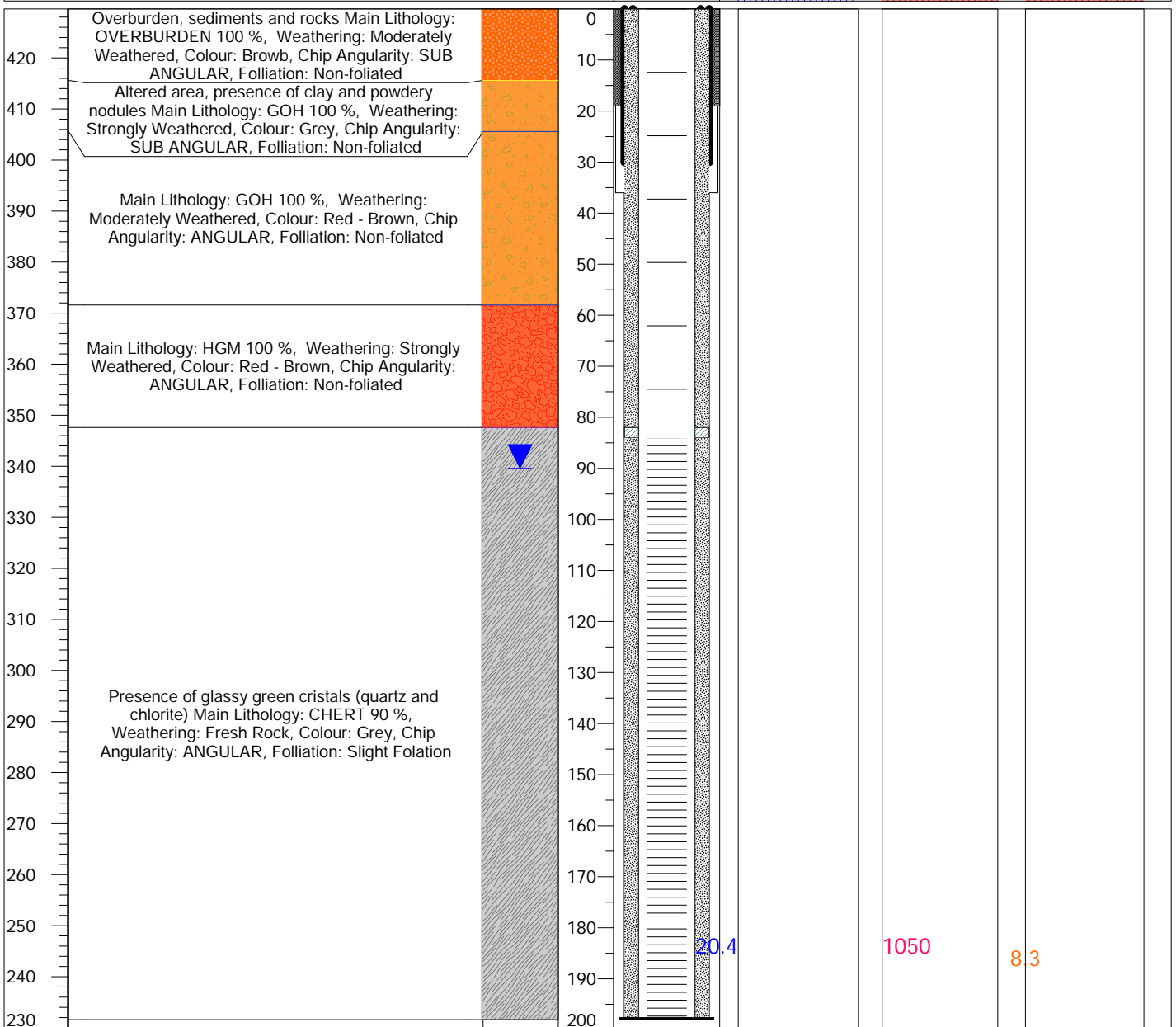
HOLE NO.: CRD0140		CLIENT: 	
LOCATION: Sparrow Lake / Razorback	PROJECT. NO.: ATL009	EASTING: 776,494.53	TOTAL DEPTH (m): 198
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,623,633.61	GROUND ELEVATION (mAHD): 423.3
DRILLING METHOD: Air Hammer	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 423.97	
START DATE: 13/03/2024	FINISH DATE: 16/03/2024	TOP OF CONCRETE PLINTH (mAHD): 423.46	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Monitoring Bore	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH)			



Geology Key				Well Construction Key			
	BASALT		GOM		HGH		LMM
	CHERT		HEH		HGM		OVERBURDEN
	Cherty BIF		HEM		LMF		QTZ
	CLY		HES		LMH		SHALE
	GOH		HGF				
	Open Hole		PVC Casing		Steel Casing		PVC Screen
	Grout		End Cap		Gravel Pack		Fall Back
	Bentonite						

HOLE NO.: CRD0141		CLIENT: 	
LOCATION: Sparrow Lake / Razorback	PROJECT. NO.: ATL009	EASTING: 776,597.37	TOTAL DEPTH (m): 198
DRILLING CONTRACTOR: FORACO	LOGGED BY: PDL/CFK	NORTHING: 7,623,367.13	GROUND ELEVATION (mAHD): 429.6
DRILLING METHOD: Mud/Air rotatory	DRILLING EQUIPMENT: RIG15	TOP OF INNER CASING (mAHD): 429.98	
START DATE: 05/04/2024	FINISH DATE: 20/04/2024	TOP OF CONCRETE PLINTH (mAHD): 429.76	
PROJECT: Sanjiv Ridge - BWT Hydro Drilling 2024		CONSTRUCTION LOG DETAILS: Non-Artesian Production Bore (7 l/s)	
NOTE: Data collected during pilot hole (8") drilling (Q (L/s), EC (µS/cm), pH). Use of Mud for drilling until ~30 m			

ELEVATION (mAHD)	FORMATION / DESCRIPTION	DEPTH (m)	CONSTRUCTION LOG	Q (L/s)				EC (µS/cm)					pH			
				20.60	20.85	21.10	21.35	1050	1050	1051	1051	1051	8.50	8.75	9.00	9.25



Geology Key						Well Construction Key			
	BASALT		GOM		HGM		Open Hole		PVC Casing
	CHERT		HEH		HGM		Steel Casing		PVC Screen
	Cherty BIF		HEM		LMM		Grout		End Cap
	CLY		HES		LMF		Gravel Pack		Fall Back
	GOH		HGF		LMH		Bentonite		
					QTZ				
					SHALE				