

Kokoseb Gold Project

Hydrological and Hydrogeological Impact Assessment



EARTH | WATER | SCIENCE | LIFE

umvoto.com

Kokoseb Gold Project *Hydrological and Hydrogeological Impact Assessment*



Version 2

Prepared for:
Environmental Compliance Consultancy

PROJECT	:	Kokoseb Gold Project
REPORT TITLE	:	Hydrological and Hydrogeological Impact Assessment
CLIENT	:	Environmental Compliance Consultancy
AUTHORS	:	Wiehan Swanepoel Khutjo Diphofe Philip Geldenhuys David McGibbon
REPORT STATUS	:	Final
VERSION	:	2
UMVOTO REPORT NUMBER	:	1059/1/1/2026
CLIENT REPORT NUMBER	:	
DATE	:	23/02/2026
APPROVED BY	:	



UMVOTO Africa (Pty) Ltd
Principal Geologist
David McGibbon



UMVOTO Africa (Pty) Ltd
Senior Hydrogeologist
Wiehan Swanepoel

Environmental Compliance
Consultancy
Luke Towers
Principal Hydrogeologist

Referencing

This report is to be referred to in bibliographies as:

Umvoto Africa (2026). Hydrological and Hydrogeological Impact Assessment, Kokoseb Gold Project. Prepared by Wiehan Swanepoel, Khutjo Diphofe, Philip Geldenhuys and David McGibbon of Umvoto Africa Pty (Ltd.) on behalf of Environmental Compliance Consultancy. Version 2; Report No. 1059/1/1/2026, pg.85 excl. appendices.

Conditions and Disclaimer

Any documentation, reports, opinions, interpretations or otherwise, generated by Umvoto Africa (Pty) Ltd and contained in this report or submitted separately, are solely for the internal use of the Client to whom the information is addressed and are not to be circulated, published, or reproduced, whether in whole or in part, outside of the Client’s organisation or with specific approval in writing by Umvoto Africa (Pty) Ltd. Umvoto Africa (Pty) Ltd will not be held liable for loss or damages resulting from work undertaken or reported in terms of this assignment, or decisions taken on the basis of such work and/or report.

Report Status

Version	Status	Reviewed By	Date
1	Final Draft	D McGibbon	13/02/2026
2	Final	D McGibbon	23/02/2026

EXECUTIVE SUMMARY

Umvoto Africa (Pty) Ltd was appointed by Environmental Compliance Consultancy (ECC) to undertake a Hydrological and Hydrogeological Impact Assessment in support of the Environmental and Social Impact Assessment (ESIA) for the proposed Kokoseb Gold Project (EPL 4818), located approximately 35 km northeast of Uis in the Erongo Region of Namibia.

The proposed project comprises an open-pit gold mine with associated waste rock dumps (WRDs), a tailings storage facility (TSF), processing infrastructure, water supply infrastructure and supporting services. Given the semi-arid climatic setting and the fractured hard-rock aquifer environment, careful assessment of both surface water and groundwater systems is critical to promote sustainable water resource management throughout the life of mine and post-closure.

Baseline Conditions

The project area lies within the Omaruru Catchment and is characterised by ephemeral drainage systems draining southwards toward the ephemeral Omaruru River. Surface water flow is episodic and event-driven, with low mean annual rainfall and high evaporation rates.

The groundwater system is defined by a structurally controlled fractured crystalline aquifer with negligible primary porosity. Groundwater occurrence is governed by fracture connectivity, lithological contacts and structural corridors rather than topographic control. Hydrocensus data indicate static water levels typically between 20 m and 45 m below ground level, with groundwater elevations clustering between approximately 1025 and 1045 mamsl. Groundwater flow is from north/northeast to south/southwest. Regression analysis confirms minimal correlation between groundwater elevation and surface topography, supporting the structurally dominated conceptual model.

Hydrochemical data indicate alkaline to circumneutral groundwater conditions, moderate salinity, and localised fluoride exceedances in routinely monitored boreholes. Newly drilled boreholes show spatially discrete trace metal enrichment (arsenic, manganese, uranium), interpreted as lithological and geogenic influences rather than indicative of anthropogenic contamination.

Static geochemical leach testing confirms that mine materials are predominantly Non-Acid Forming (NAF), with negative Net Acid Producing Potential (NAPP) values and excess Acid Neutralising Capacity (ANC). Acid Mine Drainage (AMD) risk is therefore low, with Neutral Mine Drainage (NMD) representing the more plausible geochemical pathway under oxidising conditions.

Groundwater Modelling and Predicted Behaviour

A three-dimensional numerical groundwater flow and mass transport model was developed in FEFLOW (v10.0) and calibrated using 44 observed groundwater head measurements. Calibration statistics indicate acceptable model performance (RMSE 3.54 m; NRMSE <10%; $R^2 = 0.8769$).

Steady-state operational modelling predicts:

- Groundwater inflow to the pit of approximately 1 710 m³/day;
- Maximum drawdown occurring at the pit walls;
- A regional drawdown cone extending approximately 6 km from the pit under steady-state conditions, with progressively decreasing magnitude south of the pit, from 60 m drawdown at 2 km to 10 m drawdown at 4 km. The drawdown cone remains contained within the EPL apart for the western edge, where a drawdown of 20 m is observed;

- Simulated drawdown at the EPL boundary and at identified borehole receptors remains low relative to operational drawdown at the pit.

The pit acts as a hydraulic sink during operations, capturing groundwater flow and directing potential contaminant migration toward the pit. Post closure mass transport modelling indicates plume migration as a result of the groundwater level rebound.

Conservative mass transport simulations indicate that, under assumed failure conditions of mitigation measures for pollution control surrounding mine waste infrastructure (continuous 1 mg/L source, no sorption), contaminant plumes remain localised and migrate toward the pit during active dewatering.

Post-closure steady-state simulations assume pit lake formation at approximately 1000 mamsl, functioning as a long-term hydraulic sink. Transient rebound behaviour was not simulated and is recommended for future refinement.

Impact Assessment Overview

Impacts were assessed using ECC's Impact Prediction and Evaluation Methodology (source–pathway–receptor framework and sensitivity–significance scoring matrix).

Surface Water / Drainage

The two primary direct adverse impacts to surface water systems are:

- Reduction in downstream flow (quantity); and
- Deterioration in surface water quality.

These impacts may arise from construction and operational activities including stream diversions, stormwater routing, spills, leaks, discharges (controlled or uncontrolled), sediment mobilisation and inadequate stormwater controls.

Given the ephemeral and event-driven nature of drainage systems within the EPL, and the absence of nationally or regionally sensitive aquatic receptors, impacts are assessed as localised, low to moderate in magnitude, and reversible through engineered mitigation measures.

Indirect impacts to downstream users are assessed as minor due to the episodic character of the drainage network. Structural failure of the TSF represents a high-consequence hazard event; however, this risk is mitigated through preventative engineering design, monitoring and governance controls consistent with international best practice.

Groundwater

The two primary direct adverse impacts to groundwater are:

- Reduction in groundwater availability due to pit dewatering and abstraction; and
- Potential deterioration in groundwater quality from seepage or uncontrolled releases.

These impacts may arise from dewatering, seepage from TSF and WRDs, spills, leaks, pollution control dams, and controlled or uncontrolled discharges.

Model simulations indicate that drawdown is greatest at the pit and decreases radially, with measurable influence limited to approximately 6 km under steady-state conditions. During operations, groundwater flow gradients are directed toward the pit, promoting hydraulic capture of potential contaminants. Indirect impacts to groundwater users and ecosystem services are assessed as adverse but low in regional significance.

Monitoring and Management

A preliminary monitoring network has been designed to:

- Establish defensible baseline conditions;
- Verify model predictions;
- Detect early seepage from TSF and WRDs;
- Monitor drawdown extent;
- Track post-closure rebound and pit lake evolution.

The programme includes pre-mining, operational and post-closure monitoring phases, incorporating water level loggers, hydrochemical monitoring suites aligned with baseline indicators (fluoride, arsenic, uranium, sulphate, major ions), and sentinel boreholes positioned along interpreted structural flow paths.

Overall Conclusion

The Kokoseb Gold Project will result in measurable adverse impacts to both surface water and groundwater systems.

Surface water impacts are predominantly localised and mitigated through engineered stormwater management, diversion structures, erosion control and progressive rehabilitation.

Groundwater impacts have limited regional extent (<6 km) and are mitigated through controlled dewatering and abstraction, appropriate stormwater and wastewater management controls, engineered TSF and WRD design, and continued monitoring.

With implementation of the recommended mitigation measures, monitoring programme and modelling refinements, the overall impacts to surface water and groundwater are assessed as low in significance and minor in severity under the applied impact assessment framework.

Table of Contents

Chapter	Description	Page
EXECUTIVE SUMMARY		I
	Table of Contents	iv
	List of Tables	vii
	List of Figures	viii
	List of Abbreviations	ix
1. BACKGROUND		1
1.1.	Introduction	1
1.2.	Terms of Reference	1
1.2.1.	Scope of Work	3
1.2.2.	Legislative and Standards Framework	3
1.3.	Literature Review	4
1.3.1.	Geological and Hydrogeological Context	4
1.3.2.	Climate and Hydrology	5
1.3.3.	Surface Water Baseline Studies	5
1.3.4.	Water Quality Data	6
1.3.5.	Mining and Project Development Information	6
1.3.6.	Data Gaps Identified	6
2. SITE DESCRIPTION		7
2.1.	Locality	7
2.2.	Topography	7
2.3.	Climate	8
2.4.	Hydrology	10
2.4.1.	Catchment and Surface Water Setting	10
2.4.2.	Hydrological Assessment Framework	11
2.5.	Soils	11
2.6.	Geology	14
2.7.	Mine Description	18
2.7.1.	Orebody	18
2.7.2.	Mining Method and Equipment	18
2.7.3.	Metallurgy and Processing	19
2.7.4.	Operations Support Infrastructure	19
2.7.5.	Other Mining Activities and Infrastructure	19
2.7.6.	Waste	20
2.7.1.	Water Supply	24
2.7.2.	Surface Water Management	24
3. HYDROGEOLOGICAL SETTING		25

3.1.	Aquifer Characterisation	25
3.1.1.	Hydrogeological Site Description.....	25
3.1.2.	Recharge	25
3.2.	Fieldwork	25
3.2.1.	Hydrocensus	26
3.2.2.	Water Level Distribution.....	26
3.2.3.	Groundwater Flow Direction	28
3.2.4.	Geophysical Investigation and Borehole Siting	32
3.2.5.	Borehole Targets and Siting Rationale.....	32
3.2.1.	Borehole Drilling and Construction	33
3.2.1.	Aquifer Testing and Hydraulic Behaviour	34
3.3.	Aquifer Parameters.....	37
3.4.	Hydrochemistry	37
3.4.1.	Routine Monitoring Sites (Community BH & Exploration Tank BH)	38
3.4.2.	Newly Drilled / Exploration Boreholes (November 2025)	39
3.4.3.	Comparative Water Quality Summary	40
3.5.	Geochemical Testing	42
4.	CONCEPTUAL MODEL	43
4.1.	Key Controlling Processes and System Behaviour	43
4.2.	Hydrostratigraphic conceptualisation	43
4.3.	Recharge Conceptualisation	43
4.4.	Groundwater Levels and Flow Patterns	43
4.5.	Wellfield Bias and Representativeness	43
4.6.	Model Boundary Selection.....	43
5.	NUMERICAL GROUNDWATER FLOW AND MASS TRANSPORT MODEL	46
5.1.	Modelling Software and Approach	46
5.2.	Model Assumptions	47
5.3.	Model Domain, Mesh and Discretisation	49
5.4.	Vertical Discretisation	50
5.5.	Hydraulic Parameterisation and Anisotropy	51
5.6.	Recharge	54
5.7.	Boundary Conditions	54
5.8.	Calibration and Fit Statistics	54
5.9.	Sensitivity Analysis	56
5.10.	Scenario Simulations	57
5.10.1.	Scenario 1 – Operational pit dewatering (steady-state)	57
5.10.2.	Scenario 2 – Operational Mass Transport (Conservative Tracer).....	57
5.10.3.	Scenario 3 – Post-Closure Steady-State and Pit Lake Formation	58
5.10.4.	Modelling Results Summary	62
5.11.	Limitations And Confidence.....	62
6.	MONITORING NETWORK	63
6.1.	Monitoring Network Design	63

6.1.1. Pre-Mining Monitoring..... 66

6.1.2. Operational Monitoring 67

6.1.3. Post-Closure Monitoring 68

7. IMPACT ASSESSMENT 70

7.1. Hydrology..... 72

7.1.1. Construction Phase 72

7.1.2. Operational Phase 72

7.1.3. Decommissioning Phase 73

7.2. Groundwater 77

7.2.1. Construction Phase 77

7.2.2. Operational Phase 77

7.2.3. Decommissioning Phase 78

8. CONCLUSION AND RECOMMENDATIONS..... 83

8.1. Conclusions 83

8.2. Recommendations..... 83

8.2.1. Groundwater and Surface Water Monitoring 83

8.2.2. Pit Dewatering and Water Management..... 84

8.2.3. TSF and Waste Rock Management 84

8.2.4. Modelling Refinements 84

8.2.5. Post-Closure Planning 84

9. REFERENCES 85

APPENDIX A 1: GEOPHYSICAL TRAVERSES A

APPENDIX A 2: AQUIFER TESTING RESULTS.....D

APPENDIX B: LEGISLATIVE GUIDELINES..... Y

APPENDIX C: ECC IMPACT PREDICTION AND EVALUATION METHODOLOGY..... BB

List of Tables

Table 2-1	Lithostratigraphic overview of the 2114 Omaruru area adapted from the Ministry of Mines and Energy Geological Survey of Namibia (2010) Explanation sheet. Formations highlighted in blue occur within the study area.	17
Table 2-2	Waste types, storage and use expected to be generated as part of the Kokoseb Project. These are potential sources of environmental water contamination.	22
Table 3-1	Results of the hydrocensus conducted in January 2025 by SLR	30
Table 3-2	Results of the hydrocensus undertaken by ECC in September 2025.	31
Table 3-3	Borehole targets selected from FDEM interpretation and targeted geological features (SLR, 2025).	32
Table 3-4	Borehole drilling, construction and aquifer testing summary.	35
Table 3-5	Preliminary aquifer parameters derived from aquifer testing (used as initial inputs for parameter estimation).	37
Table 3-6	Hydrochemistry of routinely monitored boreholes	38
Table 3-7	Hydrochemistry of the newly drilled boreholes.	39
Table 3-8	Subset of noteworthy trace metal analysis.	41
Table 5-1	Key mesh and model size metrics.	49
Table 5-2	Vertical discretisation and interpretation.	50
Table 5-3	Calibrated hydraulic conductivity values used in the numerical model.	52
Table 5-4	Recharge parameter applied in the model.	54
Table 5-5	Summary of boundary conditions and stresses.	54
Table 5-6	Calibration fit statistics.	55
Table 5-7	PEST objective function reduction across iterations.	55
Table 5-8	Sensitivity testing summary.	56
Table 5-9	Dewatering scenario configuration and key output.	57
Table 5-10	Transport scenario inputs	58
Table 5-11	Post-closure scenario assumptions and outputs.	58
Table 6-1	Summary of surface water and groundwater sites to be monitored	64
Table 6-2	Hydrochemical monitoring parameters	66
Table 6-3	Pre-Mining Monitoring Network	67
Table 6-4	Operational Monitoring Network	68
Table 6-5	Post Closure Monitoring Network	69
Table 7-1	Scoring matrix for assessing the sensitivity and significance of impacts.	71
Table 7-2	Impact assessment of various activities relating to drainage and hydrology.	74
Table 7-3	Impact assessment of various activities relating to groundwater.	79

List of Figures

Figure 2-1	The location of the Kokoseb EPL 4818 within the Erongo Region of Namibia.	7
Figure 2-2	Topography map of the Kokoseb EPL 4818 area. Elevations in meters above mean sea level (mamsl).	8
Figure 2-3	Climate data for Omaruru recorded between 2012 and 2023 received from ECC.	10
Figure 2-4	Terrain and hydrology map (Hydrologic Consulting, 2025).	12
Figure 2-5	Vegetation and soil runoff potential map (Hydrologic Consulting, 2025).	13
Figure 2-6	Geology of the Kokoseb EPL4818 area (based on 1:250 000 geological map sheet 2114 Omaruru.	16
Figure 2-7	Proposed resource pit, WRDs, TSF and TSF slurry positions.	21
Figure 3-1	Water level distribution.	27
Figure 3-2	Water level regression analysis.	28
Figure 3-3	Groundwater flow direction map.	29
Figure 3-4	Spatial distribution of borehole targets drilled (SLR Technical Memorandum, 2025).	33
Figure 3-5	Piper diagram showing water quality of the newly drilled boreholes.	41
Figure 4-1	Geological map and conceptual hydrogeological cross-section.	45
Figure 5-1	Model domain and mesh refinement.	50
Figure 5-2	Model cross section showing topography, model layers and the south pit.	51
Figure 5-3	Hydraulic conductivity in 2d (Slice 1).	53
Figure 5-4	Hydraulic conductivity in 3D.	53
Figure 5-5	Calibrated observed vs. simulated heads.	56
Figure 5-6	Scenario 1 - Drawdown cone due to pit dewatering.	59
Figure 5-7	Scenario 2 - Mass transport plume during mine operations. Orange arrows represent mass transport direction.	60
Figure 5-8	Scenario 3 - Mass transport plume in a post-closure scenario (ROM). Orange arrows represent mass transport direction.	61
Figure 6-1	Map showing proposed hydrogeological monitoring network boreholes.	65

List of Abbreviations

°C	-	Degrees Celsius
a	-	Annum
AMD	-	Acid Mine Drainage
ANC	-	Acid Neutralising Capacity
BH	-	Borehole
CN	-	Cyanide
DD	-	Diamond Drilling
e.g.	-	For Example
EC	-	Electrical conductivity
ECC	-	Environmental Compliance Consultancy
EPL	-	Exclusive Prospecting License
EPM	-	Equivalent porous medium
ESIA	-	Environmental and Social Impact Assessment
GIS	-	Geographic Information System
ha	-	Hectare
hr	-	Hour
km	-	Kilometre
K	-	Hydraulic Conductivity
Kxx	-	Hydraulic Conductivity in the x-direction
Kyy	-	Hydraulic Conductivity in the y-direction
Kzz	-	Hydraulic Conductivity in the vertical direction
LOM	-	Life of Mine
l/s	-	Litres Per Second
m	-	Metre
m/s	-	Metres Per Second
m ² /d	-	Metres Squared Per Day
m ³	-	Meter Cubed
m ³ /h	-	Metres Cubed Per Hour
Ma	-	Million Years
mamsl	-	Metres Above Mean Sea Level
mbgl	-	Metres Below Ground Level
mg/L	-	Milligrams Per Litre
m/d	-	Metres Per Day
ML	-	Mining License
mm	-	Millimetre
MRE	-	Mineral Resource Extent
mS/m	-	milli Siemens per metre
Mt	-	Million ton
Mtpa	-	Million ton per annum
mV	-	millivolts
NAF	-	Non-Acid Forming
NAPP	-	Net Acid Producing Potential
NMD	-	Neutral Mine Drainage
NRMSE	-	Normalised I root mean square error
ORP	-	Oxidation Reduction Potential
PEST	-	Parameter Estimation (Model Calibration Software)
Phi (Φ)	-	Objective Function Value in Model Calibration
RC	-	Reverse Circulation
RMSE	-	Root mean square error
T	-	Ton
TSF	-	Tailings Storage Facility

TH	-	Transverse Horizontal (Dispersivity)
TV	-	Transverse Vertical (Dispersivity)
WL	-	Water Level
WRD	-	Waste Rock Dump

1. BACKGROUND

1.1. Introduction

Umvoto Africa (Pty) Ltd (Umvoto) was appointed by Environmental Compliance Consultancy (ECC), the appointed Environmental Assessment Practitioner (EAP), to undertake a Hydrology and Hydrogeology Impact Assessment in support of the Environmental and Social Impact Assessment (ESIA) for the proposed Kokoseb Gold Project on Exclusive Prospecting License (EPL) 4818, located approximately 35 km northeast of Uis in the Erongo Region of Namibia.

The Kokoseb Gold Project comprises an open pit mining operation, a conventional carbon-in-leach (CIL) processing facility (5.25 Mtpa), a filtered stack tailings storage facility (TSF), waste rock dumps (WRDs), supporting infrastructure, and associated surface water diversion structures. Water supply for the Project is anticipated to be sourced primarily from regional water supply schemes (Okombahe and Ozondati Water Supply Schemes), which are hydraulically distal from the project footprint. Mine dewatering volumes are expected to be limited and will be preferentially reused within the process circuit where feasible.

Given the nature of the proposed activities, the following potential impacts are assessed in accordance with Namibian legislation, ECC's impact methodology, and international lender standards:

- Surface water systems (including ephemeral drainage lines and the Omaruru River catchment);
- Groundwater quantity (including pit dewatering impacts);
- Groundwater quality (including potential acid mine drainage, nitrate contamination and cyanide-related risks); and
- Downstream receptors and community water users.

This report presents the Phase 2 Hydrology and Hydrogeological Impact Assessment, building on the Phase 1 scoping study and desktop review.

It evaluates baseline conditions, identifies potential impacts, assesses significance through numerical groundwater modelling, and proposes mitigation and management measures to promote responsible water resource management during construction, operation and closure.

This report should be read in conjunction with the Hydrological Assessment (Hydrologic Consulting, 2025), the Mining Scoping Study (WIA Gold, 2025), and other specialist studies forming part of the ESIA submission.

1.2. Terms of Reference

The purpose of this specialist study is to assess the potential impacts of the Kokoseb Gold Project on surface water and groundwater resources within and surrounding EPL 4818, and to provide recommendations to inform the Environmental and Social Impact Assessment (ESIA) process.

- **Characterise the Baseline Environment**
 - Describe regional and local climatic conditions.
 - Characterise surface water systems, including drainage patterns, flood potential and runoff processes.
 - Characterise the hydrogeological setting of the project.
 - Identify existing water users and potential receptors.
- **Develop a Conceptual Hydrogeological Model**
 - Define aquifer types and structural controls.
 - Identify recharge mechanisms and groundwater flow directions.
 - Describe connectivity between surface water and groundwater systems.
- **Undertake Numerical Groundwater Modelling**
 - Simulate predicted drawdown associated with pit dewatering.
 - Assess the lateral extent of the drawdown cone.
 - Evaluate groundwater inflows to the pit.
 - Assess post-closure hydraulic behaviour.
- **Assess Surface Water Impacts**
 - Evaluate potential reduction in downstream flow (quantity).
 - Assess potential deterioration in surface water quality.
 - Evaluate flood interaction with proposed infrastructure.
 - Assess the adequacy of diversion and stormwater management infrastructure.
- **Assess Groundwater Impacts**
 - Quantify predicted reductions in groundwater availability (drawdown).
 - Assess risks of groundwater quality deterioration from infrastructure (TSF, WRDs, plant area).
 - Evaluate indirect impacts on groundwater users and ecosystem services.
- **Determine Impact Significance**
 - Apply the approved ESIA impact methodology.
 - Assess impacts during construction, operation and closure phases.
 - Identify residual impacts after mitigation.
- **Recommend Mitigation and Monitoring Measures**
 - Propose engineering and management controls.
 - Develop a groundwater and surface water monitoring framework.
 - Provide adaptive management recommendations.

This study is based primarily on available desktop data, field investigations conducted to date (and available to Umvoto), and information provided in the Mining Scoping Study (WIA Gold, 2025) and Hydrological Assessment (Hydrologic Consulting, 2025).

1.2.1. Scope of Work

The scope of work for the Impact Assessment follows the two-phased approach outlined in Umvoto's proposal and comprises:

Phase 1 (Completed)

- Comprehensive literature review;
- Desktop assessment;
- Gap analysis;
- Identification of data requirements;
- Preliminary conceptual hydrogeological model;
- Scoping report.

Phase 2 (This Study)

- Field-based hydrocensus (approximate 5 km radius);
- Groundwater sampling and baseline water quality analysis;
- Slug and/or pumping test data interpretation;
- Aquifer characterisation;
- Development of a conceptual groundwater model;
- Development of a numerical groundwater flow and contaminant transport model (Feflow 10.0 with FePEST calibration);
- Desktop flood hydrology assessment (via Hydrologic Consulting (2025), Roads Authority Drainage Manual 2014 compliant);
- Impact assessment aligned with ECC's methodology;
- Monitoring network recommendations;

1.2.2. Legislative and Standards Framework

The assessment has been undertaken in accordance with:

Namibian Legislation:

- Environmental Management Act, 2007.
- Environmental Impact Assessment Regulations (No. 30 of 2012).
- Water Resources Management Act, No. 11 of 2013.
- Minerals (Prospecting and Mining) Act, No. 33 of 1992.
- Soil Conservation Act, No. 76 of 1969.

- Hazardous Substances Ordinance, No. 14 of 1974.
- National Guidelines.
- Namibian Environmental Impact Assessment Guidelines for the Mining Sector.
- General Environmental Guidelines for Mining (2000).
- Integrated Water Resources Management Plan (2010).
- Environmental Principles for Mining in Namibia - Best Practice Guide (2019).

International Standards:

- International Finance Corporation (IFC) Performance Standards (2012).
- World Bank Environmental and Social Framework.
- Applicable international water quality standards for comparison purposes.

1.3. Literature Review

This literature review synthesises available published information, specialist reports, datasets, and technical documentation relevant to the assessment of surface water and groundwater impacts associated with the Kokoseb Gold Project (EPL 4818).

The review establishes the regional environmental context, identifies baseline data sources, and highlights limitations and data gaps informing the current assessment.

The literature review incorporated:

- Geological survey publications,
- Regional hydrogeological maps,
- Any available groundwater investigations in similar geological context or locally relevant (including exploration drilling results),
- Climatic and hydrological data,
- Legislative and regulatory frameworks,
- Corporate project disclosures,
- Groundwater level and quality data from routine monitoring activities.

1.3.1. Geological and Hydrogeological Context

The project lies within the Northern Central Zone of the Damara Orogenic Belt. The area is underlain by:

- Swakop Group metasediments (Arandis, Karibib and Kuiseb Formations),
- Late syn-tectonic and post-tectonic granites,
- Minor mafic dykes.

The Kuiseb Formation hosts the gold mineralisation and is characterised by quartz-biotite schists intruded by granites. The Karibib Formation contains marble units that may locally enhance secondary permeability.

Regionally, the area falls within the Brandberg–Waterberg hydrogeological region (Ministry of Agriculture, Water and Rural Development, 2011).

The dominant aquifer type comprises:

- Secondary fractured aquifers within schists, granites and marbles,
- Limited primary alluvial aquifers along ephemeral drainage lines.

Groundwater potential is classified as low to very low, with reported hydraulic conductivity in fractured systems ranging between 0.01 and 7 m/day (Edwards, 2022).

1.3.2. Climate and Hydrology

The project area is classified as hot desert (BWh, Köppen-Geiger), characterised by:

- Highly variable rainfall;
- Mean annual rainfall between ~50 mm and 350 mm;
- Concentrated summer rainfall (December–March);
- Mean max and min temperature between 26°C - 36°C and 5°C - 16°C respectively;

Rainfall events are typically short-duration and high-intensity, resulting in:

- Event-driven runoff;
- Ephemeral drainage activation;
- Limited diffuse recharge; and
- High evaporation losses.

Evaporation rates significantly exceed rainfall, reinforcing the arid to semi-arid hydrological regime.

The EPL is located north of the Omaruru River within the Omaruru Catchment (~11 500 km²). Drainage lines within the EPL are ephemeral and only flow following significant rainfall events. A detailed hydrological assessment has been undertaken by Hydrologic Consulting (2025).

1.3.3. Surface Water Baseline Studies

The Hydrological Assessment for the Kokoseb EPL 4818 Project (Hydrologic Consulting, 2025) provides a detailed evaluation of:

- Design rainfall estimation;
- Flood recurrence interval modelling (1:50 and 1:100 RI);
- Catchment delineation;
- Flow path buffering; and
- Surface water sensitivity mapping.

The study confirms that surface water systems within the project area are ephemeral and event-driven. Flood modelling identified potential interaction between infrastructure and higher-order ephemeral drainage features, informing diversion design requirements.

1.3.4. Water Quality Data

Baseline groundwater quality data provided by ECC indicate:

- Generally acceptable water quality when compared to Namibia's Water Resource Management Act, Act 11 of 2013;
- Localised fluoride exceedances (>2 mg/L);
- Minor sodium and chloride exceedances;
- Very limited aluminium and magnesium exceedances.

These data provide an initial baseline but remain spatially limited. (two sites across the EPL).

1.3.5. Mining and Project Development Information

The Kokoseb Gold Project Scoping Study (WIA Gold, 2025) provides the technical basis for the proposed mining and processing configuration, including:

- Open pit mining methodology;
- 5.25 Mtpa carbon-in-leach (CIL) processing facility;
- Filtered stack tailings storage facility (TSF);
- Waste rock dump configuration;
- Surface water diversion structures; and
- Regional water supply strategy.

The scoping study informs the scale of disturbance and infrastructure footprint used in this impact assessment.

1.3.6. Data Gaps Identified

The literature review identified the following key data gaps:

- Absence of long-term local rainfall gauge data;
- Limited regional pump testing data to calculate aquifer parameters;
- Lack of far-field borehole data (water levels, aquifer parameters, geology and yields);
- Absence of detailed site-specific hydraulic parameters;
- No detailed TSF design available; and
- Uncertainty regarding water supply strategy.

These limitations were addressed through:

- Use of satellite-derived rainfall datasets;
- Conservative modelling assumptions;
- Adoption of precautionary impact assessment principles; and
- Development of a monitoring framework to validate predictions.

2. SITE DESCRIPTION

2.1. Locality

The Kokoseb Gold Project is located within Exclusive Prospecting Licence (EPL) 4818 in the Erongo Region of Namibia, approximately 80 km west of Omaruru and approximately 320 km by road from Windhoek (see **Figure 2-1**). The assessment area includes the full extent of EPL 4818 and encompasses the anticipated Mining Licence (ML) footprint and associated infrastructure corridors. The project area is characterised by gently undulating terrain intersected by ephemeral drainage features typical of semi-arid central Namibia.

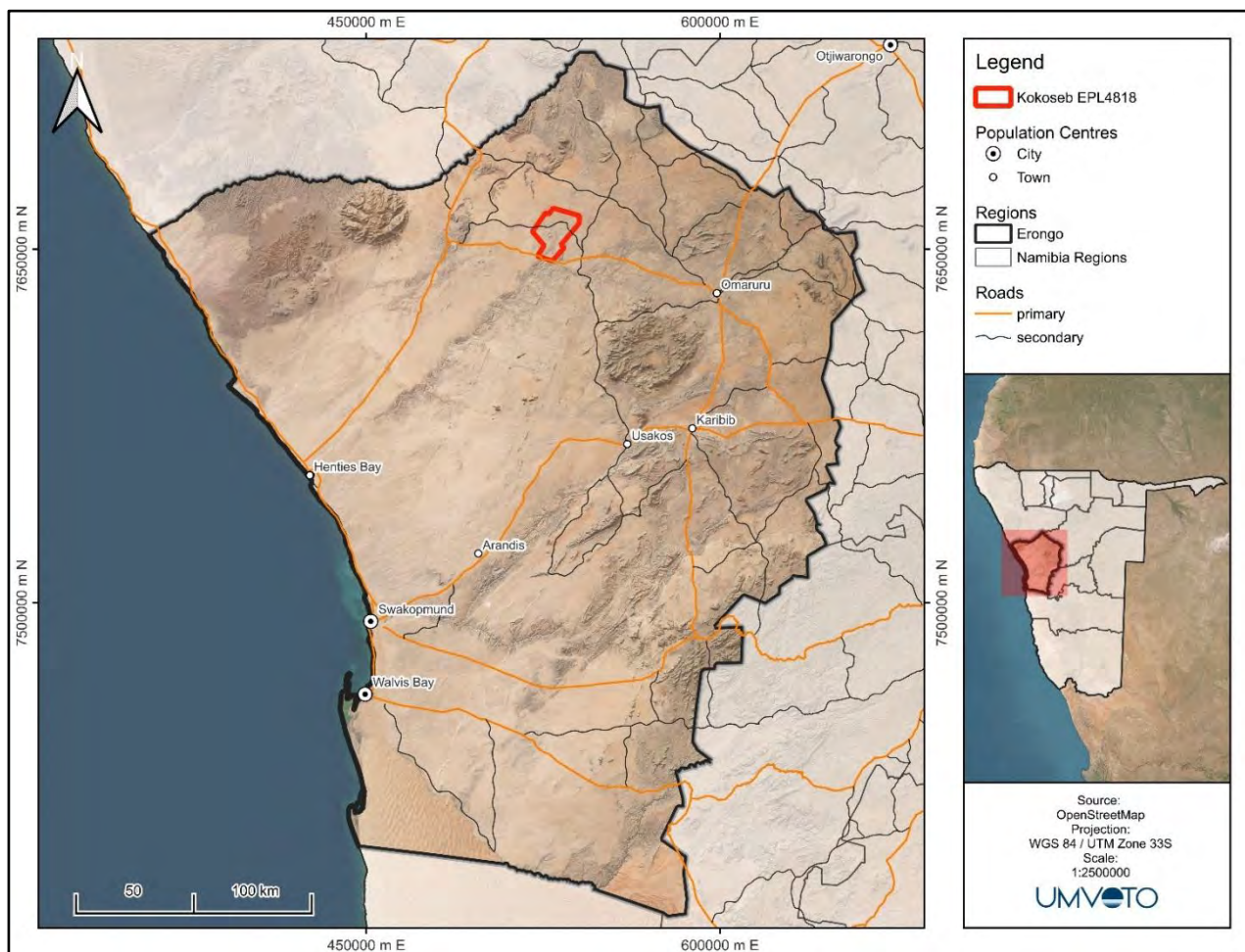


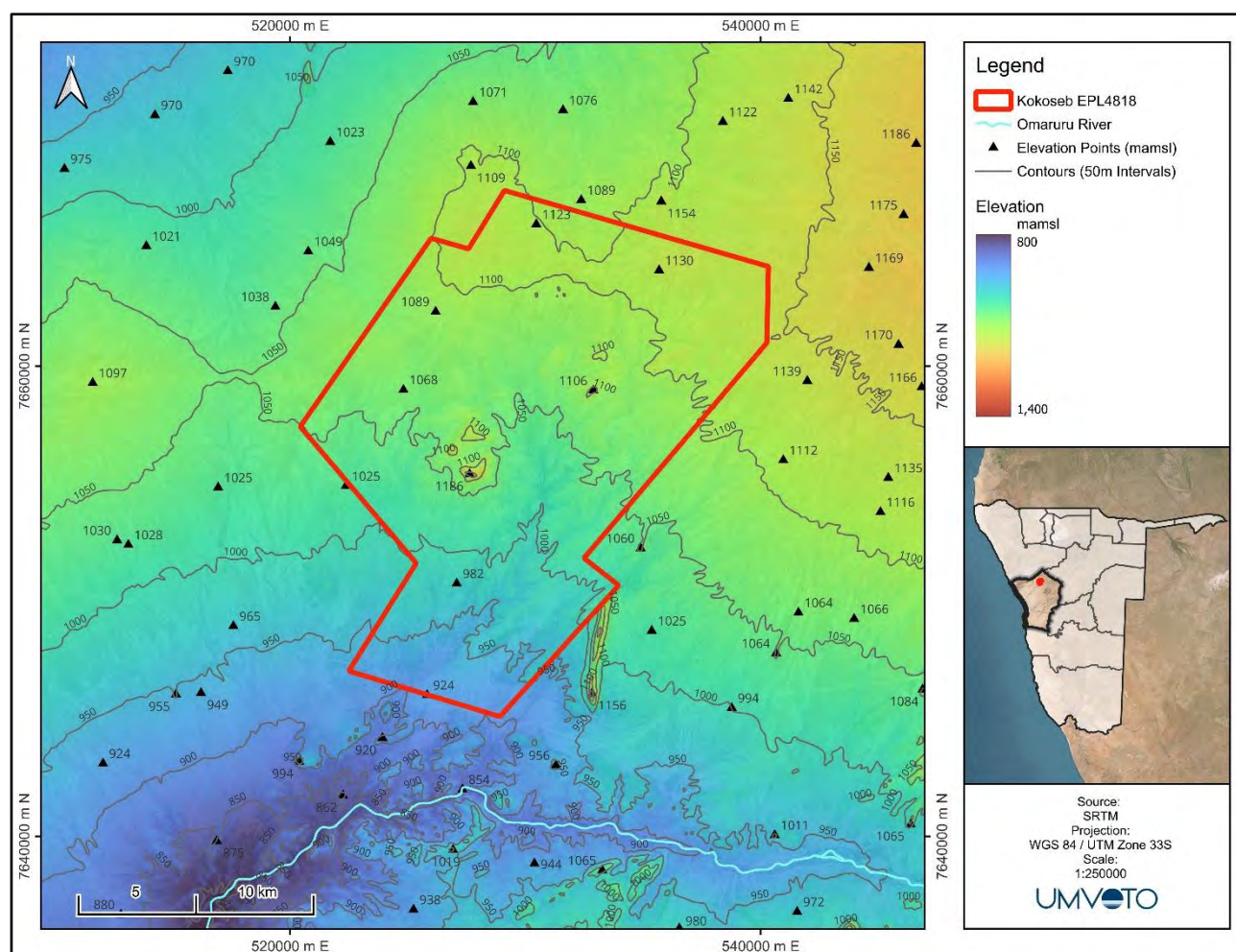
Figure 2-1 The location of the Kokoseb EPL 4818 within the Erongo Region of Namibia.

2.2. Topography

The topography of EPL4818 is relatively flat with localised rock outcrops. The elevation gradually decreases from the northeast towards the south, varying between 1130 metres above mean sea level (mamsl) to approximately 900 mamsl within the license area (see **Figure 2-2**). The central portion of the EPL forms a ~1200 mamsl high hill, surrounded by flat plains. The elevations are according to the 30 m Shuttle Radar Topography Mission (SRTM) data openly available from Namibia GeoPortal (<https://namibia.africageoportal.com/>).

No site-specific high-resolution elevation survey (e.g., LiDAR or detailed Digital Surface Model) was available at the time of assessment. Topographic analysis and hydrological modelling were therefore undertaken using the Copernicus 30 m Digital Surface Model (COP30).

The COP30 dataset is suitable for regional-scale drainage delineation and catchment assessment; however, its spatial resolution introduces some uncertainty in fine-scale flow path definition and localised drainage gradients. This limitation is considered acceptable for the current level of assessment and does not materially affect the regional-scale impact evaluation.



2.3. Climate

EPL 4818 is located within a hot arid to semi-arid climatic transition zone of central Namibia. Based on the Köppen–Geiger classification, the broader Erongo Region is characterised predominantly as BWh (hot desert climate), with transitional semi-arid conditions (BSH) occurring eastward toward Omaruru. This classification reflects low annual rainfall, high potential evaporation, strong seasonality, and pronounced inter-annual variability.

Climatic characterisation for the Kokoseb Gold Project is based primarily on the Hydrological Assessment for EPL 4818 (Hydrologic Consulting, 2025), supplemented by available regional meteorological records. In the absence of a long-term on-site rainfall gauge records, Hydrologic Consulting (2025) utilised satellite-derived datasets to characterise rainfall magnitude, seasonality and variability. These included:

- CHIRPS (Climate Hazards Group InfraRed Precipitation with Station Data) for long-term monthly rainfall estimation;
- IMERG (Integrated Multi-satellite Retrievals for GPM) for daily rainfall and rainfall frequency analysis;
- Available historical station data (Kunz, 2004) for comparative assessment.

Hydrologic Consulting (2025) reports a mean annual rainfall of approximately 170 mm at the centre of EPL 4818, based on CHIRPS-derived estimates. Rainfall is strongly seasonal, occurring predominantly between December and March. Monthly rainfall outside this period is minimal.

Regional station data demonstrate broader spatial variability across the Erongo Region. Available records indicate:

- A mean annual rainfall of approximately 306 mm for Omaruru (2012–2023 dataset);
- A long-term mean annual rainfall of approximately 88 mm for the Uis area (1979–2014 record), with recorded annual totals ranging from approximately 2 mm to 592 mm (National Centers for Environmental Prediction, 2022; Environmental Compliance Consultancy, 2021).

These differences reflect a regional east–west rainfall gradient, with higher rainfall toward Omaruru in the east and lower rainfall toward Uis in the west. The CHIRPS-derived rainfall value reported by Hydrologic Consulting (2025) for EPL 4818 is consistent with the project’s position within this gradient.

Rainfall events are typically short-duration and convective, producing high-intensity storm events separated by extended dry periods. Hydrologic Consulting (2025) incorporated this variability through annual maximum series (AMS) frequency analysis for design rainfall estimation. Mean maximum temperatures in the region range between approximately 26°C and 36°C, while mean minimum temperatures range between approximately 5°C and 16°C (Omaruru dataset, 2012–2023 shown in **Figure 2-3**). The hottest months occur between October and February, and the coldest months between June and August. Relative humidity during summer months averages approximately 55%.

Potential evaporation exceeds annual rainfall, resulting in a net annual moisture deficit. This climatic regime is consistent with ephemeral drainage systems and event-driven runoff generation within the project area.

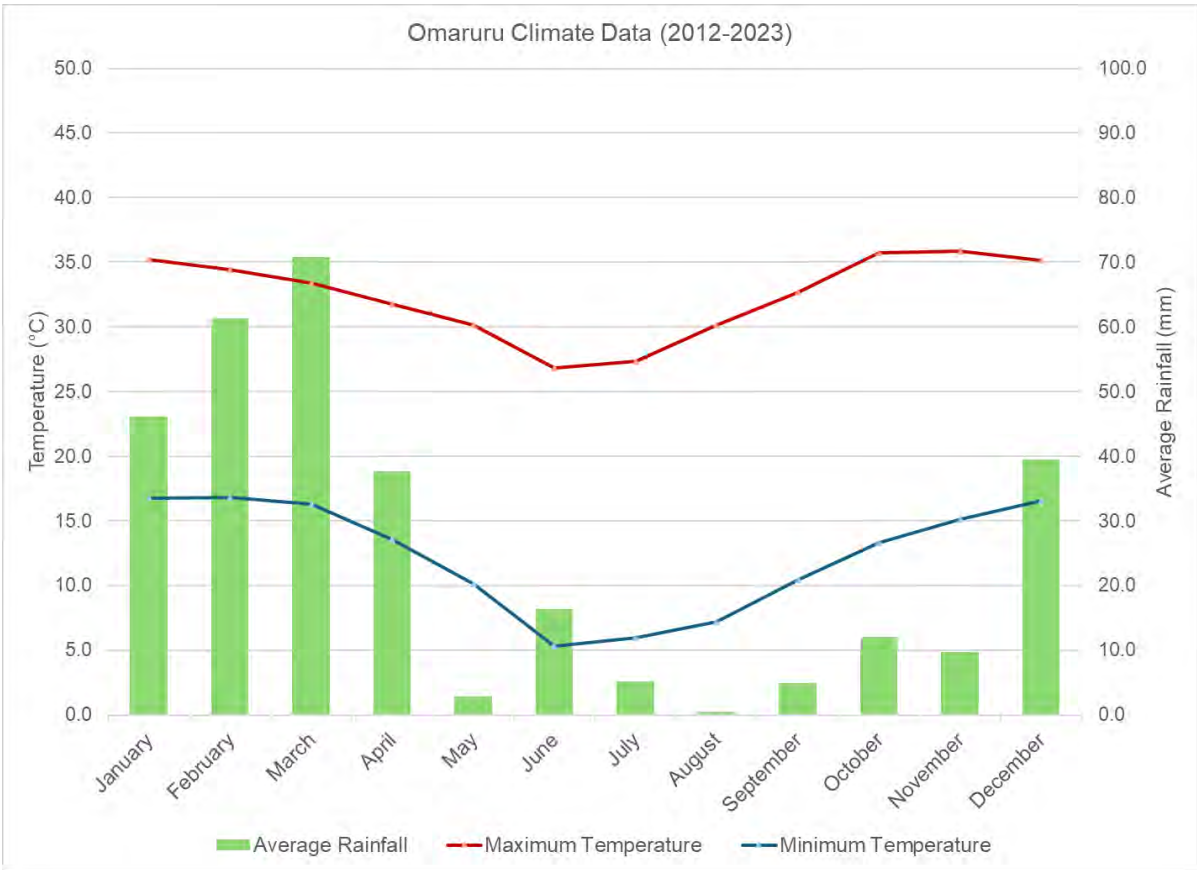


Figure 2-3 Climate data for Omaruru recorded between 2012 and 2023 received from ECC.

2.4. Hydrology

2.4.1. Catchment and Surface Water Setting

EPL 4818 is located within the broader Omaruru River catchment. The Omaruru River flows predominantly in an east–west direction south of the proposed major infrastructure footprint and represents a higher-order ephemeral drainage system within the regional hydrological framework.

Drainage within the immediate project area is characterised predominantly by first- and second-order ephemeral drainage lines (Strahler classification). These channels convey flow only during rainfall events and are shallow and weakly incised, reflecting limited sustained surface runoff and absence of perennial flow. Surface drainage across the site is controlled by modest topographic gradients and local structural influences. Flow direction is generally toward the south and southwest, contributing to ephemeral tributaries of the Omaruru River system.

The project footprint is situated near a local catchment divide. Upstream contributing areas draining across the core infrastructure footprint are therefore limited. Runoff across the site primarily reflects locally generated rainfall rather than significant upstream inflows. During high-intensity rainfall events, runoff generated within the site may migrate further downstream within the broader catchment.

Surface water systems are episodic and event-driven. Overland flow is anticipated primarily during short-duration, high-intensity convective storm events, resulting in:

- Rapid runoff response;
- Short-duration peak flows;
- Limited channel storage; and
- Minimal sustained baseflow.

This hydrological behaviour is consistent with the semi-arid climatic regime described in **Section 2.3**. **Figure 2 4** shows the terrain and hydrological setting.

2.4.2. Hydrological Assessment Framework

The Hydrological Assessment undertaken by Hydrologic Consulting (2025) defined:

- Catchment boundaries within and surrounding EPL 4818;
- Drainage hierarchy and flow paths;
- Rainfall–runoff relationships using annual maximum series (AMS) frequency analysis;
- Design rainfall depths for selected recurrence intervals; and
- Flood extents for 1:50 and 1:100 recurrence interval events.

Hydrological modelling incorporated spatial rainfall variability and local topographic controls derived from digital elevation data. The outputs informed understanding of infrastructure–drainage interactions and site-scale runoff behaviour.

2.5. Soils

Soils within EPL 4818 are generally shallow and coarse-textured, reflecting limited weathering depth and low organic content typical of arid to semi-arid environments.

Surface soils are predominantly sandy to sandy-loam with variable gravel content. Alluvial deposits associated with ephemeral drainage channels exhibit locally increased permeability relative to surrounding upland soils (refer to **Figure 2-5**). These soil characteristics influence runoff response by:

- Allowing moderate infiltration during low-intensity rainfall;
- Promoting rapid surface runoff during high-intensity storm events once infiltration capacity is exceeded; and
- Providing limited long-term moisture storage due to shallow profile depth.

The interaction between rainfall intensity, soil infiltration capacity and drainage structure governs the episodic surface water behaviour observed across the site.

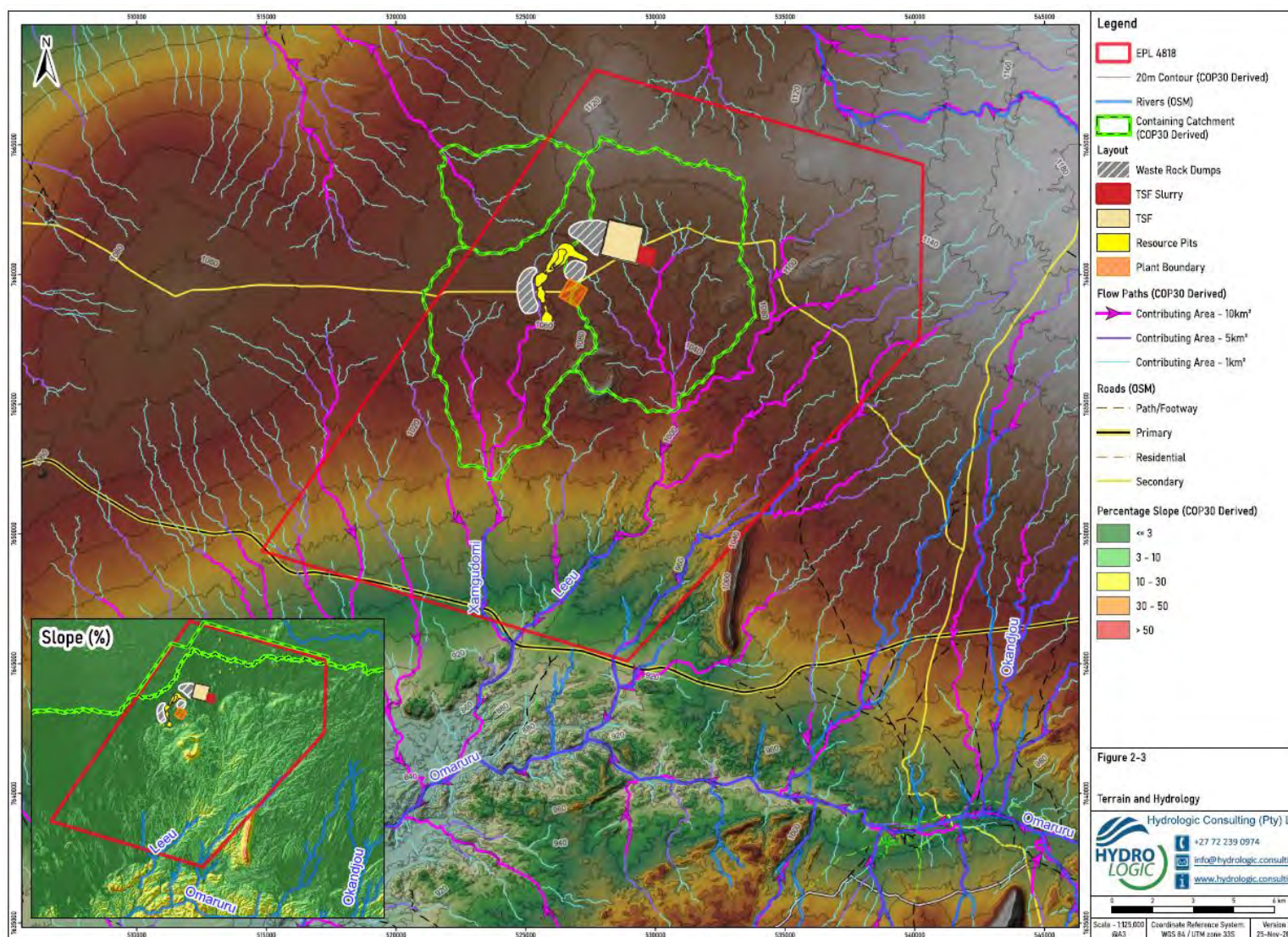


Figure 2-4 Terrain and hydrology map (Hydrologic Consulting, 2025).

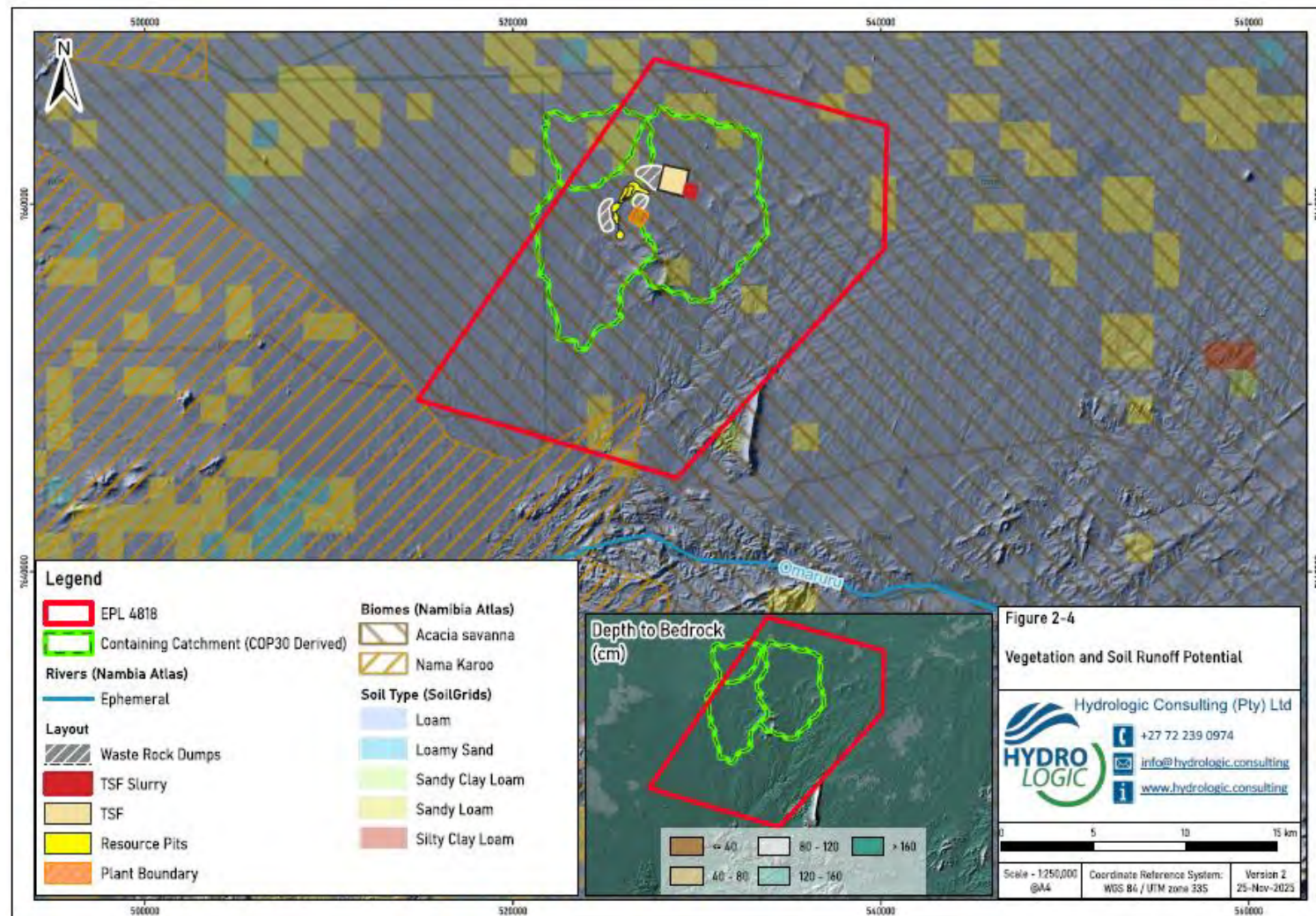


Figure 2-5 Vegetation and soil runoff potential map (Hydrologic Consulting, 2025).

2.6. Geology

The regional geological framework of the project area is defined by its position within the northeast–southwest trending Damara Orogenic Belt, a major Neoproterozoic Pan-African collisional system that developed between approximately 650 and 550 Ma during the amalgamation of Gondwana. The Damara Belt records a complete tectonostratigraphic evolution from continental rifting associated with the breakup of Rodinia (~800–600 Ma), through passive margin sedimentation, ocean basin development, subduction, continental collision, regional metamorphism and syn- to post-tectonic magmatism. Regional geological context is presented on the 1:250 000 geological map sheet 2114 (Omaruru).

The orogen is subdivided into five principal tectono-metamorphic zones that strike parallel to the NE – SW orientated regional structural grain: the Northern Zone (NZ), Northern Central Zone (NCZ), Southern Central Zone (SCZ), Southern Zone (SZ), and Southern Marginal Zone (SMZ). These zones are distinguished on the basis of structural style, metamorphic grade and stratigraphic architecture. The study area lies within the Northern Central Zone, characterised by thick successions of metasedimentary rocks of the Damara Supergroup intruded by voluminous granitoid bodies.

The Damara Supergroup unconformably overlies Paleoproterozoic basement rocks of the Abbabis Metamorphic Complex (Kheisan). The basement comprises undifferentiated gneisses, pelitic augen gneiss, amphibolite, pebbly schist and marble. The basal succession of the Damara Supergroup is represented by the Nosib Group, comprising siliciclastic and subordinate volcanic rocks deposited during early extensional tectonics. From base to top, the Nosib Group succession includes the Etusis Formation, consisting predominantly of quartzite and arkose (up to ~1000 m), overlain by the Khan Formation (calc-silicate and schist, up to ~1100 m). This is succeeded by the Tsaun Formation, composed of quartzite and mica schist, capped by felsic volcanic rocks of the Naauwpoort Formation (Summas Member) comprise ignimbrite and minor porphyritic lava (~800 m).

Progressive marine transgression led to deposition of the Swakop Group, the dominant lithostratigraphic package of the Damara Supergroup in the region. The Ugab Subgroup includes the Rössing Formation (marble, <700 m) overlain by the Chuos Formation (diamictite, 2–60 m). The Usakos Subgroup comprises the Arandis Formation, characterised by alternating mica schist, calc-silicate rock and marble. The Navachab Subgroup includes the Ghaub Formation (Daheim Member, amphibolite and metasediments, <200 m), the marble-dominated Karibib Formation, and the schist-dominated Kuiseb Formation (<3000 m). The Karibib Formation is subdivided into the Harmonie (5–10 m), Otjongeama (~500 m), Arises River (220–500 m) and Onguati (100–850 m) Members.

Convergence during ocean closure culminated in crustal thickening, polyphase deformation (D1–D3), and regional metamorphism ranging from greenschist to amphibolite facies. Syn-tectonic and post-tectonic intrusions of the Damara Intrusive Suite, including Salem-type granites and the Tsomtsaub Granite Suite were emplaced during and after peak metamorphism, producing dome-and-basin structural interference patterns and contact metamorphism.

The project occurs within a structurally complex portion of the NCZ, located approximately 15 km south of the Otjihorongo Thrust (which separates the Northern Zone from the NCZ) and about 30 km west of the NNE-trending Welwitschia Lineament (regional structural feature). These features frame the broader structural architecture of the district.

At the scale of the project, domal features cored by Arandis and Karibib Formation rocks are thrust over the Kuiseb Formation along a regional southern thrust. This structure is located immediately south of the proposed pit area but lies centrally within the broader EPL. It forms a prominent marble ridge along the southern margin of the currently defined mineralisation and is interpreted as post-D3 in age.

In addition to the southern thrust, several large-scale NE–SW trending faults traverse the EPL, cross-cutting lithological contacts and the mineralised corridor. These structures contribute to the structural complexity of the project area and result in significant lithological juxtaposition and deformation across the central and southern portions of the licence area. The combined thrust and fault architecture defines the regional structural framework of the EPL and locally controls lithological distribution and structural continuity, with secondary implications for groundwater movement.

At the scale of the project, domal features cored by Arandis and Karibib Formation rocks are thrust over the Kuiseb Formation along a This structure forms a prominent marble ridge along the southern margin of currently known mineralisation and is interpreted as post-D3 in age. The thrust and associated deformation contribute to structural complexity and lithological juxtaposition along the southern project area.

Within the project area, the Kuiseb schists form a domal feature cored by a post-tectonic leucogranite (“Central Granite Pluton”), consisting predominantly of medium-grained quartz, K-feldspar and plagioclase with accessory biotite, muscovite, magnetite, garnet and tourmaline. Granite dykes, veinlets and pegmatites cross-cut the Kuiseb schists and are interpreted as related to the same granite phase or later phases. Mineralisation is described as wrapping around this pluton in an arcuate form and is best developed along the western and northern margins of the pluton. Mineralised schists are enclosed by coarse-grained, pre- to syn-tectonic porphyritic feldspar granites in the west, east and northeast, and the Kuiseb metasediments are also intruded by minor N–S to NNE–SSW trending mafic dykes.

A map showing the geology is presented in **Figure 2-6** and **Table 2-1** shows a breakdown of the regional geology highlighting the formations within the EPL in light blue.

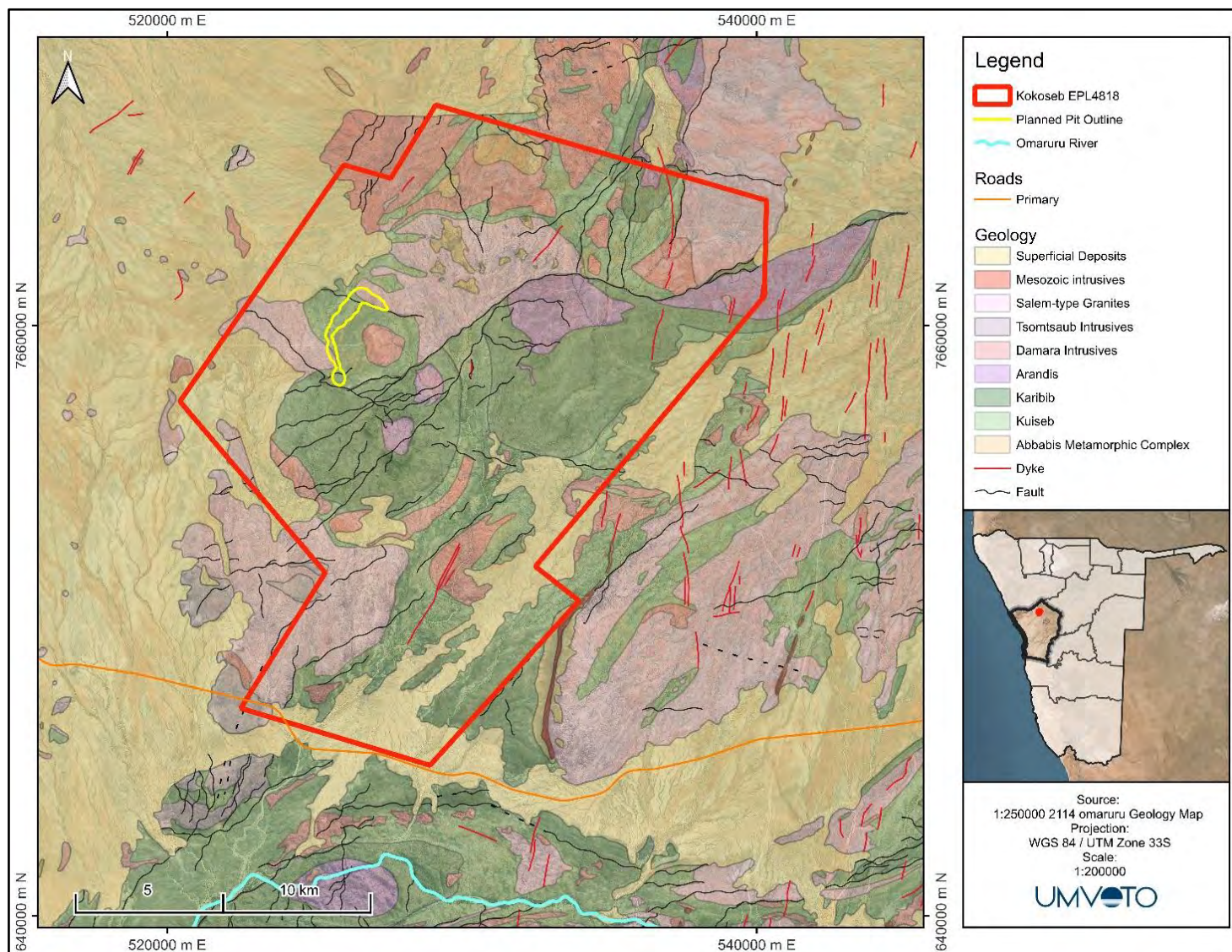


Figure 2-6 Geology of the Kokoseb EPL4818 area (based on 1:250 000 geological map sheet 2114 Omaruru).

KOKOSEB GOLD PROJECT HYDROLOGICAL AND HYDROGEOLOGIC IMPACT ASSESSMENT

Table 2-1 Lithostratigraphic overview of the 2114 Omaruru area adapted from the Ministry of Mines and Energy Geological Survey of Namibia (2010)
Explanation sheet. Formations highlighted in blue occur within the study area.

EON	ERA	SUPERGROUP	GROUP	SUBGROUP	FORMATION	MEMBER/Informal Unit	LITHOLOGY	THICKNESS		
P H A N E R O Z O I C	CENOZOIC					Unconsolidated Quaternary sediments	Sand, soil, calcrete, salt pans			
	MESOZOIC		Etendeka (KET)		Erongoberg (KEb) - south-eastern	Ekuta (KEbEk) Ombu (KEbOb) Erongorus (KEbEg)	Potassic rhyolite Porphyritic rhyolite, air-fall tuff Potassic rhyolite, porphyritic rhyodacite Quartz latite Basalt flows Quartz latite Copper Valley basalt Basalt flows	ca. 100 m < 500 m 200-370 m > 70 m 130 m 100-150 m 250-300 m		
					Springbok (KSp) Messum Mountain (KMm) Goboboseb (KGb) Tafelkop (KTK)	Kcvb	Undifferentiated quartz latite units (KETql) Undifferentiated basaltic flows (KETb)			
				Karoo	Ecca	Lion's Head (RLh) Krantzberg (PKb) Gai-As (Pga) Rhino Wash (PRw) Verbrander Berg (PVb)	Nieuwoudt (RLhNw) Etirumund (RLhEm)	Undifferentiated conglomerate, gritstone, arkose Quartz arenite Conglomeratic, feldspathic quartzite and arkose Breccia Siltstone and quartzite; gritstone Shale, mudstone, sandstone; stromatolitic carbonate Shale and mudstone	15-18 m 20-40 m < 140 m 5-180 m < 29 m < 67 m	
								Tillite; sandstone, siltstone, claystone, marl	< 15 m	
			Dwyka (CDW)							
		PALAEOZOIC	Damara Intrusives / Tsomtsaub Granite Suite / Salem Intrusives							
	P R O T E R O Z O I C	NAMIBIAN	DAMARA	Zerrissene (SKZ/NZ)		Amis River (NAM) Gemsbok River (NGe) Brak River (NBr) Brandberg West (NBw) Zebraputs (NZp)		Metagreywacke, metapelite; minor carbonate, quartz-wacke Marble and pelite Metagreywacke and pelite Marble and pelite Metagreywacke and pelite	450 m ca. 165 m 500 m (incl. NGH) 20 m <350 m	
Swakop (CZ)						Navachab	Kuiseb (NKus)		Mica schist; local phyllite; migmatite, minor calc-silicate	<3000 m
							Karibib (NKb)	Onguati (NKbOn) Arises River (NKbAi) Otjongamea (NKbO) Harmonie (NKbHm)	Mica schist, impure marble, calc-silicate Massive calcitic marble Impure marble, minor calc-silicate; local marble breccia, oolitic marble Impure marble, interbedded calc-silicate and mica schist	100-850 m 220-500 m ca. 500 m 5-10 m
				Usakos	Ghaub (NGh)	Daheim (NGhDh)	Amphibolite and metasediments	<200 m		
Arandis (NAr)					Oberwasser (NArOb) Okawayo (NArOy) Spes Bona (NArSp) Karub (NArKa)	Mica schist, minor calc-silicate Marble, interbedded calc-silicate Mica schist, interbedded calc-silicate Impure marble, calc-silicate, schist	40-210 m 10-150 m 2-25 m 30-430 m			
Chuoss (NCh)					Unconformity	Diamictite; interbedded quartzite, schist and marble	2-60 m			
paraconformity				Ugab	Rössing (NRs)	Marble	<700 m			
				Nosib (CZ)		Naauppoort (NNp) Tsaun (NTn) Khan (NKn) Etusis (NEt)	Summas (NNpSm)	Ignimbrite; minor porphyritic lava and metarhyolite Quartzite, arkose, minor mica schist; white quartzite (NTnq) Calc-silicate and schist Quartzite, arkose; minor conglomerate, quartz-mica schist	ca. 800 m <1100 m ca. 1000 m	
						KHEISAN	*ABBABIS METAMORPHIC COMPLEX (MAB)			MABs MABm MgABog

2.7. Mine Description

The mine description presented below is based on the Kokoseb Gold Project Scoping study (WIA Gold, 2025). The information reflects a scoping-level design and is subject to refinement during subsequent feasibility stages.

2.7.1. Orebody

Gold mineralisation is present as native gold grains, associated with sulphides (pyrrhotite, löllingite and arsenopyrite) in high grade plunging shoots. The mineralisation is hosted by the Kuiseb Formation metasediments as biotite-schist which are extensively intruded by both late syn-tectonic and post-tectonic granites. The mineral resource extent (MRE) of the orebody covers a cumulative 4.8 km strike with a maximum depth of approximately 370 m. The mineralisation outcrops in various areas on the EPL with a maximum cover depth of 2 m by a thin soil, colluvium or pisolitic calcrete.

2.7.2. Mining Method and Equipment

Mining is proposed as a conventional open pit load-and-haul operation using drilling and blasting in all competent material.

Key parameters:

- Ultimate pit divided into 10 stages;
- Maximum mining rate of 45 Mtpa;
- Vertical advance rates generally <60 m/year;
- Backhoe excavators mining 2.5 m flitches for grade control;
- 90 t haul trucks;
- 20 m bench heights in fresh rock;
- Berm spacing 10 m (oxide) and 20 m (fresh rock); and
- Geotechnical design assumes dewatering to maintain dry and depressurised pit wall conditions.

Total material movement over life of mine: 427.8 Mt, including:

- 58.9 Mt ore;
- 369 Mt waste;
- Strip ratio ~6.3:1 (life-of-mine average); and
- Mine life is approximately 11–12 years.

2.7.3. Metallurgy and Processing

Beneficiation involves refining raw materials to enhance their physical or chemical attributes. This typically entails processes such as crushing and separating the ore into valuable components or waste using various methods. Metallurgical testing completed in 2023 indicated a gold recovery of 92%.

Two composite samples for fresh sulphide material with average gold head grades of 1.75 g/t and 5.05 g/t, respectively underwent grinding to P80 / 75µm, followed by gravity recovery and direct cyanidation leaching, with most gold leaching in 2-4 hours. Further leach work was completed on the tails, reaching a final gold recovery of 92%.

2.7.4. Operations Support Infrastructure

The Kokoseb Gold Project will require a range of non-process operational support infrastructure to enable safe and continuous mining and processing activities. These facilities are located within the approved project footprint and have been positioned to optimise operational efficiency while limiting disturbance to natural drainage systems where practicable. Operational support infrastructure includes:

- Administration and control buildings;
- Workshops and maintenance facilities;
- Warehousing and reagent storage areas;
- Fuel storage and distribution facilities
- Explosives magazine;
- High-voltage switchyard and power reticulation;
- Pollution control dams (PCDs);
- Internal access roads;
- Accommodation village;
- Water supply and reticulation infrastructure; and
- Sewage and waste management facilities.

2.7.5. Other Mining Activities and Infrastructure

Mine development will occur in phased stages, beginning with clearing, site establishment, construction of access roads, establishment of waste rock dumps and construction of ore stockpile areas. Ore stockpiles will be located adjacent to the primary processing facilities to allow efficient feed management. Waste rock generated during mining will be transported by haul trucks to designated waste rock dump areas, where material will be placed, pushed and shaped using bulldozers in accordance with the approved mine plan.

Additional mining-related infrastructure will include:

- Run-of-mine (ROM) pad;
- Low-grade and high-grade ore stockpiles;
- Haul roads connecting pit, dumps and plant areas;
- Temporary laydown areas;
- Equipment parking and staging areas; and
- Construction material storage areas.

All infrastructure will be developed progressively in line with the mine schedule and Life of Mine planning framework.

2.7.6. Waste

The project will produce waste rock, tailings, domestic waste, and hazardous (e.g., hydrocarbons, CN) waste during operations. The Waste-Rock-Dump (WRD) will be designed to fit into the existing contours to the extent practical for stability and ultimate closure rehabilitation. Tailings produced will be disposed in a tailings storage facility (TSF), however, the final design of the TSF will be based on a set of specific and detailed studies associated with international best practices for the TSF design. See **Figure 2-7** for the approximate areas outlined for the WRD and processing facilities.

2.7.6.1. Tailings Storage Facility (TSF)

The Project will utilise a filtered stack tailings storage facility located northeast of the process plant. Mine tailings will undergo pressure filtration to produce a low-moisture cake (~14%), reducing water demand and limiting seepage potential.

The TSF will include:

- A lined basin (HDPE liner);
- Engineered embankments;
- Decant and seepage collection systems;
- Progressive raises over LOM.

Filtered tailings technology significantly reduces seepage compared to conventional slurry facilities. However, potential hazard scenarios include:

- Seepage through liner defects;
- Overtopping during extreme rainfall events;
- Structural instability (low probability, high consequence).

2.7.6.2. Waste Rock Dumps (WRDs)

Waste rock generated during pit development will be stored in engineered WRDs positioned adjacent to the pit footprint. The final WRD design and staging are described in the Scoping Study (WIA Gold, 2025). Static geochemical testing indicates that waste materials are predominantly Non-Acid Forming (NAF), with negative Net Acid Producing Potential (NAPP) values and excess Acid Neutralising Capacity (ANC). Acid Mine Drainage (AMD) risk is therefore considered low, with Neutral Mine Drainage (NMD) representing the more plausible geochemical scenario.

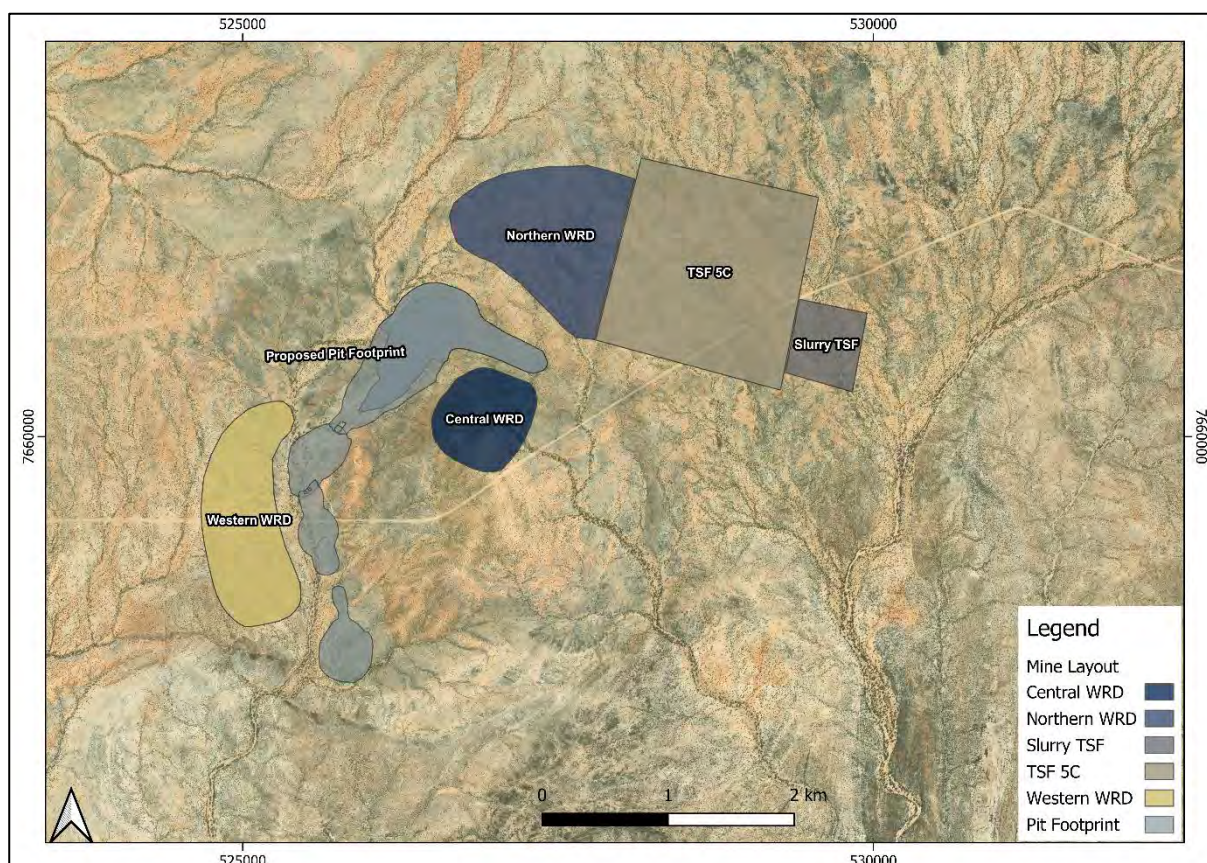


Figure 2-7 Proposed resource pit, WRDs, TSF and TSF slurry positions.

ECC (2024) states that a dedicated waste management facility will need to be constructed on site to manage the various types of waste produced. Waste will be separated at the source, stored in a manner that there can be no discharge of contamination to the environment, and either recycled or reused where possible. On-site facilities will be provided at a dedicated waste storage facility for sorting and temporary storage before removal and disposal to appropriate recycling or disposal facilities off-site. Some types of wastes expected are summarised in **Table 2-2**.

Table 2-2 Waste types, storage and use expected to be generated as part of the Kokoseb Project. These are potential sources of environmental water contamination.

Waste type	Waste types	Storage facility	End use
Non-hazardous solid waste (non-mineralised)	Wooden crates, pallets, cable drums, scrap metal, general domestic waste such as food and packaging.	Dust bins in relevant work areas will be provided for different waste types. A waste management contractor will remove dust bins regularly to a dedicated waste handling and storage area.	Waste will be sorted further at a dedicated waste handling and storage area on site. Recyclable waste will be sent to a reputable recycling company. Some items may be distributed directly to the community if possible. The remainder of the waste will be transported by the waste management contractor to a permitted landfill facility which may be constructed on site for example within the WRD.
	Building rubble and waste concrete	Designated rubble collection points will be determined to which contractors will take rubble and concrete.	The waste management contractor will regularly remove the waste from the designated collection points to the footprint of the WRD.
Hazardous contaminated solid waste (non-mineralised).	Treated timber crates, printer cartridges, batteries, fluorescent bulbs, paint, solvents, tar, empty hazardous material containers etc.	Hazardous waste will be separated at source and stored in designated containers in bunded work areas. The waste management contractor will remove these drums regularly to a dedicated waste handling and storage area.	Hazardous waste will be disposed of at the permitted hazardous disposal site (for example in Walvis Bay) by the waste management contractor.

Waste type	Waste types	Storage facility	End use
	Hydrocarbons (oils, grease)	Used oil and grease will be stored in drums in bunded areas at key points in work areas. The waste management contractor will remove these drums regularly to a dedicated waste handling and storage area. The yard will have a dedicated used oil storage area which will include a concrete slab, proper bunding and an oil sump. The appointed bulk fuel supplier will collect used oil for recycling.	Used oil will be sent to a reputable recycling company for recycling.
	Sewage	Sewage treatment will be required.	May be reused as greywater for dust suppression.
Laboratory waste	Mineral samples, mineral assay samples, chemical fluids, glass, gloves, and general laboratory waste samples	Mineral waste samples that are not required to be kept will be disposed of at the tailing storage facility and at an approved mineral disposal landfill. A mineral waste management contractor will remove the waste on a regular basis to a waste handling and storage area.	Hazardous laboratory waste will be collected regularly and transported to a hazardous disposal treatment facility (for example in Walvis Bay). Non- hazardous waste will be disposed of at an appropriate landfill which may be on site.
Medical waste	Syringes, material with blood stains, bandages, etc.	Medical waste will be stored in sealed containers. A waste management contractor will remove these drums regularly to a dedicated waste handling and storage area.	Medical waste will be transported by the waste management contractor to a permitted medical waste treatment facility.

2.7.1. Water Supply

Water supply options proposed are from regional water supply schemes (Okombahe and Ozondati), which are hydraulically distal from the project footprint. Additional groundwater development may occur along the Omaruru River basin subject to regulatory approval and detailed hydrogeological assessment. Mine dewatering water will be reused within the process circuit where feasible, reducing external abstraction requirements.

2.7.2. Surface Water Management

The Project area is characterised by ephemeral drainage systems draining southwards toward the Omaruru River catchment.

Surface water management measures include:

- Diversion channels around infrastructure;
- Clean and dirty water separation;
- Pollution control dams;
- Erosion control and sediment traps; and
- Flood design to accommodate extreme rainfall events.

3. HYDROGEOLOGICAL SETTING

3.1. Aquifer Characterisation

3.1.1. Hydrogeological Site Description

Groundwater occurs predominantly in secondary (fracture-controlled or karstic) aquifers hosted in crystalline and metamorphic rocks. The lithological framework includes Kuiseb Formation mica schists (NKs), Karibib Formation marbles and impure marbles (NKbAi, NKbHm, NKbOj), Arandis Formation schists and marble/calc-silicate units (NArOb, NArOy, NArSp), intrusive granitoids (including biotite granites and leucogranites; NgSAs/OgSA, Ogl, Egls) and local basement gneisses (MAB). Primary porosity in these formations is negligible; permeability and storage are controlled by fracture density, aperture, connectivity and weathering. Surficial cover is thin with limited to no potential for alluvial (porous) systems due to low order drainage observed on site. The system is heterogeneous and locally compartmentalised.

3.1.2. Recharge

Direct estimates of groundwater recharge for the Kokoseb Project area are not available in published literature. The site is located within a semi-arid climatic regime characterised by low mean annual precipitation (MAP), high evapotranspiration, and episodic rainfall events. Under such conditions, diffuse recharge is typically limited and highly variable, occurring primarily during infrequent high-intensity rainfall events.

Recharge in fractured hard-rock aquifer systems of central Namibia are generally reported to represent a small fraction of MAP, commonly within the range of 0.5% to 2.5% of annual rainfall (Umvoto, 2023), depending on lithology, fracture connectivity, soil thickness, and topographic position. Recharge processes are typically dominated by focused infiltration along structural features, ephemeral drainage lines, and zones of enhanced permeability, rather than uniform areal recharge.

In the absence of site-specific recharge studies (e.g., chloride mass balance, water table fluctuation analysis, or isotope-based assessments), a conservative upper-bound recharge estimate of 5% of MAP was initially considered to ensure that groundwater resource availability was not underestimated during early-stage assessments. However, it is recognised that this value likely represents the upper end of plausible recharge conditions for semi-arid fractured bedrock environments.

3.2. Fieldwork

Field investigations were undertaken to support and refine the hydrogeological understanding of the Kokoseb Gold Project area.

A hydrocensus formed part of the original scope of work and was conducted to document existing boreholes, measure groundwater levels, identify current water users and establish baseline groundwater conditions.

Following the initial desktop assessment and hydrocensus results, additional geophysical surveys, drilling and aquifer testing were undertaken to gain improved insight into subsurface lithology, structural controls on groundwater occurrence, groundwater quality variability and aquifer productivity. This additional work was required to reduce uncertainty identified during the desktop-based aquifer characterisation and to provide reliable input parameters for the numerical groundwater model developed for this study.

3.2.1. Hydrocensus

Two hydrocensus surveys were undertaken within and surrounding the project area to identify groundwater abstraction points, document infrastructure characteristics, and establish baseline static groundwater levels for conceptual and numerical hydrogeological assessment. The surveys incorporated data from the SLR Kokoseb Hydrocensus (January 2025) and the ECC WIA Hydrocensus (September 2025).

A total of 39 unique groundwater points were identified where water was present and static water levels could be measured. The dataset includes production boreholes (RC and DD), domestic wells, livestock wells, exploration boreholes, and community supply boreholes. Where available, collar coordinates, dip direction - where applicable, drilled depth, hole type, static water level (mbgl), and associated comments were recorded (see **Table 3-1** and **Table 3-2**).

3.2.2. Water Level Distribution

Measured static water levels range from 11 m to 75 m below ground level (mbgl), with a median value of 34.1 m and a mean of 33.7 m. The majority of water levels occur between approximately 20 m and 45 m below ground level, which is consistent with fractured hard-rock aquifer systems in semi-arid environments.

A subset of shallow wells (11–15 mbgl) likely reflects groundwater occurrence within weathered zones or near-surface fracture systems. These represent the most hydraulically sensitive receptors with respect to potential drawdown impacts. Conversely, deeper static levels (>50 mbgl) occur at selected boreholes, including the Community Borehole and Exploration Borehole, indicating locally deeper fracture-controlled systems or structural compartmentalisation. It should be noted that the two deepest water levels recorded are potentially dynamic water levels from pumping (Exploration BH and Community BH).

Ground elevations were extracted from the Digital Terrain Model (DTM) and combined with measured mbgl values to calculate groundwater elevation (mamsl). The majority of groundwater elevations cluster between approximately 1025 mamsl and 1045 mamsl (see **Figure 3-1**).

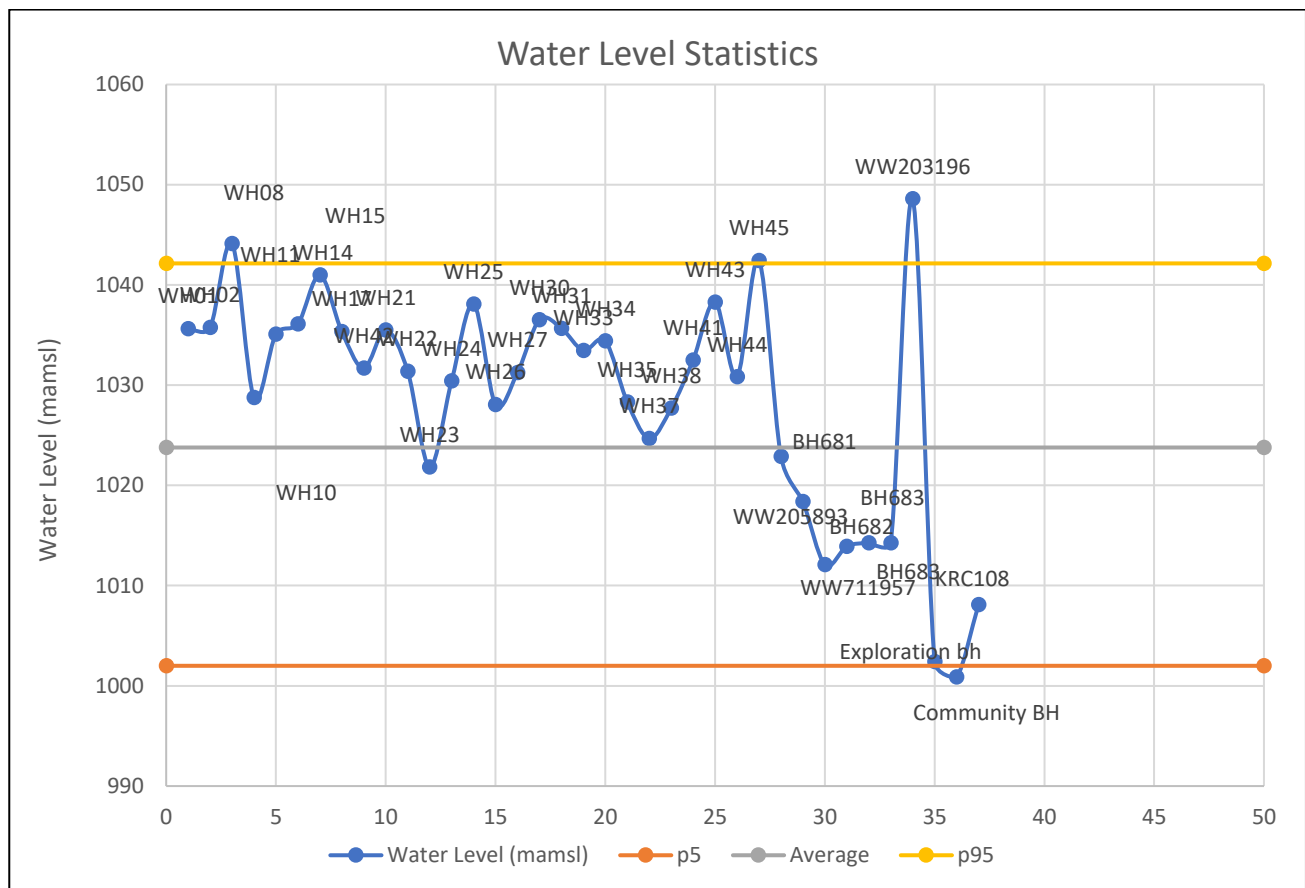


Figure 3-1 Water level distribution.

A regression analysis comparing groundwater elevation (mamsl) to surface elevation (mamsl) demonstrates a very weak correlation ($R^2 = 0.3$) (see **Figure 3-2**). This indicates that groundwater levels do not closely mimic surface topography.

The weak correlation suggests that groundwater flow is not primarily topographically driven, but rather structurally controlled. This behaviour is consistent with fractured crystalline basement aquifer systems where transmissive fracture networks, structural lineaments, and lithological contacts exert greater control over hydraulic head distribution than surface relief.

The hydrocensus dataset indicates a structurally influenced fractured aquifer system characterised by moderate unsaturated thickness and spatial variability in hydraulic head. Groundwater head distribution does not show strong conformity to surface elevation, supporting the conceptual model (**Section 4**) of fracture-dominated flow paths and potential compartmentalisation across lithological units, as boreholes were drilled to target different lithologies across the EPL.

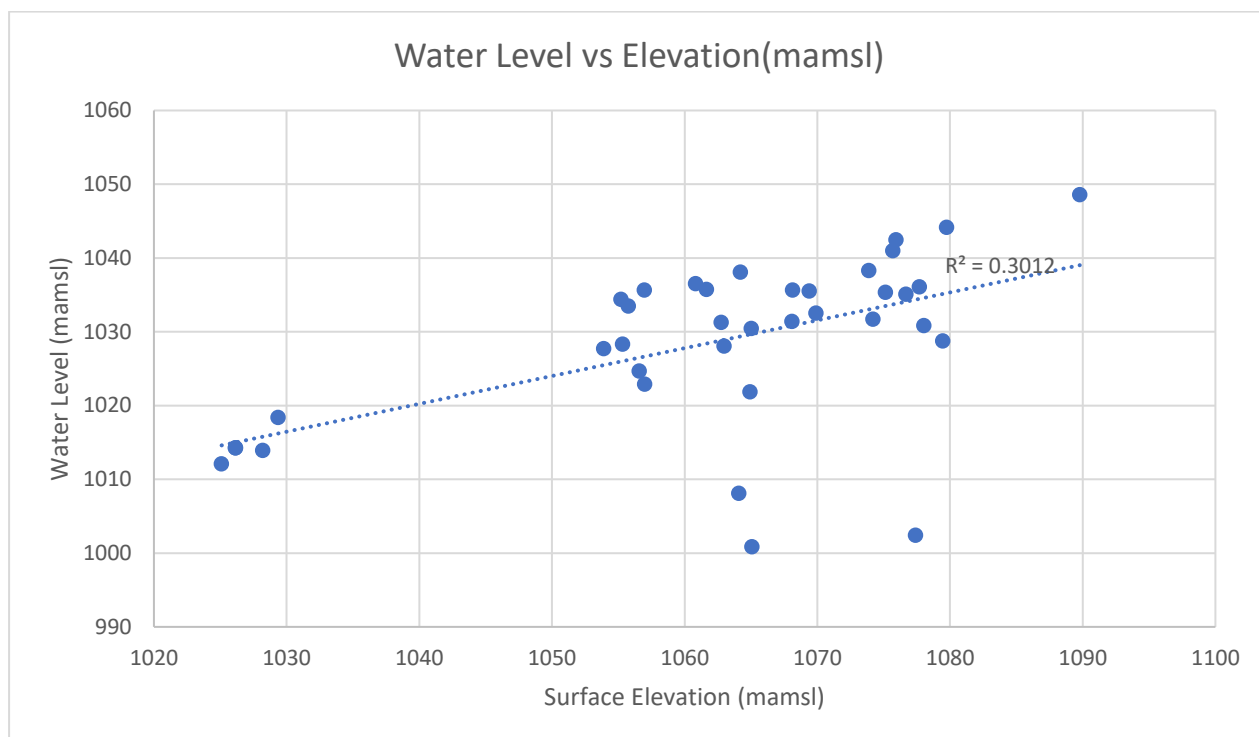


Figure 3-2 Water level regression analysis.

3.2.3. Groundwater Flow Direction

Groundwater elevation data derived from the hydrocensus measurements were spatially interpolated to produce a regional groundwater level contour map (**Figure 3-3**). The map illustrates equipotential contours (mamsl) and inferred groundwater flow directions, which occur perpendicular to the hydraulic head contours.

The contoured surface indicates a regional hydraulic gradient trending predominantly from the north and north-east toward the south and south-west. Groundwater elevations generally decrease from approximately 1060–1075 mamsl in the northern and north-eastern portions of the model domain to below 990 mamsl along the southern boundary. This establishes a broad regional flow component directed toward the southern and south-eastern parts of the project area.

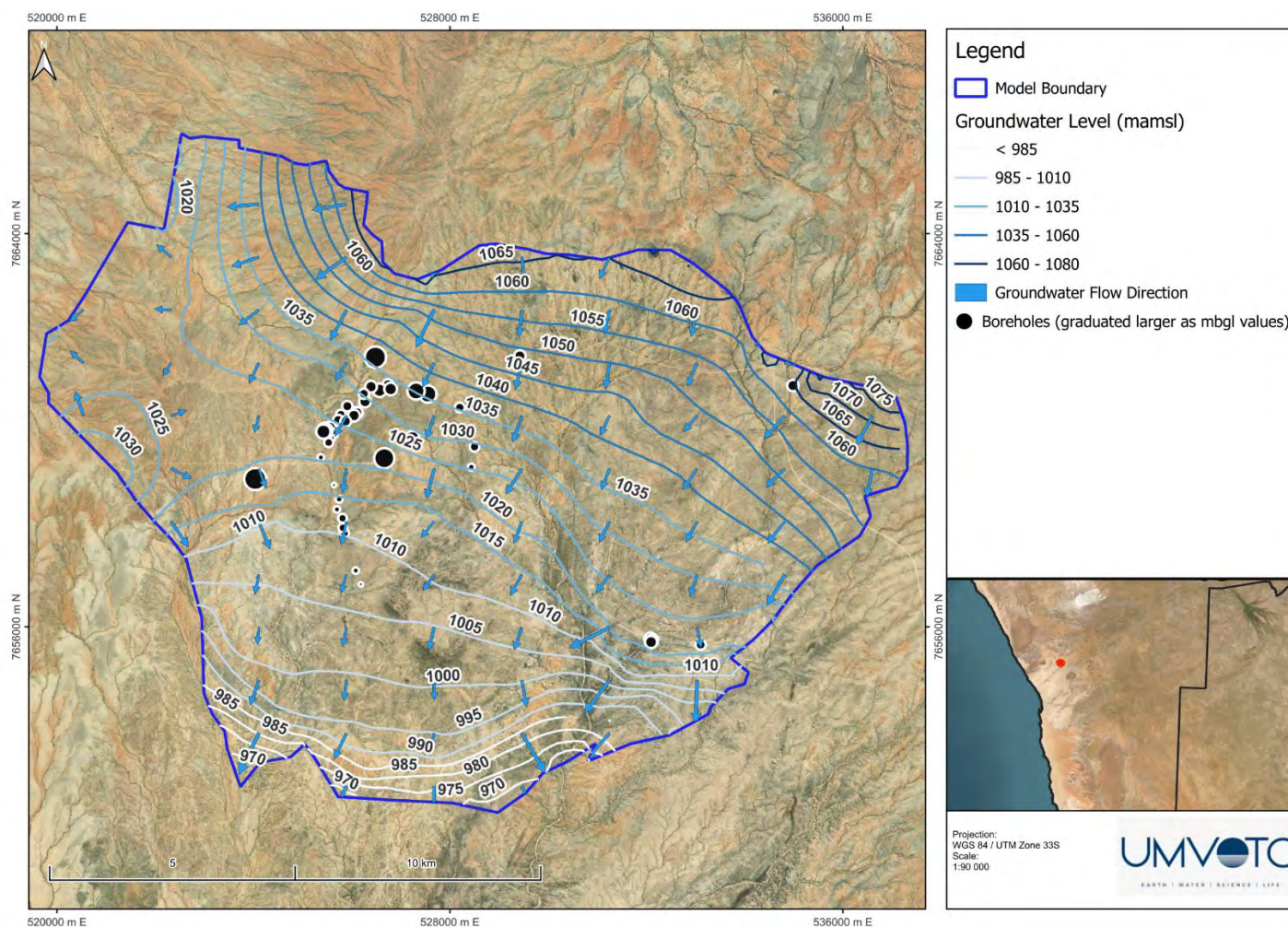


Figure 3-3 Groundwater flow direction map based on interpolated, calibrated groundwater level elevations (mamsl), shown in relation to the selected numerical model boundary (refer Section 4). Equipotential contours are derived from measured groundwater levels and illustrate regional hydraulic gradients and inferred flow directions (perpendicular to contours). Boreholes used in the interpolation are shown as graduated symbols scaled according to measured depth to groundwater (mbgl).

Table 3-1 Results of the hydrocensus conducted in January 2025 by SLR

Borehole WW/ID	Borehole Location	Coordinates		Water Source	Type of Instalation & Infrastructure	Status	Depth of Pump	Historical RWL/ Recent RWL	Borehole Depth	Borehole Yield	Groundwater use	Taps, tanks	Notes
		Northing	Easting				[mbg]	[mbg]					
EROK013	Swaartklip Opstaal	7649914	540974.8	Borehole	Submersible Grundfos Pump, Listre Engine previously installed	Equiped	72	45	85	1.2 - 3	Livestock and domestic use	2x 10 000L	Outcropped biotite schist
EROK1013	Swaartklip Opstaal	7650712	541316.7	Borehole	No Installation	Dry/Blocked		Dry borehole					Used to be constructed with a wind pump
WW203144		7651120	541193	Borehole	Submersible Pump Installed, generator	Equiped	50	26.22	90				Private installation, drilled +-7 years ago
WW34138		7654944	541193	Borehole	Submersible Pump Installed	Equiped		No Access			Livestock and domestic use	2x 10 000L, 2x taps	Drilled in 2024
BH678		7655073	537893.5	Borehole	No Installation	Not in use		40.82					Used to be constructed with a wind pump
BH680		7657753	534395.5	Borehole	Equiped with functioning Listre Engine	Equiped		No Access			Livestock		
BH681	Hamas Village	7655637	533103.8	Borehole	No Installation	Not in use		34.13					
WW205893		7655738	532121	Borehole	No Installation	Not in use		10.96					
WW711957		7655757	532083.8	Pit	No Installation	Pit in use		13.01			Livestock		Has water, using bucket system to retrieve water, located next to quartzite
BH682		7655709	532103.2	Borehole	No Installation	Not in use		14.3					Weathered biotite chips around bh
BH683		7655691	532095	Borehole	No Installation	Not in use		11.91					
WW203197		7661319	535081.7	Borehole	No Installation	Not in use		36.93					
WW6057		7661319	534984	Borehole	No Installation	Dry/Blocked		Blocked					
BH693		7655691	532095	Borehole	Submersible pump installed	Equiped		No Access	100			5000L	Weak yield according to villagers
BH694		7659995	541138.1	Borehole	No pump installation - Listre Engine previously installed	Dry/Blocked		Blocked					
BH698	Otumwe	7669251	515387.1	Borehole	Submersible Pump Installed - Equiped with Solar Panels	Equiped		47			Domestic	3 x 10 000L	Drilled in Dec 2023, Strong according to owner
BH700	Otumwe	7668464	515516.1	Borehole	Submersible Pump Installed - Equiped with Solar Panels	Equiped	66	No Access			Livestock and domestic use	2 x 10 000L	Takes 3-4 hours to fill tank according to villagers
ER/U1/022		7666844	520491.4	Borehole	Equiped with functioning Listre Engine	Equiped		No Access				3 x 10 000L	
BH703		7666600	520824.7	Borehole	No Installation	Not in use		30.29					Drilled in 1983
BH704		7666088	520868.2	Borehole	Submersible Pump Installed - Equiped with Solar Panels & Generator	Equiped		No Access			Livestock and domestic use		Weak according to villagers
BH705		7667068	532456.6	Pit	Windpump Installed - Not functioning	Dry Pit		Dry pit					
BH706		7666694	532665.3	Borehole	Submersible Pump Installed - Equiped with Solar Panels	Equiped		No Access			Livestock and domestic use	10 000L	Strong bh according to villagers, pumping 4 days a week
WW202111		7668153	536551.8	Borehole	No Installation	Not in use		No Access					
WW40991		7668184	536571.3	Borehole	Equiped with non-functioning Listre Engine	Equiped		No Access			Livestock and domestic use		Used to be constructed with a wind pump
BH709		7667754	536571.3	Borehole	Submersible Pump Installed - Equiped with Solar Panels	Equiped		No Access			Livestock and domestic use		Good bh according to villagers
WW40990		7666298	542008	Borehole	Equiped with functioning Listre Engine	Equiped		10.63	150		Livestock	3 x 10 000L	
WW40597		7666339	542285.3	Borehole	No installation	Dry/Blocked		Blocked/ collapsed					Used to be constructed with a wind pump
WW80128		7646472	525343	Borehole	Equiped with functioning Listre Engine	Equiped	42	33	43.7		Livestock and domestic use		ER-OK-051
BH685		7661425	535159.9	Borehole	Equiped with functioning Listre Engine	Equiped		No Access			Livestock and domestic use	5000L	
WW203196		7660910	534983.1	Borehole	No Installation	Not in use		41.18					Drilled in 2021 - Dry borehole
WW203638		7661262	535491.1	Borehole	No Installation	Dry/Blocked		Blocked					Dry borehole
WW35081		7662365	536944	Borehole	No Installation	Not in use		30.96					Used to be installed with solar panels
BH688		7662273	537039.1	Borehole	No Installation	Dry/Blocked		Blocked					
BH689		7661502	539138.5	Borehole	No Installation	Dry/Blocked		Blocked					
BH690		7661486	539213.3	Borehole	No Installation	Dry/Blocked		Dry borehole					
BH691		7661501	539225.4	Borehole	No Installation	Dry/Blocked		Blocked					
BH692		7659908	541002.9	Borehole	No Installation	Dry/Blocked		Blocked					Used to be installed with windpump
BH695		7661357	533805.2	Borehole	No Installation	Not in use		No Access					Used to be installed with lister engine
Exploration bh		7660799	527310.8	Exploration BH	Submersible Pump Installed - Equiped with Solar Panels	Equiped		74.95		15 000 - 20 000 L/d	Exploration		Drilled at an incline, pump water level: 106m
Community BH		7659995	525455.2	Borehole	Equiped with functioning Listre Engine	Equiped	67	64.24	98.1	4	Livestock and domestic use		ER-OK-003, installation date: 15/02/2009
KRC108		7659973	525423.8	Borehole	No Installation	Not in use		55.96	125				Drilled in May 2023, water strike: 105m
WW35082		7644956	533163	Borehole	No Installation	Dry/Blocked							

Table 3-2 Results of the hydrocensus undertaken by ECC in September 2025.

Borehole ID	Coordinates		Elevation	Water level	BH plunge from surface	Corrected WL	Comments
	Easting	Northing	[mamsl]	[mbgl]	[degrees]	[mbgl]	
WHC1	535161	7661426	3556.7424	-	-	-	no access
WHC2	533804	7661358	3553.998	-	-	-	no access
WH01	528500	7659664	3423.1816	63.1	75	60.94991964	KRC040
WH02	528436	7659251	3401.2264	51.88	80	51.09182623	KRC042
WH03	528276	7660066	3443.3072	-	-	-	KDD011 - Not foundKRC038 - Unaccessible with dip meter
WH04	528104	7660170	3445.1368	-	-	-	KRC037 - dip meter clogged at 25m. Hole angled
WH05	527543	7660569	3448.796	-	-	-	KRC011 - Could not get dipper down. Filled with oil and sand
WH06	527155	7660673	3460.6884	-	-	-	KRC009 - Could not get dipper down
WH07	526692	7660829	3462.518	-	-	-	KDD007 - Could not get dipper down due to angle
WH08	526739	7660937	3478.0696	71.15	90	71.15	KRC114
WH09	526625	7660968	3480.814	-	-	-	KRC051 - Hole blocked. Could hear dipper hitting an obstruction in the hole
WH10	526568	7660814	3485.388	88.38	50	67.70300788	KRC098
WH11	526393	7660886	3480.814	72.5	80	71.39856209	KDD008
WH12	526365	7661126	3481.7288	-	-	-	KRC075 - Hole blocked. Could hear dipper hitting an obstruction in the hole
WH13	526326	7660557	3479.8992	-	-	-	KRC012 - Blocked
WH14	526272	7660585	3483.5584	72.48	80	71.37886594	KRC057
WH15	526246.9	7660742	0	69.46	90	69.46	KRC070
WH16	526127	7660563	3485.388	-	-	-	KRC054 - Blocked
WH17	526107	7660358	3479.8992	69.4	90	69.4	KDD006
WH18	526134	7660316	3479.8992	-	-	-	KDD005 - Dipper clogged at 72m
WH19	526048	7660296	3478.9844	-	-	-	no access
WH20	525946	7660434	3478.0696	-	-	-	KRC066 - Blocked
WH21	525780	7660321	3468.9216	67.77	90	67.77	KRC086
WH22	525726	7660209	3470.7512	64.02	90	64.02	KDD024
WH23	525555	7660057	3456.1144	73.25	80	72.13716791	KRC021
WH24	525616	7659928	3463.4328	61.79	80	60.85127106	KRC022
WH25	525580	7659843	3463.4328	45.53	90	45.53	KDD001
WH26	525485	7659894	3466.1772	62.45	90	62.45	KRC024
WH27	525531	7659749	3462.518	54.94	80	54.10533795	KRC104
WH28	525410	7659706	3457.0292	-	-	-	KRC107 - Blocked
WH29	525428	7659459	3457.0292	50.8	90	50.8	KRC242
WH30	525372	7659447	3457.0292	48.52	80	47.78287218	KRC111
WH31	525638	7658886	3446.9664	42.68	75	41.22571427	KRC031
WH33	525744	7658596	3446.9664	44.6	75	43.08029185	KRC032
WH34	525700	7658390	3446.9664	41.53	75	40.11489957	KRC073
WH35	525813	7658209	3446.9664	47	75	45.39851384	KRC090
WH36	525790	7658008	3437.8184	-	-	-	no access
WH37	525848	7657906	3437.8184	55.63	80	54.7848553	KRC097
WH38	525819	7658015	3437.8184	45.7	80	45.00571431	KRC095
WH40	525329	7659598	3435.074	-	-	-	KRC249 - same vicinity as KRC107 and KRC252 (not measured)
WH41	525878	7660183	3460.6884	65.14	75	62.92040832	
WH42	526047	7660299	3469.8364	74.05	85	73.76821739	
WH43	525910	7660490	3468.0068	71.25	70	66.95309923	
WH44	526793	7660840	3478.9844	82.24	75	79.43773995	
WH45	528201	7660461	3477.1548	67.09	65	60.80418943	
WH46	528184	7660108	3468.0068	70.72	80	69.64560429	

3.2.4. Geophysical Investigation and Borehole Siting

SLR completed a Frequency Domain Electromagnetic (FDEM) survey using a Geonics EM-34 instrument. Six traverses were designed to investigate groundwater conditions across the range of geological settings in the EPL and to support initial monitoring network design (see **Figure 3-4**). Boreholes were sited using interpreted conductive anomalies associated with structural features, lithological contacts and zones of enhanced fracturing.

This targeting strategy improves the likelihood of intersecting groundwater-bearing structures and is appropriate for hydrogeological exploration and monitoring network development. It also introduces a predictable sampling bias ('wellfield bias'), where proposed hydraulic testing results could represent structurally favourable, higher-permeability domains rather than formation-wide background conditions. This bias is carried forward explicitly into parameter uncertainty and model calibration discussion.

3.2.5. Borehole Targets and Siting Rationale

Eight (8) sites were identified targeting different geological units and structures in relation to planned mining infrastructure. Refer to **Table 3-3** below for a summary of the sites.

Table 3-3 Borehole targets selected from FDEM interpretation and targeted geological features (SLR, 2025).

Borehole ID	Easting	Northing	Location Sector	Target Geological Feature
TSFs-1	529418	7661512	TSF area	Biotite granite–gneiss contact
Ns-1	527571	7660727	North	Fractured Kuiseb schist
Ns-7	526482	7661486	North	Fractured granite–mica schist contact
Es-3	527228	7659839	East	Leucogranite–schist contact
Es-4	526675	7659429	East	Fractured granite–schist contact
NWs-4	524046	7659025	North-West	Leucogranite–schist contact
SWs-2	526083	7657134	South-West	Fractured marble with dyke
SWs-3	526194	7656849	South-West	Fractured marble associated with regional fault

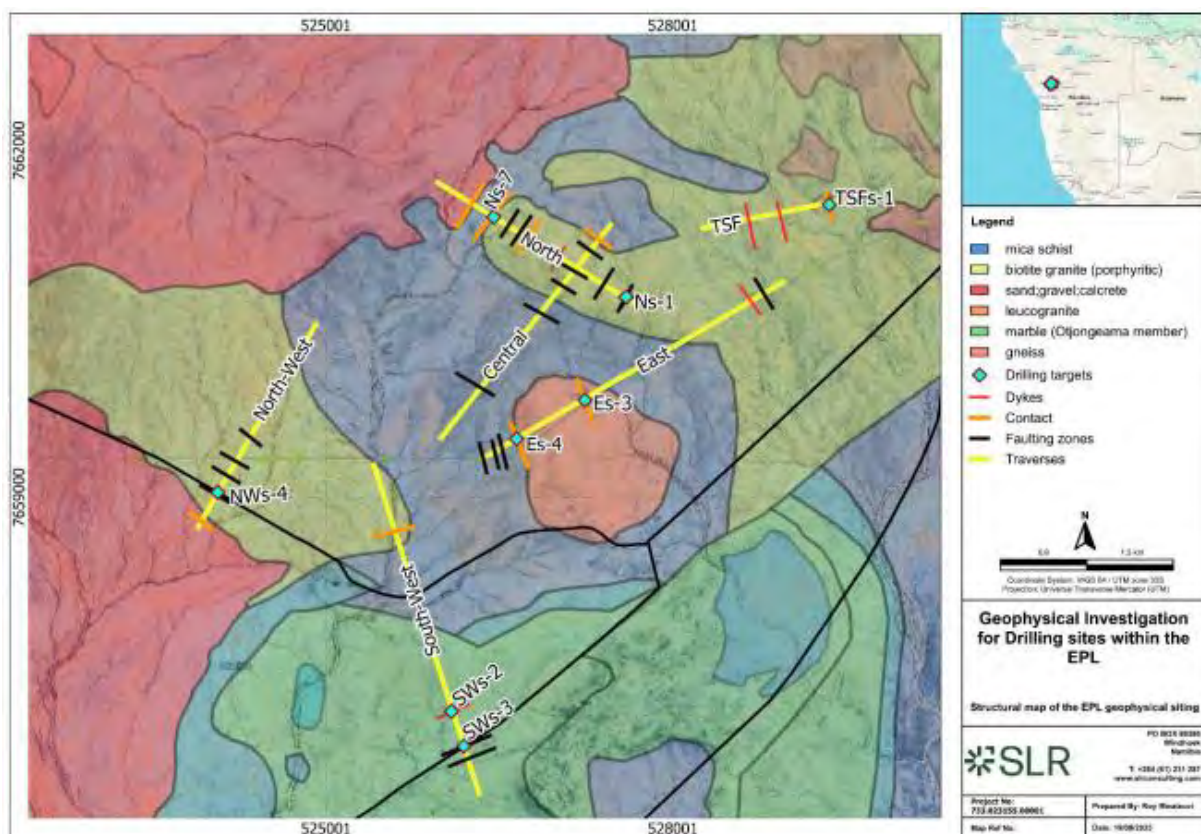


Figure 3-4 Spatial distribution of borehole targets drilled (SLR Technical Memorandum, 2025).

3.2.1. Borehole Drilling and Construction

Borehole drilling was undertaken by Hammerstein in October 2025 and included eight boreholes, sighted by the geophysics. Boreholes TSF-01, SWs-2, SWs-3 and Es-3 include multiple screened sections, reflecting discrete transmissive intervals encountered at multiple depths. Boreholes NWs-4, Ns-7 and Es-4 were left as open holes over substantial depth intervals where fractured zones were more vertically distributed.

Drilling locations were specifically selected to investigate groundwater occurrence across varied lithological and structural settings within the project footprint. Targets included granite–gneiss contacts (TSF-01), fractured Kuiseb schist (Ns-1), fractured granite–mica schist contacts (Ns-7), leucogranite–schist contacts (Es-3 and NWs-4), fractured granite–schist contacts (Es-4), and fractured marble units associated with dykes and regional faulting in the south-western sector (SWs-2 and SWs-3). This approach ensured representation of the principal lithological domains and structurally controlled groundwater targets identified during the desktop assessment.

Rest water levels (RWLs) measured shortly after drilling completion and subsequently monitored between October and late November 2025 range from 12.17 m to 118.73 m below ground level, corresponding to elevations between approximately 1,093.27 mamsl and 1,203.72 mamsl. These levels are notably deeper than those observed during the hydrocensus, confirming spatial variability in groundwater occurrence across differing lithological and structural domains.

Geological logs from drilling confirmed mapped surface geology and indicated weathering depths of approximately 40–60 mbgl, below which groundwater occurrence was associated primarily with fractured and contact-controlled intervals. Borehole details are listed in **Table 3-4**.

3.2.1. Aquifer Testing and Hydraulic Behaviour

Following borehole drilling and development, aquifer testing, including test pumping and falling head tests, was undertaken to characterise hydraulic behaviour across the site. In boreholes where sufficient yield was observed, step drawdown testing was first conducted. This involved pumping the borehole at incrementally increasing abstraction rates over a series of defined steps while monitoring water level response. The purpose of the step test is to assess borehole efficiency, distinguish between aquifer losses and well losses, and determine a suitable pumping rate for longer-duration testing. Where yields allowed, constant rate drawdown tests were subsequently performed by pumping at a fixed abstraction rate for an extended period while continuously monitoring drawdown and recovery. These tests are used to evaluate aquifer transmissivity, storage characteristics and hydraulic connectivity under sustained abstraction conditions. In boreholes where sustained pumping was not feasible due to low yields or limited saturated thickness, falling head tests were undertaken. This method involves introducing a known volume of water into the borehole and monitoring the rate at which the water level returns toward static conditions. Falling head tests provide indicative estimates of hydraulic conductivity and allow comparison of aquifer response between sites where pumping tests cannot be reliably performed.

Submersible pumps were installed in TSF-01, SWs-2 and SWs-3 for test pumping with pump inlets positioned near the borehole base. Test pumping included step drawdown tests (SWs-2 and SWs-3) and constant rate drawdown tests (TSF-01, SWs-2 and SWs-3). Step drawdown testing indicates non-linear increases in drawdown at higher abstraction rates, consistent with combined aquifer and well losses in fracture-controlled systems. Constant rate drawdown tests produced drawdowns of 93–98 m, with recovery ranging from ~66% to ~80%, indicating spatial variability in effective storage and connectivity. Falling head tests (Ns-1, Es-3, NWs-4, Ns-7 and Es-4) show rapid recovery (seconds to minutes), indicating low storage and thin saturated intervals.

Table 3-4 Borehole drilling, construction and aquifer testing summary.

	Units	TSF-01	SWs-2	SWs-3	Ns-1	Es-3	NWs-4	Ns-7	Es-4
Drilling Started	Date	08/10/2025	22/10/2025	20/10/2025	13/10/2025	15/10/2025	24/10/2025	27/10/2025	17/10/2025
Drilling Completed	Date	10/10/2025	23/10/2025	21/10/2025	13/10/2025	15/10/2025	24/10/2025	27/10/2025	17/10/2025
Drilling Contractor	Name	Hammerstein	Hammerstein	Hammerstein	Hammerstein	Hammerstein	Hammerstein	Hammerstein	Hammerstein
Easting	m	529424	526081	529424	527550	527236	524036	526482	526663
Northing	m	7661511	7657144	7661511	7660737	7659844	7659007	7661486	7659431
Elevation	mamsl	1234	1198	1170	1222	1192	1212	1220	1222
Borehole diameter	m	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208
Collar height	m	0.35	0.3	0.35	0.19	0.65	0.52	0.49	0.34
Casing diameter	m	0.165	0.165	0.165	0.165	0.165	-	-	-
Borehole depth	m	150	130	150	120	140	120	120	120
Screened Interval	m	72-96;108-114;132-138	36-48;102-108	36-58; 106-128	48-90	54-66;120-138	-	-	-
Open borehole interval	m	-	6-130	-	-	-	12-120	6-120	6-120
Air lifted yield (blow yield)	l/s	0.5	6	3.3	-	-	-	-	-
RWL	mbgl	31.07	14.99	12.17	74.93	53.74	118.73	116.28	96.51
RWL	mamsl	1202.93	1183.01	1157.83	1147.07	1138.26	1093.27	1103.72	1125.49
Pump inlet depth	mbgl	140.00	118.00	116.00	-	-	-	-	-
Pump diameter	mm	80.00	80.00	80.00	-	-	-	-	-
Pump type	mono/submersible	Submersible	Submersible	Submersible	-	-	-	-	-
Available Drawdown	m	108.93	103.01	103.83	-	-	-	-	-

KOKOSEB GOLD PROJECT HYDROLOGICAL AND HYDROGEOLOGIC IMPACT ASSESSMENT

		Units	TSF-01	SWs-2	SWs-3	Ns-1	Es-3	NWs-4	Ns-7	Es-4
Step Drawdown Test (SDT)		Start	Date	-	17/11/2025	21/11/2025	-	-	-	-
Available Drawdown		End	Date	-	17/11/2025	21/11/2025	-	-	-	-
Step Drawdown Test (SDT) Constant Rate Drawdown Test (CRDT)	Step 1	l/s, drawdown (m)	-	1.67, 11.04	0.83,2.43	-	-	-	-	-
	Step 2	l/s, drawdown (m)	-	1.94, 17.36	1.39,4.6	-	-	-	-	-
	Step 3	l/s, drawdown (m)	-	2.22, 26.38	1.94,7.9	-	-	-	-	-
	Step 4	l/s, drawdown (m)	-	2.42, 59.11	2.5,18.1	-	-	-	-	-
	Step 5	l/s, drawdown (m)	-	-	3.61,54.75	-	-	-	-	-
	Recovery	%	-	96.4	92.15	-	-	-	-	-
	Start	Date	09/11/2025	20/11/2025	24/11/2025	-	-	-	-	-
	End	Date	11/11/2025	21/11/2025	25/11/2025	-	-	-	-	-
Constant Rate Drawdown Test (CRDT) Falling Head Test (FHT)	Duration	min	1680	720	1200	-	-	-	-	-
	Drawdown	m	95.53	93.93	98.34	-	-	-	-	-
	Recovery Time	min	1680	720	420	-	-	-	-	-
	Recovery	%	79.66	65.80	80.35	-	-	-	-	-
	Water added	l	-	-	-	75	75	75	75	-
	Initial displacement	m	-	-	-	Erroneous data	2.73	0.093	0.12	-
Falling Head Test (FHT) RWL to Main Strike	Time to 70% of RWL	sec	-	-	-	Erroneous data	315	135	165	75
	Time to 90% of RWL	sec	-	-	-	Erroneous data	540	150	180	0.17
	m	48.93	18.01	96.83	-	-	-	-	-	45

3.3. Aquifer Parameters

Preliminary aquifer parameters derived from aquifer testing (test pumping and falling head tests) provide starting values for calibration (see **Table 3-5**). Uncertainty remains high due to wellfield bias, well losses and the absence of observation boreholes. Parameters are therefore treated as indicative and constrained within defensible ranges during calibration rather than accepted as formation-wide constants.

Table 3-5 Preliminary aquifer parameters derived from aquifer testing (used as initial inputs for parameter estimation).

BH ID	T (Formation m ² /d)	T (Fracture m ² /d)	K (calculated)	K Fracture (m/d)
ES-3	1.09	0.88	0.01	4.39
ES-4	5.57	18.72	0.24	93.62
NS-7	2.91	5.52	0.78	27.58
NWS-4	3.33	7.12	2.62	35.58
TSF-01	0.05	n/a	0.001	n/a
SWs-2	0.48	n/a	0.027	n/a
SWs-3	0.67	n/a	0.007	n/a

3.4. Hydrochemistry

Groundwater chemistry data were assessed for routine monitoring boreholes (Community BH and Exploration Tank BH; January and July 2024) and newly drilled hydrogeological exploration and monitoring boreholes sampled in November 2025. **Table 3-6** and **Table 3-7** below present results in mg/L (unless otherwise stated) with screening limits as provided under the Namibia Water Resource Management Act (Act 11 of 2013). The hydrochemical table presented for the newly drilled boreholes are not exhaustive of all analytical constituents reported in the laboratory certificates. Rather, these include parameters that are directly comparable to those historically analysed at the routine monitoring boreholes. Additional analytes determined for the newly drilled boreholes, including extended trace element suites and field parameters, are summarised in **Table 3-6** and **Table 3-7** separately below. Particular attention is given to sulphate concentrations, as sulphate represents a key tracer constituent in systems where gold mineralisation is associated with sulphide-bearing minerals (e.g. pyrrhotite and arsenopyrite). Oxidation of sulphide minerals can generate sulphate irrespective of whether measurable acidity develops. In high-alkalinity, carbonate-buffered groundwater environments, any acid generated through sulphide oxidation may be rapidly neutralised by the natural acid neutralising capacity of the host lithologies (e.g. marble and calcareous units), thereby masking classical Acid Mine Drainage (AMD) indicators such as low pH. Under such conditions, sulphate enrichment may represent the earliest and most sensitive indicator of sulphide oxidation and associated water quality change. Sulphate is therefore considered a primary monitoring parameter for assessing potential geochemical impacts within the project area.

3.4.1. Routine Monitoring Sites (Community BH & Exploration Tank BH)

Routine groundwater quality monitoring is undertaken at the Community Borehole and Exploration Tank Borehole which were sampled in January and July 2024.

Table 3-6 Hydrochemistry of routinely monitored boreholes.

Chemical Constituent	Namibia's Water Resource Management Act, Act 11 of 2013	Community BH	Exploration Tank BH	Community BH	Exploration Tank BH
	Standard Limit	15-Jan-24	15-Jan-24	01-Jul-24	01-Jul-24
pH	>6 to <9	8.69	8.96	8.3	8.64
Conductivity (mS/m)	<300	148	186	128	146
Langelier Saturation Index	-	1.43	0.81	1.01	0.42
Macrochemistry (in mg/l)					
Total Dissolved Solids	<2000	1065	1053	1014	1040
Total Suspended Solids	-	4.5	4.5	9	4.5
Total Alkalinity	-	559	360	569	343
Total Hardness	<1000	661	165	582	152
Bicarbonate	-	534	331	559	330
Calcium	-	113	22.9	112	22.3
Magnesium	<70	98.7	28.2	76.4	23.7
Sodium	<300	183	397	163	354
Potassium	<100	8.34	1.14	10.3	5.56
Chloride	<300	173	291	161	304
Fluoride	<2	3.16	4.73	3.41	4.82
Sulphate	<300	74.7	90.9	70	95.4
Orthophosphate	-	0.148	0.005	0.334	0.316
Ammonium (NH ₄) as N	<0.5	0.008	0.008	0.426	0.488
Nitrate	<11	10	0.289	6.24	0.906
Nitrite	<0.15	0.065	0.065	0.065	0.065
Total Oxidised Nitrogen as N	-	10	0.293	6.27	0.926
Metals (in µg/l)					
Aluminium (Total)	<300	3	3	103	111
Iron (Total)	<300	2	2	291	2
Iron (Dissolved)	<300	4	4	4	4
Manganese (Total)	<100	3	2	8	8
Manganese (Dissolved)	<100	1	1	7	7
Total Chromium	<50	10	30	10	10
Total Copper	<2000	50	18	31	16
Total Nickel	<70	7	7	7	9
Total Zinc	<5000	317	59	270	77
Total Cobalt	-	2	2	2	2
Total Cadmium	<3	1	1	1	1
Total Lead	<10	12	12	12	12
Total Selenium	<40	12	12	12	12
Total Arsenic	<10	7	17	6	15
Total Molybdenum	-	98	46	107	49

Groundwater at the Community Borehole is characterised by:

- Alkaline pH (8.3–8.7)
- Moderate salinity (TDS ~1000 mg/L)
- Elevated hardness (582–661 mg/L)
- Dominant Ca–Mg–HCO₃ composition
- Fluoride concentrations between 3.16–3.41 mg/L

The Exploration Tank Borehole is characterised by:

- Alkaline pH (8.6–8.9)
- Similar salinity to Community BH
- Lower hardness (152–165 mg/L)
- Elevated sodium (354–397 mg/L)
- Elevated chloride (291–304 mg/L)
- Fluoride between (4.73–4.82 mg/L)

Fluoride exceeds 2 mg/L at all routine monitoring locations. Sodium exceeds 300 mg/L at the Exploration Tank Borehole in both sampling rounds. Chloride marginally exceeds 300 mg/L in July 2024 at the Exploration Tank Borehole. Nitrate and ammonium remain below screening limits.

3.4.2. Newly Drilled / Exploration Boreholes (November 2025)

After borehole development, the newly drilled boreholes that contained water were sampled in November 2025 for hydrochemical analysis.

Table 3-7 Hydrochemistry of the newly drilled boreholes.

Chemical Constituent	Namibia's Water Resource Managem ent Act, Act 11 of 2013	ES-3	TSF-1	NS-1	NWs-4	SWs-2	SWs-3
	Standard Limit	06-Nov-25	10-Nov-26	11-Nov-25	11-Nov-25	22-Nov-25	25-Nov-25
pH	>6 to <9	7.62	8.11	7.89	8.01	7.26	7.12
Conductivity (mS/m)	<300	140	232	185	168	97.6	140
Langelier Saturation Index	-	0.17	0.84	0.35	0.38	0.04	
Macrochemistry (in mg/l)							
Total Dissolved Solids	<2000	925	1466	1141	1063	668	910
Total Suspended Solids	-	24	5	146	344	63	331
Total Alkalinity	-	466	522	480	318	394	339
Total Hardness	<1000	432	805	441	425	474	660
Bicarbonate	-	465	515	476	315	393	413
Calcium	-	84.2	118	67.8	81.2	161	218
Magnesium	<70	53.8	124	66.1	53.9	17.2	27.8
Sodium	<300	160	218	250	225	34.9	52.4
Potassium	<100	7.89	5.44	7.01	9.21	1.61	2.82
Chloride	<300	149	474	285	330	93.6	218
Fluoride	<2	0.514	1.39	0.813	1.8	0.737	1.27
Sulphate	<300	108	139	123	122	37.8	81.7
Orthophosphate	-	<0.009	<0.009	<0.009	<0.009	<0.009	
Ammonium (NH ₄) as N	<0.5	0.136	0.013	0.012	0.017	0.01	0.014
Nitrate	<11	3.56	1.37	1.38	1.67	6.81	7.86
Nitrite	<0.15	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Total Oxidised Nitrogen as N	-	3.57	1.38	1.38	1.67	6.81	
Metals (in mg/l)							
Aluminium (Total)	<0.1						
Iron (Total)	<0.3	0.0001	0.2706	0.0001	0.0001	0.0001	0.0001
Manganese (Total)	<0.1	2.8	1.8	2.1	0.8984	0.0684	0.0001
Total Chromium	<0.1	0.1326	0.1444	0.1208	0.0361	0.0001	0.0001
Total Copper	<2	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Nickel	<0.15	0.0803	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Zinc	<5	0.2768	2.8	1.7	0.1436	0.4049	0.1241
Total Cobalt	<0.5	0.0078	0.0165	0.0288	0.0207	0.0064	<0.0001
Total Cadmium	<150	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Total Lead	<0.05	0.041	<0.0001	0.0105	<0.0001	<0.0001	0.0002
Total Selenium	<0.05	0.0404	0.011	0.0091	0.0112	0.0118	<0.0001
Total Arsenic	0.05	0.0876	0.1102	0.1384	0.264	0.0425	0.0386
Total Molybdenum	-	0.0417	0.0054	0.0249	0.1407	0.0023	0.0001

The newly drilled boreholes show:

- pH between 7.1 and 8.1
- TDS ranging from 668 to 1466 mg/L
- Hardness between 425 and 805 mg/L
- Chloride elevated at:
 - TSF-1 (474 mg/L)
 - NWS-4 (330 mg/L)
- Fluoride is below 2 mg/L at all new sites.

Trace element screening shows:

- Arsenic elevated at ES-3, TSF-1, NS-1, and NWS-4 (maximum 0.264 mg/L)
- Manganese elevated at ES-3, TSF-1, NS-1, and NWS-4
- Chromium slightly elevated at ES-3, TSF-1, and NS-1
- Uranium elevated at ES-3 (3.9 mg/L) relative to other boreholes

Several new boreholes exhibited elevated suspended solids and turbidity during sampling potentially showing under development due to insufficient water column in the boreholes and test pumping limitations as a result of the very low yields encountered.

A piper diagram showing the water types of the newly drilled boreholes are shown in **Figure 3-5** below. The Piper diagram indicates that groundwater within the study area is predominantly of the Ca–Cl to Ca–Cl–SO₄ hydrochemical facies. Cation chemistry is consistently calcium-dominated, with minor magnesium and low sodium contributions, indicating limited ion exchange processes. Anion composition shows chloride dominance with moderate sulphate and minor bicarbonate, suggesting that groundwater chemistry is controlled by water–rock interaction within fractured granites and marble units, with additional sulphate derived from sulphide oxidation and minor evaporative concentration effects. The marble-hosted sample shows enhanced calcium dominance consistent with carbonate dissolution.

3.4.3. Comparative Water Quality Summary

- Routine monitoring boreholes are characterised by alkaline pH (8.3–8.9), moderate salinity (TDS approximately 1,000–1,050 mg/L), elevated hardness at the Community Borehole, and sodium enrichment at the Exploration Tank Borehole. Fluoride concentrations exceed 2 mg/L in the routine monitoring dataset.
- Newly drilled boreholes exhibit pH values between 7.1 and 8.1 and TDS concentrations between 668 and 1,466 mg/L. Hardness ranges from 425 to 805 mg/L. Elevated chloride is observed at TSF-1 (474 mg/L) and NWS-4 (330 mg/L). Fluoride concentrations are below 2 mg/L in all newly drilled boreholes.
- The routine monitoring boreholes show limited trace metal enrichment. In contrast, newly drilled boreholes show elevated arsenic at ES-3, TSF-1, NS-1 and NWS-4, elevated manganese at several boreholes, minor chromium exceedances at selected locations, and elevated uranium at ES-3 (3.9 mg/L).

- Trace metal variability is spatially discrete rather than uniform across the site, as expected from the varied lithologies. Elevated suspended solids recorded at selected boreholes indicate that some total metal concentrations may reflect particulate contributions.
- The newly drilled boreholes were analysed for an extended ICP-MS suite including alkali metals, alkaline earth elements, transition metals, rare earth elements and selected precious metals.

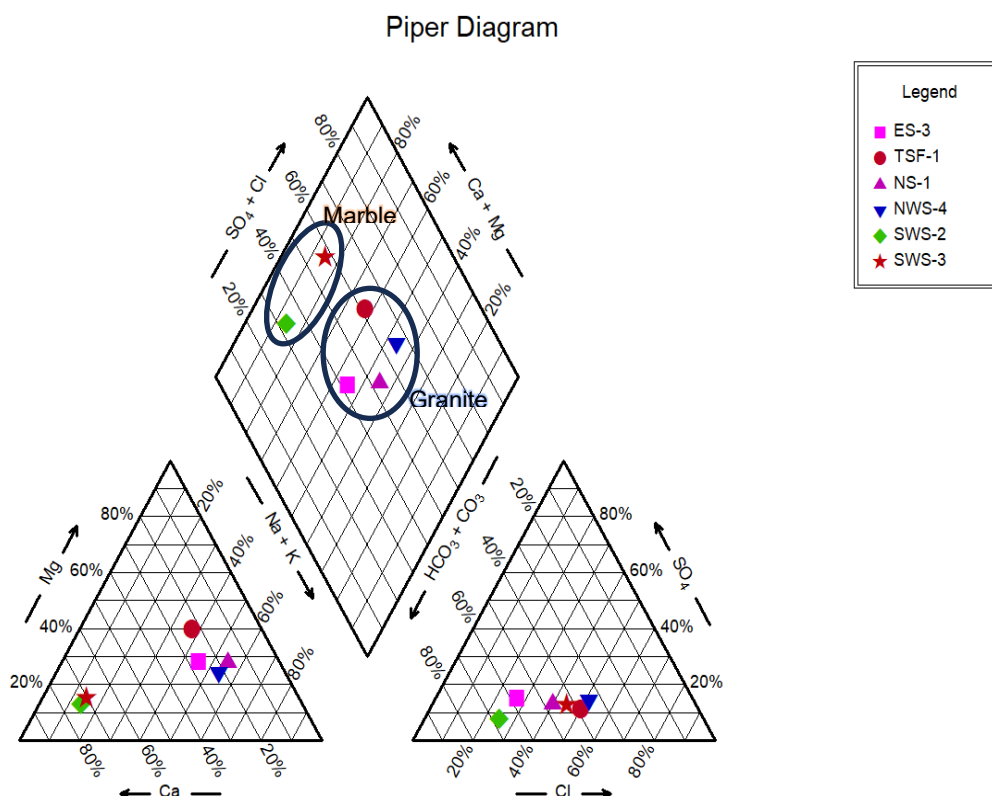


Figure 3-5 Piper diagram showing water quality of the newly drilled boreholes.

Table 3-8 Subset of noteworthy trace metal analysis.

Element	Observed Range / Notable Value
Strontium (Sr, mg/L)	3.8 – 13.6
Uranium (U, mg/L)	0.037 – 3.9
Lithium (Li, mg/L)	0.126 – 1.2
Boron (B, mg/L)	0.26 – 1.5
Tungsten (W, mg/L)	Up to 0.4262 (NWS-4)

- Strontium is consistently elevated across the site and likely reflects lithological control. Uranium mobility is consistent with alkaline, oxidising groundwater conditions. Most rare earth elements and platinum group elements were reported at or below analytical detection limits.

- The groundwater system is characterised by alkaline to circumneutral conditions, moderate salinity, bicarbonate buffering and spatially variable trace metal mobility. Elevated uranium (predominantly within the granite units) and arsenic appear localised and likely controlled by lithology and redox conditions rather than regional contamination.

3.5. Geochemical Testing

The static geochemical assessment undertaken by RGS (2025) indicates that mine materials associated with the Kokoseb Project are predominantly Non-Acid Forming (NAF), with all 75 tested samples exhibiting excess Acid Neutralising Capacity (ANC) relative to Maximum Potential Acidity (MPA). Net Acid Producing Potential (NAPP) values are negative for all samples, confirming a low intrinsic risk of Acid & Metalliferous Drainage (AMD) generation.

From a groundwater impact perspective:

- The majority of waste rock and potential tailings materials are sulphur-barren ($\leq 0.1\%$ S) and unlikely to generate acidity.
- Leachate derived from laboratory water extracts is alkaline (pH 8.2–9.9) and low in salinity (EC generally $< 200 \mu\text{S/cm}$).
- Dissolved sulphate concentrations are low relative to international livestock and freshwater ecosystem guideline values.
- Trace metal concentrations are low, with isolated exceedances observed for dissolved aluminium, arsenic and fluoride under laboratory “worst-case” extraction conditions.

The geochemical characterisation therefore supports the conclusion that:

1. Acid-driven mobilisation of metals is unlikely under site conditions. The high ANC and consistently alkaline pH conditions significantly reduce the risk of acid-induced dissolution of environmentally sensitive metals such as Al, Fe, Mn and Zn.
2. Neutral Mine Drainage (NMD) and Saline Drainage (SD) represent the more plausible geochemical pathways, should impacts occur. While materials are not acid generating, oxidation of minor sulphide phases over time may contribute to localised increases in sulphate and associated cations under neutral to alkaline conditions.
3. Arsenic, sulphate and fluoride represent the primary geochemical indicators for groundwater monitoring. Elevated dissolved arsenic in selected water extracts, particularly from ore and potential tailings materials, is consistent with arsenopyrite mineralisation associated with the deposit. Fluoride and sulphate enrichment is likely lithologically controlled. These parameters form critical constituents in the groundwater monitoring programme.

4. CONCEPTUAL MODEL

4.1. Key Controlling Processes and System Behaviour

The groundwater system is conceptualised as a fracture-dominated hard-rock aquifer with localised transmissive corridors embedded within broadly low-permeability rock. Recharge is episodic and occurs primarily through focused infiltration during high-intensity rainfall events along drainage lines, fracture corridors and weathered zones. Storage is limited, and hydraulic responses can be dominated by a small number of connected fractures rather than by matrix properties.

4.2. Hydrostratigraphic conceptualisation

For modelling, the hydrostratigraphy is simplified into three functional layers: a thin surficial cover (Quaternary/regolith), an upper weathered/fractured bedrock zone (Secondary fractured aquifer), and a deeper low-permeability basement (fracture-limited). The simplification supports stable inversion while preserving the dominant controls on flow and capture by mine features. Geological contacts between lithological units (metasediments versus granites) were inserted vertically.

4.3. Recharge Conceptualisation

Recharge is represented as a long-term equivalent average flux and treated as calibratable. A starting estimate equivalent to 5% of mean annual precipitation was adopted and refined through calibration, due to high uncertainty and a lack of long-term data that can be used to quantify recharge. Spatial variability of focused recharge is not represented explicitly because it is insufficiently constrained.

4.4. Groundwater Levels and Flow Patterns

Measured groundwater elevations range from approximately 1002 mamsl to 1049 mamsl. This range reflects combined effects of topography, structural compartmentalisation and spatial variability in fracture intensity. Flow directions are expected to follow regional gradients (generally south towards the Omaruru river) but are locally diverted along faults and lithological contacts.

4.5. Wellfield Bias and Representativeness

As boreholes were intentionally sited on conductive anomalies and interpreted structural targets, the aquifer parameter dataset preferentially samples higher-permeability domains. In the numerical model this is managed through geology-aligned zonation, defensible parameter bounds and calibration to observed heads to ensure regional realism.

4.6. Model Boundary Selection

Model boundaries were defined based on the regional geological map and topographic setting. To the north, east and south, the domain limits follow major lithological contacts identified on the regional geological map. These contacts represent changes in rock type and associated hydraulic properties and are therefore considered appropriate locations for domain boundaries in a fractured hard-rock aquifer system.

To the west, the boundary coincides with a regional watershed divide, representing a natural hydraulic boundary separating adjacent drainage systems. Under long-term average conditions, groundwater flow across this divide is expected to be limited.

The overall domain extent was selected to include the majority of the EPL while ensuring that the proposed pit, TSF and WRDs are located sufficiently far from model boundaries. This minimises boundary effects on simulated drawdown and inflow predictions and supports stable numerical performance.

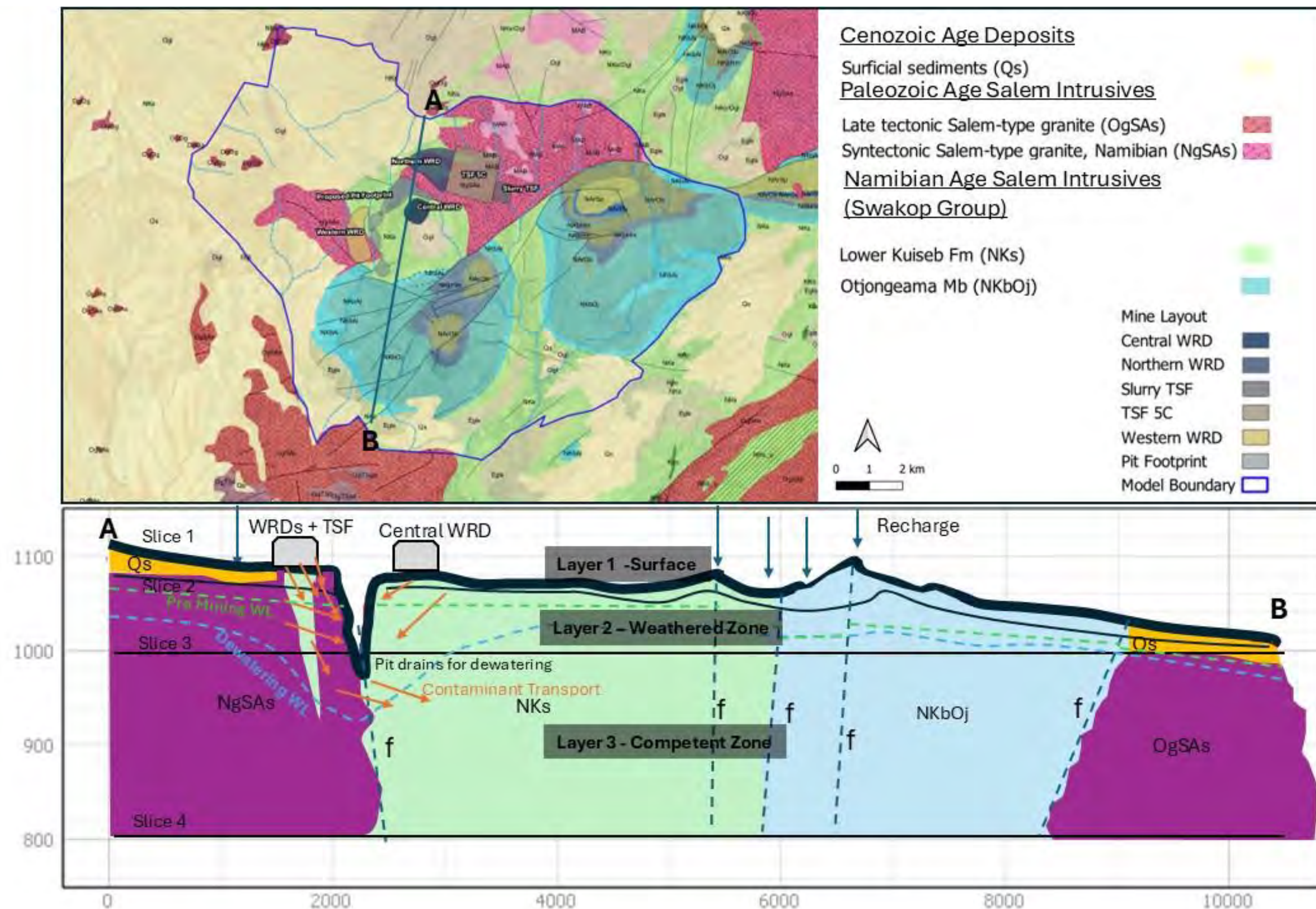


Figure 4-1 Geological map and conceptual hydrogeological cross-section (A–B) illustrating lithological units, mine infrastructure, and groundwater flow conditions. The upper panel shows the regional geological setting, mine layout and model boundary. The lower panel presents the interpreted hydrostratigraphy comprising surficial sediments (Layer 1), weathered zone (Layer 2), and competent fractured bedrock (Layer 3), including NKs, NKbOj and Salem granites. The green broken line indicates the pre-mining regional groundwater level and associated north–south flow regime. The blue dashed line represents the dewatering-induced groundwater level during mining, illustrating drawdown toward the pit and development of a localised cone of depression. Vertical arrows indicate recharge, preferentially associated with fault structures (f). Orange arrows depict conceptual contaminant transport pathways under operational conditions.

5. NUMERICAL GROUNDWATER FLOW AND MASS TRANSPORT

MODEL

This chapter documents the hydrogeological characterisation and the numerical groundwater flow and mass transport modelling undertaken for the Kokoseb Gold Project. It provides the technical basis for baseline conceptualisation, prediction of pit-related inflow and drawdown, screening-level evaluation of contaminant migration potential from mine infrastructure (TSF, WRDs and pit footprint), and consideration of post-closure groundwater conditions. The modelling results are used directly to inform the impact assessment by quantifying the magnitude, spatial extent and duration of predicted groundwater level changes and simulated mass transport behaviour.

5.1. Modelling Software and Approach

Groundwater flow and transport simulations were developed in FEFLOW v10.0 (September 2025) using a three-dimensional finite element formulation. The fractured rock system is represented as an equivalent porous medium at the element scale, with effective hydraulic properties assigned by zonation and refined through calibration. All scenarios presented are steady-state (long-term average equilibrium). As a result of the insufficient temporal data available to produce a transient model.

FEFLOW is a three-dimensional finite-element package capable of simulating contaminant and heat flow and transport (Diersch, 2014). FEFLOW also has a built-in grid-design, problem editing and graphical post processing display modules that allow rapid model development, execution and analysis. Detailed descriptions of the governing equations and theoretical development and benchmarking of the FEFLOW code can be found in Kolditz et al. (1998), Diersch and Kolditz (1998) and Diersch (2014), with a brief overview as follows.

According to Darcy's law, flow through porous media, accounting for varying fluid density, can be expressed as follows:

$$\mathbf{q} = -\frac{\mathbf{k}}{\mu}(\nabla p - \rho \mathbf{g}) \quad 5.1$$

where $\mathbf{k}$ is the permeability tensor [L^2], μ represents dynamic viscosity [$ML^{-1}T^{-1}$], p is pressure [ML^{-1}]. ρ is the density of the fluid [ML^{-3}], $\mathbf{g}$ is acceleration due to gravity [LT^{-2}].

Based on the principle of mass conservation for fluid and solute, the rate of accumulation of mass stored in a representative elementary volume is equal to the sum of mass fluxes across the face of the element and the mass exchange from sinks or sources. The mathematical expression for the conservation of mass is thus:

$$\frac{\partial(\rho\theta)}{\partial t} = -\nabla \cdot (\rho\mathbf{q}) + \bar{\rho}q_s \quad 5.2$$

where $\bar{\rho}$ is the density of water entering/leaving from a sink/source [ML^{-3}], q_s is the volumetric flow rate per unit volume of aquifer representing sources and sinks [T^{-1}], θ is porosity [-] and t is time [T]. The first section of the right-hand side is the net flux of mass into the medium and the second part is the mass which enters/exists through sources and sinks. The left hand is the time rate of change in the mass stored.

If q in equation (5.2) is replaced with equation (5.1), then one equation results:

$$\frac{\partial(\rho\theta)}{\partial t} = -\nabla \cdot \left(\rho \frac{\mathbf{k}}{\mu} (\nabla p - \rho \mathbf{g}) \right) + \bar{\rho} q_s \quad 5.3$$

For saturated soil water conditions, the left-hand side of equation (5.3) can be further expanded to obtain the general form of the partial differential equation for variable-density groundwater flow in saturated porous media:

$$\rho S_p \frac{\partial p}{\partial t} + \theta \frac{\partial \rho}{\partial c} \frac{\partial c}{\partial t} = -\nabla \cdot \left(\rho \frac{\mathbf{k}}{\mu} (\nabla p - \rho \mathbf{g}) \right) + \bar{\rho} q_s \quad 5.4$$

where p is pore pressure [ML⁻¹T⁻²], c is solute concentration [ML⁻³], in which S_p is the specific storage in terms of pressure [M⁻¹LT⁻²]. On the left the first term is rate of fluid mass accumulation due to pore pressure change and the second term is rate of fluid mass accumulation due to the change in solute concentration. If density is constant this last term cancels.

Groundwater flow is often simulated using equation (5.4) and assuming that density, viscosity, porosity and permeability are constant, in which case it is a differential equation for p and can be solved numerically if certain boundary and initial conditions are specified (Holzbecher, 1998).

5.2. Model Assumptions

In its current state, the numerical groundwater flow and mass transport model for the Kokoseb Gold Mine represents the current understanding of the fractured hard-rock aquifer system within EPL 4818. The model is consistent with the developed conceptual hydrogeological model, provides a good representation of available field data, and is hydrogeologically defensible at the scale of this impact assessment.

The following assumptions are highlighted:

- Although the fractured aquifer system is represented using an equivalent porous medium (EPM) approach, this is a simplification of a structurally controlled system. At a regional scale this is appropriate; however, at local scale, discrete fractures, structural corridors and lithological heterogeneity may strongly influence groundwater flow rates and directions. The 3D geological representation is simplified and based on a limited number of boreholes and regional geological mapping. High spatial variability and limited drilling density may result in geometric inaccuracies that influence local-scale predictions.
- Hydraulic properties were derived from aquifer testing undertaken at boreholes targeted on geophysical anomalies and structurally favourable zones. These data are therefore biased toward higher-permeability domains and may not represent background formation properties. No dedicated observation boreholes were available during pumping tests, increasing uncertainty in storativity and transmissivity estimates.
- Recharge is applied as a spatially uniform long-term equivalent flux calibrated to observed groundwater levels. Episodic recharge events, focused recharge along drainage lines, and interannual climatic variability are not explicitly represented. In practice, recharge is likely spatially and temporally variable.
- No lateral inflow from deeper basement formations beyond the defined model boundaries is explicitly simulated. While boundaries were selected based on geological contacts and watershed divides, some cross-boundary flow may occur in reality.

- Surface water–groundwater interaction is represented in a simplified manner. Ephemeral drainage lines are treated as seepage faces that only discharge when groundwater levels intersect the channel. No measured flow data were available to constrain conductance or exchange rates. Surface water bodies are therefore conceptualised in a simplified equilibrium manner and do not account for event-based recharge pulses or downstream re-infiltration.
- All predictive scenarios are steady-state and represent long-term equilibrium conditions. Seasonal variability, episodic rainfall events, transient drawdown development, delayed yield effects, and groundwater rebound dynamics are not simulated. Time-to-steady-state inflow and drawdown propagation were not assessed.
- The predicted pit inflow of approximately 1,710 m³/day represents an equilibrium value under the assumed final pit geometry. Therefore, representing the maximum inflow under modelled conditions and assumptions. It does not represent instantaneous operational pumping requirements nor account for staged pit development.
- Model geometry, including pit shell, pit floor elevation, TSF footprint and WRD extents, is based on spatial data provided by the Client. Any revisions to mine layout, sequencing, depth, or infrastructure footprint may alter predicted inflows, drawdown extents and contaminant transport behaviour.
- Mass transport simulations apply a conservative tracer approach with a continuous source concentration. Reactive geochemical processes (sorption, precipitation, redox reactions, degradation, density effects and matrix diffusion) are not included. Effective porosity and dispersivity values are assumed (FEFLOW defaults) but are not site-measured parameters. Transport predictions therefore represent conservative screening-level estimates.
- Post-closure simulations assume pit lake formation at approximately 1000 mamsl and that the pit will function as a long-term hydraulic sink. Groundwater rebound time and transient filling dynamics were not modelled. Overflow under extreme rainfall conditions was not assessed within the groundwater model.
- The distribution of hydraulic conductivity within geological units is assumed to be adequately represented by zonation aligned with mapped lithology and structural domains. Directional horizontal anisotropy was not implemented. Vertical anisotropy is fixed at $K_{zz} = 0.1 \times K_{yy}$.
- Calibration is based on 44 groundwater head observations. While calibration statistics indicate a good fit (RMSE ~3.5 m; NRMSE <10%), the available dataset remains spatially limited and dominated by structurally targeted boreholes.
- Predictive uncertainty was assessed qualitatively through sensitivity testing of recharge, bulk hydraulic conductivity and boundary heads. A formal predictive uncertainty analysis (e.g., PEST predictive mode or Monte Carlo simulation) was not undertaken. As such, absolute predictions carry uncertainty not fully quantified statistically. Given the limited density of site-specific hydraulic data and the structurally complex nature of the aquifer (s), predictive uncertainty remains inherently high at this stage, and a formal statistical uncertainty analysis would not meaningfully reduce that uncertainty beyond what can be demonstrated through sensitivity testing.
- It is assumed that groundwater abstraction by third-party users outside the mine footprint is negligible or adequately represented by boundary conditions. Detailed abstraction volumes and temporal distribution of use by other users are not fully constrained.

- Topographic data are derived from regional digital elevation models (30 m resolution). No high-resolution LIDAR survey was available. Local drainage gradients and subtle surface features may therefore be imperfectly represented.
- It is assumed that all data supplied by the Client and third parties, including pit geometry, drilling logs, laboratory results and historical hydrocensus records, are accurate and complete. Umvoto has relied on these datasets and has not independently verified all underlying source information.

Overall, the model is considered appropriate for impact assessment, scenario comparison and monitoring design at a regional to site scale. However, due to simplifications inherent in steady-state modelling, anisotropy, structural heterogeneity of fractured systems, and data density limitations, predictions should be interpreted as reasonable estimates under stated assumptions rather than precise forecasts. Model refinement, including transient simulation, expanded hydrogeological data collection, predictive uncertainty analysis and updated mine design inputs, would improve confidence in long-term operational and closure predictions.

5.3. Model Domain, Mesh and Discretisation

The model domain covers $1.48846 \times 10^8 \text{ m}^2$ and a volume of $4.06495 \times 10^3 \text{ m}^3$. Mesh refinement was applied around the pit, TSF, WRDs, boreholes, rivers and mapped faults (see **Figure 5-1**). Topography was transferred to the mesh using kriging. Mesh quality checks indicate ~2.2% Delaunay-violating triangles. **Table 5-1** summarises the model metrics.

Table 5-1 Key mesh and model size metrics.

Mesh metric	Value
Min element size (m)	0.14643
Max element size (m)	1371.78
Mean element size (m)	92.80
No. layers	3
No. slices	4
Elements per layer	25982
Nodes per slice	13460
Model area (m^2)	1.48846×10^8
Model volume (m^3)	4.06495×10^3
Delaunay-violating triangles	2.2%

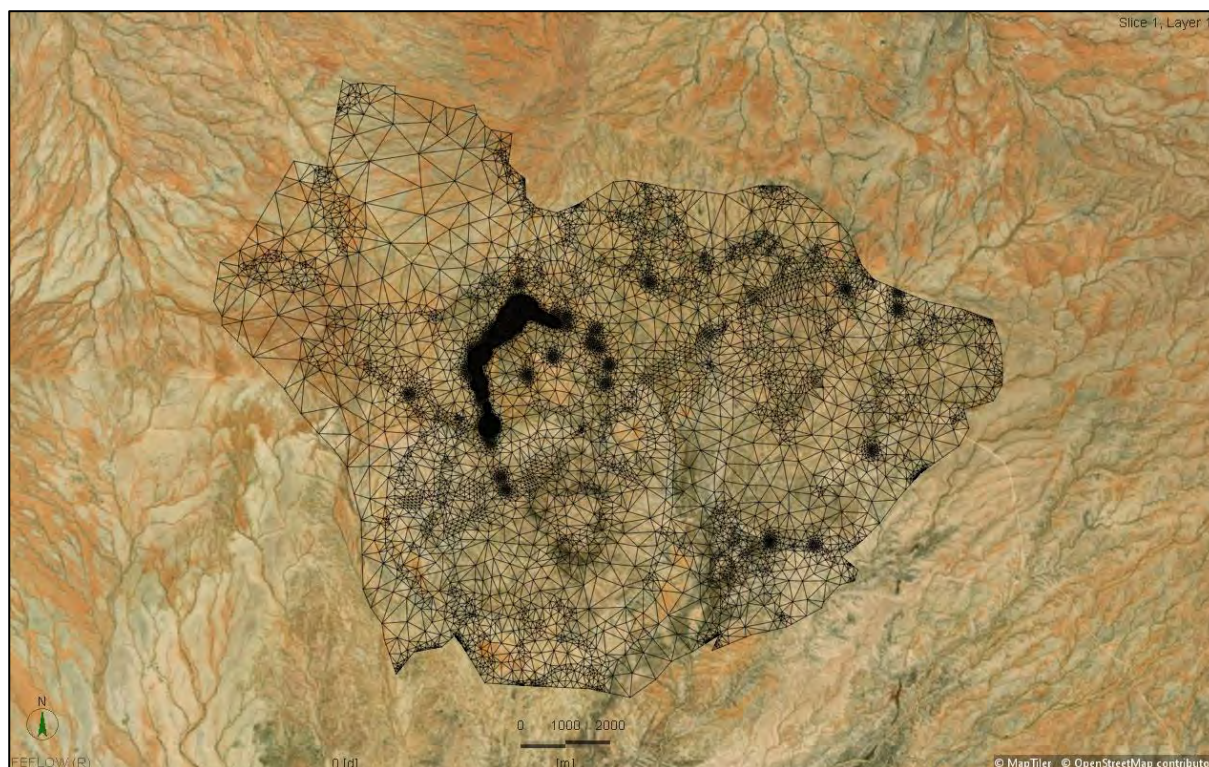


Figure 5-1 Model domain and mesh refinement.

5.4. Vertical Discretisation

The model comprises three layers: Layer 1 (1061–1058 mamsl; 3 m) represents surficial cover/regolith; Layer 2 (1058–1000 mamsl; ~58 m) represents the primary weathered/fractured aquifer; Layer 3 (1000–800 mamsl; 200 m) represents deeper low-permeability fresh rock. A summary is shown in **Table 5-2** and **Figure 5-2**.

Table 5-2 Vertical discretisation and interpretation.

Layer	Elevation (mamsl)	Approx. thickness (m)	Representation
1	Surface elevation – 3 m (~1058 mamsl [average])	3	Surficial cover / Quaternary
2	1058–1000	~58	Weathered and fractured bedrock
3	1000–800	200	Lower-permeability basement (fracture-limited)

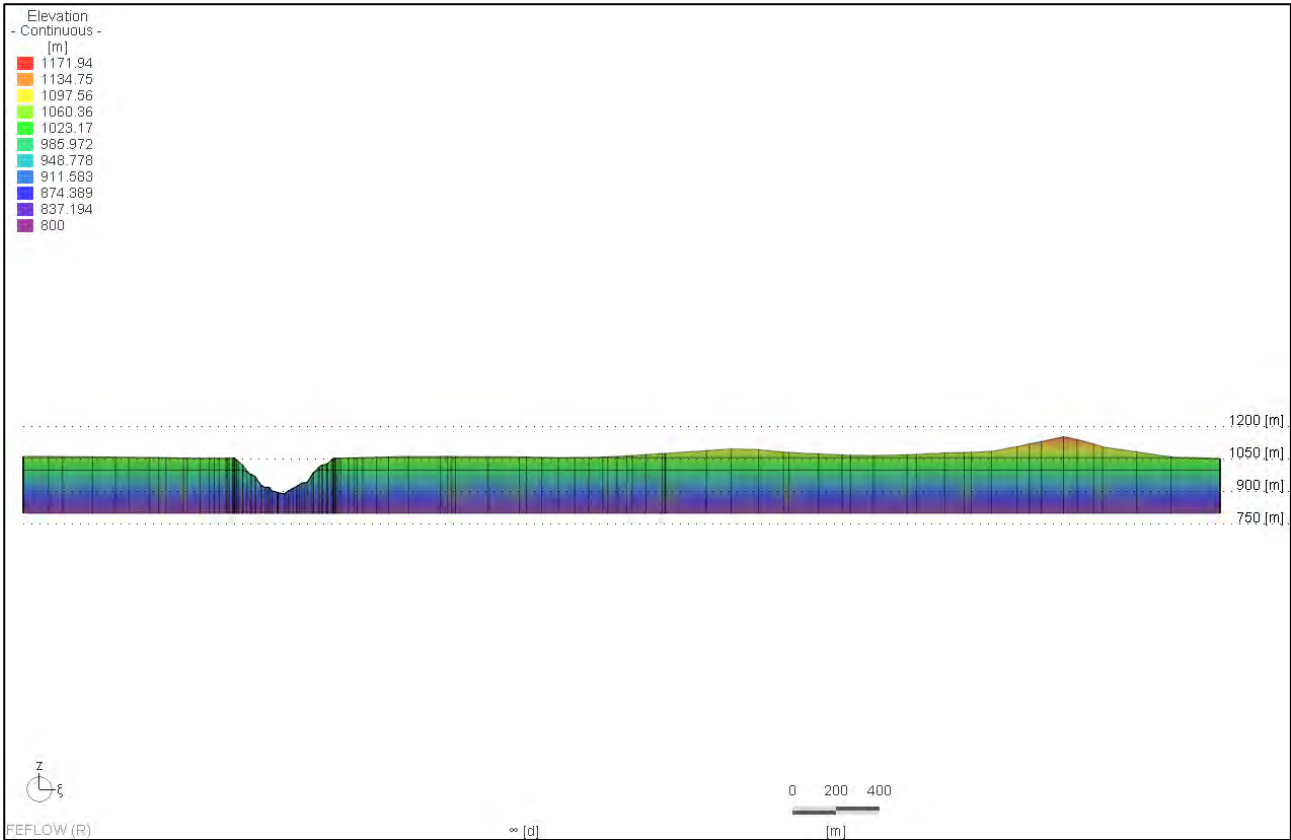


Figure 5-2 Model cross section showing topography, model layers and the south pit.

5.5. Hydraulic Parameterisation and Anisotropy

Thirteen hydraulic zones were defined and aligned to geological units and structural domains and refined through PEST. Horizontal isotropy is assumed ($K_{xx} = K_{yy}$) and vertical anisotropy applied as $K_{zz} = 0.1 \times K_{yy}$. Directional horizontal anisotropy was not implemented. The hydraulic parameters are shown in **Table 5-3**. **Figure 5-3** and **Figure 5-4** below shows a slice view and 3D view of the parameterisation.

Table 5-3 Calibrated hydraulic conductivity values used in the numerical model.

Zone	Parameter ID	Calibrated K (m/day)	Notes
Pit North	rde_001	0.017	Pit north structural domain
Pit South	rde_002	0.001	Pit south structural domain
Quaternary (Qs)	rde_003	0.489	Surficial cover effective K (Layer 1)
Mica schist (NArOb)	rde_004	2.000	Oberwasser schist domain (structurally enhanced)
Mica schist (NKs)	rde_005	0.898	Kuiseb schist
Marble (NKbHm)	rde_006	0.062	Harmonie impure marble/calc-silicate
Marble (NKbAi)	rde_007	0.018	Arises River massive marble
Marble (NKbOj)	rde_008	0.180	Otjongeama impure marble
Marble (NArOy)	rde_009	1.341	Okawayo marble/calc-silicate
Marble/schist (NArSp)	rde_00A	0.637	Spes Bona schist/calc-silicate
Biotite granite (NgSAs)	rde_00B	0.491	Biotite granite
Granite gneiss (MAB)	rde_00C	0.020	Basement gneiss
Infill granites	rde_00D	0.021	Minor intrusive infill
Leucogranite (Ogl)	rde_00E	1.346	Leucogranite
Leucogranite foliated (Egls)	rde_00F	0.001	Foliated leucogranite (low K)

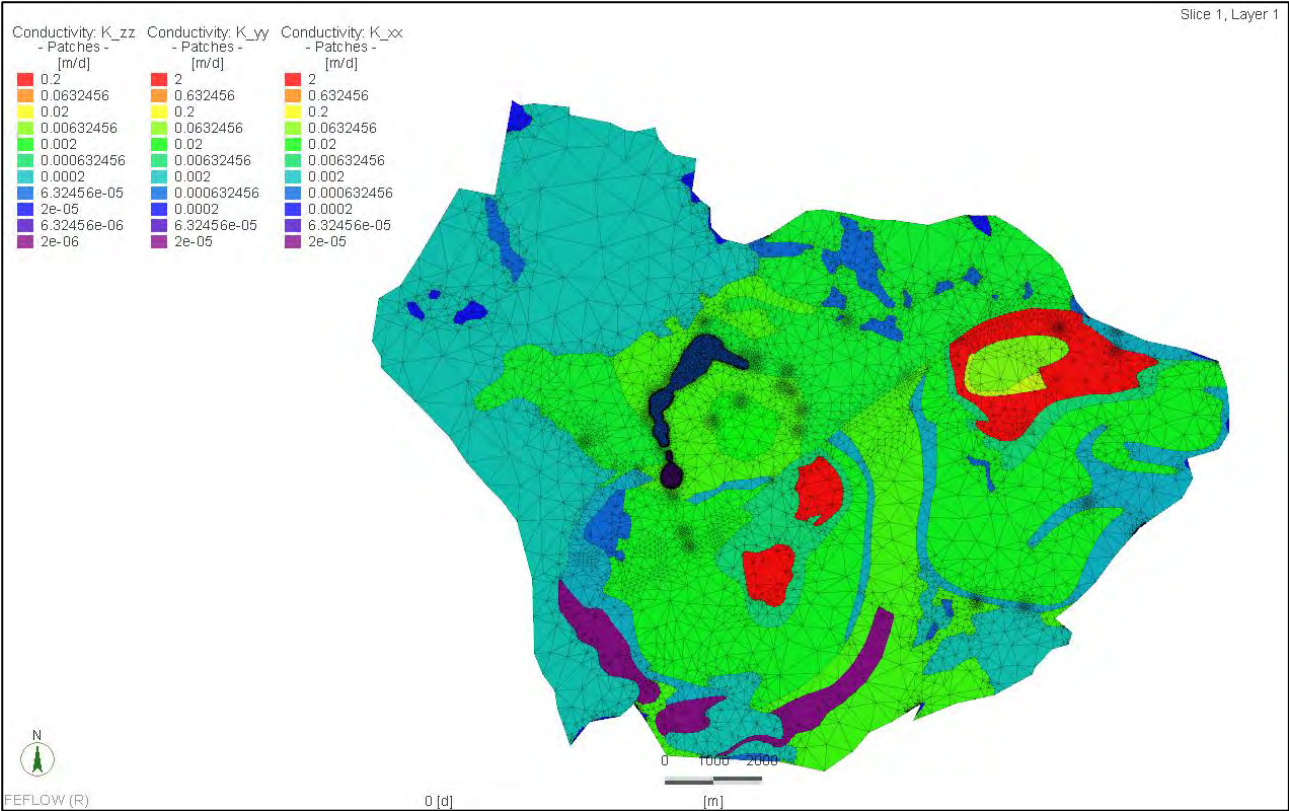


Figure 5-3 Hydraulic conductivity in 2d (Slice 1).

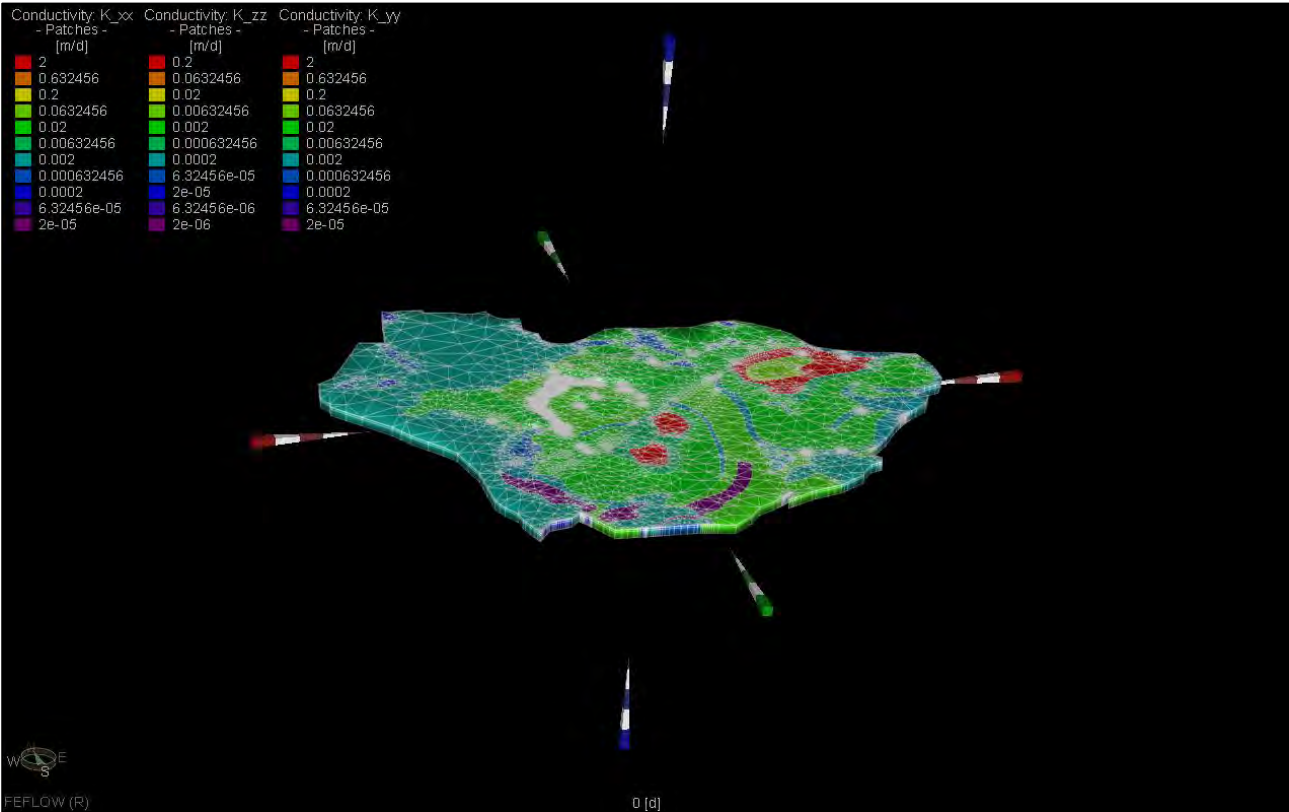


Figure 5-4 Hydraulic conductivity in 3D.

5.6. Recharge

Recharge was applied as a uniform areal flux at the model top boundary and treated as a calibratable parameter. An initial recharge estimate equivalent to approximately 5% of mean annual precipitation (MAP) was adopted as an upper-range starting value for model calibration. This value represents the higher end of typical recharge percentages and was used to ensure the model had sufficient flexibility during calibration. The calibrated recharge parameter equals 1.36986e-06 in m/d (~0.5% of MAP) (refer to **Table 5-4**).

Table 5-4 Recharge parameter applied in the model.

Value Recharge parameter	Units	Implementation
1.36986e-06	m/d	Uniform areal recharge

5.7. Boundary Conditions

A summary of the boundary conditions applied to the model is shown in **Table 5-5** below.

Table 5-5 Summary of boundary conditions and stresses.

Feature	Boundary / stress type	Conceptual meaning	Rationale
Model perimeter	Specified head (Dirichlet)	Regional head control	Maintains gradients; limits boundary artefacts
Pit	Seepage face	Passive drainage where head reaches pit	Represents inflow without prescribing pumping
Ephemeral rivers	Seepage face	Discharge only when head reaches channel	Prevents unrealistic recharge
Recharge	Distributed flux	Net infiltration to water table	Represents long-term average

5.8. Calibration and Fit Statistics

Calibration used 44 head observations from hydrocensus measurements. Key fit statistics (hydraulic head groupings) are RMSE 3.54088 m, NRMSE 9.70637%, MAE 3.00654 m. Twenty-six residuals carried non-zero weight. Mean weighted residual is -0.7422 (**Table 5-6**).

Table 5-7 shows the objective function and reduction in Phi (measure of error), **Figure 5-5** presents the final observed vs simulated heads.

Table 5-6 Calibration fit statistics.

Statistic	Value	Notes
RMSE (m)	3.54088	Head targets
NRMSE (%)	9.70637	Normalised to observed range
MAE (m)	3.00654	Mean absolute error
Non-zero weighted residuals	26	Subset of 44
Mean weighted residual	-0.7422	Simulated slightly higher than observed on average
Max weighted residual	6.433	hea_011
Min weighted residual	-8.101	hea_015
R ²	0.8769	From observed vs simulated pairs

Table 5-7 PEST objective function reduction across iterations.

Iteration	Phi
0	3478.1
1	1176.4
2	1102.5
3	792.33
4	731.6
5	727.91
6	514.21
7	445.1
8	488.61
9	351.62
10	337.64
11	326

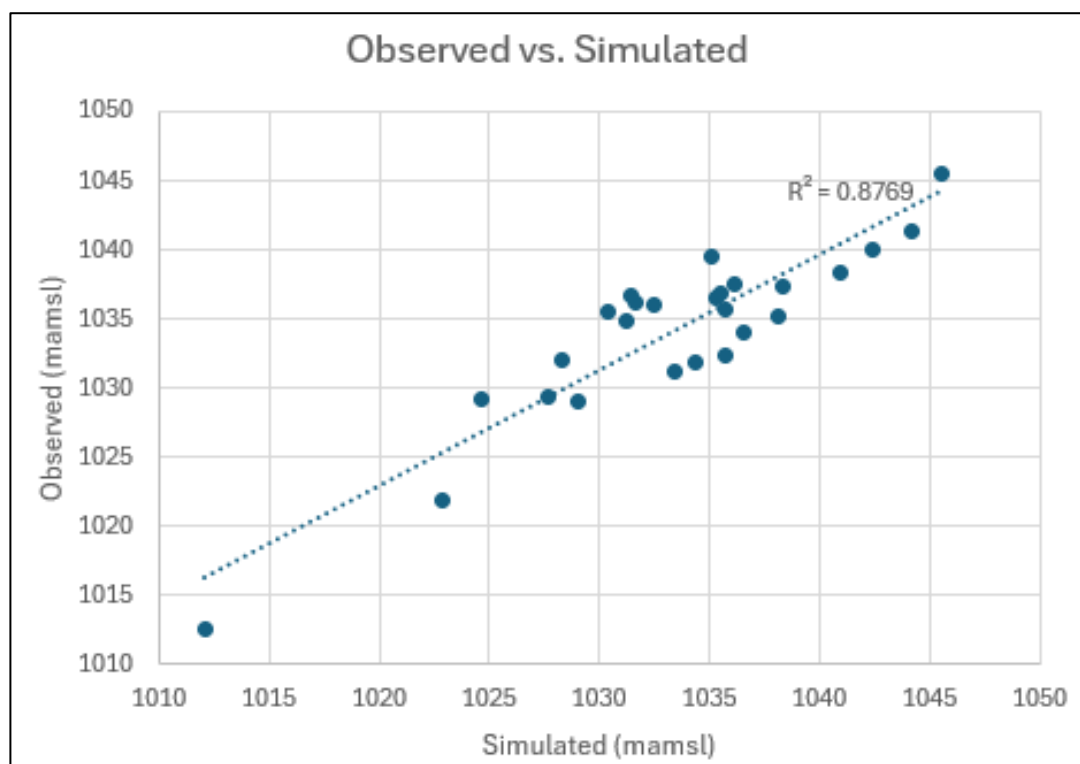


Figure 5-5 Calibrated observed vs. simulated heads.

5.9. Sensitivity Analysis

Manual sensitivity testing was undertaken for recharge, boundary heads and bulk hydraulic conductivity (hydraulic conductivity exerts the greatest influence on drawdown extent and capture; boundary heads and recharge influence regional gradients and plume behaviour). Predictive uncertainty analysis (PEST predictive mode) was not undertaken. Refer to the summary in **Table 5-8** below.

Table 5-8 Sensitivity testing summary.

Parameter tested	Tested	Primary influence	Comment
Recharge	Yes	Regional gradients / water balance	Uniform recharge; uncertainty remains high
Hydraulic conductivity (bulk)	Yes	Drawdown extent / inflow	Not tested per-layer
Boundary heads	Yes	Plume length / gradients	Boundary uncertainty not formally quantified
Anisotropy (directional)	No	Preferential flow	Not implemented

5.10. Scenario Simulations

The numerical modelling undertaken as part of this assessment includes three primary scenarios designed to evaluate groundwater quantity and quality impacts under operational and post-closure conditions. Scenario 1 simulates full operational pit dewatering under steady-state conditions to quantify predicted inflow rates, drawdown extent and regional hydraulic response, thereby assessing potential impacts on groundwater level, flow and surrounding groundwater users and receptors. Scenario 2 evaluates operational mass transport using a conservative tracer applied beneath the pit, TSF and WRDs to assess the potential extent and direction of contaminant migration under active dewatering conditions; this scenario provides a screening-level assessment of containment performance assuming failure of mitigation measures. Scenario 3 simulates post-closure steady-state conditions with pit lake formation to evaluate long-term groundwater recovery, hydraulic re-equilibration and contaminant plume behaviour following cessation of dewatering. Together, these scenarios provide a structured assessment of groundwater system behaviour during mining operations and closure, allowing comparison of quantity and quality impacts under conservative assumptions.

5.10.1. Scenario 1 – Operational pit dewatering (steady-state)

The pit reaches a maximum depth with the deepest floor at approximately 840 mamsl. Predicted steady-state inflow into the pit is 1,710 m³/day. Transient time-to-steady-state was not simulated. **Table 5-9** presents the key outputs and **Figure 5-6** the final steady state drawdown cone expected.

Full pit dewatering: simulating the mine at its full planned extent, this scenario determined a drawdown cone extending ~6 km south from the pit, with progressively decreasing magnitude, from 60 m drawdown at 2 km to 10 m drawdown at 4 km. The drawdown cone remains contained within the EPL, apart for the western edge, where a drawdown of 20 m is observed.

Table 5-9 Dewatering scenario configuration and key output.

Scenario parameter	Value	Notes
Deepest pit floor	~840 mamsl	Varies
Steady-state inflow	1710 m ³ /day	Equilibrium inflow
Transient simulation	No	Not undertaken

5.10.2. Scenario 2 – Operational Mass Transport (Conservative Tracer)

A continuous source concentration of 1 mg/L (species not specified; conservative tracer) was applied at slice 1 beneath the WRDs, TSF and pit footprint. Reactive processes were not included. Effective porosity and dispersivity values are not yet defined (i.e., default values are used) and must be confirmed to complete a defensible transport parameter set. **Table 5-10** presents the key outputs and **Figure 5-7** the final steady state mass plume during ROM scenario and the hydraulic heads associated with the configuration.

Mass transport during mining: this scenario evaluates the potential extent of contaminant transport in the event that operational mitigations (e.g., liners, bunding, and containment measures) fail. Contamination plumes remain localised and migrate toward the pit.

Table 5-10 Transport scenario inputs.

Transport input	Value	Status
Source concentration	1 mg/L	Applied; species not specified
Source type	Continuous	Applied for steady-state period
Applied depth interval	Slice 1	Applied to WRDs, TSF and pit footprint
Effective porosity	0.1	Conservative estimation
Dispersivity (L/TH/TV)	5;0.5	Default settings, Sensitivity was tested
Sorption (Kd)	Not included	Conservative unless confirmed otherwise

5.10.3. Scenario 3 – Post-Closure Steady-State and Pit Lake Formation

Post-closure conditions were assessed under steady-state assumptions. Groundwater is assumed to recover toward pre-mining levels, with a pit lake forming and acting as a long-term sink. Final pit lake elevation is assumed to stabilise at approximately 1,000 mamsl. Rebound time is not quantified. **Table 5-11** presents the key outputs and **Figure 5-8** the final steady state drawdown mass plume and hydraulic heads associated with this configuration. The pit acts as a sink and constrains the plume extent and migration as a result.

Post-mining mass transport: this scenario assesses groundwater flow and contaminant transport after mining activities have ceased, with waste rock dumps (WRDs) and the tailings storage facility (TSF) as continued sources of contamination.

Table 5-11 Post-closure scenario assumptions and outputs.

Post-closure parameter	Value	Notes
Pit lake	Assumed	Acts as sink
Final pit water elevation	1000 mamsl	Assumed
Rebound time	Not simulated	Transient not modelled
Overflow	Not tested	Requires event-based assessment

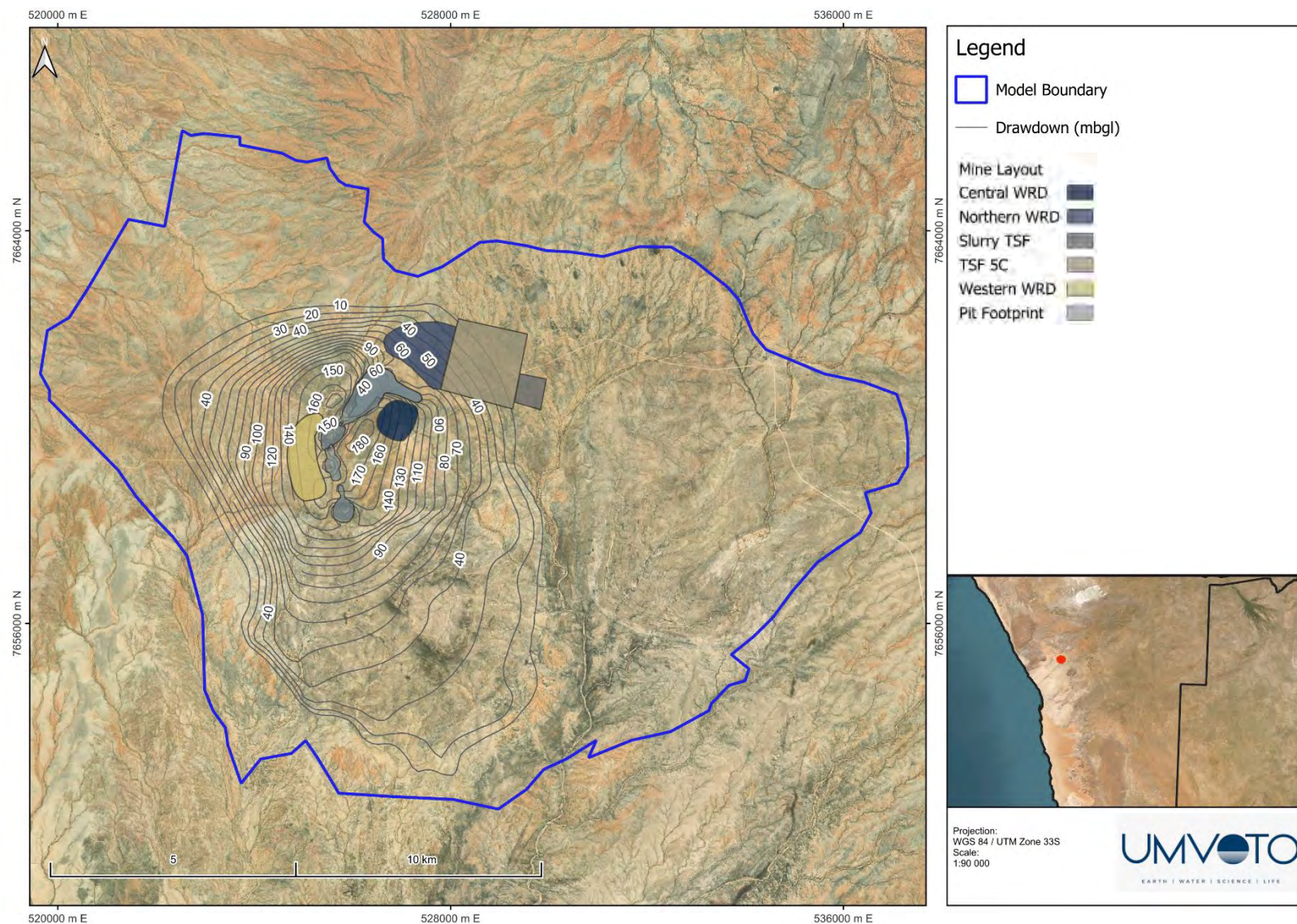


Figure 5-6 Scenario 1 - Drawdown cone due to pit dewatering.

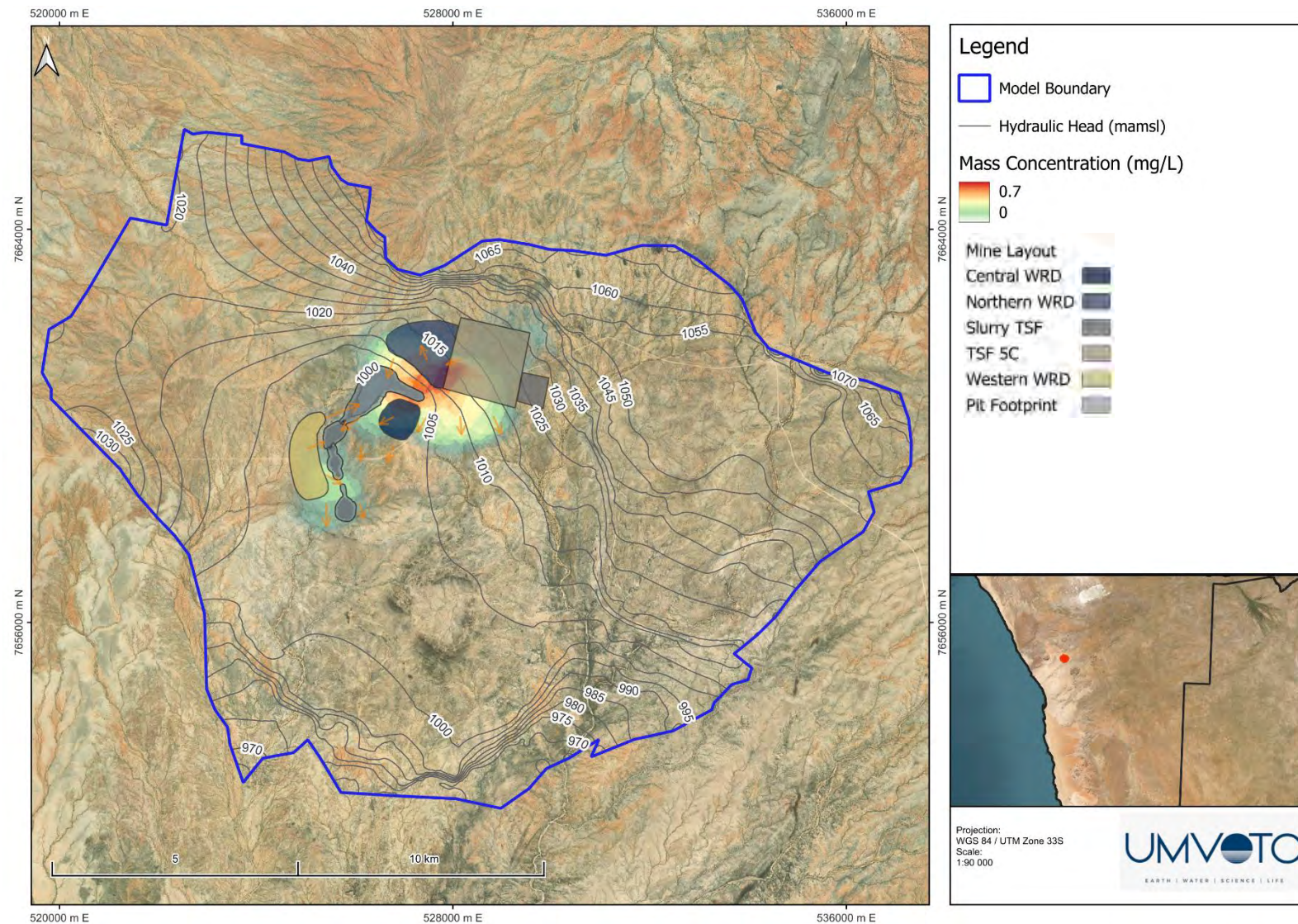


Figure 5-7 Scenario 2 - Mass transport plume during mine operations. Orange arrows represent mass transport direction.

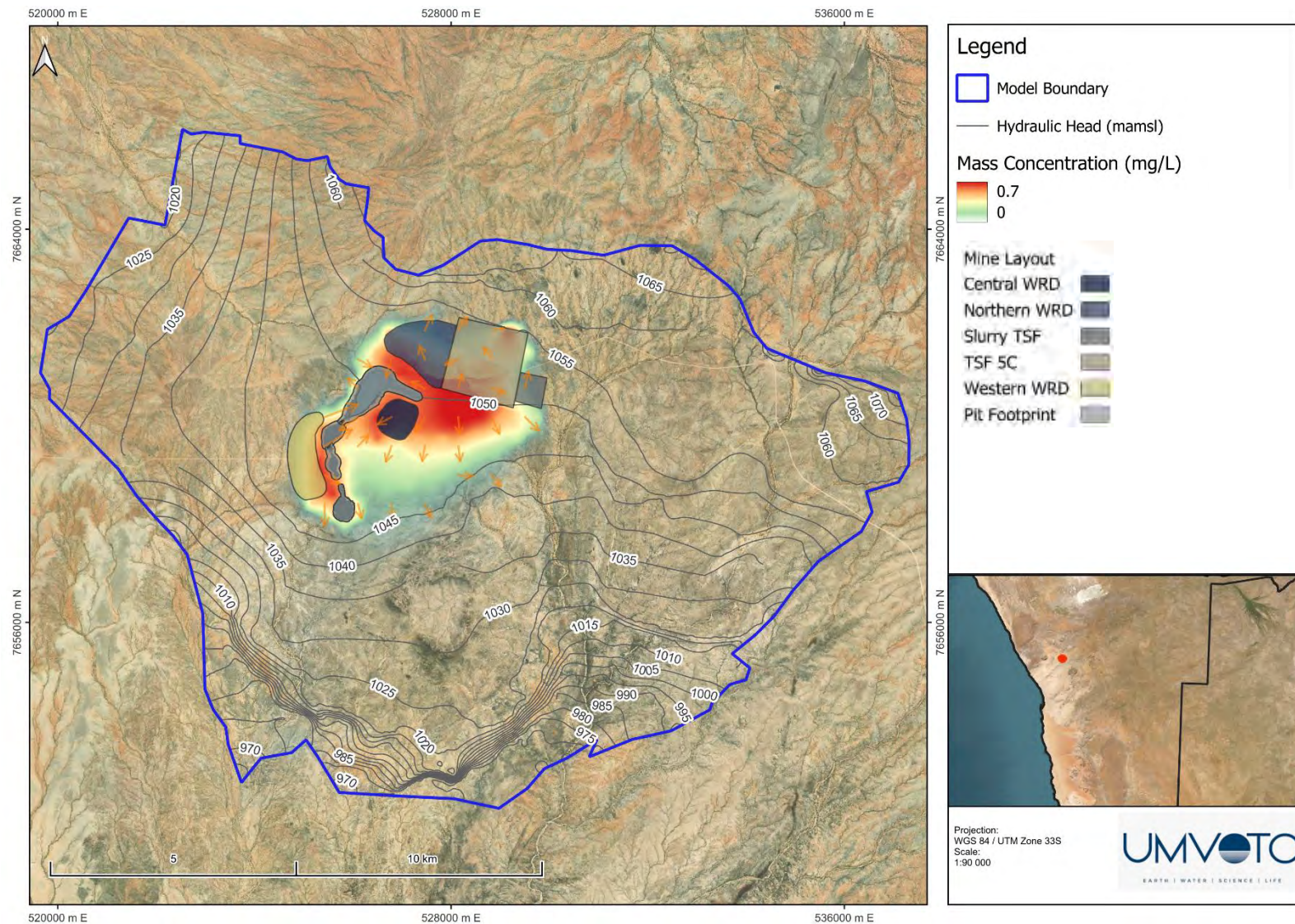


Figure 5-8 Scenario 3 - Mass transport plume in a post-closure scenario (ROM). Orange arrows represent mass transport direction.

5.10.4. Modelling Results Summary

The numerical modelling undertaken for the Kokoseb Gold Project provides quantitative support to the groundwater-related impact assessment and confirms the dominant hydrogeological processes identified in the conceptual model. Under operational steady-state conditions, predicted pit inflow is approximately 1,710 m³/day, with development of a drawdown cone extending approximately 6 km to the south of the pit, with progressively decreasing magnitude towards the outer model boundary. The pit functions as a hydraulic sink, lowering rest water levels (RWL) within the fractured aquifer and reorienting regional gradients toward the excavation. This represents the primary groundwater quantity impact during operations. However, given that communities located within the predicted drawdown footprint will be relocated as part of mine planning, the impact to existing groundwater users is substantially reduced, and residual impacts are considered manageable through monitoring and adaptive management.

The operational mass transport simulation applies a conservative tracer beneath the pit, TSF and WRDs to represent a containment failure scenario. Results indicate that under active dewatering conditions, hydraulic gradients direct groundwater flow toward the pit, and contaminant plumes remain largely confined within the hydraulic capture zone. The pit therefore acts as a containment feature during operations, limiting outward regional migration. Predicted concentration contours show convergence toward the excavation rather than expansion toward distal receptors. These findings support the impact assessment conclusion that groundwater contamination risks during operations are localised and controlled by inward-directed gradients, provided infrastructure integrity and monitoring are maintained.

Post-closure steady-state modelling assumes cessation of dewatering and formation of a pit lake at approximately 1,000 mamsl. Groundwater levels are predicted to recover toward equilibrium conditions, although the rate of rebound was not simulated. Under the assumed steady-state configuration, the pit lake continues to function as a hydraulic low point, capturing groundwater flow and limiting regional plume propagation. While rising water levels may mobilise previously oxidised materials locally, the model does not predict outward large-scale contaminant migration under conservative assumptions. Long-term groundwater quality risks are therefore expected to remain predominantly local to the mine footprint and associated waste facilities.

5.11. Limitations And Confidence

Key limitations include equivalent porous media (EPM) representation of fractures, wellfield bias from geophysical targeting, lack of observation boreholes (spatially representative) constraints, uniform recharge representation, steady-state-only scenarios, incomplete transport parameter documentation, and limited boundary-condition uncertainty evaluation. These constraints primarily affect the precision of absolute predictions rather than the ability of the model to support comparative impact assessment and monitoring design.

6. MONITORING NETWORK

A groundwater monitoring programme is required to verify model predictions, protect environmental receptors, confirm containment performance of mine infrastructure, and support adaptive water resource management throughout the life of mine and post-closure period. The aquifer is a fracture-controlled, structurally influenced hard-rock aquifer. Groundwater flow is governed by gradients, fracture connectivity and lithological contacts rather than surface topography. Monitoring must therefore prioritise interception of preferential flow pathways and early detection of deviations from predicted behaviour.

6.1. Monitoring Network Design

The monitoring network comprises:

1. Existing routine monitoring boreholes (Exploration BH and Community BH);
2. Hydrogeological boreholes drilled for the Kokoseb study;
3. Proposed additional monitoring boreholes strategically located upgradient of the mine to form a background site, along interpreted structural pathways, down gradient of the mine to monitor contamination plume and drawdown extent.

The proposed additional monitoring sites (Kok_mon_01 to Kok_mon_08) have been positioned to:

- Provide upgradient background information
- Intercept potential plume migration from the mine;
- Provide early warning prior to impacts at regional receptors;
- Improve long-term dataset robustness for adaptive management and model upgrades / updates for future requirements.

Monitoring boreholes are proposed based on the current understanding of the project. Monitoring boreholes final location should be sited using scientifically sound geophysical methods, targeting fracture zones where groundwater flow is predominantly expected. The additional proposed boreholes in this section are considered preliminary, based on regional geology, numerical groundwater flow and mass transport model results.

Table 6-1 Summary of surface water and groundwater sites to be monitored.

ID	Easting	Northing	Comment
Groundwater Monitoring Sites			
Exploration BH	527308	7660795	Current routine monitoring (near field)
Community BH	525461	7659999	Current routine monitoring (near field)
TSFs-1	529424	7661511	Biotite granite–gneiss contact (near field)
Ns-1	527550	7660737	Fractured Kuiseb schist (near field)
Es-3	527236	7659844	Leucogranite–schist contact (near field)
NWs-4	524036	7659007	Leucogranite–schist contact (near field)
Ns-7	526482	7661486	Fractured granite–mica schist contact (near field)
Es-4	526663	7659431	Fractured granite–schist contact (near field)
SWs-2	526081	7657144	Fractured marble with dyke (far field)
SWs-3	526187	7656866	Fractured marble associated with regional fault (far field)
Kok_mon_01	529428	7662230	Granite upgradient of TSF (background)
Kok_mon_02	528560	7658739	Granite Marble contact along fault (far field)
Kok_mon_03	525305	7656899	Fault within Marble (far field)
Kok_mon_04	525262	7661091	Schist west of mine works (background)
Kok_mon_05	528610	7656630	Marble contact along regional fault (far field)
Kok_mon_06	528611	7660435	Granite downgradient of TSF (near field)
Kok_mon_07	526268	7658577	Schist proximal to south pit (near field)
Kok_mon_08	526941	7658015	Marble within thrust fault (near field)
Surface Water Monitoring Sites (Hydrologic Consulting, 2025)			
SW01	523073	7641375	Captures the area of works influence on the Omaruru river
SW02	522266	7640792	Captures the area of works influence on the Omaruru river
SW03	527568	7642044	Extends to the full site (on the Omaruru River)
SW05	523578	7652011	Extends to the full site (on the Omaruru River)
SW06	530674	7654674	Captures the area of works (localised)
SW07	521693	7664926	Captures the area of works (localised)

Table 6-1 summarises the boreholes included in the monitoring network. The spatial distribution of the monitoring network is shown in **Figure 6-1**. Blue dots indicate current routine monitoring boreholes, red dots indicate hydrogeological investigation boreholes drilled for Kokoseb, and green dots indicate proposed additional monitoring boreholes. Light blue dots indicate surface water sites SW05, SW06 and SW07 based on the findings of the hydrological assessment (Hydrologic Consulting, 2025). Four (4) additional surface water monitoring sites are given in the Hydrologic Consulting (2025) report, which are located further south at the Omaruru river.

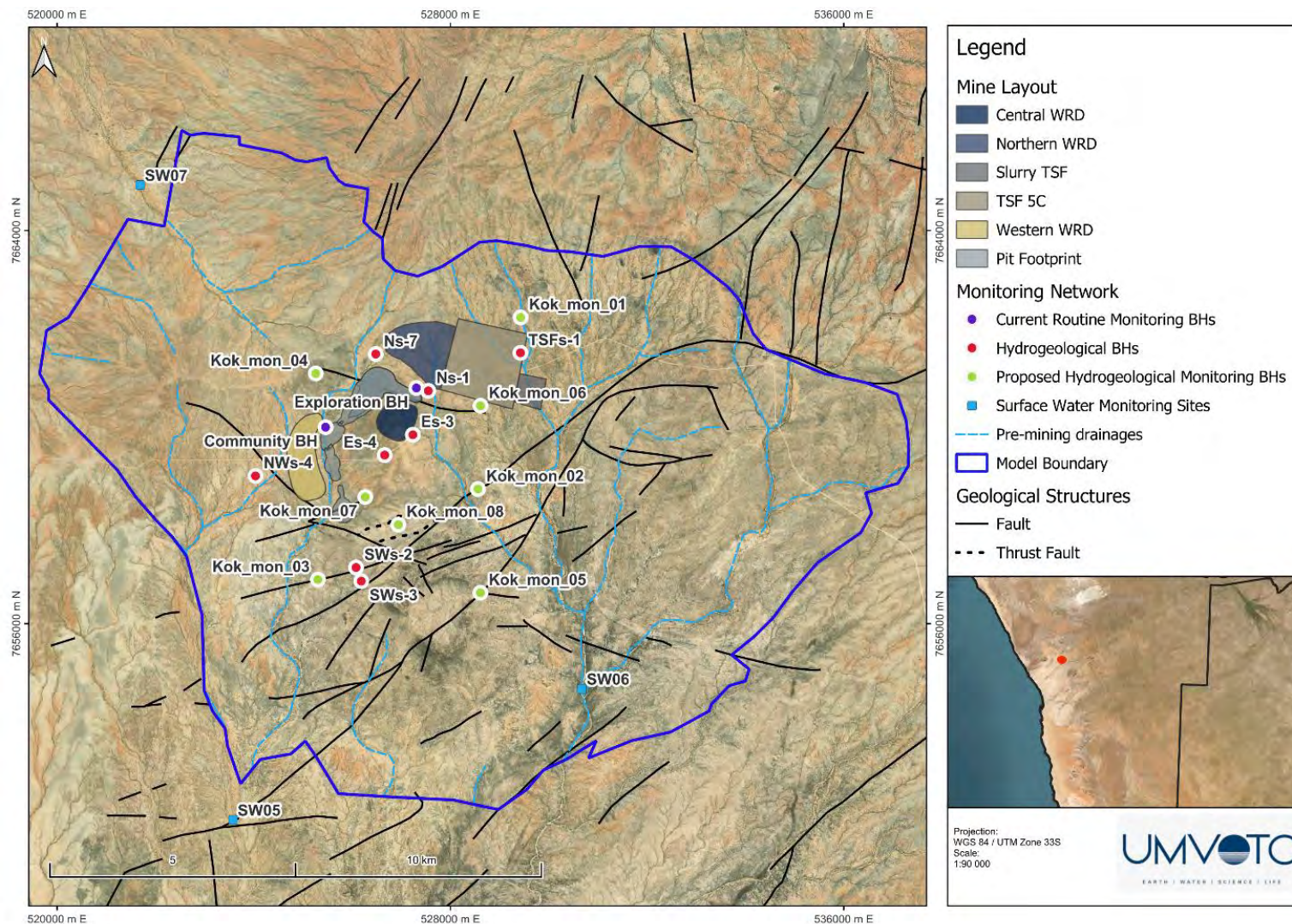


Figure 6-1 Map showing proposed hydrogeological monitoring network boreholes. The dark blue dots indicating current monitoring taking place, red dots the hydrogeological boreholes for Kokoseb and proposed additional monitoring borehole in green. Surface water sites are shown in light blue.

The parameters listed in **Table 6-2** serve as a guideline for the surface and groundwater monitoring of the pre-mining, operational and post closure water quality monitoring to be conducted. If any known parameters of concern are omitted from this list, it should be included.

Table 6-2 Hydrochemical monitoring parameters.

Infield Measurements		
pH	Conductivity (mS/m)	Dissolved Oxygen
Laboratory Analysis		
pH	Nitrate	Total Selenium
Conductivity (mS/m)	Nitrite	Total Arsenic
Total Dissolved Solids	Total Oxidised Nitrogen as N	Total Molybdenum
Total Suspended Solids	Aluminium (Total)	Total Lead
Total Alkalinity	Iron (Total)	Total Chromium
Total Hardness	Iron (Dissolved)	Chrome IV
Bicarbonate	Manganese (Total)	Total Barium
Calcium	Manganese (Dissolved)	Total Boron
Magnesium	Phosphate	Total Tin
Sodium	Total Chromium	Total Lithium
Potassium	Total Copper	Total Thorium
Chloride	Total Nickel	Total Mercury
Fluoride	Total Zinc	Total, Free and WAD Cyanide
Sulphate	Total Cobalt	Total Silver
Orthophosphate	Total Cadmium	Total Uranium
Ammonium (NH ₄) as N	Total Lead	Total Strontium

6.1.1. Pre-Mining Monitoring

The objective of the pre-mining monitoring phase is to establish a defensible hydrogeological and hydrochemical baseline against which operational impacts can be assessed.

Pre-mining monitoring will:

- Characterise seasonal groundwater level fluctuations;
- Define natural geochemical variability and background concentrations;
- Establish statistical trigger thresholds;
- Confirm hydraulic gradients and structural flow pathways.

Water levels at all hydrogeological boreholes is proposed for quarterly monitoring, with electronic water level loggers installed where indicated to record daily intervals and responses to rainfall events. Manual verification will occur during site monthly visits.

Water quality sampling during the pre-mining phase is to be carried out as per **Table 6-2**.

These parameters are based on the baseline hydrochemical assessment presented in **Section 3.3** and reflect the natural geochemical fingerprint of the aquifer.

The pre-mining monitoring programme is summarised in **Table 6-3**.

Table 6-3 Pre-Mining Monitoring Network.

BH ID	Easting	Northing	Water Quality		Water Levels	
	X	Y	Frequency	Constituents	Frequency	Method
Exploration BH	527308	7660795	Quarterly	As per Table 6-2	Monthly	Manual + Electronic water level logger (12 hourly intervals - downloaded when manual water level monitoring takes place)
Community BH	525461	7659999				
TSFs-1	529424	7661511				
Ns-1	527550	7660737				
Es-3	527236	7659844				
SWs-2	526081	7657144				
SWs-3	526187	7656866				
NWs-4	524036	7659007				
Ns-7	526482	7661486				
Es-4	526663	7659431				
Surface Water						
SW01	523073	7641375	Seasonally	As per Table 6-2	When possible	Measure streamflow where possible
SW02	522266	7640792				
SW03	527568	7642044				
SW05	523578	7652011				
SW06	530674	7654674				
SW07	521693	7664926				

6.1.2. Operational Monitoring

Water quality sampling during operations will be in line with **Table 6-2**.

During operations, monitoring intensity will increase to verify predicted behaviour and detect early impacts.

Operational monitoring focuses on:

- Confirmation of drawdown extent;
- Verification of steady-state inflow conditions;
- Detection of seepage from the TSF and WRDs;
- Recording of dewatering abstraction volumes.

Water levels at key boreholes will be monitored monthly, supported by electronic water level loggers recording at 12 hourly intervals. Dewatering volumes from the pit will be recorded daily and reported cumulatively on a monthly basis to allow comparison with predicted inflow of approximately 1,710 m³/day. A transient state calibrated dewatering specific model is needed to estimate dewatering volumes and methods in more detail. The operational monitoring network is summarised in **Table 6-4**.

Table 6-4 Operational Monitoring Network.

ID	Easting	Northing	Water Quality		Water Levels		Dewatering Volumes
	X	Y	Frequency	Constituents	Frequency	Method	Frequency
Exploration BH	527308	7660795	Annual for 5 years at least	As per Table 6-2	Weekly for the first 3 months after cessation of dewatering, thereafter monthly for 1 year followed by quarterly for at least up to 5 years post dewatering	Manual + Electronic water level logger (12 hourly intervals - downloaded when manual water level monitoring takes place)	Recorded Daily and Reported Cumulatively Monthly
Community BH	525461	7659999					
TSFs-1	529424	7661511					
Ns-1	527550	7660737					
Es-3	527236	7659844					
SWs-2	526081	7657144					
SWs-3	526187	7656866					
NWs-4	524036	7659007					
Ns-7	526482	7661486					
Es-4	526663	7659431					
Kok_mon_01	529428	7662230					
Kok_mon_02	528560	7658739					
Kok_mon_03	525305	7656899					
Kok_mon_04	525262	7661091					
Kok_mon_05	528610	7656630					
Kok_mon_06	528611	7660435					
Kok_mon_07	526268	7658577					
Kok_mon_08	526941	7658015					
Surface Water							
SW01	523073	7641375	Quarterly	As per Table 6-2	When possible	Measure streamflow where possible	N/A
SW02	522266	7640792					
SW03	527568	7642044					
SW05	523578	7652011					
SW06	530674	7654674					
SW07	521693	7664926					

6.1.3. Post-Closure Monitoring

Post-closure monitoring is critical due to:

- Groundwater rebound following cessation of dewatering;
- Pit lake formation;
- Potential delayed contaminant mobilisation;
- Long-term hydraulic re-equilibration.

Immediately following cessation of dewatering:

- Water levels will be monitored weekly for the first three months;
- Thereafter monthly for one year;
- Followed by quarterly monitoring for at least up to five years post-mining.

This intensified monitoring period is required to capture rebound dynamic. Water quality will be monitored annually for at least up to five years post-closure, with parameters consistent with the operational routine suite and **Table 6-2**.

Long-term post-closure monitoring may be extended based on:

- Rebound rate;
- Observed water quality trends;
- Regulatory requirements.

The post-closure monitoring programme is summarised in **Table 6-5**.

Table 6-5 Post Closure Monitoring Network.

ID	Easting	Northing	Water Quality		Water Levels	
	X	Y	Frequency	Constituents	Frequency	Method
Exploration BH	527308	7660795	Annual for 5 years at least	As per Table 6-2	Weekly for the first 3 months after cessation of dewatering, there after monthly for 1 year followed by quarterly for at least up to 5 years post dewatering	Manual + Electronic water level logger (12 hourly intervals - downloaded when manual water level monitoring takes place)
Community BH	525461	7659999				
TSFs-1	529424	7661511				
Ns-1	527550	7660737				
Es-3	527236	7659844				
SWs-2	526081	7657144				
SWs-3	526187	7656866				
NWs-4	524036	7659007				
Ns-7	526482	7661486				
Es-4	526663	7659431				
Kok_mon_01	529428	7662230				
Kok_mon_02	528560	7658739				
Kok_mon_03	525305	7656899				
Kok_mon_04	525262	7661091				
Kok_mon_05	528610	7656630				
Kok_mon_06	528611	7660435				
Kok_mon_07	526268	7658577				
Kok_mon_08	526941	7658015				
Surface Water						
SW01	523073	7641375	Biannual for the first 3 years and annually thereafter	As per Table 6-2	When possible	Measure streamflow where possible
SW02	522266	7640792				
SW03	527568	7642044				
SW05	523578	7652011				
SW06	530674	7654674				
SW07	521693	7664926				

7. IMPACT ASSESSMENT

Impact assessments are important tools for decision-making ensuring that all potential consequences of project activities are thoroughly understood and effectively managed. An impact is considered as a deviation from the baseline conditions on site. Identification and evaluation of potential impacts and appropriate mitigation measures is crucial to the process. Various anticipated impacts on drainage (hydrology) and groundwater throughout the mining and ore processing operations are discussed, including construction phase, operational phase, and decommissioning phase. The methodology presented by the ECC Impact Predication and Evaluation Methodology (**Appendix C**), adapted from the 2008 Draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plan (EMP), is followed.

Definitions of key terms and criteria used to evaluate impacts are:

- Source – the point, location, or activity that generates an impact.
- Pathway – the route or course through which impacts can migrate or propagate from a source to potentially affected receptors or receptors of concern.
- Receptor – a resource, individual or group residing in close proximity to an impact source, potentially exposed to the effects of project activities.
- Baseline environment – the existing environmental conditions and characteristics of a study area before any proposed project, activity, or development is implemented.
- Nature – whether the impact positively (beneficial) or negatively (adversely) changes the baseline environment.
- Type – impacts can be direct (direct interaction between the activity and the receptor), indirect (a secondary activity related to the project which causes an impact and may occur at a later date or wider area), or cumulative (impacts that are result of another impact).
- Reversibility – refers to the permanence of the impact i.e., will the impact be reversible (reversible and recoverable in the future), partly reversible (only some of the impact can be reversed whilst some remains), or will the impact be irreversible (and therefore permanent).
- Duration – the time over which the impact will be felt, i.e., will it be temporary (less than 1 year), short term (1 – 5 years), medium term (5 – 15 years), long term (more than 15 years until after decommissioning of the project) or permanent.
- Magnitude – the degree of loss or change of a resource's quality, integrity, characteristics, features and/or elements etc., as described as very high (unknown), high (major), moderate and low (minor).
- Extent – the area affected by the impact, i.e., whether it is onsite (within the boundaries of the project site), local (within the local area and impacts the local community), regional (impacts to a receptor), national (impacts a receptor that is nationally important) or international (impacts a receptor that is internationally important).
- Probability – likelihood of an impact occurring and exerting influence as described as improbable (rare), low probability (unlikely), medium probability (possible), high probability (likely) and definite (almost certain).

- Sensitivity –degree to which an impact has the capacity to change or accommodate change, as described by low, medium, and high.
- Significance – degree to which impacts are expected to influence decision-making processes taking into consideration sensitivity and magnitude of change thresholds and as described by low- beneficial, low – negative, minor, moderate, and major sensitivity.
- Mitigation – action taken with the intention of either minimising or preventing exposure, or the probability of exposure to impacts.

To assess the overall impact, based on significance and sensitivity, a score is established. This is done by multiplying the ratings of each (low, medium, high for sensitivity and low, minor, moderate, major, for significance) to obtain an overall score with larger values being worse than lower values.

Table 7-1 shows this in detail.

Table 7-1 Scoring matrix for assessing the sensitivity and significance of impacts.

		Significance			
		Low (1)	Minor (2)	Moderate (3)	Major (4)
Sensitivity	High (3)	Minor (3)	Moderate (6)	Major (9)	Major (12)
	Medium (2)	Low (2)	Minor (4)	Moderate (6)	Major (8)
	Low (1)	Low (1)	Low (2)	Minor (3)	Moderate (4)

7.1. Hydrology

Main impacts relate to altered drainage regimes, changes in flow timing and magnitude, potential surface water contamination, and, under rare but high-consequence scenarios, catastrophic flooding. These impacts are evaluated in **Table 7-2** using the applied Impact Assessment methodology. Surface water impacts are derived from and aligned with the Hydrological Assessment prepared by Hydrologic Consulting (2025).

7.1.1. Construction Phase

During construction, a decrease in runoff may occur locally where temporary works intercept, redirect or temporarily block minor flow paths identified in the Hydrological Assessment (Hydrologic Consulting, 2025). Given the event-based nature of drainage, any reduction in runoff is expected to be localised and short-term. Pollutants entering the surface water environment may arise from sediment mobilisation during earthworks or from hydrocarbon spills associated with construction activities. Transport would occur during rainfall events via overland runoff.

Altered drainage may occur through temporary diversions, access road crossings or infrastructure placement across ephemeral flow paths.

Flooding represents a potential impact where construction activities are located within flood-sensitive areas identified in the 1:50 and 1:100 recurrence interval (RI) modelling undertaken by Hydrologic Consulting (2025). Flood depths and velocities identified in that assessment inform infrastructure placement and stormwater controls. With implementation of erosion control measures, stormwater management and clean/dirty water separation consistent with the Hydrological Assessment (Hydrologic Consulting, 2025) recommendations, residual construction-phase surface water impacts are assessed as low. As reflected in **Table 7-2**, these impacts are generally of low magnitude and short duration, with moderate to minor significance.

7.1.2. Operational Phase

During operations, decrease in runoff may occur where runoff is captured within infrastructure footprints or diverted around facilities. As drainage systems are rainfall-driven and lack sustained baseflow, this represents redistribution of event-based runoff rather than permanent loss of flow.

Pollutants entering the surface water environment may arise from contact water runoff, TSF seepage, hydrocarbon releases or uncontrolled discharges. These represent potential pathways through which water quality may be affected.

Altered drainage will occur where ephemeral channels are permanently realigned to accommodate mining infrastructure. Engineered diversion channels and stormwater systems will be designed to accommodate at least the 1:100 RI event, consistent with the Hydrological Assessment.

Flooding during extreme rainfall events remains a potential impact where infrastructure intersects flood-prone areas identified in the Hydrological Assessment (Hydrologic Consulting, 2025). Flood modelling indicates that flooding is generally confined to defined ephemeral channels, and engineered berms, diversions and stormwater controls will reduce the likelihood and severity of flooding impacts. With implementation of engineered stormwater management systems, containment measures and monitoring, operational surface water impacts are assessed as low in regional significance.

7.1.3. Decommissioning Phase

During decommissioning, re-contouring and rehabilitation activities may temporarily increase sediment mobilisation and alter local drainage patterns. Decrease in runoff may occur where final landform profiles differ from baseline conditions; however, drainage will remain rainfall-driven and event-based. Pollutants entering the surface water environment are expected to reduce following cessation of active operations and removal of potential contamination sources.

Altered drainage associated with final landform design will be stabilised through erosion control and revegetation.

Flooding risk will be managed through retention of appropriate diversion structures or stable final landform design consistent with hydrological recommendations.

With progressive rehabilitation and erosion control, residual surface water impacts during decommissioning are assessed as low.

Table 7-2 Impact assessment of various activities relating to drainage and hydrology.

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Scoring	Mitigation
Construction Phase													
Altered Drainage Regime	Surface water flowing across the site may be diverted, causing a lag/change in flow to downstream areas	Adverse	Direct	Short term	On site	Almost certain	Low	Partly Reversible	High	Low	Moderate	Minor	- Drainage regime to be restored as per a post mining rehabilitation plan - Ensure stream diversions accommodate and encourage natural water flow regimes as far as possible
Decrease Runoff	Containment of contaminated water may reduce runoff	Adverse	Direct	Short term	On site	Unlikely	Low	Reversible	High	Low	Low	Low	- Keep the contained dirty area to a minimum, thereby limiting this impact - Where relevant, discharge excess water of an acceptable quality back into the river (Hydrologic Consulting, 2025)
Contaminated Water Courses	Deterioration of surface water quality	Adverse	Direct	Short term	Local	Unlikely	Moderate	Partly Reversible	Moderate	Low	Minor	Low	Implement a stormwater management program to separate dirty and clean water
	Contaminated runoff generated onsite flows to downstream ecosystems	Adverse	Indirect	Short term	Local	Possible	Moderate	Partly Reversible	Moderate	Low	Minor	Low	
Soil Erosion	Soil erosion leads to increased sedimentation and turbidity in watercourses, altering drainage patterns, forming preferential flow paths, and degrading water quality	Adverse	Direct	Short term	Local	Possible	Moderate	Partly Reversible	High	Low	Minor	Low	- Minimise and phase vegetation clearance - Stabilise exposed soils through re-vegetation or erosion control materials
	Loss of soils fertility, stability and biodiversity	Adverse	Indirect	Short term	Local	Possible	Moderate	Partly Reversible	High	Low	Minor		
Flooding	Flooding if surface water flows are inadequately controlled	Adverse	Indirect	Temporary	Onsite	Unlikely	Moderate	Reversible	High	Low	Minor	Low	Implement flood protection or stormwater management where necessary
Operational Phase													
TSF Failure	TSF failure results in catastrophic flooding and contamination of downstream water courses	Adverse	Direct	Long term	Regional	Rare	Very high	Irreversible	Moderate	Medium	Major	Major	Establish early warning systems for wall stability, water levels, seepage, and dam deformation
Altered Drainage Regime	Water flowing from upgradient side may be diverted, causing lag in flow to downstream	Adverse	Direct	Permanent	Local	Almost certain	Low	Partly Reversible	High	Low	Major	Moderate	- Ensure stream diversions accommodate and encourage natural water flow regimes as far as possible - Monitor flow rates and changes - Ensure drainage channels can withstand increased flow - Implement effective stormwater management program
	Diversion or containment of water may reduce availability to other users and aquatic and terrestrial ecosystems	Adverse	Indirect	Medium term	Local	Unlikely	Moderate	Reversible	Moderate	Low	Minor	Low	

KOKOSEB GOLD PROJECT HYDROLOGICAL AND HYDROGEOLOGIC IMPACT ASSESSMENT

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Scoring	Mitigation
Decrease Runoff	Containment of contaminated water may reduce runoff	Adverse	Direct	Permanent	Local	Almost certain	Low	Partly Reversible	High	Low	Major	Moderate	- Keep the contained dirty area to a minimum, thereby limiting this impact - Where relevant, discharge excess water of an acceptable quality back into the river (Hydrologic Consulting, 2025).
Flooding	Operational risk when extreme rainfall events exceed the capacity of drainage and stormwater infrastructure, leading to potential inundation of operational areas and disruption to mining activities	Adverse	Direct	Long Term	Local	Possible	Moderate	Reversible	High	Medium	Low to Moderate	Low	- Design stormwater and drainage infrastructure - Routine inspection and maintenance of drainage systems and culverts
Contaminated Water Courses	Contaminated runoff generated onsite flows downstream	Adverse	Direct	Temporary to Medium term	Regional	Possible	Moderate	Partly Reversible	Moderate	Low	Minor	Low	- Implement effective stormwater management program - Ensure early warning systems are in place - Implement dust suppression techniques, such as water spraying, dust suppressant chemicals, etc at dust generation points like crushing and drilling sites and along overhaul roads - Construct sedimentation/settling ponds to allow suspended solids to settle
	Contaminated runoff in distal areas where dust has settled on surface in upwind direction	Adverse	Indirect	Medium term	Regional	Likely	Low	Reversible	Moderate	Low	Minor	Low	
	Runoff of mineralised waste causing contamination of stream sediments	Adverse	Direct	Short term	Onsite	Possible	Low	Irreversible	Moderate	Low	Low	Low	
Decommissioning Phase													
Flow Changes in Regional Catchments	A slight delay in the flow rate of water reaching the downstream environment due to the diversion	Adverse	Direct	Long Term	Regional	Almost certain	Low	Partly Reversible	Moderate	Low	Minor	Low	Create diversion in manner that reduces lag time where necessary
Altered/ Obstructed Water Flow	Drainage never returns to normal as remaining structures and site alterations obstruct flow	Adverse	Direct	Permanent	On site	Almost certain	Moderate	Irreversible	High	Medium	Moderate	Moderate	Remove all structures and rehabilitate site to (near) natural state
Decrease Runoff	Containment of contaminated water may reduce runoff	Adverse	Direct	Permanent	Local	Almost certain	Low	Irreversible	High	Low	Minor	Low	- Keep the contained dirty area to a minimum, thereby limiting this impact - Where relevant, discharge excess water of an acceptable quality back into the river (Hydrologic Consulting, 2025)
Contaminated Water Courses	Persistent contaminants (ore, metals etc.) continue as diffuse sources of pollution	Adverse	Direct	Medium term	Regional	Likely	Moderate	Partly Reversible	Moderate	Low	Moderate	Minor	Remediate contamination using appropriate techniques, dilution

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Scoring	Mitigation
													bioremediation, or chemical treatment. Remove pollutants from site following mine closure and dispose of correctly
Flooding	Poorly rehabilitated landforms, blocked drainage structures, or altered surface gradients may result in localised flooding, erosion, or ponding during episodic rainfall events	Adverse	Direct	Medium - Long Term	Local	Possible	Low	Reversible	High	Medium	Low	Low	- Final landform shaping to reinstate natural drainage patterns - Removal of temporary flow obstructions and redundant infrastructure - Stabilisation of slopes and drainage channels

7.2. Groundwater

During the operational phase, potential groundwater impacts are associated primarily with pit dewatering, hydraulic redistribution within the fractured aquifer system, and seepage from mine infrastructure including WRDs, TSF, ore stockpiles and associated facilities.

Although regional recharge is low, the fractured hard-rock aquifer may facilitate vertical and lateral migration of seepage along structurally controlled pathways. Groundwater quality impacts are closely linked to the geochemical behaviour of mined materials. The predominance of Non-Acid Forming (NAF) material significantly reduces the likelihood of sustained acid mine drainage (AMD) generation. However, oxidation of sulphide minerals under circumneutral conditions may result in elevated sulphate concentrations and mobilisation of certain metals (neutral mine drainage conditions). The impacts are evaluated using the applied Impact Assessment methodology (refer to **Appendix B**).

7.2.1. Construction Phase

During construction, reduction in groundwater availability may occur where limited abstraction is required for site establishment. Such abstraction is expected to be minor and temporary.

Deterioration in groundwater quality may arise from hydrocarbon storage, chemical handling or accidental spills associated with construction activities. Transport pathways would be limited to localised infiltration through fractured bedrock.

With implementation of bunded storage, spill response procedures and appropriate waste management controls, construction-phase groundwater impacts are assessed as low and localised.

7.2.2. Operational Phase

During operations, the primary impact to groundwater is reduction in groundwater levels and availability. This impact results from pit dewatering required to maintain dry mining conditions.

Continuous abstraction of groundwater to offset inflows to the open pit establishes a hydraulic gradient toward the excavation, resulting in drawdown of groundwater levels surrounding the pit. Numerical groundwater flow modelling indicates maximum drawdown at the pit, with radially decreasing drawdown extending outward to 6 km under steady-state conditions. Simulated drawdown at identified borehole receptors and at the EPL boundary remains negligible relative to operational drawdown at the pit.

Reduction in groundwater availability is therefore assessed as moderate within the zone of influence and low at regional scale. The impact persists for the duration of active dewatering and is expected to partially recover following cessation of abstraction.

Deterioration in groundwater quality during operations may occur due to seepage from mine waste infrastructure, contact water infiltration or releases from process areas. These activities represent mechanisms through which groundwater quality may be altered. Static geochemical testing indicates mine materials are predominantly Non-Acid Forming, reducing the likelihood of significant acid generation.

During operations, the open pit functions as a hydraulic sink, capturing groundwater flow and limiting outward migration of dissolved constituents. Conservative mass transport simulations indicate that potential contaminant migration remains spatially limited and directed toward the pit under active dewatering conditions. With implementation of engineered containment systems, seepage control measures and groundwater monitoring, operational groundwater quality impacts are assessed as low following mitigation.

7.2.3. Decommissioning Phase

Following cessation of dewatering, groundwater rebound will occur as hydraulic gradients recover toward a new equilibrium condition.

Reduction in groundwater availability will progressively decrease as groundwater levels recover. Post-closure modelling indicates pit lake formation functioning as a residual hydraulic sink, albeit under reduced hydraulic gradients relative to operational conditions.

Deterioration in groundwater quality during the decommissioning phase may be influenced by pit lake geochemistry and redistribution of dissolved constituents during rebound. Given the predominance of Non-Acid Forming materials and arid climatic conditions, long-term impacts are expected to remain localised.

With continued groundwater monitoring and adaptive management, decommissioning-phase groundwater impacts are assessed as low to moderate and limited in spatial extent.

Table 7-3 Impact assessment of various activities relating to groundwater.

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Score	Mitigation
Construction Phase													
Reduced Localised Recharge	Reduction in groundwater recharge volume and quality from riverbeds due to surface water containment and diversion	Adverse	Indirect	Short term	Local	Unlikely	Low	Partly Reversible	Medium	Low	Minor	Low	None
Depleted Groundwater Resources	Reduction or depletion of groundwater resources and availability (lowering of water table, fracture dewatering)	Adverse	Direct	Long term	On-site	Unlikely	Low	Irreversible	High	Low	Minor	Low	Utilise groundwater sustainably
	Decreased availability for groundwater-dependent ecosystems (gaining rivers and springs) and other users due to abstraction/dewatering	Adverse	Indirect	Long term	Onsite	Rare	None	Irreversible	Medium	Low	Low	Low	
Chemical and Hydrocarbon Spills	Groundwater contamination due to chemical and hydrocarbon spills and leaks from construction activities, refuelling stations, maintenance workshops etc.	Adverse	Direct	Short term	Onsite	Unlikely	Low	Partly Reversible	Medium	Low	Minor	Low	- Hazardous materials must be managed within designated spill containment/bunded systems. - Oil spill kits should be available. - Conduct routine inspections and maintenance of structures, equipment, and storage areas. - Regular service of vehicles in designated repair bays. - Refuelling of vehicles only in designated areas.
	Contaminated groundwater may affect surface water quality (gaining streams), soil quality, and groundwater-dependent ecosystems and users	Adverse	Indirect	Long term	Onsite	Rare	None	Partly Reversible	Low	Low	Minor	Low	
Changes to Aquifer Characteristics	Changes to recharge, vadose zone thickness, and preferential flow paths resulting from land clearing, topsoil and overburden removal, blasting, and impermeable surfaces	Adverse	Direct	Permanent	Onsite	Almost certain	Low	Partly Reversible	High	Low	Moderate	Minor	- Minimise footprint of impermeable surfaces and promote early restoration of near-surface recharge processes - Implement controlled blasting near hydrogeologically sensitive zones or identified fracture corridors
	Blasting-induced fracturing increases aquifer porosity, creating additional flow paths and enhanced storage capacity	Beneficial	Direct	Permanent	Onsite	Unlikely	Moderate	Irreversible	Low	Low	Minor	Low	None

KOKOSEB GOLD PROJECT HYDROLOGICAL AND HYDROGEOLOGIC IMPACT ASSESSMENT

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Score	Mitigation
Operational Phase													
Changes to Aquifer Characteristics	Changes to recharge, vadose zone thickness, and preferential flow paths resulting from land clearing, topsoil and overburden removal, blasting, and impermeable surfaces	Adverse	Direct	Long term	Onsite	Almost certain	Low	Irreversible	High	Low	Major	Moderate	- Minimise footprint of impermeable surfaces and promote early restoration of near-surface recharge processes - Implement controlled blasting near hydrogeologically sensitive zones or identified fracture corridors
	Blasting-induced fracturing increases aquifer porosity, creating additional flow paths and enhanced storage capacity	Beneficial	Direct	Long term	Onsite	Unlikely	Moderate	Irreversible	Low	Low	Minor	Low	None
	Increased rock fracturing leading to unstable subsurface conditions	Adverse	Direct	Long term	Onsite	Possible	Moderate	Partly Reversible	Medium	Medium	Low	Low	Install blasting mats, barriers, or cushions made of materials like rubber or straw to dampen the shockwave and reduce the impact on surrounding rock
Mine Dewatering	Pit dewatering and over-abstraction from local and distal groundwater sources will lower the water table	Adverse	Direct	Long term	Local	Likely	Moderate	Partly Reversible	High	Low	Moderate	Minor	Provide alternative water supply to affected users
	Reduction or depletion of groundwater resources and availability, leading to reduced water supply to groundwater-dependent ecosystems (baseflow, gaining rivers and springs) and other users	Adverse	Indirect	Long term	Local	Unlikely	Moderate	Partly Reversible	Low	Low	Minor	Low	None
Aquifer Interconnection and Water Quality Mixing	Previously separate aquifers become connected resulting in mixing of water qualities (if not already connected)	Adverse	Direct	Short term	Regional	Possible	Moderate	Irreversible	Medium	Low	Minor	Low	Backfill/seal to restore confining layers.
TSF Leakage	TSF leaking may contaminate the groundwater and deteriorate water quality	Adverse	Direct	Long term	Local	Possible	Moderate	Partly Reversible	High	Low	Moderate	Minor	- Ensure the installation of appropriate liners to prevent leaks. - Implement early warning systems
	Water quality contamination by TSF leakage may affect surface water quality (gaining streams), soil quality, and groundwater-dependent ecosystems and users.	Adverse	Indirect	Long term	Local	Unlikely	Moderate	Partly Reversible	Medium	Low	Minor	Low	
Leakage of ore, waste rock stockpiles, set	Leakage of ore, waste rock stockpiles, and chemical storage may seep into and contaminate groundwater	Adverse	Direct	Temporary to long term	Onsite	Possible	Moderate	Partly Reversible	Medium	Low	Minor	Low	Store materials on an appropriate liner or bunded area to contain

KOKOSEB GOLD PROJECT HYDROLOGICAL AND HYDROGEOLOGIC IMPACT ASSESSMENT

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Score	Mitigation
explosives and chemical storage	Runoff from stockpiles infiltrate downstream	Adverse	Direct	Temporary	Onsite	Possible	Low	Partly Reversible	Medium	Low	Low	Low	- and control leachate/leakages - Minimise contact of substances with water through appropriate storage and stormwater management plans
Chemical and Hydrocarbon Spills	Chemical and hydrocarbon spills from refuelling and servicing equipment deteriorates water quality	Adverse	Direct	Long term	Local	Possible	Moderate	Partly Reversible	Medium	Low	Moderate	Minor	- Oil spill kits should be available to contain emergency spills of hydrocarbons - Service and refuel vehicles in designated bays - Store in bunded areas and carry out regular inventory checks
	Contaminated groundwater may affect surface water quality (gaining streams), soil quality, and groundwater-dependent ecosystems and users	Adverse	Indirect	Long term	Local	Unlikely	Moderate	Partly Reversible	Low	Low	Minor	Low	
Neutral Mine Drainage	Saline-drainage can develop when sulphide minerals oxidise over time. This oxidation can raise sulphate levels and mobilise metals	Adverse	Direct	Long term	Local	Possible	Low	Partly Reversible	Medium	Low	Low	Low	- Selective handling and segregation of waste materials based on geochemical classification - Implement effective stormwater management to minimise infiltration through waste facilities - Ongoing geochemical monitoring to confirm long-term drainage behaviour
Acid Mine Drainage	Acid Mine Drainage contaminates groundwater	Adverse	Direct	Long term	Local	Rare	Moderate	Partly Reversible	High	Low	Low	Low	- Continue geochemical characterisation to confirm long-term acid-generating potential - Minimise exposure of sulphide-bearing materials to oxygen and water
Decommissioning Phase													
Groundwater Level Recovery	Water levels may take decades to recover to normal levels	Adverse	Direct	Long term	Regional	Almost certain	High	Reversible	High	Medium	Moderate	Moderate	- Implement recharge enhancing or managed aquifer recharge practices - Adjust the pumping rates of boreholes and dewatering systems to minimise the impact on water levels - Implement artificial recharge techniques, such as infiltration basins or more boreholes. Regular monitoring of water levels
Groundwater Contamination	Acid mine/mineral leachate from ore and waste rock stockpiles contaminate groundwater	Adverse	Direct	Medium term	Local	Likely	Moderate	Partly Reversible	Moderate	Low	Minor	Low	Rehabilitation efforts should be aimed at ensuring groundwater

Impact	Pathway/ Receptor/Result	Nature of Impact	Type of Impact	Duration	Extent	Probability	Magnitude of Change	Reversibility	Confidence	Sensitivity	Significance	Score	Mitigation
	Rising water levels mobilise oxidised contaminants in host rock	Adverse	Direct	Medium term	Local	Almost certain	Moderate	Permanent	Medium	Low	Minor	Low	contamination does not continue in the future, i.e., remove tailings and waste rock, etc. • Backfill applicable areas with cement to decrease exposed rock surfaces • Evaluate pit closure options, including partial backfilling, to minimise long-term ink effects • Promote rapid stabilisation and rehabilitation of pit walls to reduce stabilisation of pit walls • Monitor post-closure groundwater levels and quality around the pit
	Pit may function as a hydraulic sink, capturing groundwater and surface runoff, resulting in contamination	Adverse	Direct	Long Term	Local	Possible	Moderate	Partly Reversible	High	Low	Low	Low	

8. CONCLUSION AND RECOMMENDATIONS

8.1. Conclusions

This Hydrological and Hydrogeological Impact Assessment evaluated the baseline conditions, potential impacts, and predictive groundwater behaviour associated with the proposed Kokoseb Gold Mine (EPL 4818). The assessment incorporated hydrocensus surveys, aquifer testing, hydrochemical analysis, conceptual model development, and numerical groundwater flow and mass transport modelling.

The groundwater system is characterised as a structurally controlled fractured hard-rock aquifer with limited primary porosity, moderate unsaturated thickness, and localised transmissive fracture corridors. Recharge is episodic under semi-arid climatic conditions. Groundwater levels are structurally controlled rather than topographically driven, consistent with fractured basement systems.

Baseline hydrochemistry indicates alkaline to circumneutral groundwater conditions, moderate salinity, localised fluoride exceedances in routine monitoring boreholes, and spatially discrete arsenic and uranium elevations likely controlled by lithology and redox conditions. Geochemical testing show predominantly Non-Acid Forming (NAF) results, with all 75 tested samples exhibiting excess Acid Neutralising Capacity (ANC) relative to Maximum Potential Acidity (MPA). Net Acid Producing Potential (NAPP) values are negative for all samples, confirming a low intrinsic risk of Acid and Metalliferous Drainage (AMD) generation.

Numerical modelling predicts steady-state pit inflow of approximately 1,710 m³/day, with a drawdown cone extending up to approximately 6 km south of the pit under equilibrium conditions. The pit will function as a hydraulic sink during operations and into closure. Contaminant transport modelling under conservative assumptions indicates that potential plumes remain localised and migrate toward the pit under prevailing hydraulic gradients.

Post-closure steady-state simulations indicate pit lake formation at approximately 1000 mamsl, acting as a long-term hydraulic sink. Transient rebound behaviour was not simulated and remains an area for further refinement.

With implementation of recommended mitigation measures, groundwater quantity impacts are assessed as moderate but manageable, groundwater quality risks are low to moderate under conservative failure assumptions, and surface water impacts are localised and manageable. No fatal hydrological or hydrogeological flaws were identified.

8.2. Recommendations

8.2.1. Groundwater and Surface Water Monitoring

- Establish baseline monitoring;
- Install additional monitoring boreholes;
- Establish time series groundwater and surface water quality database; and
- Establish time series groundwater level database.

8.2.2. Pit Dewatering and Water Management

- Develop a detailed operational dewatering strategy including transient modelling.
- Evaluate beneficial use of dewatering water within the processing circuit.
- Establish stakeholder engagement protocols for potentially affected borehole users, where applicable.

8.2.3. TSF and Waste Rock Management

- Ensure TSF design incorporates liner systems, seepage collection and underdrain monitoring compliant with IFC standards.
- Implement stormwater diversion, erosion control and controlled placement of reactive material in WRDs.
- Undertake geochemical testing to refine contaminant source term for transient mass transport modelling.

8.2.4. Modelling Refinements

- Convert steady state model into transient groundwater flow model for operational and rebound phases.
- Data requirements include inter-alia time series groundwater levels, water quality, packer testing, additional test pumping, geotechnical inputs and geological models / data.
- Undertake predictive uncertainty analysis.
- Implement directional anisotropy testing where structurally justified.
- Refine recharge and boundary condition sensitivity analysis.
- Update the model periodically as additional monitoring data becomes available.

8.2.5. Post-Closure Planning

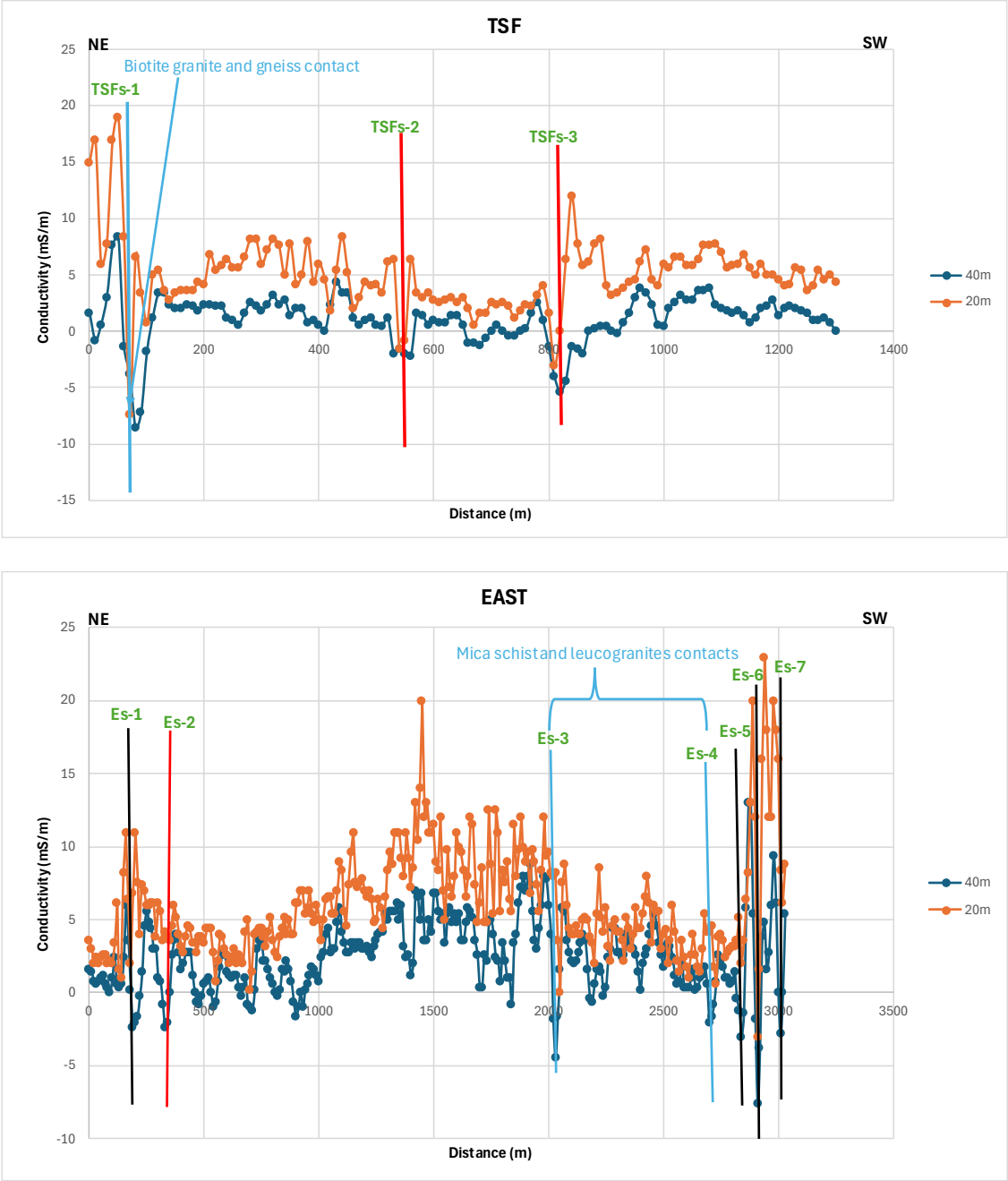
- Conduct transient rebound modelling to estimate pit lake formation timeline.
- Evaluate long-term pit lake water quality evolution.
- Assess extreme rainfall overflow scenarios.
- Develop a long-term (10–20 year) post-closure groundwater and pit lake monitoring programme.

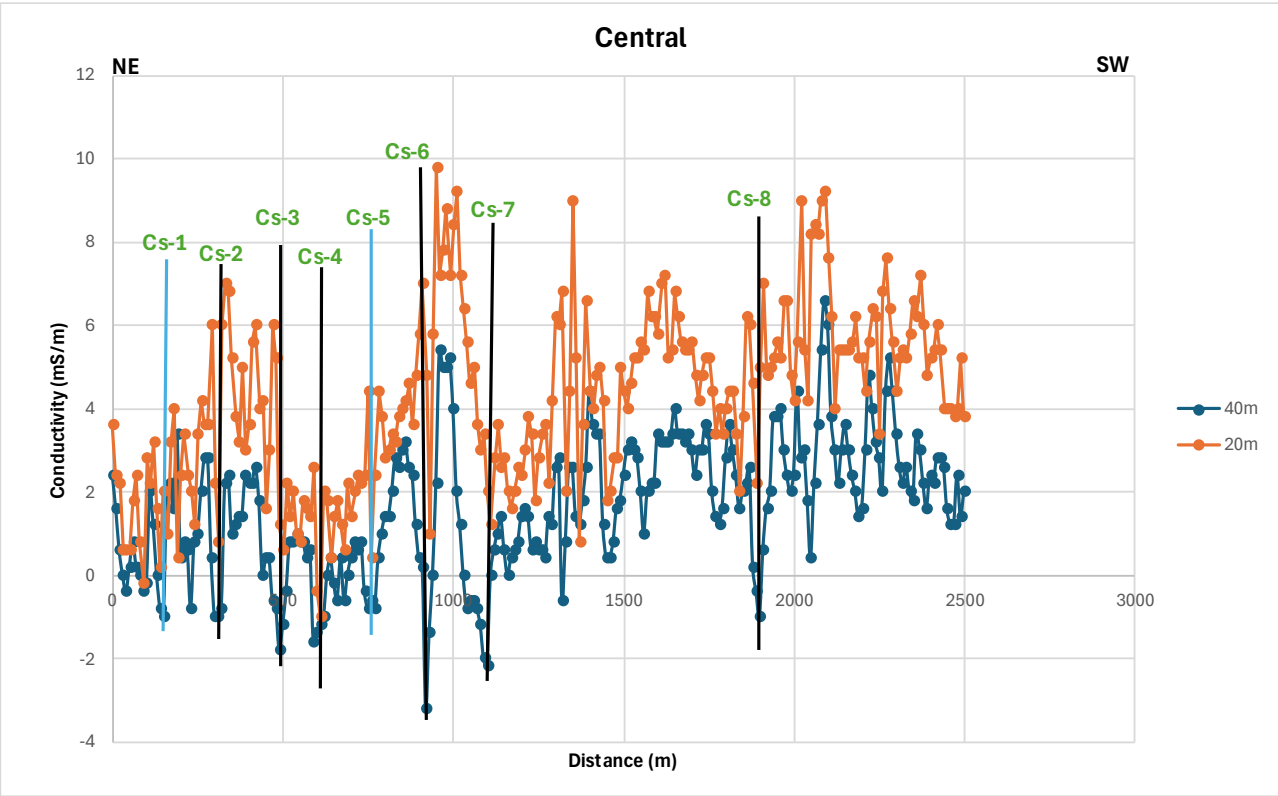
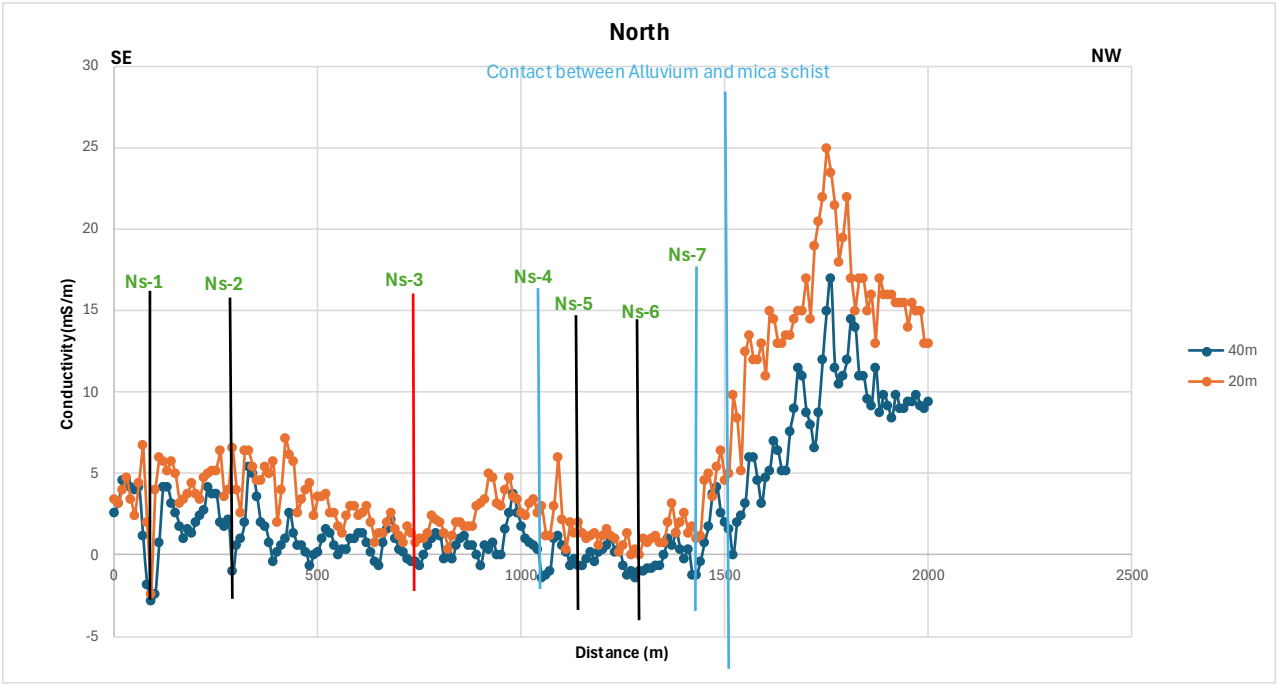
9. REFERENCES

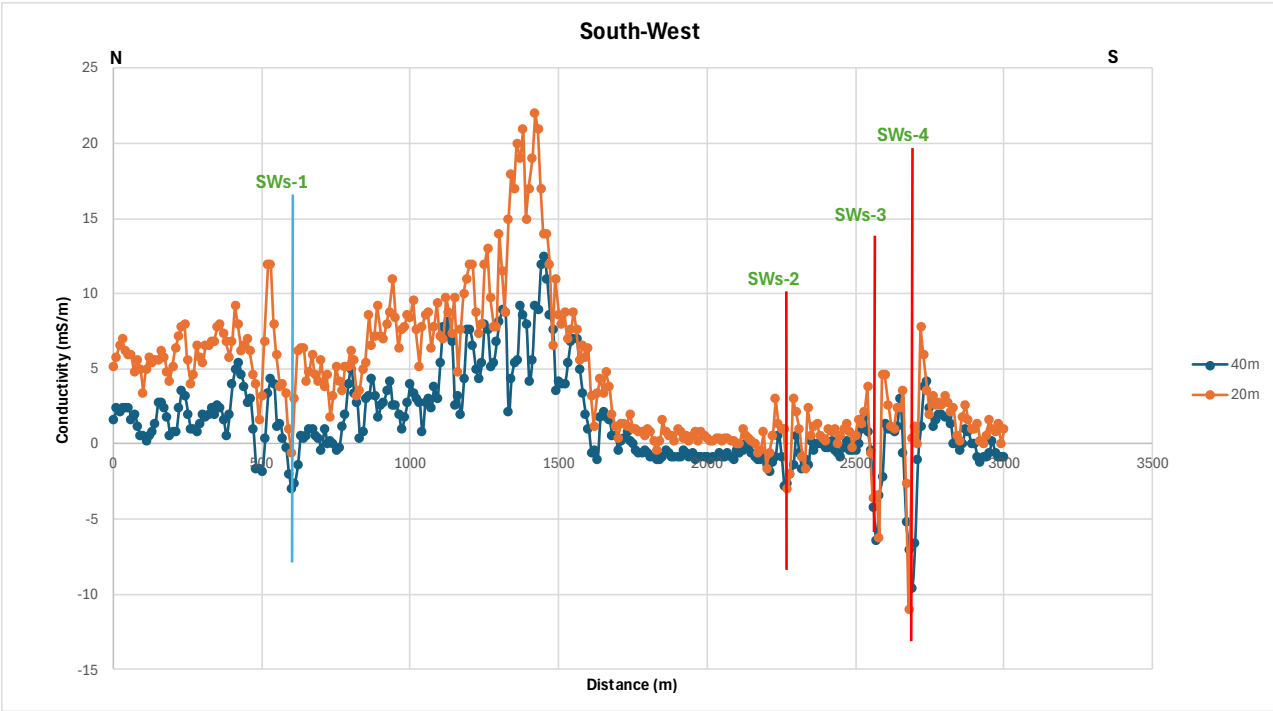
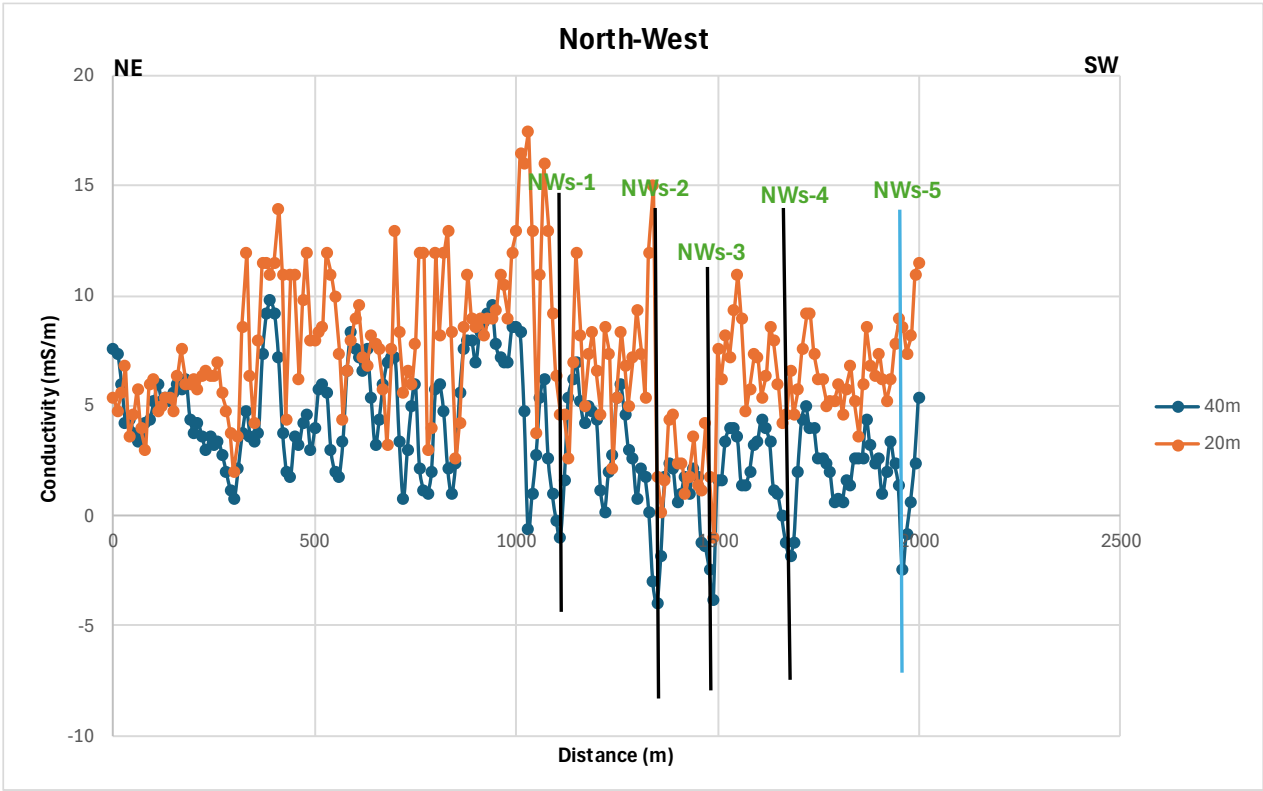
- Badenhorst, F.P. (1992). The lithostratigraphy of area 2115 B and D in the Central Zone of the Damara Orogen, Namibia: with emphasis on facies changes and regional correlations. Unpublished. M.Sc. thesis, Univ. Port Elizabeth, 124pp.
- Bollaert, M. (2024). Hydrological assessment for the Kokoseb EPL 4818 project, Erongo region, Namibia
- Coffee, N & Mwateuvi, R (2025). Geophysical Investigation for Drilling sites within the EPL Technical Memorandum
- Hydrologic Consulting, 2025. Hydrological Assessment for the Kokoseb EPL 4818 Project, Erongo, Namibia, Prepared by M. Bollaert of Hydrologic Consulting (Pty) Ltd for Umvoto Africa
- Diersch, H.J.G. (2014) FEFLOW: Finite Element Modeling of Flow, Mass and Heat Transport in Porous and Fractured Media. Berlin: Springer-Verlag Berlin Heidelberg. doi: 10.1007/978-3-642-38739-5.
- Diersch, H.J.G. and Kolditz, O. (1998) 'Coupled groundwater flow and transport: 2. Thermohaline and 3D convection systems', *Advances in Water Resources*, 21(5), pp. 401–425. doi: 10.1016/S0309-1708(97)00003-1.
- Doherty, J. (2002) Model-Independent Parameter Estimation. 4th edn, Watermark Numerical Computing. 4th edn. Watermark Numerical Computing.
- Doherty, J. (2015). Calibration and Uncertainty Analysis for Complex Environmental Models. In *Groundwater* (Vol. 53). Brisbane, Australia: Watermark Numerical Computing.
- Doherty, J., (2003), Groundwater model calibration using pilot-points and regularization: *Ground Water*, v. 41, no. 2, p. 170–177, doi:10.1111/j.1745-6584.2003.tb02580.x.
- Doherty, J., Hunt, R., & Tonkin, M. (2010). Approaches to Highly Parameterized Inversion : A Guide to Using PEST for Model-Parameter and Predictive-Uncertainty Analysis: U.S. Geological Survey Scientific Investigations Report 2010 – 5211. 71.
- Domenico, P. A. & Schwartz, F. W., 1990. Physical and Chemical Hydrogeology
- Edwards, M. (2022). Groundwater Supply Investigation for the Uis Tin Project, Namibia. Digby Wells Environmental
- Holzbecher, E. O. (1998) Modeling Density-Driven Flow in Porous Media. Berlin, Heidelberg: Springer Berlin Heidelberg. doi: 10.1007/978-3-642-58767-2.
- Kolditz, O. et al. (1998) 'Coupled groundwater flow and transport: 1. Verification of variable density flow and transport models', *Advances in Water Resources*, 21(1), pp. 27–46. doi: 10.1016/S0309-1708(96)00034-6.
- Management, R. M. W. a. W., 2025. Technical Report: Geochemistry Assessment, Prepared by RGS Mine Waste and Water Management for Environmental Compliance Consultancy (Pty) Ltd.
- Ministry of Agriculture, Water and Rural Development, 2011. Groundwater in Namibia. An Explanation to the Hydrogeological Map, s.l.: s.n.
- Schreiber, U.M. (2010). The Geology of area 2114 Omaruru, Explanation sheets of 2114 (1:250 000) by the Ministry of Mines and Energy Geological Survey of Namibia.

Umvoto Africa. (2023). Windhoek Aquifer Modelling – Numerical Groundwater Model Report. Prepared by J. Weitz, L. Goslin, K. Gibson, G. Bluff and E. Wise of Umvoto Africa (Pty) Ltd on behalf of the University of the Western Cape (for the City of Windhoek). Draft Report, Umvoto Report No. 986/1/2021, 78pp.

Appendix A 1: Geophysical Traverses







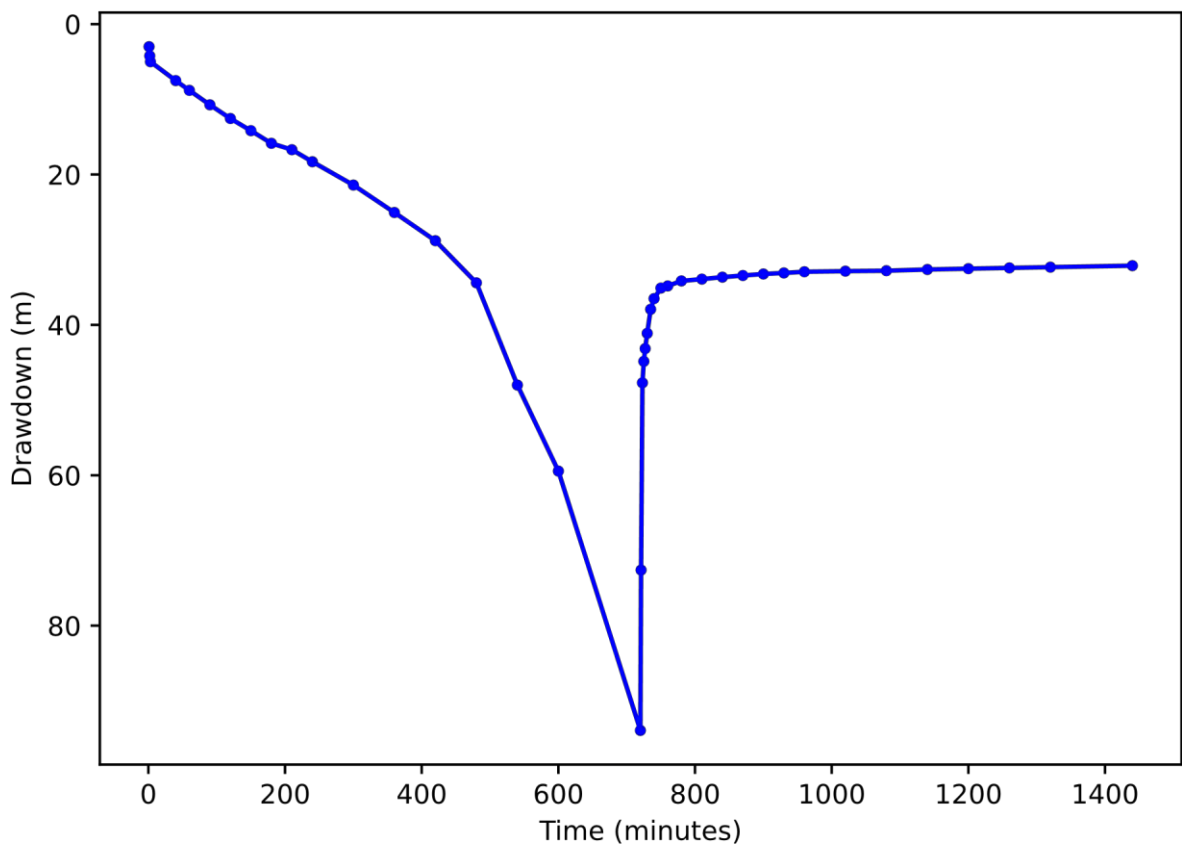
Appendix A 2: Aquifer Testing Results

WIA Gold: SWs-2 Report

Aquifer Test Details

Test Type	Constant Rate Test
Test Analyst	Wiehan
Test Contractor	
Test Date	20/11/2025
Abstraction Rate	88.8 m³/d
Abstraction Duration	12.0 hours
Recovery Duration	12.0 hours
Recovery Percentage	65.8 %

Drawdown vs. Time Graph



Borehole Geospatial Information

Latitude	0.0
Longitude	0.0
Elevation	0.0 mamsl

Borehole Construction Information

Collar Height	0.3 m
Depth	130.0 m
Radius	0.104 m
Rest Water Level	14.99 mbgl

Provided Aquifer Information

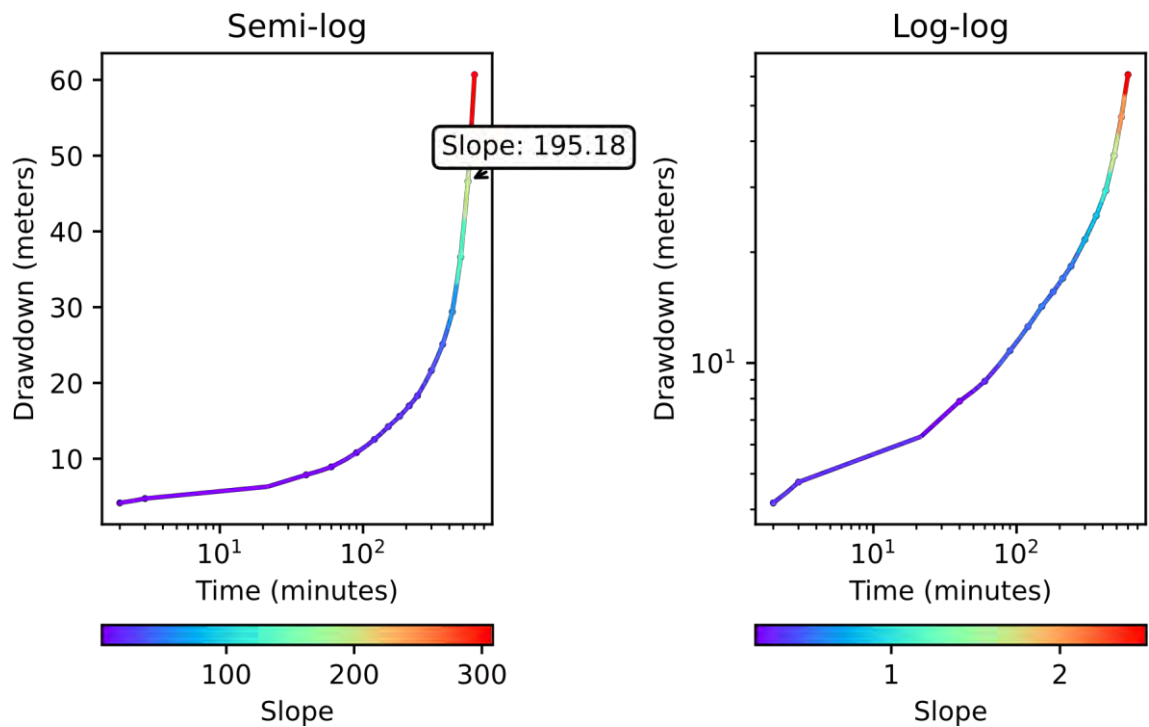
Aquifer Type	Fractured
Aquifer Thickness	115.01 m
Distance from rest water level to main water strike	18.01 m

Aquifer Test Analysis & Results

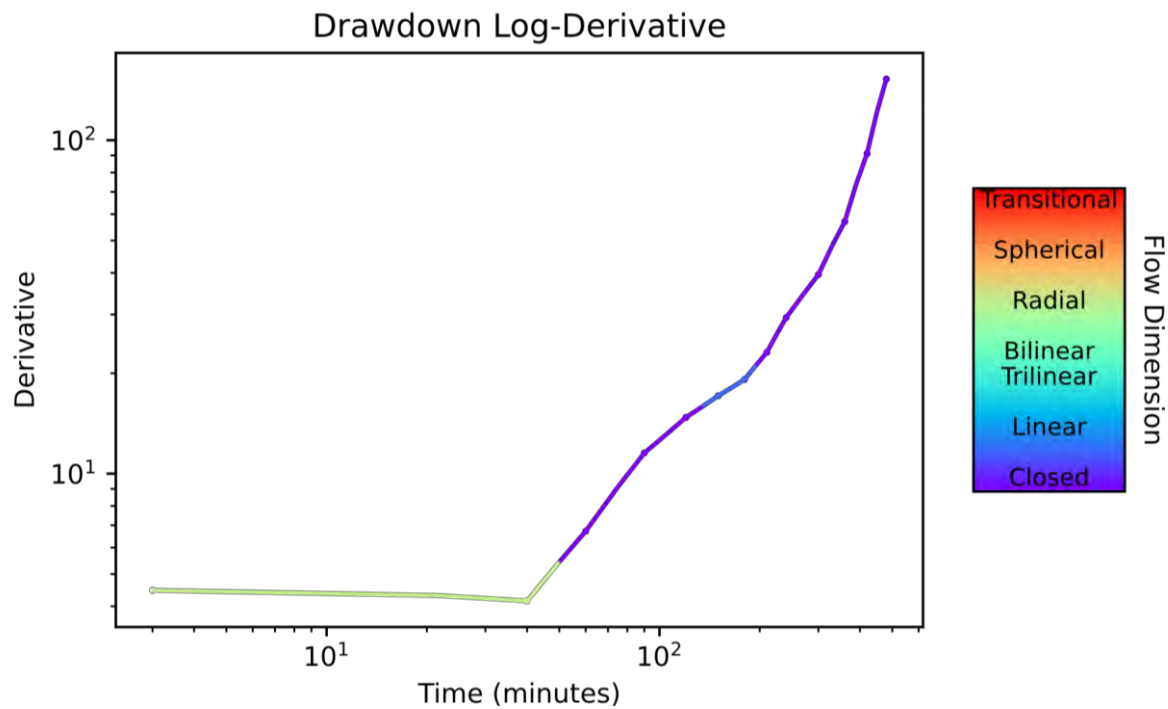
Summarized results of the analysis by means of the following methods:

- Diagnostic Plots
- Drawdown Log-Derivative Plot
- Theis Method
- Cooper-Jacob Method
- Theis Recovery Method
- FC Method: Basic Managed Yield

Diagnostic Plots



Drawdown Log-Derivative Plot

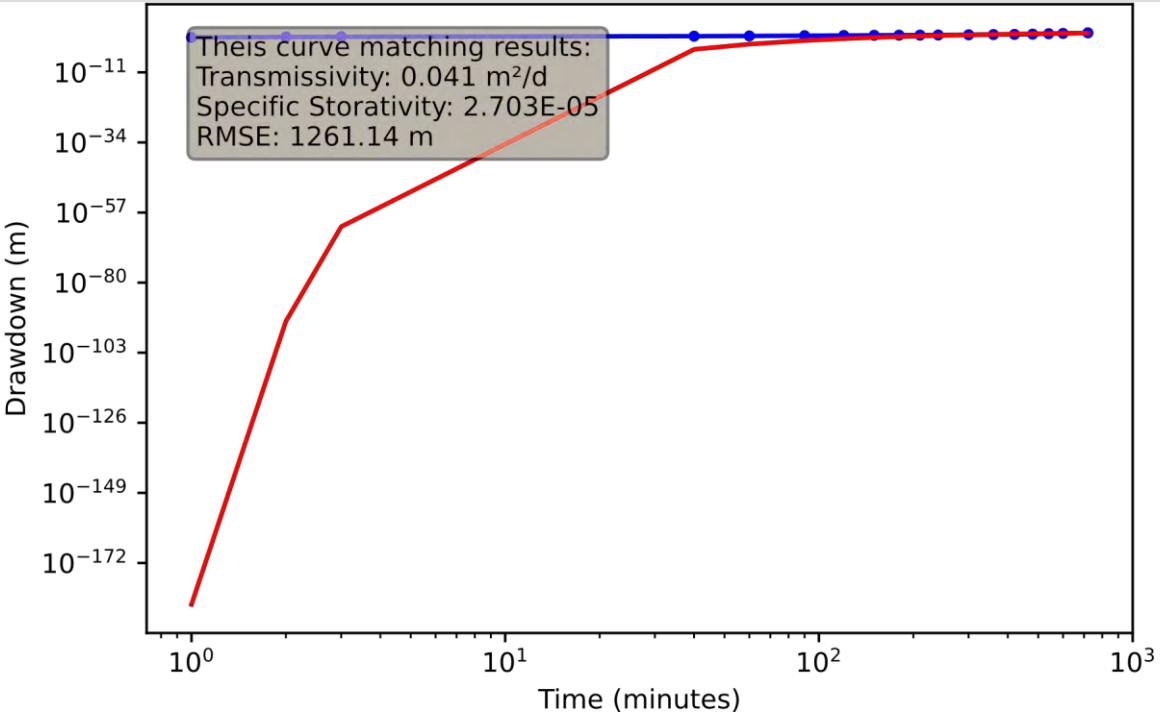


Theis Method for Confined Aquifers - Theis Method Input:

Radius	42.45 m
--------	---------

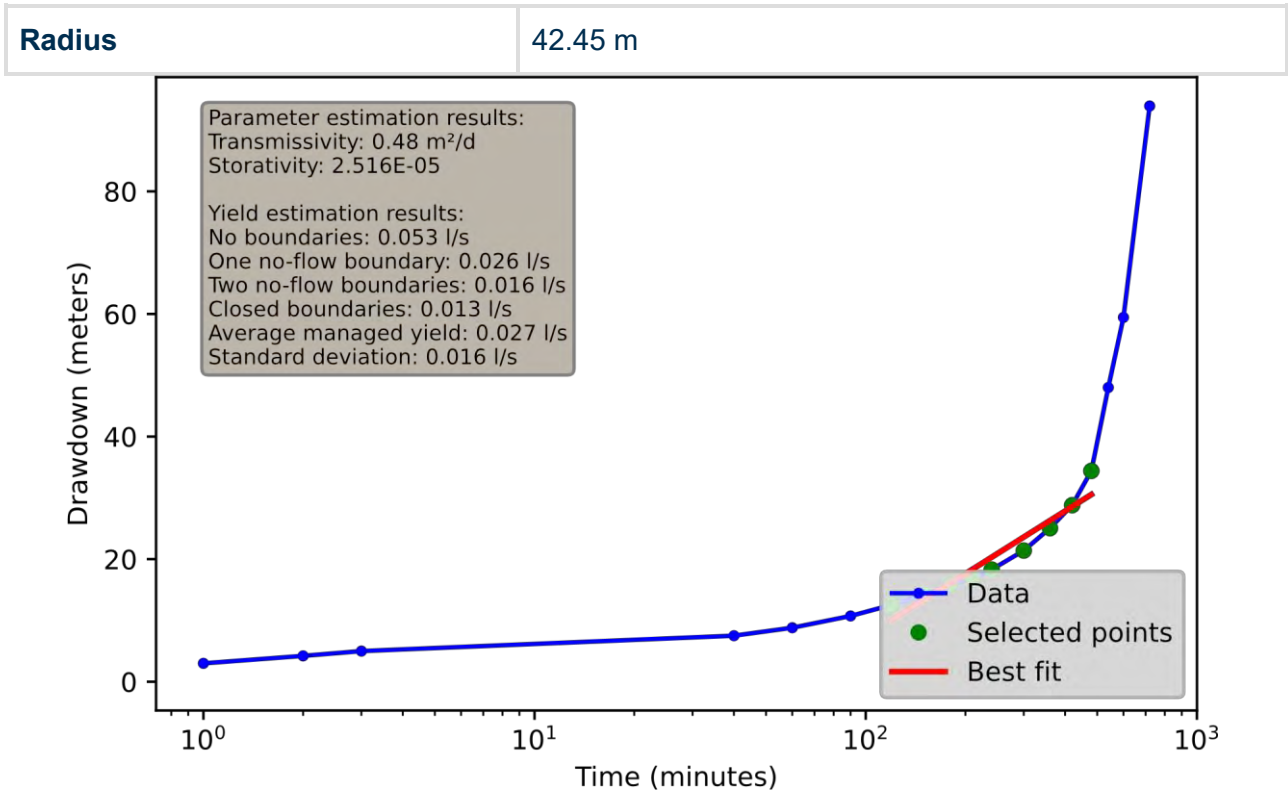
Theis Method Solver Parameters:

Parameter	Minimum	Result	Maximum
Transmissivity	1.000E-03 m²/d	0.041 m²/d	1000.0 m²/d
Storativity	1.000E-07	2.703E-05	5.000E-03



Managed Yield with No Boundaries	0.053 l/s
Managed Yield with One No-Flow Boundary	0.026 l/s
Managed Yield with Two No-Flow Boundaries	0.016 l/s
Managed Yield with Closed Boundaries	0.013 l/s
Average Managed Yield	0.027 l/s
Standard Deviation	0.016 l/s

Cooper-Jacob Method for Confined Aquifers - Cooper-Jacob Method Input:

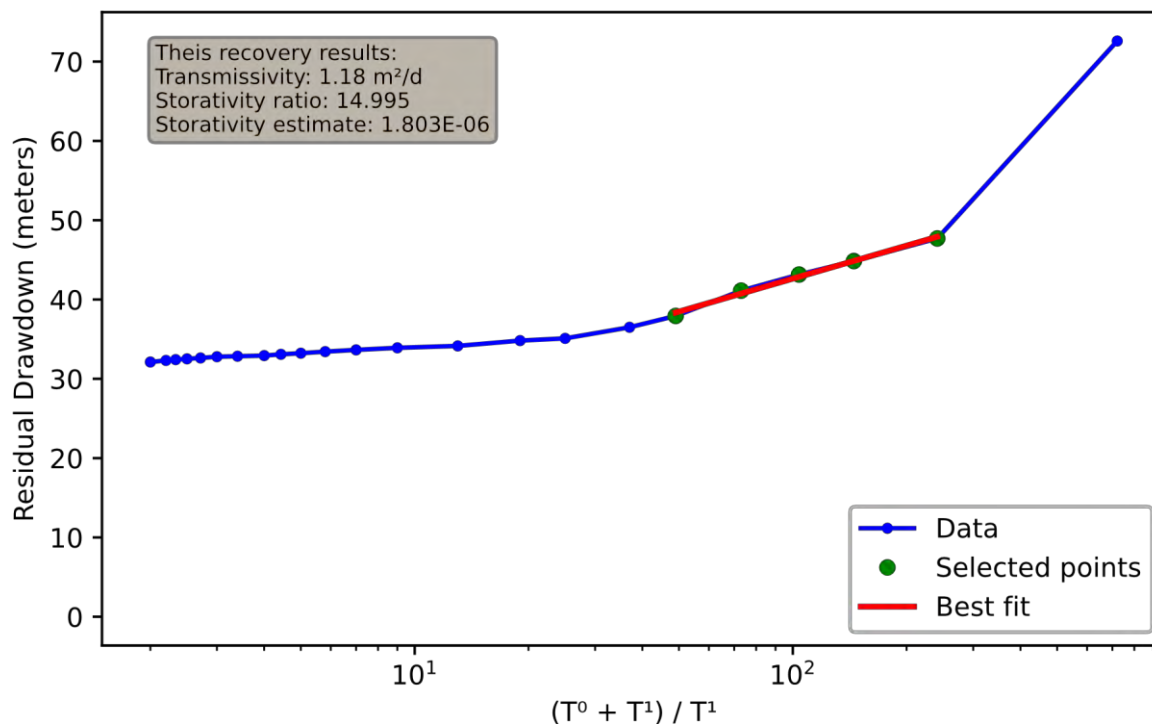


Cooper-Jacob method results: Hydraulic Parameter Estimation

Transmissivity	0.48 m ² /d
Specific Storativity	2.516E-05
u	0.071

Cooper-Jacob method results: Managed Yield Estimation

Theis Recovery Method for Confined Aquifers



Theis Recovery method results:

Transmissivity	1.18 m ² /d
Storativity Ratio	14.99
Storativity	1.803E-06

5.3 Basic FC Method for Managed Yield Estimation - FC Method - Basic Input:

Extrapolation Time	5.0 years
Available Drawdown	18.01 m

FC Method - Basic Managed Yield Estimation Results:

Managed Yield with No Boundaries	0.029 l/s
Managed Yield with One No-Flow Boundary	0.016 l/s
Managed Yield with Two No-Flow Boundaries	0.011 l/s
Managed Yield with Closed Boundaries	5.505E-03 l/s
Average Managed Yield	0.013 l/s
Standard Deviation	8.604E-03 l/s

Summary

Parameter Estimation Results:

Method	Transmissivity	Specific Storativity	Specific Yield
Theis	0.041 m ² /d	2.703E-05	-
Cooper-Jacob	0.48 m ² /d	2.516E-05	-
Theis Recovery	1.18 m ² /d	1.803E-06	-

Managed Yield Estimation Results:

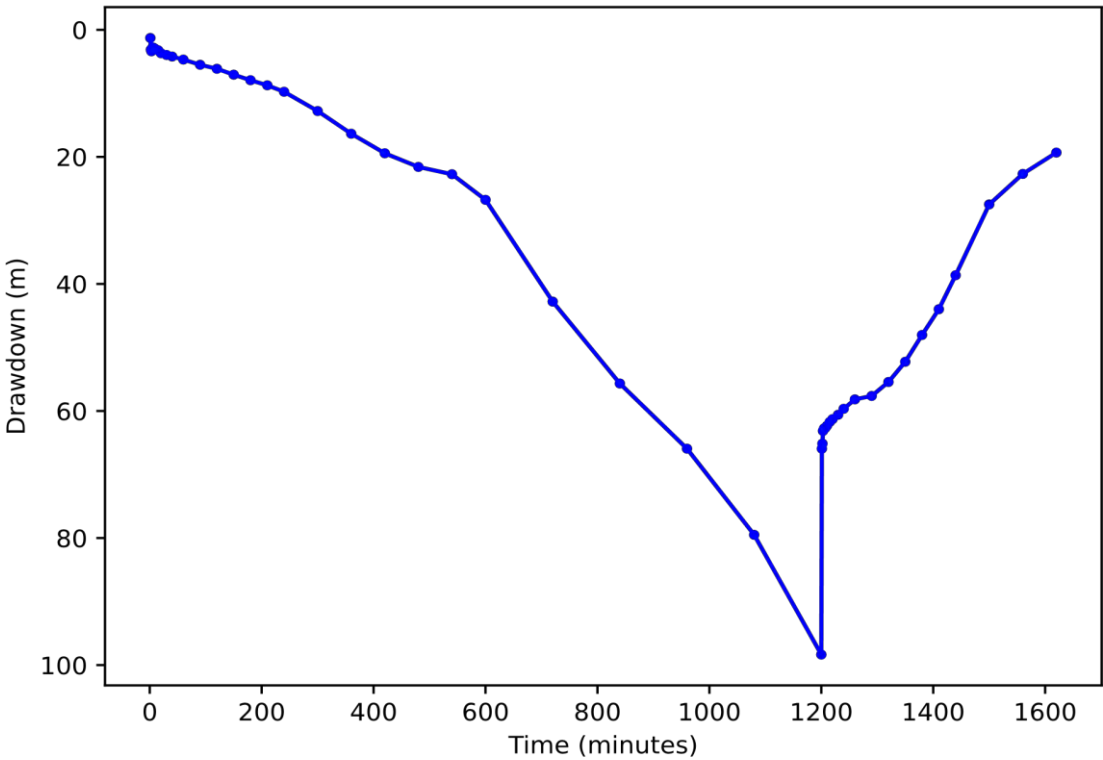
Method	No Boundaries	Average	Closed Boundaries	Standard Deviation
Cooper-Jacob	0.053 l/s	0.027 l/s	0.013 l/s	0.016 l/s
Basic FC	0.029 l/s	0.013 l/s	5.505E-03 l/s	8.604E-03 l/s

WIA Gold: SWs-3 Report

Aquifer Test Details

Test Type	Constant Rate Test
Test Analyst	Wiehan
Test Contractor	
Test Date	24/11/2025
Abstraction Rate	132.0 m³/d
Abstraction Duration	20.0 hours
Recovery Duration	7.0 hours
Recovery Percentage	80.35 %

Drawdown vs. Time Graph



Borehole Geospatial Information

Latitude	0.0
Longitude	0.0
Elevation	0.0 mamsl

Borehole Construction Information

Collar Height	0.35 m
Depth	150.0 m
Radius	0.104 m
Rest Water Level	12.17 mbgl

Provided Aquifer Information

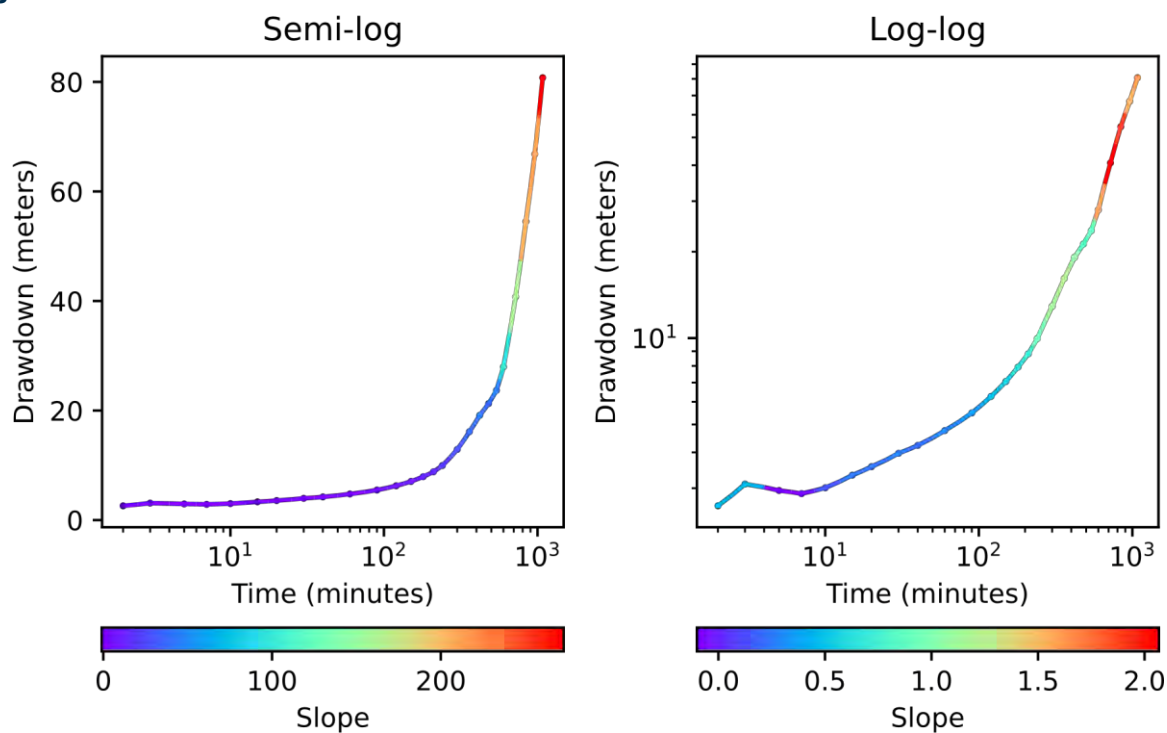
Aquifer Type	Fractured
Aquifer Thickness	137.83 m
Distance from rest water level to main water strike	96.83 m

Aquifer Test Analysis & Results

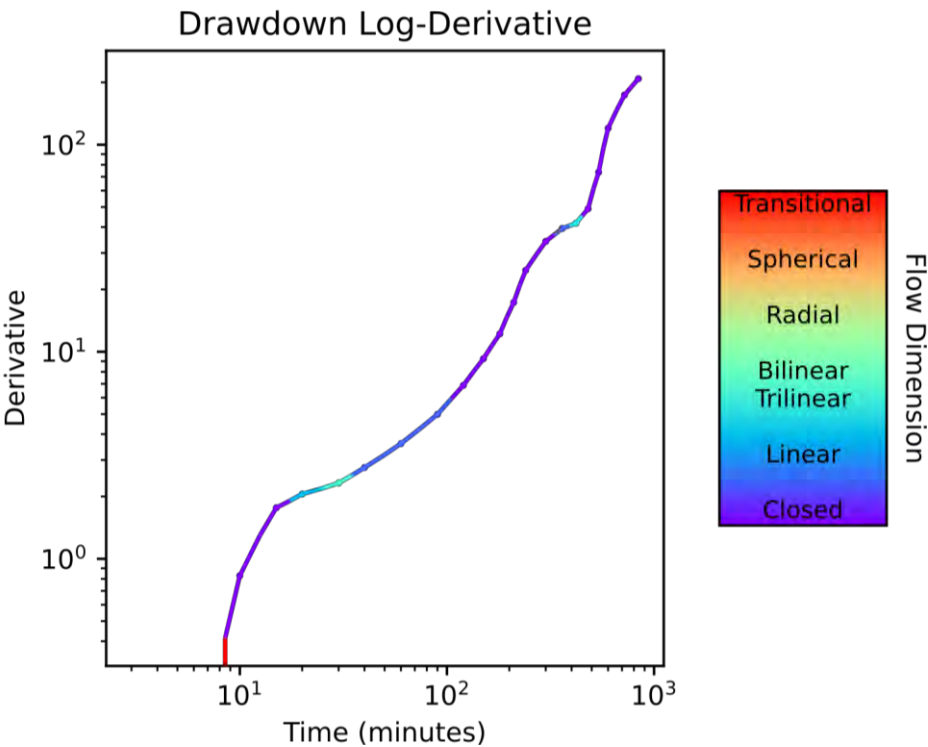
Summarized results of the analysis by means of the following methods:

- Diagnostic Plots
- Drawdown Log-Derivative Plot
- Theis Method
- Cooper-Jacob Method
- Theis Recovery Method
- FC Method: Basic Managed Yield

Diagnostic Plots



Drawdown Log-Derivative Plot



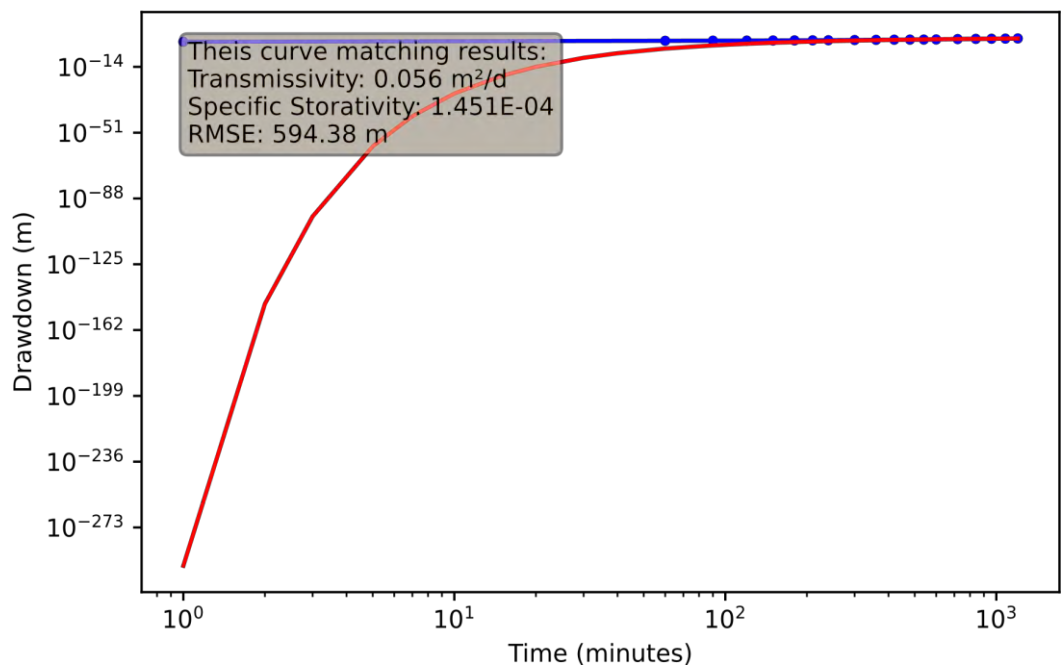
Managed Yield with No Boundaries	0.41 l/s
Managed Yield with One No-Flow Boundary	0.2 l/s
Managed Yield with Two No-Flow Boundaries	0.12 l/s
Managed Yield with Closed Boundaries	0.1 l/s
Average Managed Yield	0.21 l/s
Standard Deviation	0.12 l/s

Theis Method for Confined Aquifers - Theis Method Input:

Radius	27.0 m
--------	--------

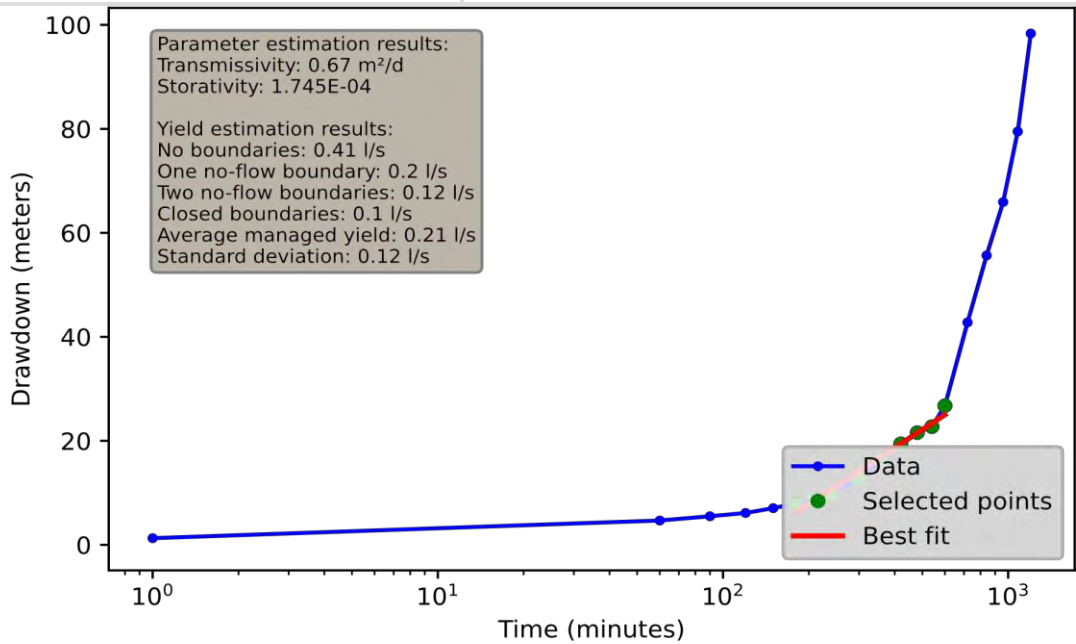
Theis Method Solver Parameters:

Parameter	Minimum	Result	Maximum
Transmissivity	1.000E-03 m ² /d	0.056 m ² /d	1000.0 m ² /d
Storativity	1.000E-07	1.451E-04	5.000E-03



Cooper-Jacob Method for Confined Aquifers - Cooper-Jacob Method Input:

Radius	27.0 m
--------	--------

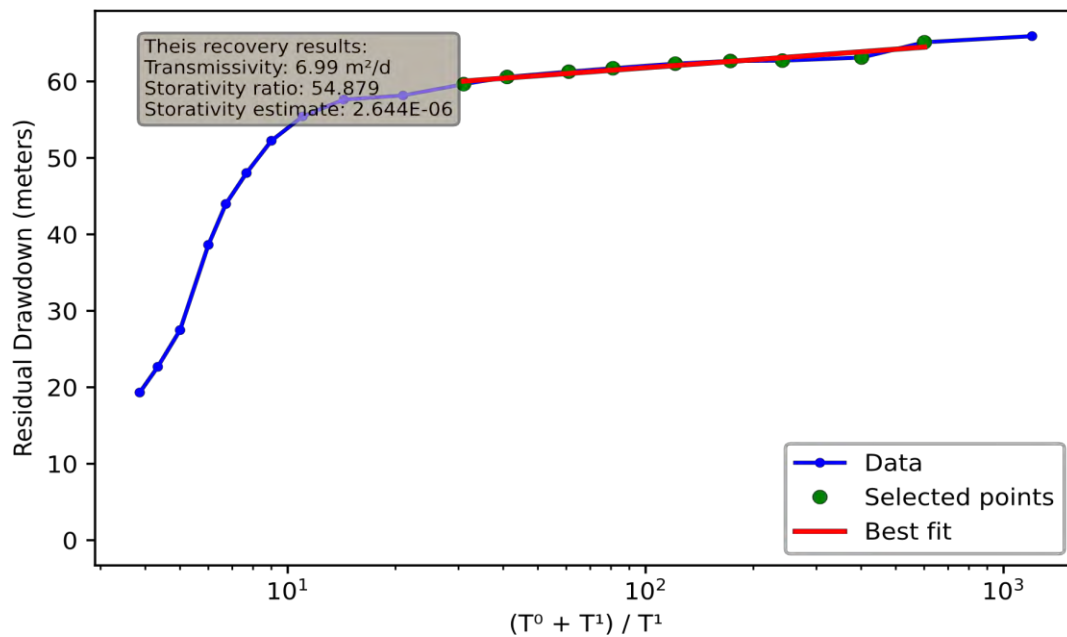


Cooper-Jacob method results: Hydraulic Parameter Estimation

Transmissivity	0.67 m ² /d
Specific Storativity	1.745E-04
u	0.11

Cooper-Jacob method results: Managed Yield Estimation

Theis Recovery Method for Confined Aquifers



Theis Recovery method results:

Transmissivity	6.99 m ² /d
Storativity Ratio	54.88
Storativity	2.644E-06

Basic FC Method for Managed Yield Estimation - FC Method - Basic Input:

Extrapolation Time	5.0 years
Available Drawdown	96.83 m

FC Method - Basic Managed Yield Estimation Results:

Managed Yield with No Boundaries	0.18 l/s
Managed Yield with One No-Flow Boundary	0.099 l/s
Managed Yield with Two No-Flow Boundaries	0.067 l/s
Managed Yield with Closed Boundaries	0.035 l/s
Average Managed Yield	0.081 l/s
Standard Deviation	0.56 s

Summary

Parameter Estimation Results:

Method	Transmissivity	Specific Storativity	Specific Yield
Theis	0.056 m ² /d	1.451E-04	-
Cooper-Jacob	0.67 m ² /d	1.745E-04	-
Theis Recovery	6.99 m ² /d	2.644E-06	-

Managed Yield Estimation Results:

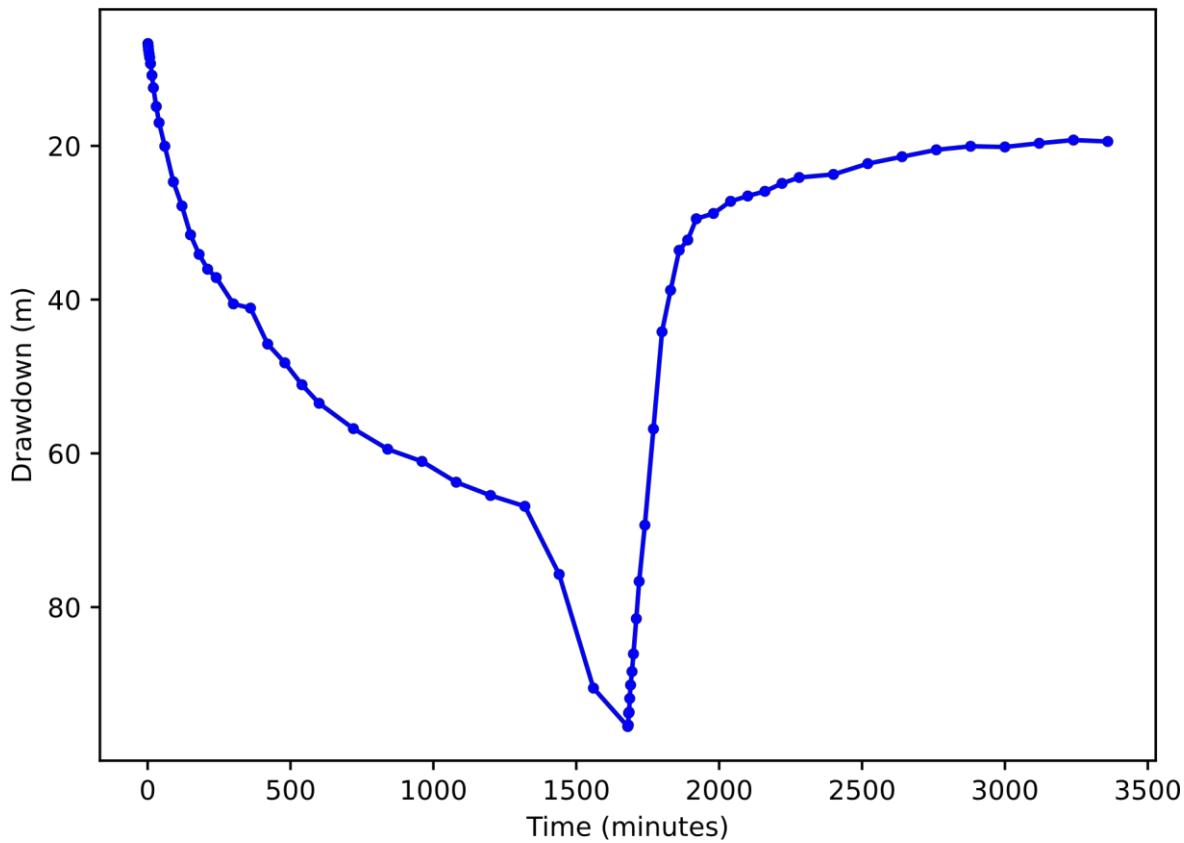
Method	No Boundaries	Average	Closed Boundaries	Standard Deviation
Cooper-Jacob	0.41 l/s	0.21 l/s	0.1 l/s	0.12 l/s
Basic FC	0.18 l/s	0.081 l/s	0.035 l/s	0.056 l/s

WIA Gold: TSF-01 Report

Aquifer Test Details

Test Type	Constant Rate Test
Test Analyst	Wiehan
Test Contractor	
Test Date	09/11/2025
Abstraction Rate	12.0 m³/d
Abstraction Duration	28.0 hours
Recovery Duration	28.0 hours
Recovery Percentage	79.66 %

Drawdown vs. Time Graph



Borehole Geospatial Information

Latitude	0.0
Longitude	0.0
Elevation	0.0 mamsl

Borehole Construction Information

Collar Height	0.35 m
Depth	150.0 m
Radius	0.104 m
Rest Water Level	31.07 mbgl

Provided Aquifer Information

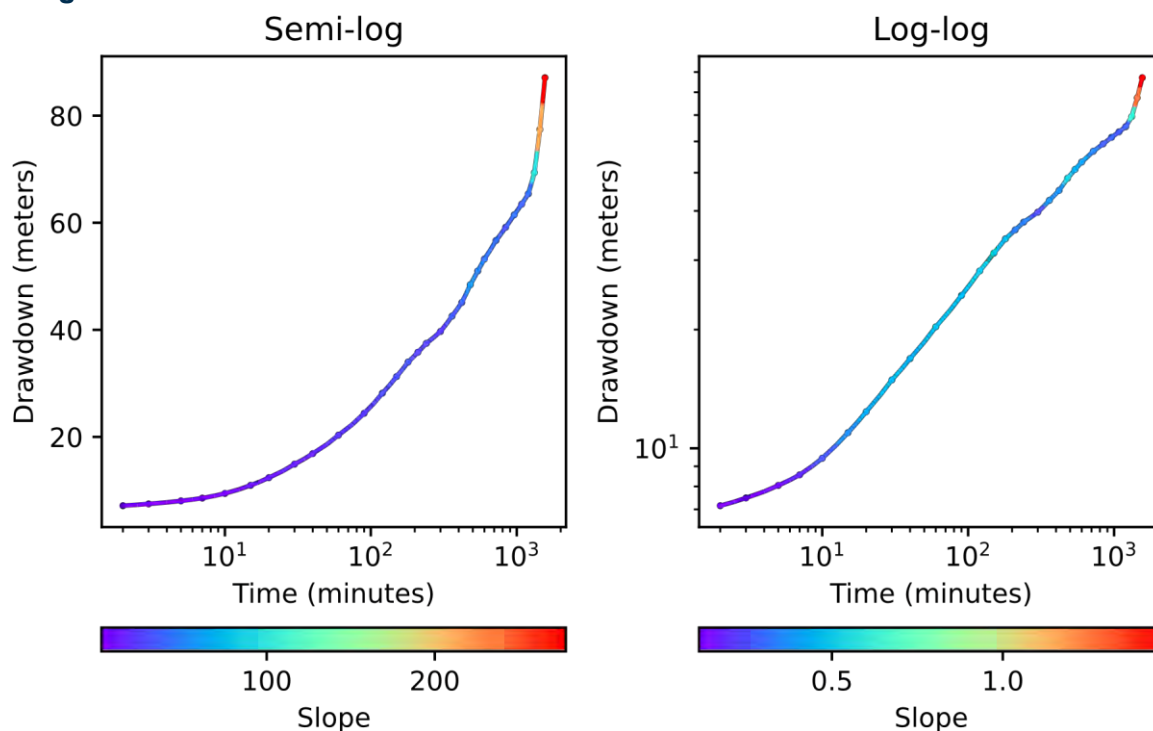
Aquifer Type	Fractured
Aquifer Thickness	118.93 m
Distance from rest water level to main water strike	48.93 m

Aquifer Test Analysis & Results

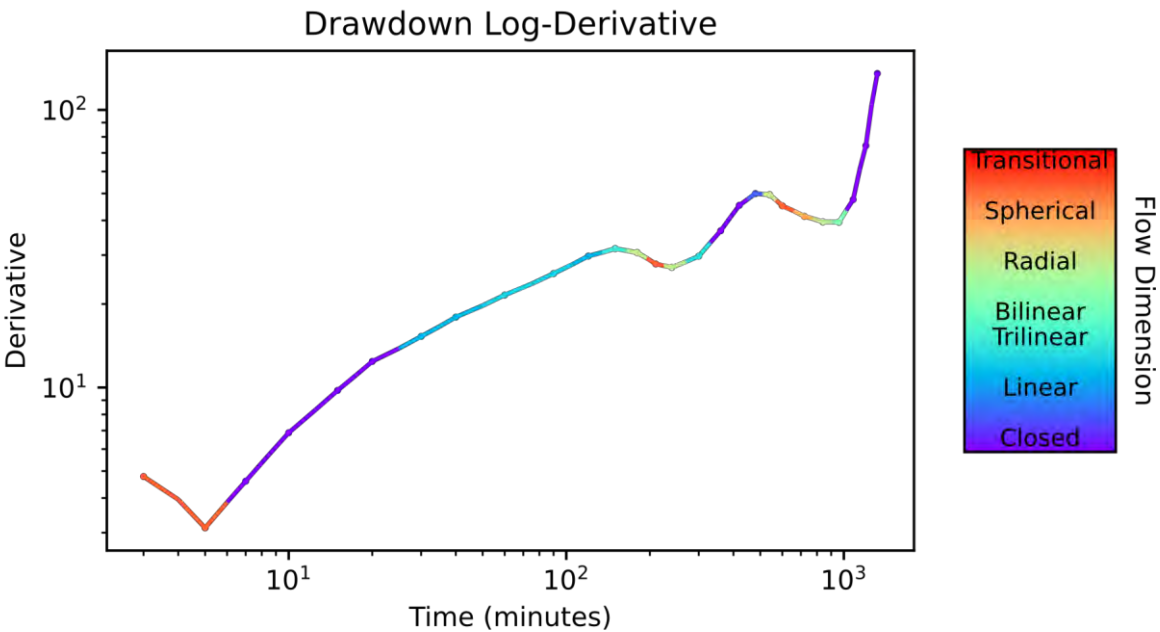
Summarized results of the analysis by means of the following methods:

- Diagnostic Plots
- Drawdown Log-Derivative Plot
- Theis Method
- Cooper-Jacob Method
- Theis Recovery Method
- FC Method: Basic Managed Yield

Diagnostic Plots



Drawdown Log-Derivative Plot

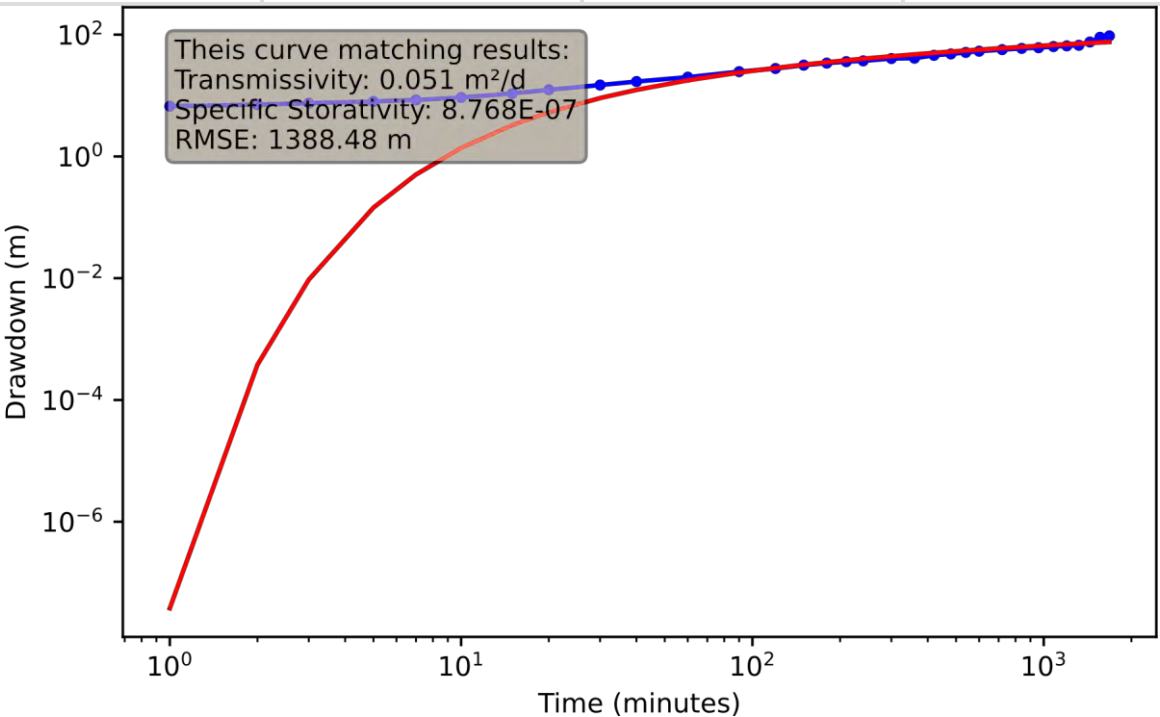


Theis Method for Confined Aquifers - Theis Method Input:

Radius	52.41 m
--------	---------

Theis Method Solver Parameters:

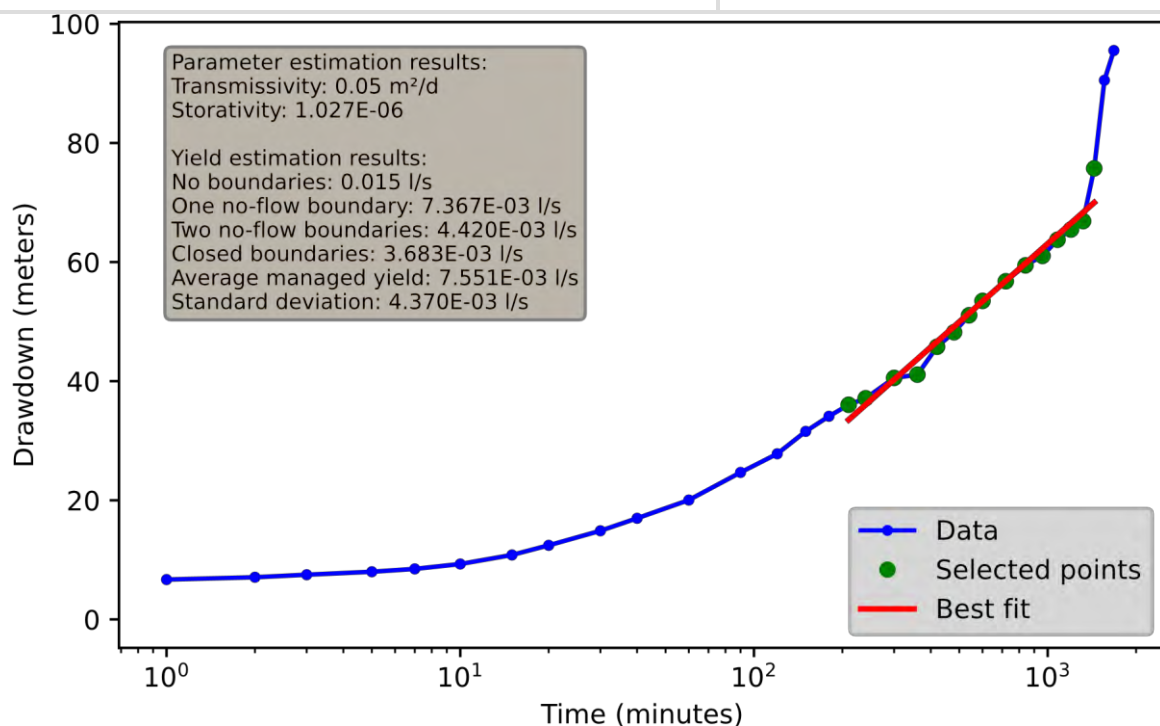
Parameter	Minimum	Result	Maximum
Transmissivity	5.000E-03 m ² /d	0.051 m ² /d	1000.0 m ² /d
Storativity	1.000E-07	8.768E-07	5.000E-03



Cooper-Jacob Method for Confined Aquifers - Cooper-Jacob Method Input:

Radius	52.41 m
--------	---------

Managed Yield with No Boundaries	0.015 l/s
Managed Yield with One No-Flow Boundary	7.367E-03 l/s
Managed Yield with Two No-Flow Boundaries	4.420E-03 l/s
Managed Yield with Closed Boundaries	3.683E-03 l/s
Average Managed Yield	7.551E-03 l/s
Standard Deviation	4.370E-03 l/s

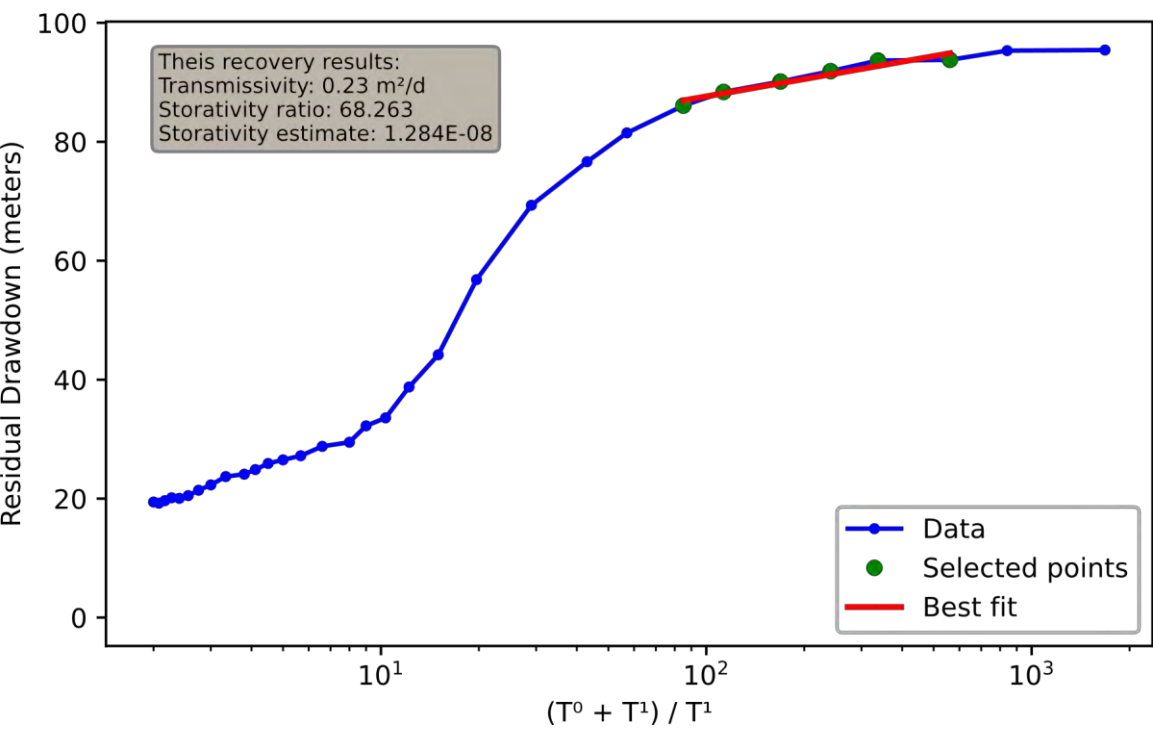


Cooper-Jacob method results: Hydraulic Parameter Estimation

Transmissivity	0.05 m ² /d
Specific Storativity	1.027E-06
u	0.014

Cooper-Jacob method results: Managed Yield Estimation

Theis Recovery Method for Confined Aquifers



Theis Recovery method results:

Transmissivity	0.23 m ² /d
Storativity Ratio	68.26
Storativity	1.284E-08

Basic FC Method for Managed Yield Estimation - FC Method - Basic Input:

Extrapolation Time	5.0 years
Available Drawdown	41.1 m

FC Method - Basic Managed Yield Estimation Results:

Managed Yield with No Boundaries	0.011 l/s
Managed Yield with One No-Flow Boundary	5.929E-03 l/s
Managed Yield with Two No-Flow Boundaries	4.093E-03 l/s
Managed Yield with Closed Boundaries	2.121E-03 l/s
Average Managed Yield	4.851E-03 l/s
Standard Deviation	3.202E-03 l/s

Summary**Parameter Estimation Results:**

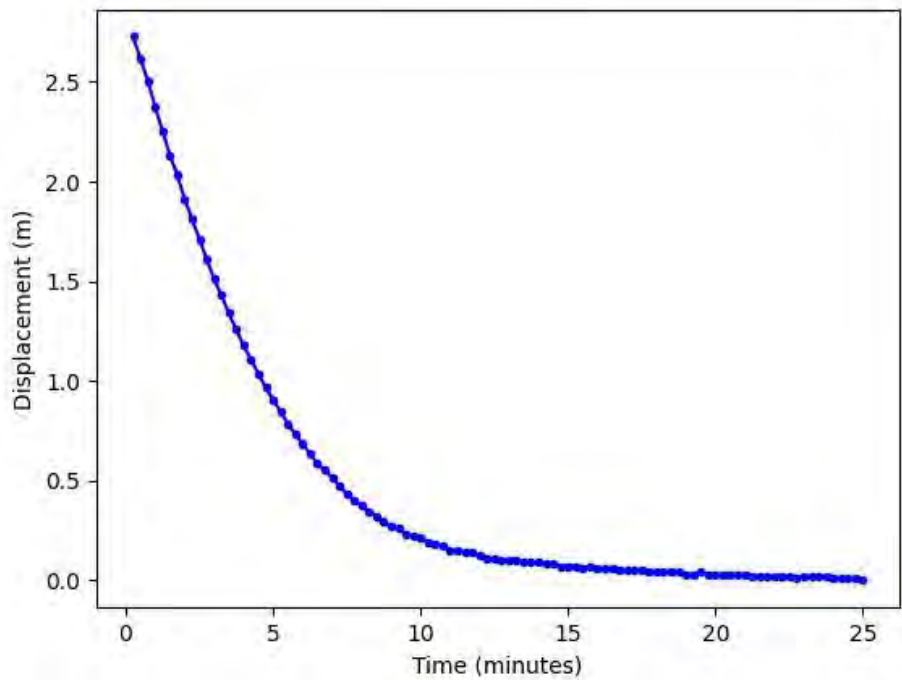
Method	Transmissivity	Specific Storativity	Specific Yield
Theis	0.051 m ² /d	8.768E-07	-
Cooper-Jacob	0.05 m ² /d	1.027E-06	-
Theis Recovery	0.23 m ² /d	1.284E-08	-

Managed Yield Estimation Results:

Method	No Boundaries	Average	Closed Boundaries	Standard Deviation
Cooper-Jacob	0.015 l/s	7.551E-03 l/s	3.683E-03 l/s	4.370E-03 l/s
Basic FC	0.011 l/s	4.851E-03 l/s	2.121E-03 l/s	3.202E-03 l/s

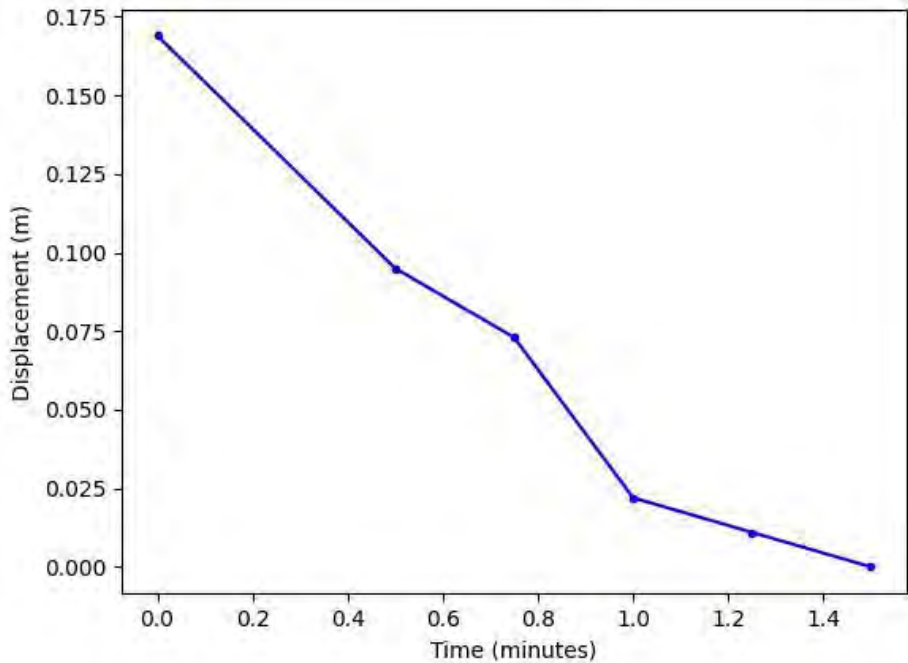
ES 3 Falling Head test

WIA Gold - ES 3

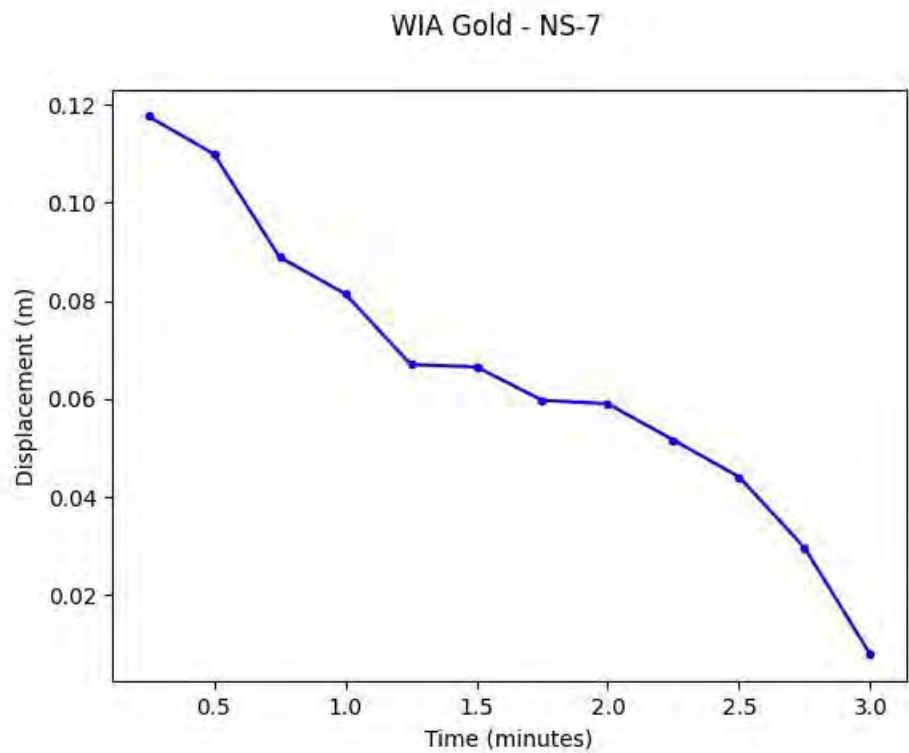


ES-4 Falling Head Test

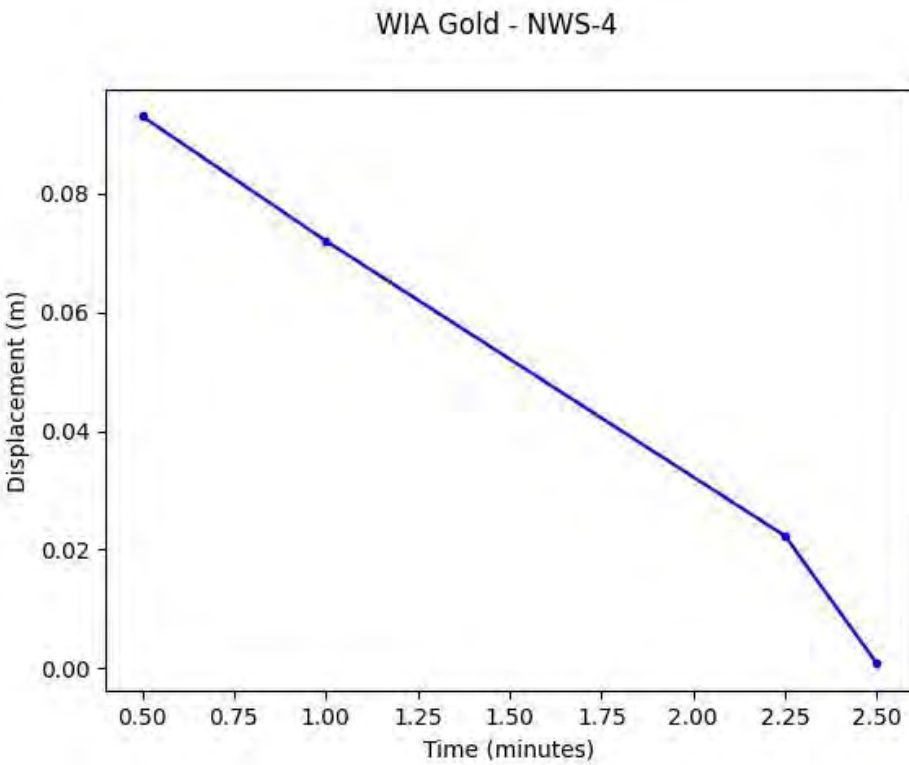
WIA Gold - ES 4



NS-7 Falling Head Test



NWs4 – Falling Head Test



Appendix B: Legislative Guidelines

LEGISLATION/ GUIDELINE	SUMMARY
Soil Conservation Act, No. 76 of 1969	This legislation provides for the conservation and protection of soil and vegetation, as well as the prevention of soil erosion. Soil is a critical component of the hydrogeological cycle, and the Act also addresses the protection of water resources. Mining activities may disturb or contaminate existing soils or generate new soils through the weathering of waste rock brought to the surface. The Act further addresses matters incidental to these objectives.
Hazardous Substances Ordinance, No. 14 of 1974	This legislation is designed to regulate substances that have the potential to cause harm, injury, illness, or even death to human beings due to their toxic, corrosive, irritant, strongly sensitising, or flammable properties. Mining waste and processing chemicals can be of a hazardous nature to the receiving environment. The Act proposes to categorise these substances into different groups based on the level of danger they pose. It further seeks to control, and prohibit where necessary, the importation, manufacturing, sale, use, disposal or dumping of such hazardous substances.
Minerals (Prospecting and Mining) Act, No. 33 of 1992	This legislation aims to establish regulations, guidelines, and licensing procedures for conducting exploration, prospecting, and mining activities in Namibia, as well as the proper disposal of mineral and mineral waste, which is of importance for the Impact Assessment. It groups different minerals into classes, and grants authority for exercising control over these mineral resources. The Act also addresses related incidental matters that may arise during these licensed activities.
Namibia's Environmental Assessment Policy for Sustainable Development and Environmental Conservation, 1995	This policy aims to integrate environmental considerations into decision-making processes, promote sustainable development practices, and conserve natural resources for present and future generations. The policy emphasises the use of EIAs to assess and mitigate potential environmental impacts, encourages public participation in decision-making, supports biodiversity conservation, focuses on pollution control, and outlines roles and responsibilities of stakeholders in implementing environmental management measures. Overall, the policy aims to ensure that developmental activities, such as the Kokoseb EPL 4818, are environmentally conscious for the preservation of unique ecosystems.
The Water Resources Act of Namibia Act, No. 11 of 2013	This legislation, which repealed the Water Act, 1956, establishes provisions for the effective management, protection, development, use, and conservation of water resources in Namibia. The Act governs the allocation and use of water, including the process for obtaining water rights and permits for activities such as mining and protects against over abstraction and pollution of water resources. It includes regulations for monitoring and compliance of water uses, pollution control, management practices and addresses incidental matters. This applies to surface and groundwater resources as a whole, rather than two separate resources. Compliance with this act is essential for mining companies to operate legally and sustainably to ensure the protection and preservation of water as a scarce resource in Namibia.

LEGISLATION/ GUIDELINE	SUMMARY
General Environmental Guidelines for the Mining (Onshore and Offshore) Sector in Namibia, 2000	These guidelines are designed to assist mining developers in preparing Environmental Assessments (EAs) at both project specific and strategic levels, serving as the foundation for EMPs. The guidelines present checklists of major activities for onshore and offshore mining, along with corresponding impacts and common mitigation measures. Some discretion is necessary to distinguish operational activities from mitigation measures, and the checklists broad to account for the environmental diversity in Namibia. The checklists are based on reviews of previous EAs, however, they are not exhaustive and project specific knowledge should be applied.
Environmental Management Act, 2007	The purpose of the Environmental Management Act is to promote the use of natural resources in a manner which can be managed sustainably through the establishment of specific principles. It outlines certain activities, such as mining, that may not be undertaken without environmental authorisation and provides a guide on how to obtain this authorisation, such as ESIA's. The principles are used for decision making on matters which affect the environment. Where activities have significant effects on the environment, the Act provides processes to follow for environmental assessment, control, management, and environmental incidents, as well as the establishment of a Sustainable Development Advisory Council, an Environmental Commissioner, and subsequent officers.
Draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management, No. 1 of 2008	This document serves as a guideline for the procedure of conducting EIAs and Environmental Management Plans (EMP). It offers a comprehensive list of tasks from the initial project proposal to conducting baseline studies, carrying out preliminary and detailed assessments (with this Impact Assessment being part of the detailed assessment phase), and implementing EMPs which aim to mitigate and manage the identified risks and impacts of the EIA. It also outlines the monitoring and reporting process of the associated activities.
Integrated Water Resources Management Plan for Namibia, 2010	Integrated Water Resources Management (IWRM) considers all water uses together, factoring in their impacts on each other and aligning with social, economic, and environmental objectives. It involves participatory decision-making, allowing diverse user groups to influence water resource strategies effectively. IWRM ensures sustainable development, allocation, and monitoring of water resources. The mining industry makes up a large percentage of water use, and so understanding the IWRM and its implication for mining is important.
Environmental Impact Assessment Regulations, No. 30 of 2011	This Government Gazette provides a schedule of regulations to aid an applicant in preparing an Environmental Impact Assessment (EIA) for environmental authorisation for an activity listed in the Act above. The list of regulations is intended to guide the applicant through all stages of the EIA and includes, but is not limited to, listed activities, environmental clearance certificates, scoping, lists of competent authorities, reporting, decision-making, public consultation, appeals, record-keeping, and fees.

LEGISLATION/ GUIDELINE	SUMMARY
International Finance Corporation (IFC) - Policy and Performance Standards, 2012	The IFC, a member of the World Bank Group, offers investment, advisory and asset management services to private sectors in developing countries. The IFC Performance Standards outlines sustainability principles and guidance on identifying risks and impacts as well as mitigation and management thereof. Performance Standard 1, 3 4 and 6 are of most importance and pertain to Assessment and Management of Environmental and Social Risks and Impacts, Resource Efficiency and Pollution Prevention, Community Health, Safety, and Security, and Biodiversity Conservation and Sustainable Management of Living Natural Resources, respectively.
Water Resources Management Act, No. 11 of 2013	This legislation establishes provisions for the effective management, protection, development, use, and conservation of water resources in Namibia. The act governs the allocation and use of water, including the process for obtaining water rights and permits for activities such as mining and protects against over abstraction and pollution of water resources. It includes regulations for monitoring and compliance of water uses, pollution control, management practices and addresses incidental matters. This applies to surface and groundwater resources as a whole, rather than two separate resources (as in the Water Act, 1956). Compliance with this act is essential for mining companies to operate legally and sustainably to ensure the protection and preservation of water as a scarce resource in Namibia.
NamWater Integrated Annual Report, 2020/21	This report aims to share information with stakeholders about the bulk water supply in Namibia, from which Kokoseb EPL 4818 will draw water supply. The organisation adopts an integrated approach for corporate reporting, which provides insights into NamWater's resources, business relationships, risks, and its contribution to the environment to create long-term value. Embracing holistic thinking, NamWater seeks to continually enhance its implementation of integrated reporting as set out by the guidelines of the International Integrated Reporting Framework.
Environmental Principles for Mining in Namibia - A Best Practice Guide (n.d)	This Best Practice Guide was developed by ECC in collaboration with key stakeholders, including the Chamber of Mines, the Namibian Chamber of Environment, the Namibian Government, and members of the Namibian mining industry. Mining is significant in the country's social and economic development, and the guide emphasises responsible and sustainable practices in line with the National Development Plan. The guide outlines leading practices in all aspects of the mining life cycle, including construction, mining and processing, closure and rehabilitation. By applying these leading practices in the Impact Assessment, Kokoseb EPL 4818 can actively contribute to sustainable development, maintain positive relationships with regulators and communities, and uphold sound environmental and social principles.
Environmental Compliance Consultancy Predication Evaluation Methodology, n.d.	This document, produced by ECC, outlines a sound methodology to identify, predict and evaluate the impacts of an activity which may arise during the EIA process. The methodology applies the source-pathway-receptor approach to risk assessments and rating index for sensitivity and significance of impacts. The methods are based on the principles upheld by the IFC, the Namibian Draft Procedures and Guidelines for EIA and EMP, and Environmental Principles for Mining in Namibia, a Best Practice Guide., and will be applied in the Impact Assessment.

Appendix C: ECC Impact Prediction and Evaluation Methodology



		SIGNIFICANCE OF IMPACT					
Significance of Impact	Biophysical	Social	Significance of Impact				Significance Description
			Low	Minor (2)	Moderate (3)	Major (4)	
High (3)	Minor (2)	Moderate (3)	Major (4)	Major (5)	Major (6)	Major (7)	Significance Description
Medium (2)	Low (1)	Minor (2)	Moderate (3)	Major (4)	Major (5)	Major (6)	
Low (1)	Low (1)	Low (2)	Minor (2)	Moderate (3)	Moderate (4)	Moderate (5)	Significance Description

SIGNIFICANCE DESCRIPTION

Low - Major Beneficial (All Scores)

Impacts are considered to be beneficial to the environment and society.

Low (negative) 0 - 25

Impacts are considered to be of low significance and are unlikely to be critical to decision-making.

Minor (negative) 25 - 50

Impacts are considered to be of minor significance and are unlikely to be critical to decision-making.

Moderate (negative) 50 - 75

Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features that are unique and which, if lost, cannot be replaced or relocated.

Major (negative) 75 - 100

Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly value/desirable resources/receptors. Impacts are expected to be permanent and not reversible on a national scale and/or have international significance or result in a legislative non-compliance.