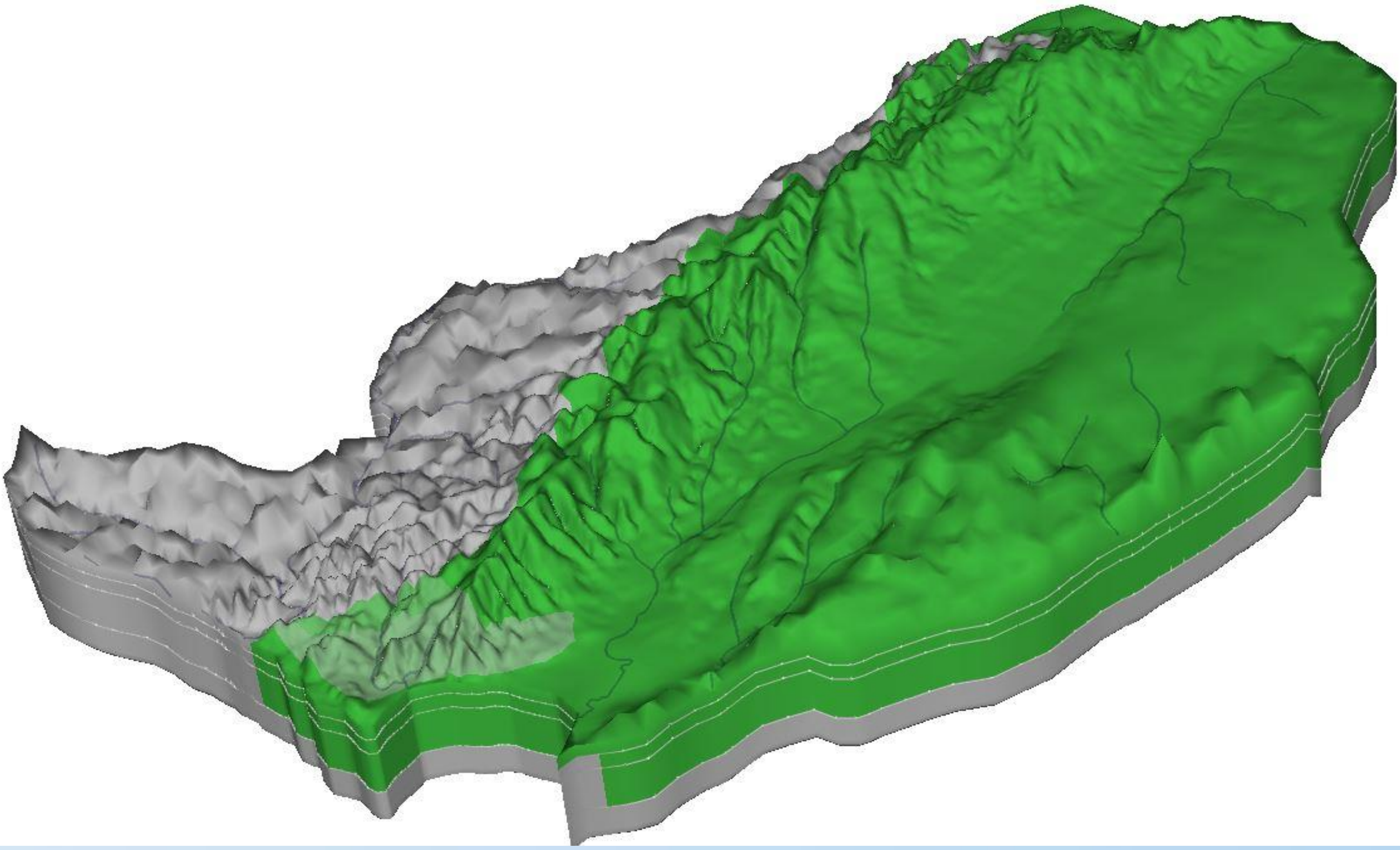
Tronox KZN Sands (Pty) Ltd

INTEGRATED ENVIRONMENTAL AUTHORISATION FOR THE PORT DURNFORD MINE, KWAZULU-NATAL

Hydrogeological Investigation



41106008-REP-00001
MARCH 2025

CONFIDENTIAL

Tronox KZN Sands (Pty) Ltd

INTEGRATED ENVIRONMENTAL AUTHORISATION FOR THE PORT DURNFORD MINE, KWAZULU-NATAL

Hydrogeological Investigation

FINAL REPORT CONFIDENTIAL

PROJECT NO. 41106008
OUR REF. NO. 41106008-REP-00001

DATE: MARCH 2025

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EXECUTIVE SUMMARY

This report provides the groundwater specialist report for the Port Durnford mining operations.

Background:

Tronox KZN Sands (Pty) Ltd (herein referred to as Tronox) currently operates the Fairbreeze mine where the heavy mineralised sand dunes mined south-west of Mtunzini in the Greater Richards Bay area. This is supported by a Tronox Mineral Separation Plant (MSP) and Smelter (collectively known as the Central Processing Complex (CPC)) in the Empangeni area. Tronox's previous mining operation, Hillendale, is currently in the mine closure phase.

The proposed project is for the mining of heavy minerals including ilmenite, rutile, zircon and heavy minerals within the Port Durnford Mining Rights area. It is proposed that the mining activities will be undertaken in two phases.

The objective of the groundwater study was to establish the baseline geohydrological conditions on site and understand the potential impact of the proposed Port Durnford mining activities on the groundwater and surface water resources. The scope of work included a hydrocensus (November 2022), description of baseline, numerical groundwater modelling and impact assessment.

The site is currently occupied by forestry activities and will return to these operations upon completion of mining and subsequent rehabilitation. The main receptor from groundwater are surface water (rivers) resources and wetland areas that contribute to baseflow, where groundwater dependent ecosystems are a common feature along the northeastern coastline of KwaZulu-Natal. Wetlands east of the project site, mainly along the drainage channels feeding Lake Cubhu and around Kraal Hill, are fed by shallow groundwater from perched aquifers formed by underlying clay rich dune sands. The Mlalazi estuary is also fed by shallow groundwater in the area.

The project area is underlain by Quaternary sands of the Maputaland Group towards the east, with rocks of the Vryheid Formation and Natal Group outcropping south-west of the site and the Natal Metamorphic Province situated west and north, forming the basement lithologies. Groundwater levels range from artesian conditions to 59 mbgl across the area. Shallower water levels are observed near the rivers and in the down gradient areas closer to the coast. A combination of topography and textural characteristics of the geological formations influence the baseflow component of the project area, which appears to be more prominent east of the N2 national route.

Groundwater flow from the site is generally towards the east and south-east, in the direction of the Indian Ocean and Mlalazi River respectively. Based on information from previous studies in the region, the primary aquifer is unconfined and has variable hydraulic conductivity generally between 0.1 – 10 m/day with variable yields, generally below 2 L/s. For the secondary aquifer, hydraulic conductivity ranges between 0.1 – 0.001 m/day with higher values anticipated for the dolerite contact and fault zones and low yields ranging from 0.1 L/s to 1.5 L/s.

The baseline groundwater quality in the area is generally good with marginal to poor quality noted in some boreholes along the site boundary. The background water quality in the Port Durnford area is generally good with electrical conductivity ranging between 0–150 mS/m. Iron, manganese, aluminium and lead were locally present in some boreholes.

Potential sources of contamination were identified but due to the low salinity; the mining is anticipated to have a low impact to the groundwater resource and surface resources receiving baseflow.

The model results show that in the first 10 years of low-rate mining, the simulated ingress is approximately 3 500 m^3/d. Thereafter the average simulated ingress for the “mining only” scenario is 8 911 m^3/d. By including the additional water from backfilling and residue deposition the total ingress rises to 51 311 m^3/d in 2065. Model results further show that the reduction in baseflow is mostly insignificant and that the backfilling allows for quick recovery of the drawdown during mining.

Due to high recharge in the sand aquifer and the additional water added to the system with the backfill, the coarse sand tailings deposits and the fine residue, as well as the benign nature of the waste streams, the contaminant concentration in the aquifer is attenuated. This is the opposite of what is generally expected from contamination sources. Therefore, the residue and backfill material are not strictly sources of contamination and will have a positive impact on the groundwater and river qualities in most areas.

The impact assessment indicates that dewatering and groundwater quality are the main impacts on the system. Impacts were found to be moderate without mitigation and low after mitigation.

The existing monitoring network consists of fourteen (14) known boreholes although not all of them are monitored and some of them are outside the mining boundary. Approximately six (6) of the boreholes are within the mining area and will most probably be destroyed during mining. The proposed future monitoring is guided by a risk-based source-pathway-receptor principle. The boreholes in the network should cover the following:

- Source monitoring – monitoring close to possible contaminant sources (this can be achieved by replacing boreholes W2 and W7 after mining).
- Plume (pathway) monitoring – monitoring along identified contamination plumes (W5, W11 and TBH1).
- Impact (receptor) monitoring – monitoring at expected sensitive receptors. Surface water monitoring is proposed for
  - The Mzingwenya River (P_SW1).
  - The Amanzamnyama River (P_SW2).
  - Tributary of the KwaGugushe River (P_SW3).
  - Tributary of the Mhlatuze river (P_SW4)

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1 INTRODUCTION

WSP Group Africa (Pty) Ltd (WSP) was appointed by Tronox KZN Sands (Pty) Ltd (Tronox) to undertake an independent environmental impact assessment (EIA), associated authorisation and licencing processes and specialist studies to support the mining right application for the proposed Port Durnford Mining Rights Area (MRA).

This report provides the groundwater specialist report as informed by the requirements set out by Annexure D.5. of Regulation 267 (R267) of March 2017.[1] for geohydrology specialist, (Government Gazette No. 40713).

1.1 OBJECTIVES

The objective of the groundwater study is to establish the baseline geohydrological conditions on site and potential impacts of the proposed Port Durnford mining activities on the groundwater and surface water receptors in support of the environmental authorization.

1.2 LOCALITY

Port Durnford mine is situated in the uMhlatuze Local Municipality that falls under the King Cetshwayo District Municipality. It is located approximately 15 km south-west of Richards Bay and between 4 and 15 km north-east of Mtunzini in the Greater Richards Bay area.

The N2 highway as well as the R102 traverse the length of the proposed MRA (Figure 1-1). The R102 is located to the north-west of the MRA and the N2 runs through the centre. There is also a railway line just south of the N2 that also traverses the mining right area.

Mondi is currently leasing most properties under the prospecting rights for commercial forestry purposes. The plan is to rehabilitate the site and restore it to forestry after mining.

1.3 DESCRIPTION OF ACTIVITIES

1.3.1 EXISTING MINING

Tronox currently operates the Fairbreeze mine, to the south-west of the Port Durnford[2] MRA, where mineralised sand dunes are mined by hydraulic mining using a high-pressure hose that turns the in-situ sand into slurry. The slurry is then pumped to the plant for processing. This is supported by a Tronox Mineral Separation Plant (MSP) and Smelter, collectively known as the Central Processing Complex (CPC) in the Empangeni area (Figure 1-2). Tronox's previous mining operation, Hillendale, is currently in the mine closure phase and located to the north-east of the MRA.

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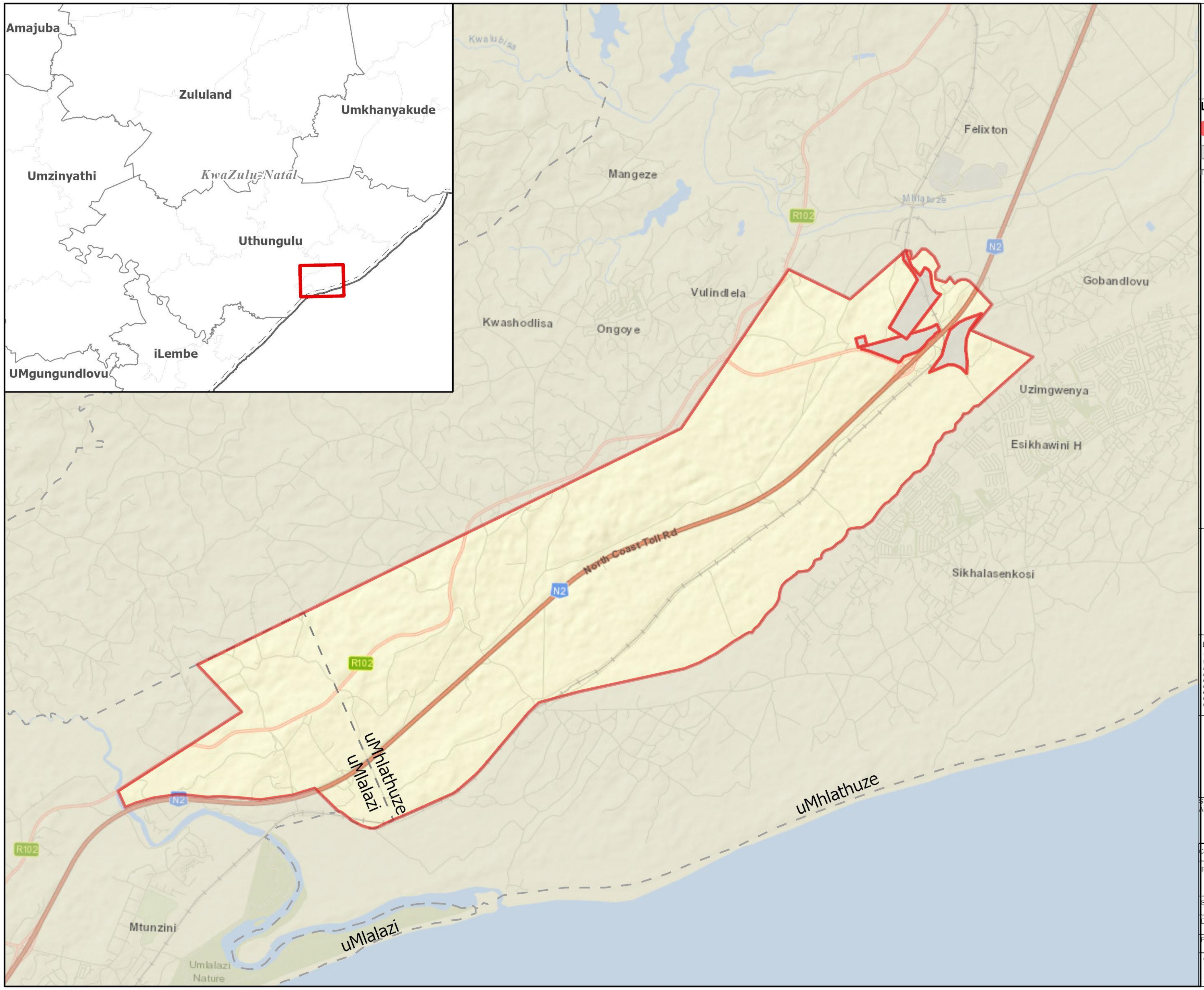
[1] A revision to these regulations (GN 48630 dated 19 May 2023) was published for comment on the 10 March 2023.

[2] Note that Durnford and Dunford is used interchangeably



TRONOX
PORT DUNFORD

LOCALITY MAP

Legend

🟥	Port Dunford Mining Right Area
▨	Excluded Areas
⌐ ¬	Local Municipalities

N

0 720 1 440 2 160 2 880

Metres

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DATE: 2024/07/26	REVIEWED BY: NM	
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Figure 1-1 - Locality map

1.3.2 WATER AND MINE WASTE MANAGEMENT

Process water is distributed to the Primary Wet Plant (PWP) as make-up water from two process water storage dams via a header and pump distribution system. Process water supply to the new Dozer Trap Mining Unit (DTMU) is supplied from the process water manifold using dedicated water supply pumps. The process water is supplemented with raw water from the raw water dam which in turn is supplied from the Mhlatuze River bulk water supply station (Hatch, 2020).

The following tails products are received from the Central Processing Complex (CPC) for disposal with the various tails' products at the PWP:

- Mineral Separation Plant (MSP) tails are received by tip truck from the MSP. It is tipped directly into a slurry hopper where it is slurried before pumping directly into the rougher sand tails tank for disposal with the coarse sand (PWP) tails.
- Gypsum filter cake from the MSP is received via truck from the CPC and deposited on a dedicated stockpile. The cake is reclaimed and fed into a materials handling facility for re-slurrying before being fed to the thickener underflow tank for disposal together with the fine tails to the RSF.

1.3.3 PROPOSED MINING

The Port Durnford project proposes mining of heavy minerals including ilmenite, rutile, zircon and heavy minerals from the mineralised sand dunes with an average mining depth of 45 m. The MRA is approximately 4733.64 ha. The mining footprint area has been reduced to 1800 ha to exclude approximately 825 ha of "environmentally sensitive areas" (ecosystems such as swamp forests and wetland habitat with high ecological function and value) and is presented in Figure 1-2. The mining timeline is from 2025 to 2069 and is discussed in further detail in Section 7. It is proposed that the mining activities will be undertaken in two phases:

- Phase 1 (approximately 41 ha) will be a small-scale mining phase for the first 10 years where an estimated 70 400 tons per annum (tpa) run-of-mine (ROM) sands will be mined and transported to the existing Fairbreeze Mine for processing. The rate of mining will be 100 tons per hour (tph) and mining will only take place for 5 days in a month.
- The proposed Phase 2 mining operation will commence from 2036 onwards and will involve developing a 3 000 ton per hour (tph) hydraulic sand mine within in the Port Durnford MRA which will be of similar scale to the Fairbreeze mining operation. From 2036 it was assumed that mining will be active for one year per mining block. A primary wet plant (PWP) will be constructed on site to separate the run of mine (ROM) feed into a heavy mineral concentrate (HMC). Fines will go to two proposed Residual Storage Facilities (RSF 9 and RSF C) and the coarse sand tailings will be temporarily stored to the south (A1, A2, & A3) and west (8B) of the mine area before being returned as backfill to the pit. Both fine residue and coarse sand tails will be disposed of above ground or in mined out pit areas, depending on disposal area availability. The HMC will be transported to the existing Tronox Mineral Separation Plant (MSP). Figure 1-3 indicates the location of RSF Site C on the mining area and RSF Site 9 to the west of the mining area as well as the areas where sand tailings will be deposited.

The backfill timeline follows the fine residue deposition schedule as provided by Tronox in March 2024 (Table 1-1). It should be noted that this schedule reflects information that was used in the setup of the groundwater model, however this has subsequently been updated.

- RSF C will be built on mining blocks 2036 to 2055. RSF C will become operational in 2069.

- RSF 9 will be active from 2036 to 2046 according to the spatial data received in March 2024.
- The RSF slurry contains 28% solids and 72% water (although the latest data (January 2025) indicates a ratio of 35% solids to 65% water).

The coarse sand tailings will be deposited as a slurry with 50% solids and 50% water and will become active from 2036 to 2068 as follows:

- Sand tailings A1 to A3 from 2036 to 2047.
- Sand tailings North from 2054 – 2055, two years after mining of the northern mining blocks.
- Sand tailings 4 from 2056 to 2059, two years after mining of the south-western mining blocks.
- Sand tailings 5 from 2060 to 2063, two years after mining.
- Sand tailings 3 from 2063 to 2068, two years after mining.
- Sand tailings 8B from 2047 to 2053.

The slurry ratio of 50% solids to 50% water for the coarse sand tailings is based on measured data from Fairbreeze for the period January 2021 to August 2022. The latest information received in January 2025 indicates that the ratio is 45% solids to 55% water, however, no data was available on the percentage water recovery or losses due to evaporation. It is recommended that this be confirmed during the feasibility study.

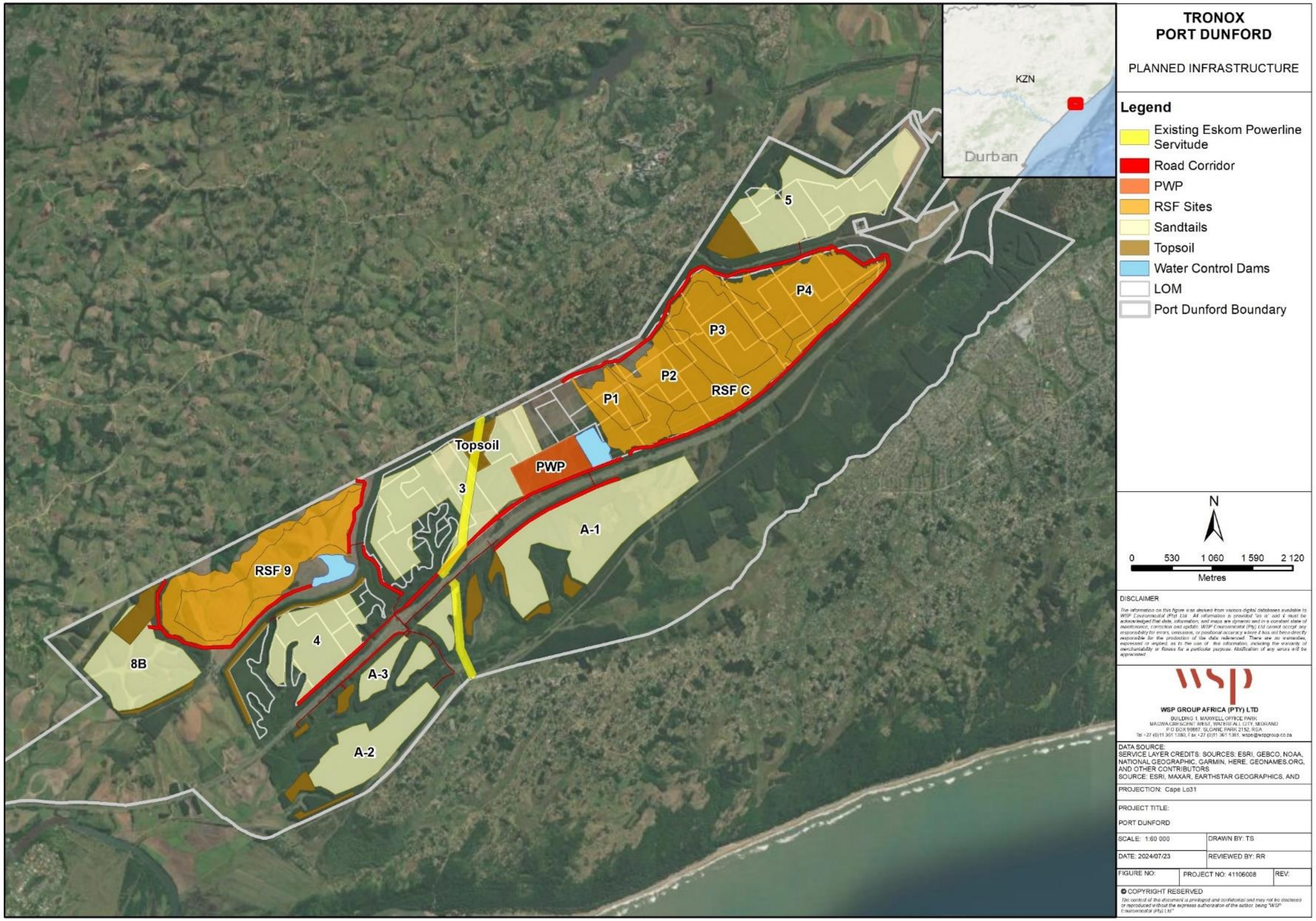

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Figure 1-2 - Planned infrastructure for Port Durnford operation

Table 1-1 – Sand tailings deposition schedule (received March 2024)

Area	Capacity (Mt)	Sequence	Unit	Jan 36	Jan-37	Jan-38	Jan-39	Jan-40	Jan-41	Jan-42	Jan-43	Jan-44	Jan-45	Jan-46	Jan-47	Jan-48	Jan-49	Jan-50	Jan-51	Jan-52	Jan-53	Jan-54	Jan-55	Jan-56	Jan-57	Jan-58	Jan-59	Jan-60	Jan-61	Jan-62	Jan-63	Jan-64	Jan-65	Jan-66	Jan-67
Backfill A1, A2, A3	150	1	Mt	9.4	11.2	14.2	18.2	18.1	11.2	11.2	7.6	10.9	12.0	18.3	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backfill 4	117	8	Mt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.8	12.9	17.2	17.4	18.2	12.0		-	-	-	-	-	-	-
Backfill 3	133	10	Mt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.7	17.4	17.3	17.7
Backfill 5	96	9	Mt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.3	19.0	18.7	18.7	19.1	15.0			
RSF Site 9	18	2	Mt	6.2	7.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RSF Site C P1	18	3	Mt	-	-	-	-	-	7.5	7.5	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RSF Site C P2	21	4	Mt	-	-	-	-	-	-	-	7.3	7.3	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RSF Site C P3	21	5	Mt	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5	7.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RSF Site C P4	4	6	Mt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2	-	-	-	-	-	-	-	-	-	-	-	-
Backfill 8	89	7	Mt	-	-	-	-	-	-	-	-	-	-	-	11.1	19.0	10.9	11.0	13.3	18.7	18.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backfill (Site 9 Sand capping)	11	-	Mt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**678.20**	**-**	**Mt**	16	19	19	18	18	19	19	18	18	19	18	18	19	18	18	19	19	18	17	17	17	17	18	18	19	19	19	19	18	17	17	18

Figure 1-3 - Mining schedule

2 GEOGRAPHICAL SETTING

2.1 TOPOGRAPHY AND DRAINAGE

The topography of the area is characterised by moderately sloping incised valleys in the north-west, which grades to undulating terrain towards the coastline, with wide valleys representative of floodplains of prominent drainage channels. Surface elevations range between 10 – 130 mamsl. A whaleback ridge crest extends from the Forest Inn area towards the north-eastern boundary, west of the N2, with highpoints at 112 – 125 mamsl (Hatch, 2020). The low-lying coastal plain is separated from the Indian Ocean by an elevated aeolian dune cordon (GCS, 2020).

Port Durnford mine is situated within the Usuthu to Mhlathuze[3] water management area (WMA) and is bisected by two quaternary catchments: W12F (north-east) and W13B (south-west) as indicated in Figure 2-1. Within the W12F quaternary catchment, the perennial Mhlathuze River flows past the northern boundary and its tributaries drain the north-western areas. The perennial Mzingwenya River and its associated tributaries flow along the eastern site boundary from southwest to north-east where it drains into Lake Cubhu.

Within the W13B quaternary catchment, the perennial Amanzamnyama and Ojinjini Rivers and their associated tributaries flow from north-east to south-west within the site boundary and confluences with the Mlalazi River. Another tributary of the Mlalazi River runs further south of this site boundary. The Mlalazi River runs along the southwestern site boundary and eventually drains into the Indian Ocean.

Where the groundwater intersects the land surface in topographical depressions between the coastal dunes, wetlands are likely to occur as shown in the sections through the Siyaya catchment. Significant interflow is likely to contribute to stream flow from sloped land surfaces. Sensitive wetland areas are presented in Figure 2-2.

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[3] Refer to Section 3 for river naming convention

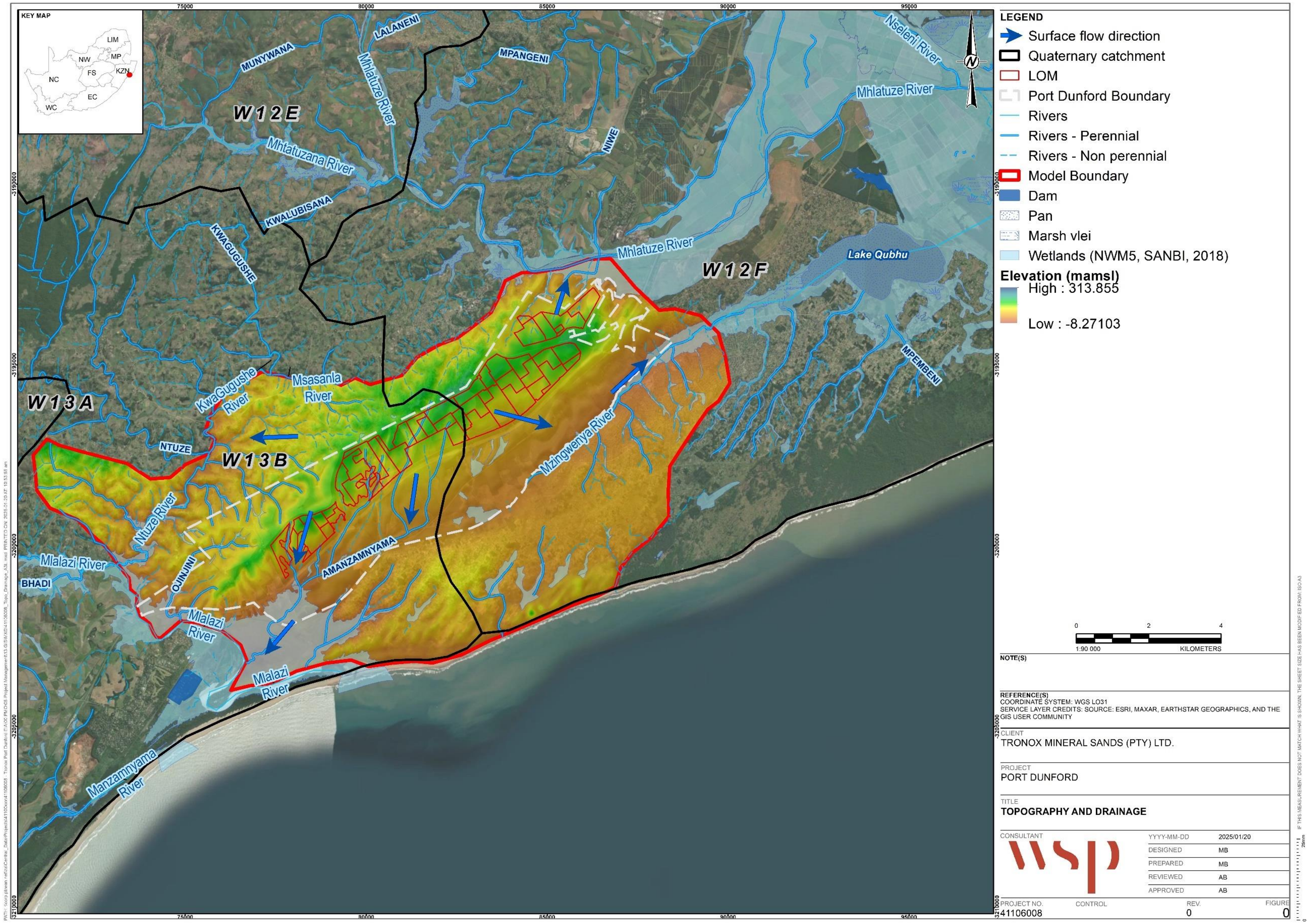

Figure 2-1 - Topography and drainage

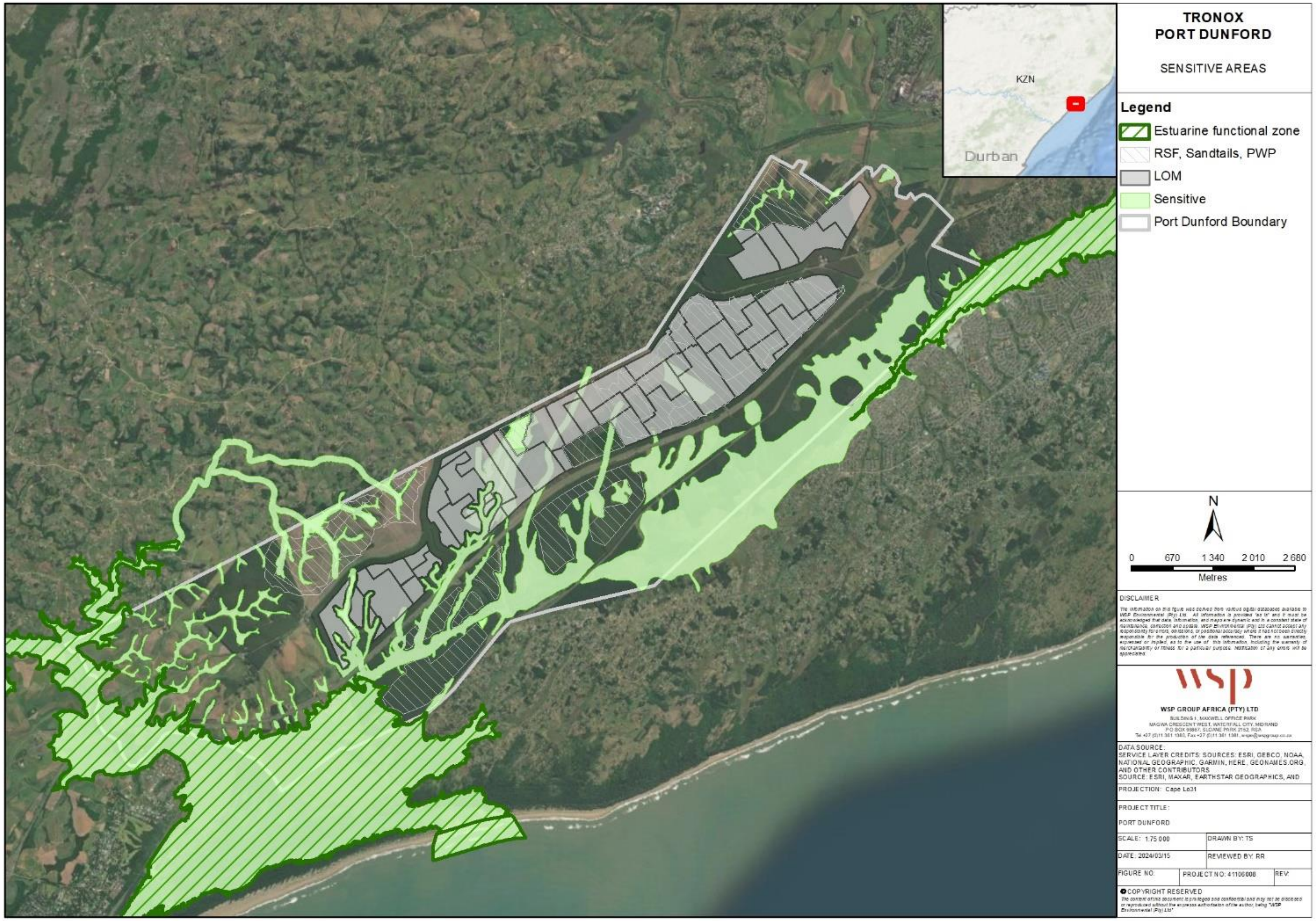

Figure 2-2 – Sensitive wetland areas

2.2 CLIMATE

According to GCS (2020), the area experiences a warm temperate, fully humid climate with hot summers. Temperatures during summer months range between 21 – 28° C and in winter months between 11 – 22 °C. High humidity is experienced in the area within the range of 61 – 88 %. Prevailing winds are mainly northeast and southwest running parallel to the coast (Hatch, 2020).

GCS (2020) noted that the area receives rainfall of between 1 200 – 1 400 mm/a. Historical rainfall data was supplied by Tronox for the SASRI Weather Web station located in Mtunzini, ~5 km south-west of Tronox for the period January 1966 – May 2022. Based on the data received, the area experiences a mean annual precipitation (MAP) of 1 224 mm/a. Figure 2-3 shows the average monthly rainfall for the area between 1966 – 2021. Evaporation ranges between 1 300 – 1 400 mm/a within the project area (Hatch, 2020).

According to Hatch (2020), rainfall occurs through the year, predominantly during the summer months. Extreme rainfall conditions have occurred on several occasions in the region due to tropical cyclones which occasionally move close enough to the coast to produce extensive flooding, causing loss of life and damage to property. The increasing frequency of such events are considered important for future planning and development in the area.

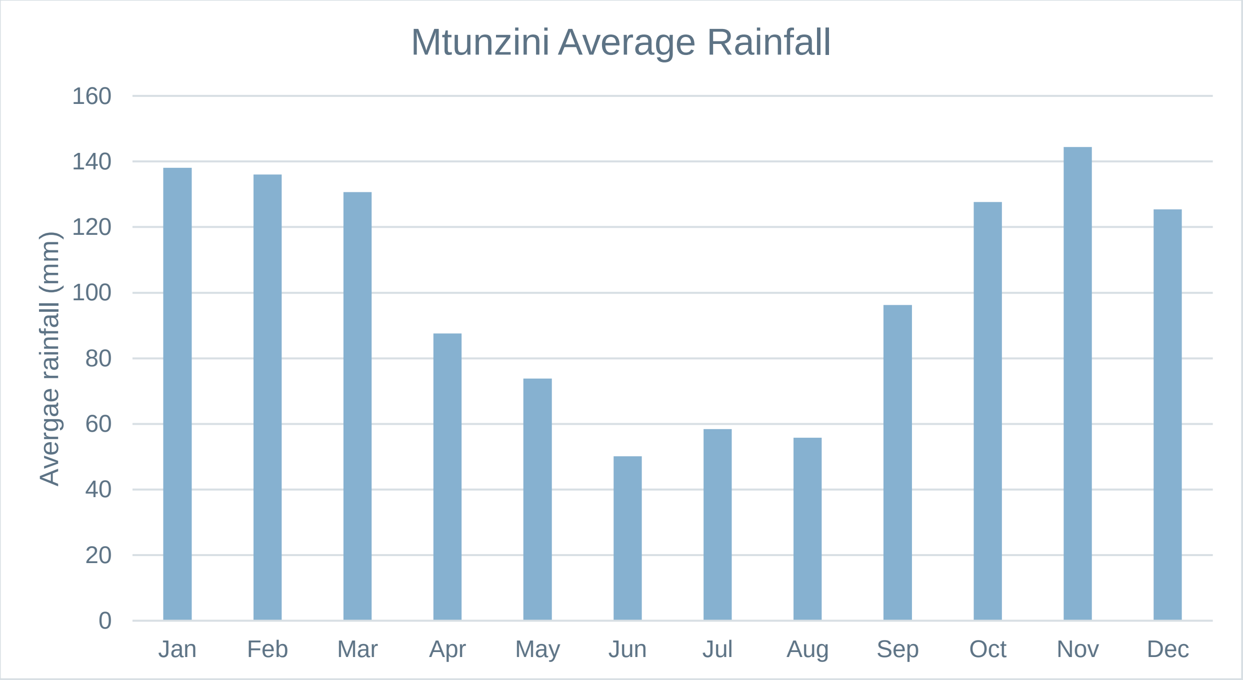

Figure 2-3 - Average monthly rainfall for Mtunzini (1966 - 2021)

3 SCOPE OF WORK

The scope of work includes the following:

- A review of the available information (baseline assessment).
- Hydrocensus conducted in November 2022 including groundwater sampling and analyses.
- Identify data gaps and/or limitations required to inform the R267 report and/or updated groundwater model and impact assessment.

- Numerical modelling and impact assessment (IA) with updates following changes in the mine plan including
  - Development and revision of the groundwater conceptual model/ understanding.
  - Initial groundwater monitoring programme.
  - Qualitative impact assessment.
- Compilation of the groundwater specialist report as informed by the requirements set out by Annexure D.5. of Regulation 267 (R267) of March 2017. for geohydrology specialist, (Government Gazette No. 40713).

Data gaps and limitations

It should be noted that the naming convention followed for the rivers follows the 1:50 000 topographical maps. Lake Cubhu and Qubhu are used interchangeably, as well as uMlalazi and Mlalazi and uMhlathuze and Mhlathuze.

The following limitations were noted as part of the study:

- The study is based on available data and is informed by the hydrogeological reports (refer section 4). Site specific installation of boreholes, borehole logs and aquifer test data were not available other than from the available reports.
- Monitoring borehole information was obtained from the hydrocensus data carried out in previous studies (2017 and 2020) and by WSP in November 2022.
- Water strike and lithological information is not available for the boreholes.
- The study focused on water quality considerations for metals and inorganic species and did not consider additions from anthropogenic sources such as forestry or sewage.
- During the hydrocensus, the detection limits for Cu and Cr were higher than the guidelines for Aquatic and Marine ecosystems. methodology

3.1 DESK STUDY

An information review of existing hydrogeological reports was undertaken to gain an understanding of the hydrogeology and geology of the investigation area. Existing geological, groundwater, and hydrological reports, geological information and maps were studied as part of the information review and formed part of the basis of understanding. The following documents were consulted to provide an understanding of the site hydrogeology, assess impacts and formulate mitigation measures as presented in Table 3-1.

Table 3-1 - Summary of available information and communications

Date	Report reference
August 2024	WSP, August 2024, Port Durnford (EA) Study, geochemistry specialist report.
September 2020	GCS Water and Environmental Consultants, 2020, Baseline Hydrogeological Assessment for the Proposed Tronox Port Durnford Mining Right Area (Final Report). GCS Reference Number: 20-0472.
2020	Hatch, 2020, Tronox KZN Sands (Pty) Ltd – Port Durnford PFS Project Study Report. Report H362603-00000-100-146-0001, Rev. 0.

Date	Report reference
June 2020	SRK Consulting (2020). Tronox Everglades current and proposed RSF and RWD: Surface and groundwater specialist report. Report number 468000/10/Rev1

3.2 HYDROCENSUS

Previous hydrocensus surveys were performed in 2010 (SRK Consulting, 2010), in 2017 (SRK Consulting, 2017) for the area west of the MRA, and in 2020 in the MRA area (GCS, 2020). Thirty-six boreholes were identified in and around the MRA by GCS which included 22 privately owned boreholes, of which 6 (TBH2, TBH4, TBH5a, TBH8, TBH19, and TBH21) were in use, and 12 monitoring wells, of which 2 were dry and one damaged. Approximately 71 boreholes are identified in the National Groundwater Archive (NGA) with several indicated in the same location. The locality of the previous hydrocensus' boreholes and NGA borehole is indicated on Figure 3-1. Photos of the hydrocensus boreholes were included in Appendix A.

A hydrocensus survey was conducted within a 2 km radius of the MRA in November 2022 (Figure 3-2). The survey involved the collection of data from accessible boreholes. GPS co-ordinates, landowners' details, existing equipment, current use, reported yield, measured well depth and static water level were assessed and water levels obtained where accessible. A total of 31 boreholes were identified and visited during the survey of which 20 fall within the MRA (Figure 4-1). The field observations are summarised in Figure 3-1 with further detail provided in Appendix A. The borehole naming convention followed that of the GCS hydrocensus with coordinates within 50 m of the previous census. The previous census information by GCS (2020) is included for reference in Table 4-2. Selected boreholes were sampled and submitted for analyses (refer Section 5.6).

The data was compared to the previous hydrocensus information as follows:

- Of the 71 boreholes identified in the National Groundwater Archive within 2 km of the MRA, only one (2831DD00131) was confirmed during the 2022 hydrocensus (Refer Table 3-2) and was found to be damaged.
- Of the 16 privately owned boreholes identified by GCS, 12 were reassessed with TBH6 and TPH9 confirmed to be in use (not in use in 2020). TBH4 and TBH8 were locked with limited access and are therefore also assumed to still be in use as were TBH5a and TBH19 as these were not included in the 2022 hydrocensus. TBH2 and TBH21 (noted to be in use in 2020) were found to no longer be in use. The locality of boreholes in use are included in Figure 3-1.
- Of the 12 monitoring boreholes identified in 2020, two were still dry/damaged.

Water levels and borehole depths vary from artesian to > 50 mbgl with borehole depths also varying from 1.5-<120 mbgl. Water strike and lithological information is not available for the boreholes.

The hydrocensus data confirms that there are limited groundwater users in the area. Although details of their yields are limited, no large-scale abstraction is taking place.

Other receptors include the sensitive areas namely, the aquatic system as a wetland, the estuaries, and the ocean.

Figure 3-1 – Previous and Current Hydrocensus boreholes

Table 3-2 -Hydrocensus Information

BH ID	Relative location	2022 Hydrocensus: 09-11 November 2022						2020 Hydrocensus; 6 – 10 July 2020 (GCS, 2020)						
		GPS -coordinate[4]		Water Level	BH Depth	Opera-tional	Current Status	Owner Information (GCS, 2020)	Opera-tional	Eleva-tion	Water level information	Borehole Depth	Opera-tional	Comment
		Latitude	Longitude	(mbgl)	(mbgl)	[Yes/No]			[Yes/ No]	(Mamsl)	[mbgl]	[mbgl]	[Yes/No]	
W1	W12F- On Southern boundary and dg of MRA - adjacent to Mzingwenya River	-28.07402	31.89224	2.09	12.14	Mon	Monitoring borehole (Sampled)	Tronox	Mon	16	1.5 (2017) 3.03 (2020)	13	Mon	Monitoring borehole had an Allen key lock and was in good condition
W2	W12F- Inside the Eastern-most portion of the MRA	-28.86715	31.87173	58.55	75.87	Mon	Monitoring borehole.	Tronox	Mon	89	58.9 (2017) 54.85 (2020)	65	Mon	Monitoring borehole had an Allen key lock and was in good condition
W3	W12F-On northern boundary (upgradient)	-28.86645	31.85545		86.88	Mon	Monitoring borehole.	Tronox	No	84	Dry at 45m (2017 & 2020)	45	Mon	Monitoring borehole had an Allen key lock and was in good condition
W4	W12F- Inside the Eastern-most portion of the MRA	-28.87189	31.86835	38.06	61.86	Mon	Monitoring borehole. (Sampled)	Tronox	Mon	89	39.3 (2017) 23.15 (2020)	55	Mon	Monitoring borehole had an Allen key lock and was in good condition
W5	W12F - Within MRA but south of proposed RSF, near topographic watershed but dg of MRA	-28.88717	31.86041	2.87	35.33	Mon	Monitoring borehole. (Sampled)	Tronox	Mon	33	3.78 (2020)	35	Mon	Monitoring borehole had an Allen key lock and was in good condition
W6	W13B - west of topographic watershed within MRA	-28.88597	31.83893	38.11	65.45	Mon	Monitoring borehole.	Tronox	Mon	107	57.05 (2020)	65	Mon	Monitoring borehole had an Allen key lock and was in good condition
W7	W13B - on northern boundary, the KwaGugushe and Msasandla Rivers are to the north.	-28.88943	31.81531	18.53	63.07	Mon	Monitoring borehole. (Sampled)	Tronox	Mon	111	36.46 (2020)	65	Mon	Monitoring borehole had an Allen key lock and was in good condition
W9	W13B - Within MRA on southern boundary near the Amanzamnyama river and near topographic watershed	-28.90648	31.83956			No	Not in use. Destroyed.	Tronox	No		Destroyed (2020)	27	Mon	Monitoring borehole had an Allen key lock and was in good condition
W11	W13B - Within MRA on southern boundary on northern side of Amanzamnyama river and west of W9	-28.91088	31.82568	1.39	25.65	Mon	Monitoring borehole. (Sampled)	Tronox	Mon	25	0.9 (2017) 1.62 (2020)	23	Mon	Monitoring borehole had an Allen key lock and was in good condition
W12	W13B - Within MRA (north-western portion) on northern boundary	-28.90149	31.78862	24.55	56.75	Mon	Monitoring borehole. (Sampled)	Tronox	Mon	59	0.9 (2017) 24.69 (2020)	39	Mon	Monitoring borehole had an Allen key lock and was in good condition
W13	W13B - western portion of the MRA between RSF and sand tail area	-28.90704	31.80481			Mon	Monitoring borehole.	Tronox	Mon	99	73.4- dry at 57 (2017) Dry (2020)	57	Mon	Monitoring borehole had an Allen key lock and was in good condition
W14	W13B - Within MRA on southern boundary on southern side of Amanzamnyama river	-28.93239	31.80258	2.2	20.45	Mon	Monitoring borehole. (Sampled)	Tronox	Mon	11	2.3 (2017) 2.25 (2020)	19.6	Mon	Monitoring borehole had an Allen key lock and was in good condition. Located near plantation
2831 DD001 31	W13B_Inside MRA adjacent to northern boundary near watershed	-25.97568	32.58957	-	5.86	No	Damaged.							Not identified
TBH1	W13B - Inside the mine area just south of W7	-28.89338	31.82102	3.68	32.96	No	Not in use. Pump disconnected.	Siya Qhubeka Forestry	No	57	2.76 (2020)	35	No	Borehole was not locked and did not have a cap or pump installed.

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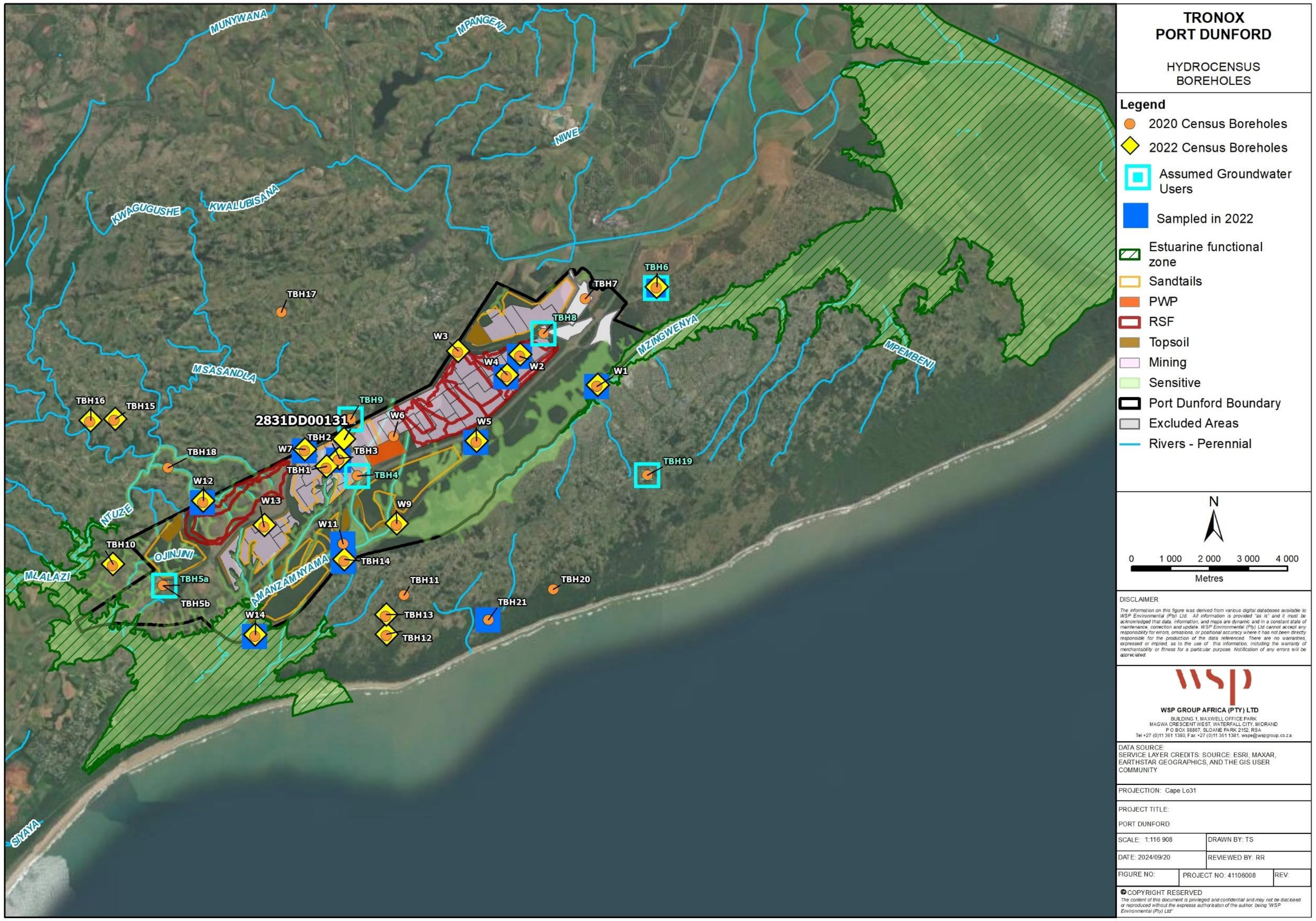
[4] Coordinate based on GPS readings in November 2022. Coordinates are within 50m of previous GCS, 2020 locality. Boreholes not identified in 2022 include the coordinate provided by GCS and are highlighted in grey text. Elevation is as indicated by GCS, 2020

BH ID	Relative location	2022 Hydrocensus: 09-11 November 2022						2020 Hydrocensus; 6 – 10 July 2020 (GCS, 2020)						
		GPS -coordinate[4]		Water Level	BH Depth	Opera-tional	Current Status	Owner Information (GCS, 2020)	Opera-tional	Eleva-tion	Water level information	Borehole Depth	Opera-tional	Comment
		Latitude	Longitude	(mbgl)	(mbgl)	[Yes/No]			[Yes/ No]	(Mamsl)	[mbgl]	[mbgl]	[Yes/No]	
TBH2	W13B - Inside the mine area south of W7 and east of TPH1 and next to TPH3	-28.89146	31.82438	8.91	65.43	No	Not in use. Pump disconnected. (Sampled)	Siya Qhubeka Forestry	**Yes**	65	NA (2020)	Unk	Yes	Submersible pump. Supplied water to the staff houses at Siya Qhubeka Forest. Locked pump house.
TBH3	W13B - Inside the mine area south of W7 and east of TPH1 and next to TPH2	-28.89145	31.82434	8.84	51.8	No	Not in use. Pump disconnected.	Siya Qhubeka Forestry	No	61	NA (2020)	Unk	No	Historically supplied water to the staff houses (Submersible pump). Replaced by TBH2 when borehole collapsed.
TBH4	W13B - Inside the mine area east of TPH1 and next to TPH2	-28.89508	31.82931			**Yes**	Locked.	Siya Qhubeka Forestry	**Yes**	64	NA (2020)	Unk	Yes	Locked and protected by housing. Submersible pump installed.
TBH5a	W13B- West of mine but within the MRA - SW of RSF	-28.92081	31.77874			Assumed Yes	Not included in 2022 hydrocensus	Waterloo farm	Yes	49	NA (2020)	30	Yes	Protected by steel housing. Access to the borehole was granted by the farm owner. Submersible pump installed with yield estimated as 0.83- 1.11 L/s assumed
TBH5b	As above	-28.92082	31.7784				Not included in 2022 hydrocensus	Waterloo farm	No	49	8.19 (2020)	30	No	Located next to TBH5a and protected by a pump house. The farmer mentioned submersible pump equipment from borehole was stolen
TBH6	W12F - Outside MRA to the east	-28.85128	31.90754			**Yes**	In use. Potable water, irrigation and drinking. Hand pump installed. No access. (Sampled)	Community	No	79	NA (2020)		No	Previously used by community as a source of domestic water supply (hand pump). Plots close to borehole 2831DDG4380 on GRIP Database, which reports a depth of 63 mbgl and yield of 0.42 L/s.
TBH7	W12F - Within MRA Eastern boundary	-28.85387	31.88891	10.44		No	Not in use. Pump disconnected.	Jocks Farm	No	36	13.5 (2020)	Unk	No	Pump house was in dense grass inside the forest (approximately 20m into the forest). Equipment had been removed from the borehole.
TBH8	W12F - Within MRA between the sand tails and proposed RSF	-28.86188	31.87807			**Yes**	Locked. Assumed to be use based on previous hydrocensus	Unknown	**Yes**	117	NA (2020)	50	Yes	Locked with a bolt and nut. The borehole was located next to the Vodacom tower opposite Mhlathuze water reservoirs.
TBH9	W13B - just outside northern boundary and west of topographic watershed (north of W6).	-28.882	31.8275			**Yes**	In use. Potable water, irrigation and drinking. (Sampled)	Community	No	87	NA (2020)	Unk	No	The borehole hand pump was broken.
TBH10	W13B-NW of mine - outside the mine area	-28.91631	31.76503			No	Not in use. Damaged.	Savalela	No	28	1 (2020)	30	No	The borehole was in a sugarcane field. The borehole does not have a cap and was not protected. Historically equipped with a submersible pump.
TBH11	W13B-Outside and to the south of the mine area between the mine area and the coastline (TPBH11, 12 and 13 near each other)	-28.9226	31.84184			No	Not included in 2022 hydrocensus	Community	No	60	Blocked (2020)	Unk	No	The hand pump was removed (stolen) and the borehole was blocked at1.2 m. Plots close to borehole 2831DD00144 on NGA Database.
TBH12	W13B-Outside and to the south of the mine area between the mine area and the coastline (TPBH11, 12 and 13 near each other)	-28.93206	31.83714			No	Not in use. Blocked.	RBM	/	32	NA (2020)	Unk	/	Borehole RBM16 of Zulti South. PVC Casing filled with sand. No access for water level.
TBH13	W13B-Outside and to the south of the mine area between the mine area and the coastline (TPBH11, 12 and 13 near each other)	-28.92756	31.83699			No	Not in use. Damaged.	Unknown	No	33	Blocked (2020)	68*	/	Located inside rusted housing and blocked at 3 mbgl. Plots close to borehole 2831DDG2852 on GRIP Database, with a yield of 1.11 L/s, depth of 68 mbgl and water level of 37.4 mbgl in 1995.

BH ID	**Relative location**	**2022 Hydrocensus: 09-11 November 2022**						**2020 Hydrocensus; 6 – 10 July 2020 (GCS, 2020)**						
		GPS -coordinate[4]		**Water Level**	**BH Depth**	**Opera-tional**	**Current Status**	**Owner Information (GCS, 2020)**	**Opera-tional**	**Eleva-tion**	**Water level information**	**Borehole Depth**	**Opera-tional**	**Comment**
		Latitude	**Longitude**	**(mbgl)**	**(mbgl)**	**[Yes/No]**			**[Yes/ No]**	**(Mamsl)**	**[mbgl]**	**[mbgl]**	**[Yes/No]**	
TBH14	W13B - Within MRA on southern boundary on northern side of Amanzamnyama river and west of W9	-28.91486	31.8259	-0.29	1.52	No	Not in use. Artesian conditions. (Sampled)	Unknown	No	25	0 (2020)	10	/	Located next to an old power station near railway. Artesian. Plots close to borehole 2831DD00139 on GRIP and NGA database, which was reported to be located at a sawmill and used for domestic water supply.
TBH15	W13B - outside and to the north of the Msasandla River	-28.88267	31.76535			No	Not in use. Pump disconnected.	Unknown	No	73	NA (2020)	157*	No	Located on church premises but mono-pump not working. Plots close to borehole2831DDG4368 on GRIP Database, with a depth of 157 mbgl and yield of 0.67 L/s.
TBH16	W13B - outside and to the north of the Msasandla River	-28.88308	31.75885			No	Not in use. Hand pump broken.	Community	No	71	NA (2020)	120*	No	Located in an open area. Hand pump not working. Plots close to BH 2831DDG4382on GRIP Database, with a depth of 120 mbgl, water level of 25 mbgl in 1995 and yield of 2.83 L/s.
TBH17	W13B - outside and to the north of MRA west of the watershed	-28.85741	31.80899			No	Not in use. Pump disconnected.	Community	No	77	NA (2020)	Unk	No	Borehole not operating and handpump was removed. Plots at BH 2831DD00154 on GRIP and NGA Databases, with a yield of 1.1 L/s.
TBH18	W13B - outside and between the Msasandla River and the northern boundary of the MRA	-28.89353	31.77943				Not included in 2022 hydrocensus	Community	No	79	NA (2020)	*97**	No	Hand pump was broken. Plots close to BH 2831DDV1227 on GRIP Database with a depth of 97 mbgl and water level of 7.8 mbgl in1998
TBH19	W12F - Outside MRA Between the Mzingwenya River (coincident with southern boundary of MRA) and Coastline	-28.89442	31.90556			Assumed Yes	Not included in 2022 hydrocensus	Community	**Yes**	34	NA (2020)	*Unk*	Yes	The borehole had a hand pump. The Borehole was located behind Zulti South Site Office.
TBH20	W12F - Outside MRA South of Mzingwenya River near the coastline	-28.92106	31.88103				Not included in 2022 hydrocensus	RBM (Zulti South)	No	20	NA (2020)	*20**	/	Located at Zulti South Offices but gate locked. Plots at borehole 2831DDV1458 (RBM13) on GRIP Database, with a depth of 20 mbgl. Also plots close to BH2831DDV1457 (RBM12) with a depth of 15 m.
TBH21	W12F - Outside MRA South of Mzingwenya River near the coastline	-28.92814	31.86408	0.58	3.23	No	Unknown. Likely not in use. (Sampled)	RBM (Zulti South)	**Yes**	18	0.41 (2020)	4 (18*)	Yes	Located next to a wetland with datalogger installed and was locked with bolt and nut. Borehole had collapsed as original depth was reported to be18 mbgl on GRIP Database borehole 2831DDV1459 (RBM14).



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DATA SOURCE:
SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

Figure 3-2 – Hydrocensus boreholes (2020 & 2022)

3.3 GEOPHYSICAL SURVEY AND RESULTS

Geophysical surveys were not available but there are existing monitoring boreholes available to inform the baseline.

3.4 DRILLING AND SITING OF BOREHOLES

Borehole information is limited to hydrocensus boreholes and historic reports. The existing monitoring network consists of twelve (12) monitoring boreholes of varying depths with two dry (W3 and W13) and one damaged (W9), Refer Table 3-1and Figure 3-1.

3.5 AQUIFER TESTING

No field tests were conducted during this investigation; therefore, the hydraulic conductivity data reported by GCS (2007b) is evaluated. GCS (2007b) evaluated permeability data for the greater study area based on existing data contained in the public domain, other studies performed by GCS in the area and grain size distribution data for run of mine and tailing samples at the Fairbreeze and Hillendale Mines.

Table 3-3 presents a wide range of hydraulic conductivities obtained for the aquifers during previous studies, which can be attributed to the large variation of deposit grain size and distribution. The hydraulic conductivity of the unconsolidated deposits can vary substantially and depends on the clay content of the material (SRK Consulting, 2011). The expected range of hydraulic conductivity of the shallow aquifer is in the order of 0.1 to 10 m/day. According to WR2012 (2012), transmissivity values up to 100 m^2/day is recorded for the project area.

The saturated hydraulic conductivity of secondary aquifers within the study area varies between 0.001 to 0.1 m/day. Larger hydraulic conductivity values are associated with dolerite contacts and fault zones (GCS, 2019). According to SRK Consulting (2011), hydraulic conductivities in the order of 3.7 m/day have been recorded for the secondary aquifer.

Table 3-3 - Hydraulic Conductivity of aquifers within the Maputaland Group sediments

Source	Hydraulic Conductivity (m/d)				Comment
	Pump tests		Laboratory Test	Other/not known	
	Drawdown Test	Recovery Test			
Pumping test – GCS4S Zulti South EMPR – Groundwater study (GCS, 2020)	0.9	0.9			Fine-grained sands of the KwaMbonambi Formation. Aquifer 20 metres thick.
Pumping test – GCS6S Zulti South EMPR – Groundwater study (GCS, 2020)	0.3 (GCS6A – 3 metres away)	0.2 – Theis recovery			Fine to coarse grained ands of the KwaMbonambi/Kosi Bay Formations. Aquifer 14 metres thick.
Report to Richards Bay Minerals on the geology and geohydrology of the Zulti South lease area for the purposes of complying with the minimum requirements for the rehabilitation programme (Davies Lynn & Partners, 1993)				26	Cover sand – Sibayi Formation
Landform geomorphology and geology (Davies, Lynn & Partners, 1992)			13-26		Cover sand – Sibayi Formation
			0.83-0.88		Older cover sands – KwaMbonambi Formation
			7.5		Low clay fraction Port Durnford sands – (Upper Port Durnford Member) Kosi Bay Formation
			0.11-0.59		Yellow to Grey Port Durnford sand
KwaZulu Natal geohydrological mapping project mapping unit 7 (Meyer et al., 1994)			15.6		Cover sand – Sibayi Formation
			0.87		Older cover sands – KwaMbonambi Formation
			4.3		Port Durnford and Kosi Bay Formations
Specialist study on hydrology and water quality (Iscor Heavy Minerals Project KwaZulu Natal) (Kelbe & Rawlins, 1996)			4 (2 – 8)		Unconsolidated sands (Sibayi and KwaMbonambi Formations)

Source	Hydraulic Conductivity (m/d)				Comment
	Pump tests		Laboratory Test	Other/not known	
	Drawdown Test	Recovery Test			
Geohydrological studies of the primary coastal aquifer in Zululand (Kelbe et al., 2016)				25	Upper Arenaceous layer (probably Sibayi, KwaMbonambi and Kosi Bay Formations)
				0.3-2.5	Argillaceous layer (probably Port Durnford)
Block P Pre-Feasibility Study – Hydrogeological Study. Hydraulic conductivities calculated using grain size distribution data				0.1 – 0.2	Fairbreeze (run of mine)
				0.3 – 0.7	Fairbreeze (sand tail)
				12.1 – 26.4	Hillendale (sand tail)
Fairbreeze Mine Integrated Water Use License Application Hydrogeological Assessment (SRK Consulting, 2011)				0.11 - 26	Based on studies by Kelbe et al (2001), Rison (2004) and SRK (2005)
Fairbreeze Mine Numerical Model (SRK Consulting, 2020)				10	Hydraulic conductivity attributed to dunes in numerical model.

3.6 SAMPLING AND CHEMICAL ANALYSIS

Groundwater samples were collected during the hydrocensus survey of existing boreholes to determine the current groundwater conditions. The sampling was undertaken as per WSP's standard sampling procedure and samples were submitted to a SANAS accredited laboratory (Element Materials Technology Laboratory)[5] for chemical analysis.

The analytical suite for water samples included major cations (sodium, potassium, magnesium and calcium), major anions (chloride, fluoride, sulfate, nitrate, total alkalinity and cyanide), physico-chemical parameters (pH, electrical conductivity, Total Dissolved Solids (TDS)), and metals such as iron, aluminium, copper, lead and zinc as determined by ICP-OES).

This information is assessed and reported in Section 5-6.

3.7 GROUNDWATER RECHARGE CALCULATIONS

Groundwater recharge was assumed from the available information as 10 – 17% of the mean annual precipitation, GC, 2020. An overall reduction in recharge is expected from the coast towards the inland areas.

3.8 GROUNDWATER MODELLING

Groundwater modelling has been carried out as part of this study, the results of which are included in Section 7.

3.9 GROUNDWATER AVAILABILITY ASSESSMENT

Large areas of Port Durnford are currently under commercial forestry, leased by Mondi and owned by the Phalani Community Trust. Therefore, forestry is the main groundwater use in the area. During mining, Mondi will move out of the area and the plan is that they will re-establish forestry plantations after mining. Based on the hydrocensus, groundwater use is generally for local domestic, irrigation, stock watering and firefighting.

According to the Aquifer Classification of South Africa (DWAF, 2012) the groundwater yield is between 0.5 L/s and 2 L/s which is consistent with the information obtained by GCS from the GRIP and NGA data.

4 PREVAILING GROUNDWATER CONDITIONS

4.1 GEOLOGY

4.1.1 REGIONAL GEOLOGY

A geological map of the area is provided in Figure 4-1. According to the 1:250 000 Geological Map Series 2830 Dundee and GCS (2020), lithologies of the of the Natal Metamorphic Province outcrop

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[5] Element's South Africa-based environmental laboratory extends SANAS ISO/IEC 17025 accreditation (February 2018)

west and north of the Port Durnford mining area and consist mainly of ultramafic rocks and gneiss. This is overlain by sedimentary rocks of the Natal Group which outcrop in the north-west and south-west. This is in turn overlain by shales and sandstones of the Ecca Group, Karoo Supergroup which are found south-west of the site. Rocks of the Ecca Group are finally overlain by Quaternary deposits of the Maputaland Group which form the coastal dune deposits in the area.

Geological Structures

Thrust faults trending predominantly west to east are observed to the west of the MRA (Figure 5-1) the most notable include:

- The Mhlatuze fault which trends in a W – E direction to the northwest whilst the Mlalazi Fault extends in a westerly direction along the valleys of the Mlalazi and Ntuze Rivers and marks the down faulted southern boundary of the Ngoye Horst. The displacement along the fault decreases from east to west (Golder, 2014).
- The Matigulu Group and Buhleni Gneiss are juxtaposed and repeat as a series of nappes along northeast – south-west aligned thrust faults towards the west and south, known as the Ngoye Horst. These rocks dip steeply (~70°) towards the south (GCS, 2020).
- The Mlalazi and Mhlatuze faults underlie the mineralized sands of the Zulti South lease area. As a result of the geological structures, groundwater is localized along fault and weathered zones towards the west. At Tronox and the area along the coast, the more recent thick sedimentary rocks post-date and cover these geological structures (Golder, 2014).

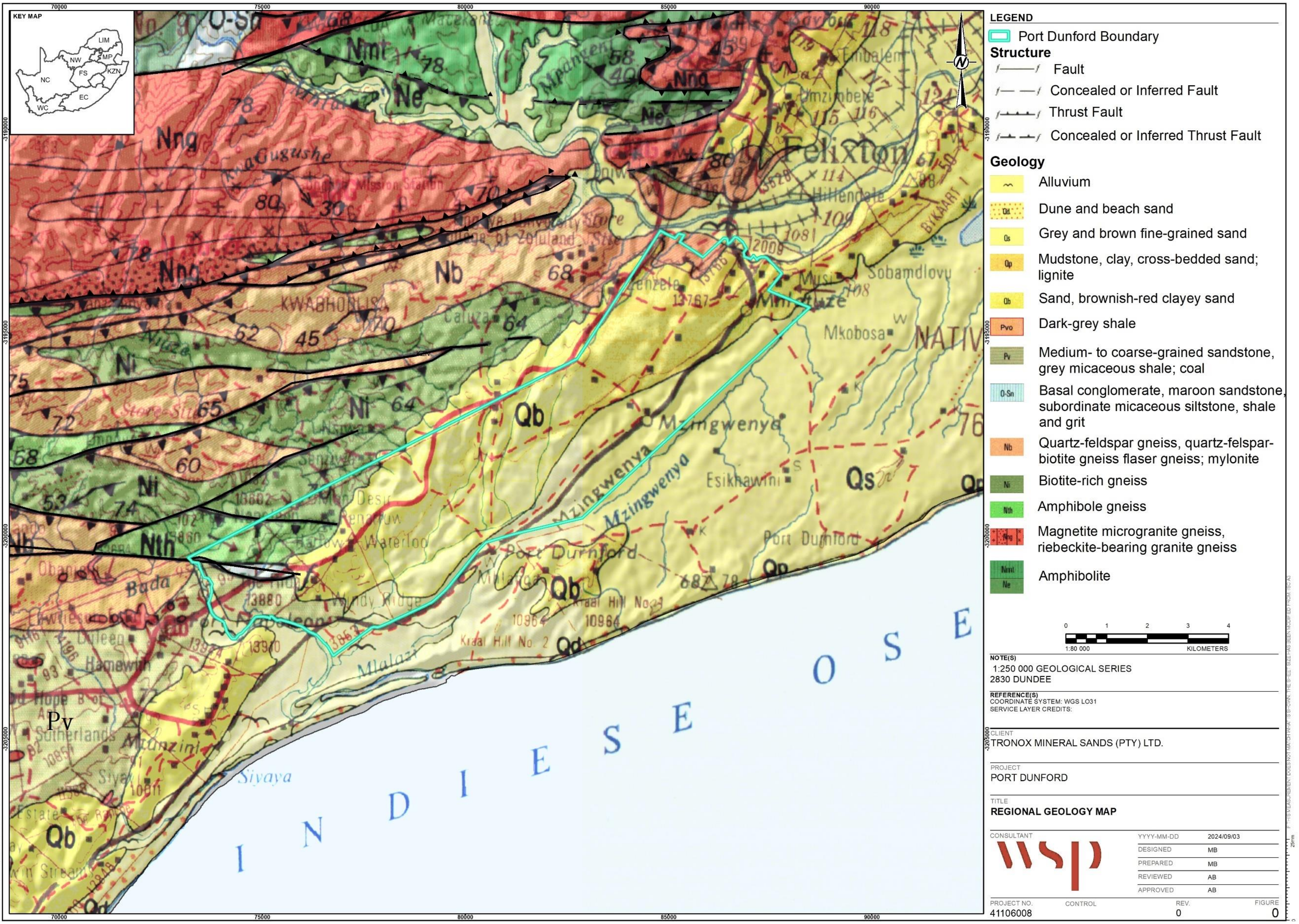

Figure 4-1 – Geological map

4.1.2 LOCAL GEOLOGY

Lithologies of the Matigulu Group and Buhleni Gneiss of the Natal Metamorphic Province mainly consisting of ultramafic rocks, amphibolite gneiss, biotite gneiss and quartz-feldspathic gneiss outcrop in the west and north of Port Durnford and form the base of the succession.

A small outcrop of the Natal Group consisting of basal conglomerate, sandstone, siltstone, and shale occurs in the southwest. The Ecca Group outcrops south of this and comprises medium to coarse grained sandstones, micaceous shale, and coal. Dolerite dykes and sills are found as intrusions in the rocks from the Ecca Group.

The bedrock layers are overlain by deposits of the Maputaland Group (summarized in Figure 4-2). The basal contact with granitoid rocks has a mean elevation of 76 mamsl, whilst the contact in the eastern portion occurs at ~15 mamsl. The thickness of the Maputaland Group may be more than 50 m thick (GCS, 2020).

The tertiary Uloa and Umkwelane Formations form the base of the Maputaland Group. The Umkwelane Formation is overlain by Berea-type red sands. This is in turn overlain by the quaternary Port Durnford Formation which comprises calcarenite at the base, fossiliferous mudrock as well as beachrock, coral-bearing coquina and lignite. Throughout the thickness of the Port Durnford deposit, heavy minerals are deposited. Mineralization gradually decreases with depth (GCS, 2020).

The Kosi Bay Formation overlies the Port Durnford Formation and is in turn overlain by Berea-type red sands. According to Hatch (2020), the Port Durnford deposit is covered by the Berea Type Red Sands. The KwaMbonambi Formation lies east of the Port Durnford prospecting area, which is characterized by a low-lying coastal plain. The dunes in this Formation are approximately 10m thick and are non-calcareous. Further towards the coast, dunes of the Sibayi Formation occur with an average thickness of ~10m (GCS, 2020).

Mining

It is understood that mining will occur within the sands that form the ore body present on site. The Port Durnford deposit (~20–25 m thick) is covered by Berea-type red sands has been de-calcified by leaching and the feldspars have been kaolinized. The red color of the sands is a result of pigmentation due to decomposition of the ferromagnesian minerals. Mineralization in the dune is erratic (vertically and laterally) but is more concentrated in the upper horizons of red sands (Hatch, 2020). The ore body is reasonably large by mineral sands standards (1 billion tons of mineral resources) (GCS, 2020).

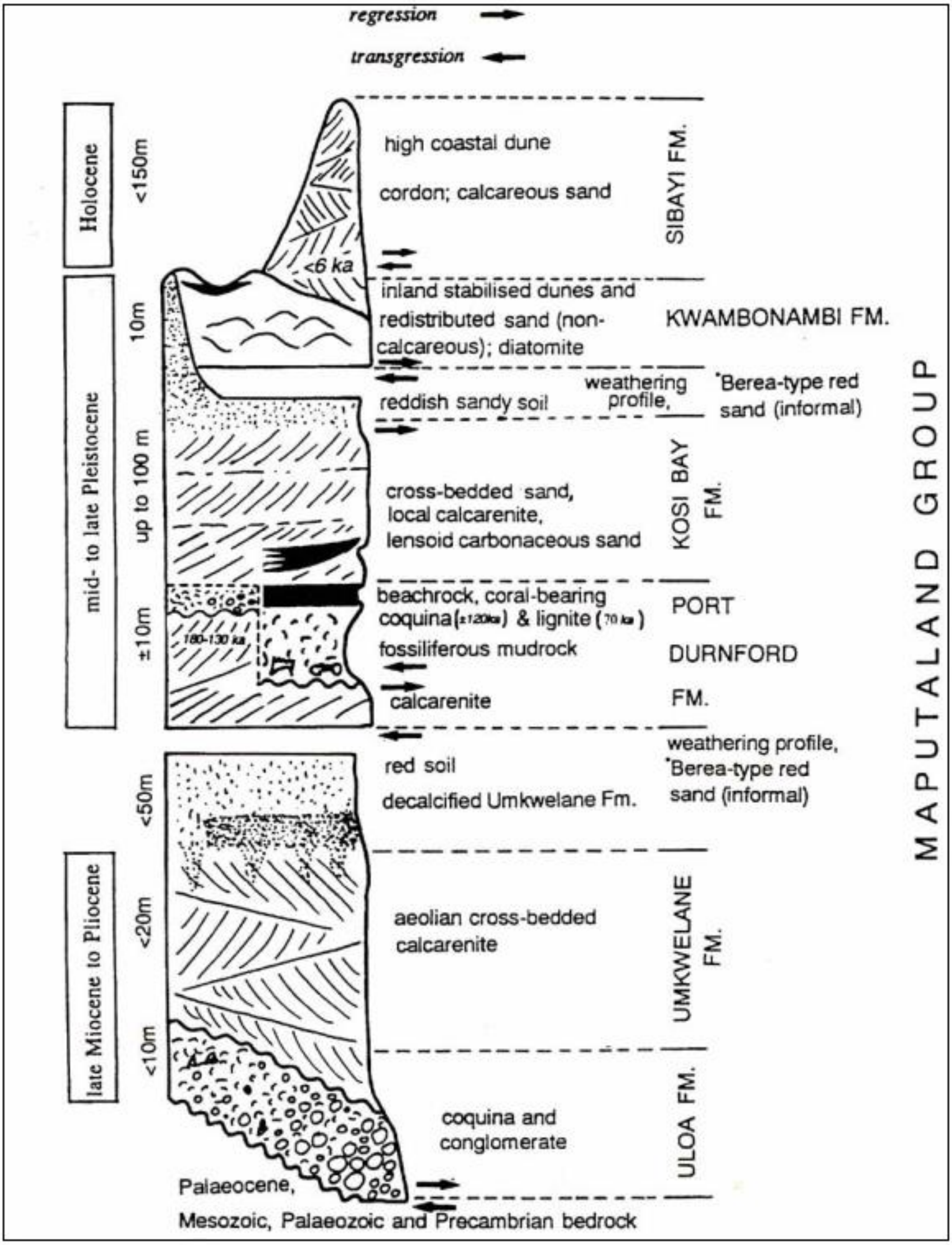

Figure 4-2 - Simplified stratigraphy of the Zululand coastal region (Botha 1997))

4.2 ACID GENERATION CAPACITY

Acid mine drainage conditions are not anticipated to be generated within the mining areas (WSP, 2024b).

4.3 HYDROGEOLOGY

The hydrogeological units can be characterized by a primary intergranular aquifer which is hosted within the coastal dune deposits as well as a secondary intergranular and fractured aquifer within the sedimentary and metamorphic rocks. Both aquifers are low to moderate yielding with yields between 0.5 – 2 L/s (GCS, 2020).

4.3.1 UNSATURATED ZONE

The unsaturated zone varies across the site, encompassing the zone above the water table. The unsaturated zone is thin closer along the drainage lines where the depth to groundwater table is shallow (1.39 m thick in W11), compared to 58.55 m thick in W2. There is limited hydraulic information available for the unsaturated zone.

4.3.2 SATURATED ZONE

The saturated zone encompasses the section below the water table. The saturation within the intergranular aquifer is high relating to porosity of the overburden compared to the fractured aquifer. Within the fractured secondary aquifer, water saturation is limited to the fractures.

The hydraulic characterisation of the saturated zones (shallow and deep aquifers) is detailed in the subsequent section.

4.3.3 HYDRAULIC CONDUCTIVITY

Primary aquifer

The primary intergranular aquifer is unconfined and hosted in undifferentiated coastal deposits of the Maputaland Group and alluvium deposited within Mlalazi and Mhlathuze River systems. This aquifer is a source of water for rivers, lake and most wetlands during dry periods and is recharged by these systems in wet periods. Groundwater discharge zones in areas below 50 mamsl support permanent wetlands and swamps (GCS, 2020). Hydraulic conductivities of this aquifer can range between 0.1 – 10 m/d whilst transmissivity value up to 100 m2/d have been recorded (GCS, 2020). The shallow and deep aquifers noted within the study area are characterised (GCS, 2020) as the primary intergranular aquifer. GCS (2020) also mentions the primary coastal aquifer located along the coastline.

Secondary aquifer

The secondary intergranular and fractured aquifer is hosted within mainly argillaceous rocks of the Karoo Supergroup and mainly meta-arenaceous rocks of the Natal Metamorphic Province. The weathered and intergranular portion of the aquifer is ~10 – 15 m thick, whilst the fractured portion is ~ 150 – 170 m thick. The thrust faults in the western and southern portions of the site play an important role in terms of storage and flow of groundwater given their potential to act as preferential flow pathways or barriers. This is also anticipated from dolerite intrusions with the Karoo Supergroup. The saturated hydraulic conductivity for this aquifer within the study area varies between 0.001 – 0.1 m/d, with higher values anticipated for the dolerite contact and fault zones. SRK (2011) noted hydraulic conductivities in the order of 3.7 m/d (GCS, 2020).

4.4 GROUNDWATER LEVELS

The results from the hydrocensus are summarised in Figure 3-2and Table 3-2.

The data was evaluated to provide an understanding of depth to groundwater level across the study area. The groundwater level ranges, and borehole depths vary from artesian conditions to 58.55 meter below ground level (mbgl), with a median of 8.2 mbgl. The water level (0-4 mbgl) and borehole depth (1.5 - 35 mbgl) is generally shallower (< 4 mbgl) in the boreholes in or near the sensitive estuarine zones (W1, W5, W11, W14, TBH10, TBH14) and on the coastline (TBH21 and TBH20) with water levels otherwise generally <25 mbgl (8 – 24.5 mbgl) such as in W7, W12, TBH2, TBH3, TBH7 and previously TBH5 and TBH18. Three boreholes (W2, W4, W6) have water levels at depths greater than 38 mbgl (38 – 58.55 mbgl). W3 and W13 are dry.

Water levels are generally similar (within 3 m) in the shallower boreholes (water levels <25 mbgl) as compared to 2017 and 2020 except for W7 which reported 36.5 mbgl in 2020 and 18.5 mbgl in 2022. The deeper boreholes (water level >38 m) were also variable particularly W3 (23.1 – 38.1 in 2020 and 2022 respectively) and W6 (57.05-38.1 mbgl in 2020 and 2022 respectively).

A groundwater level map was generated based on water level data recorded from the hydrocensus survey to illustrate the inferred groundwater flow direction distribution of the water level data (Refer Figure 4-4). It is evident that the groundwater flow direction is towards the rivers and ocean, mimicking the surface topography.

There is a strong correlation between the water levels and topography at the lower elevations (shallow boreholes), but the boreholes at higher elevations (W2, W4, W6. W7 and W12 which represent the deeper aquifer) do not show a strong correlation (Table 4-3).

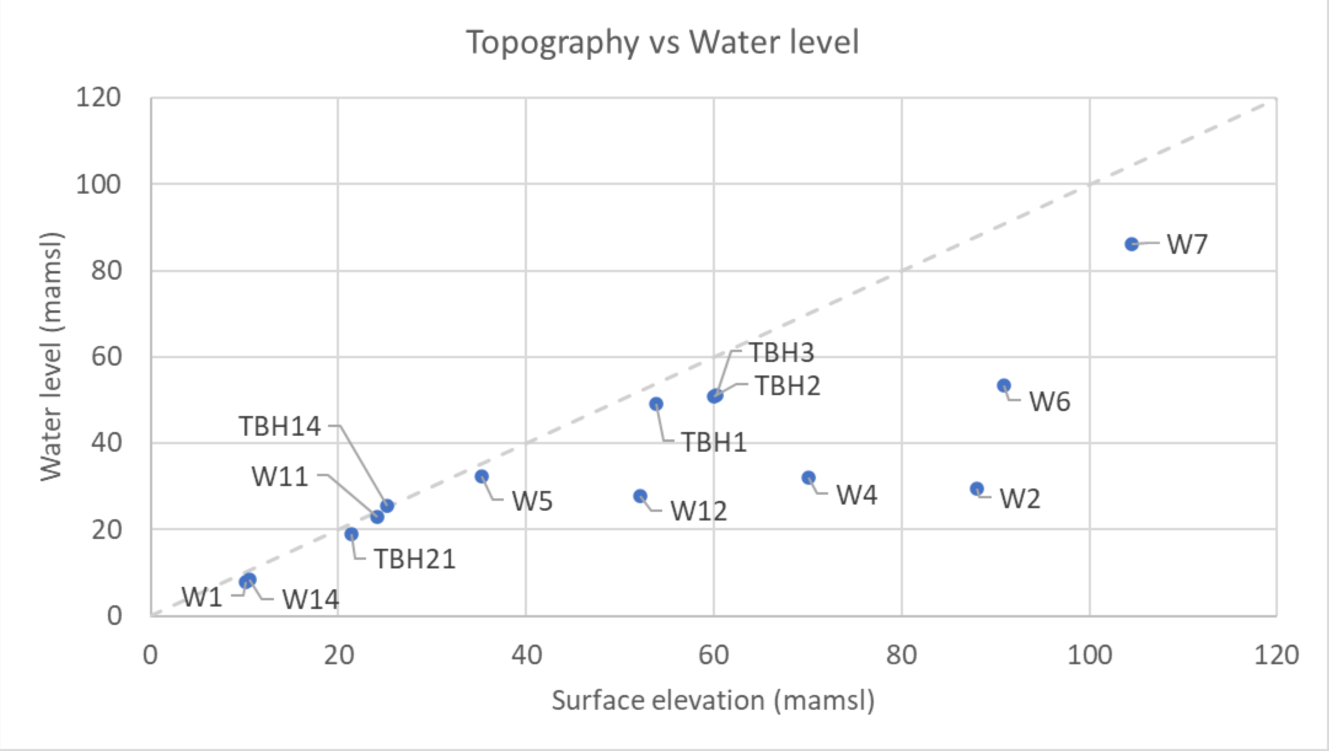

Figure 4-3 - Topography vs water level

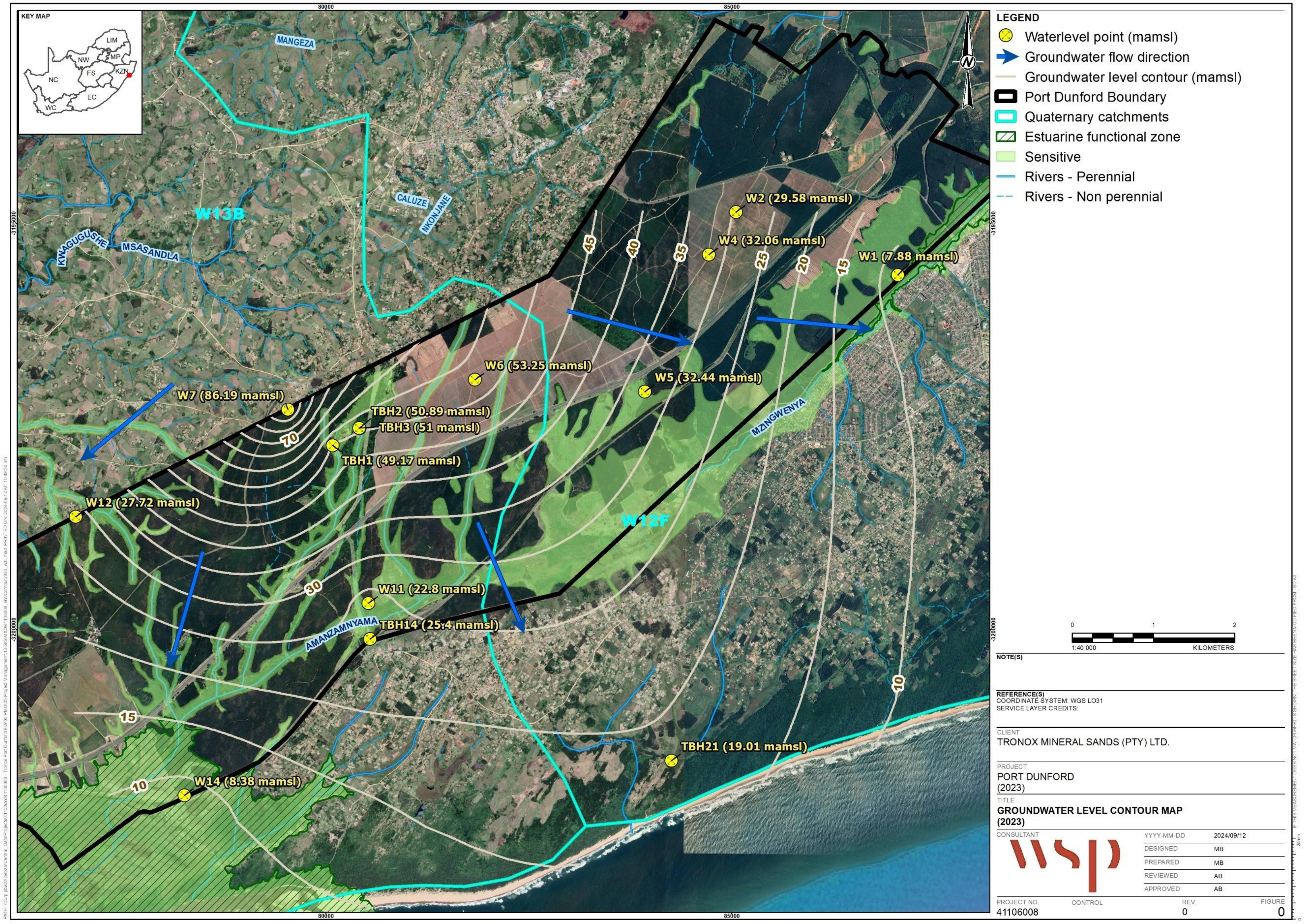

Figure 4-4 - Groundwater level from November 2022 hydrocensus

4.5 GROUNDWATER QUALITY

Groundwater quality was obtained for selected boreholes in November 2022. The results of the groundwater quality testing for the samples obtained during the was compared to the following guidance:

- The ambient groundwater quality as characterised by GCS (2020) represents the water quality range for boreholes sampled in 2020 within the shallow and deeper primary aquifer along the coastline. The water quality as reported by GCS (2020) is included for reference in Appendix B.
- The Department of Water Affairs and Forestry (DWAF) Quality of Domestic Water Supplies Volume 1: Assessment Guide, Second Edition, 1998 (Refer Table 5-1) provides a mechanism to classify the water quality in terms of its suitability for domestic use but it should be noted is not applicable for monitoring boreholes that are not in use. The water quality range for Class 1 and Class 4 is included for comparison in Table 4-1.
- South African National Standard: Drinking water (SANS 241-1), 2015 is included for reference in Table 5-2 where red text is used to indicate where concentrations are elevated above this limit. SANS 241:2015 refers to standards for treatment of water for drinking water.
  - The Operational limit (O) refers to concentrations above which affect the efficient operation of treatment systems and risks to infrastructure.
  - Aesthetic (A) refers to a determinant that taints water with respect to taste, odour or colour and that does not pose an unacceptable health risk if present at concentration values exceeding the numerical limits specified.
  - Acute health (AH) refers to a determinant that poses an immediate unacceptable health risk if present at concentration values exceeding the numerical limits specified.
  - Chronic health (CH) refers to determinant that poses an unacceptable health risk if ingested over an extended period if present at concentration values exceeding the numerical limits specified.

Table 4-1 – DWAF Water Quality Classes (1998)

Class	Description	Drinking health effects
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects
Class 2	Marginal water quality, water suitable for short-term use only	May be used without health effects by majority of users but may cause effects in some sensitive groups. Some effects possible after lifetime use.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children and the elderly. May be used for short-term emergency supply with no alternative supplies available.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use.

Table 4-2 shows the water quality data obtained from the November 2022 analysis.

Table 4-2 - Groundwater quality (Hydrocensus: November 2022)

	Sample ID	SANS 241:2015	Class 1	Class 4	Ambient	W14	W11	TBH14	W5	W1	Ambient	TBH21*	Ambient	W12	W7	TBH2	TBH9*	TBH6*	W4
Aquifer					Shallow aquifer						Coastline aquifer		Deeper aquifer						
Water level (mbgl)						2.2	1.39	0	2.87	2.09		0.58		0	18.53	8.91			38.06
Catchment						W13B	W13B	W13B	W12F	W12F		W12F		W13B	W13B	W13B	W13B	W12F	W12F
pH	pH units	5-9.7	9.5-10	>11	6.8-9.3	8.53	8.72	7.28	8.74	7.81	7.1-7.6	6.77	7.9-8.2	8.38	7.94	7.51	7.66	6.45	8.73
EC	mS/m	170 (A)	70-150	>520	31-51	42.4	28.3	35	29.1	44.2	68-105	48.6	44-60	52.3	51	27.4	40.1	26.1	46.4
TDS	mg/L	1200 (A)	450-1000	>3400	182-296	188	163	199	129	240	370-556	320	242-296	186	278	177	247	155	164
NO_3 as N	mg/L	11 (AH)	"6-10	>40	0.1-0.4	<0.05	<0.05	0.07	<0.05	1.02	<0.14	<0.05	<0.04	0.45	<0.05	0.79	0.20	<0.05	0.43
SO_4	mg/L	250 (A), 500 (AH)	200-400	>1000	0.3-5	3.2	3.2	0.7	3.2	3.2	0.4-33	<0.5	2-5	3.2	25.9	7.2	45.5	3.2	3.4
Cl	mg/L	300 (A)	100-200	>1200	39-99	103.6	36.8	33.3	40.5	44.9	145-173	96.2	73-79	75.8	30.5	33.1	60.6	55.3	45.9
F	mg/L	1.5 (CH)	0.7-1.0	>3.5	0.1-0.5	0.6	0.4	<0.3	0.4	<0.3	<0.3	<0.3	0.1-0.2	<0.3	0.5	0.3	<0.3	<0.3	<0.3
P	mg/L	-	-	-		<0.005	0.027	0.005	<0.005	<0.005		<0.005		<0.005	0.022	0.068	<0.005	<0.005	<0.005
T Alk as $CaCO_3$	mg/L	-	-	-	22-160	44	80	112	84	136	30-231	80	52-166	132	184	76	48	48	156
Ca	mg/L	-	-	-	1-33	2.2	3.8	28.7	2.5	7.1	10-57	18.5	12-13	5.4	16.6	9.9	10.6	5.8	8.7
Mg	mg/L	-	70-100	>400	0.3-7.1	1.6	1.8	6	2.5	2.9	17-30	11.6	13-18	5.4	8.4	5.1	9.4	4	9.8
Na	mg/L	200 (A)	70-100	>400	33-79	74.2	48.3	30.3	48.9	72	75-92	56.6	43-76	56.8	54.7	35.8	46.2	35.5	36.4
K	mg/L	-	25-50	>500	2-10	2.9	3.4	1	3.6	9.5	2-3	1.4	4-5	12.8	23	2.4	3.4	2.3	9.8
Al	mg/L	0.3 (O)	-	-	<0.03	0.047	0.053	<0.02	<0.02	<0.02	<0.02	0.158	<0.02	0.863	1.383	0.155	0.072	0.073	<0.02
As	mg/L	0.01 (CH)	0.01-0.05	>2	<0.04	<0.003	<0.003	<0.003	<0.003	<0.003	<0.04	<0.003	<0.04	0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Co	mg/L	-	-	-	<0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	<0.002	<0.02	0.002	0.011	<0.002	<0.002	0.012	<0.002
Cr	mg/L	0.05 (CH)	-	-	<0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	<0.002	<0.02	<0.002	0.004	0.003	<0.002	<0.002	<0.002
Cu	mg/L	2 (CH)	0.5-1	>15	<0.02	<0.007	<0.007	<0.007	<0.007	<0.007	<0.02	<0.007	<0.02	<0.007	0.013	<0.007	<0.007	<0.007	<0.007
Fe	mg/L	0.3 (A), 2 (CH)	0.5-1	>10	<0.11	9.429	0.951	5.859	2.47	0.403	<0.04	0.468	<0.02 (<0.02-20 in TBH7)	0.286	3.657	0.093	0.022	53.04	<0.02
Mn	mg/L	0.1 (A), 0.4(CH)	0.1-0.4	>10	0.03-0.04	0.26	0.15	0.34	0.092	0.13	0.2-0.5	0.21	<0.13 (<0.02-0.76 in TPH6)	0.568	1.02	0.005	0.006	0.765	0.479
Ni	mg/L	0.07 (CH)	-	-	<0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	<0.002	<0.02	0.003	0.025	<0.002	<0.002	0.008	<0.002
Pb	mg/L	0.01 (CH)	-	-	<0.03	<0.005	0.015*	<0.005	<0.005	<0.005	<0.03	<0.005	<0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ba	mg/L	0.7 (CH)	-	-	<0.02	0.013	0.012	0.018	<0.003	<0.003	0.03-0.1	0.063	0.02-0.1	0.072	0.323	0.009	0.045	0.09	0.054
B	mg/L	2.4 (CH)	-	-	<0.03	0.055	0.03	0.043	0.047	0.078	<0.02	0.028	<0.02	0.015	0.017	0.041	0.039	<0.012	0.014
Sr	mg/L	-	-	-	0.04-0.2	0.038	0.037	0.195	0.023	0.061	0.1-0.3	0.151	<0.1	0.088	0.117	0.06	0.083	0.027	0.07
Zn	mg/L	5 (A)	<3	->20	<0.02	0.053	0.037	0.033	0.07	0.014	0.3-3	0.008	<0.03	0.112	0.098	0.008	0.012	9.47	0.005
Class					0	3 (Fe)	1 (Fe, Mn)	3 (Fe)	2 (Fe)	1 (Mn)	0	1 (Mn)		2 (Mn)	2 (Fe & Mn)	0	0	4 (Fe)	2 (Mn)

Notes: Concentrations reported as below detection are indicated in grey text. Cyanide and metals reported at or below detection are excluded from the table.

* Underlined boreholes are assumed to be in use.

SANS 241:2015 refer to standard for treatment of water for drinking water. The Operational limit (O) refers to concentrations above which affect the efficient operation of treatment systems and risks to infrastructure. Aesthetic (A) refers to a determinant that taints water with respect to taste, odour or colour and that does not pose an unacceptable health risk if present at concentration values exceeding the numerical limits specified, Acute health (AH) refers to a determinant that poses an immediate unacceptable health risk if present at concentration values exceeding the numerical limits specified, chronic health (CH) refers to determinant that poses an unacceptable health risk if ingested over an extended period if present at concentration values exceeding the numerical limits specified

Table 4-2 is discussed as follows:

- The background water quality in the Port Durnford area is generally of ideal to good water quality (Class 0 – 1: 42% of samples), with marginal water quality noted in 33% of boreholes and poor/unacceptable water quality noted in 25% of boreholes. The marginal and poor quality being due to manganese (0.005 - 1.2 mg/L) and iron (0.09-53.04 mg/L) concentrations that are elevated compared to the guideline values. The water quality is discussed based on the November 2022 as follows:
  - Manganese (0.006 – 1.02 mg/L) is slightly higher in the secondary aquifer (Class 2 in W12, W7, TBH6 and W4) as compared to the shallow aquifer (Class 1) and
  - Iron is locally highest in TBH6 (deeper aquifer) at 53 mg/L and 3.7 mg/L in W7 but otherwise <0.5 mg/L (Class 0) in the secondary aquifer. Concentrations are similarly variable (0.09-0.34 mg/L) in the shallow aquifer but are generally <0.4 mg/L (Class 1).
- The GCS data in 2020 was analysed by Talbot and Talbot laboratory where the metal analyses detection limits were higher than provided in 2022. Metal concentrations were reported at higher concentrations in 2022 as compared to 2020 in both the shallow and deeper aquifers where metals were, except for TBH7 (iron of >20 mg/L), less than the Class 1 guidance values.
- pH varies from 5.6 (TBH7 in GCS, 2020) to 9.3 (W14, GCS 2020 record) but is generally within the ideal range for water quality of 7 – 9.5.
- Electrical conductivity (EC) was generally below 60 mg/L (ideal range) in November 2022 with a locally higher concentration of 105 mS/m reported for TBH21 (coastal aquifer) by GCS in 2020. Similarly, TDS is generally <300 mg/L in boreholes located in and around the MRA and slightly higher (320-556 mg/L) in boreholes in the coastal aquifer (TBH19 and TBH21) to the south of the MRA.
- Concentrations are generally similar in the shallow and deeper aquifers except for sulfate, typically < 8mg/L, but locally higher in W7 (25.9mg/L) and TBH9 (45.5 mg/L) (secondary aquifer).
- Concentrations for aluminium (Al) are locally elevated in W7 and W12 (0.86-1.4 mg/L) compared to the other samples, for lead (Pb) in W11 (0.015 mg/L) and for zinc[6] at (9.47 mg/L). As these concentrations represent only one sample run, it is recommended that the metal concentrations be confirmed.
- The boreholes TBH14 (GCS data), TBH7 (GCS data), and TBH6 are not recommended for domestic use due to the elevated iron concentrations. Of these, only TBH6 was noted to be in use at the time of the hydrocensus. Based on the information provided in the GCS report, the community are aware of the poor quality of this borehole. TBH14 is artesian. Discharge of elevated concentrations of manganese (>0.37[7] mg/L) could potentially affect the aquatic environment depending on the flow volume (load) to the sensitive wetland receptor.

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[6] The locally elevated concentration of Zn, if confirmed by routine monitoring, is <10 mg/L. While aesthetic effects are possible, health effects from drinking water are generally only noted at concentrations > 20 mg/L (DWAF, 1998).

[7] DWAF, 1996, South African Water Quality Guidelines – Aquatic Ecosystems, Volume 7 where Chronic effect value is 0.37 mg/L and acute effect value is 1.3 mg/L for dissolved manganese

- Salinity (sodium and chloride) is not reported as elevated in either 2020 or November 2022 since sodium concentrations vary from 24 – 94 mg/L and chloride concentrations vary from 30.5-173 mg/L (< Class 1). Elevated sodium and chloride are however noted for boreholes in the Fairbreeze area (SRK, 2020). This is most likely related to the underlying geology and deeper groundwater. Most of these boreholes appear to be abstracting groundwater from the Karoo sediments, which is generally associated with poorer water qualities.

A piper diagram was constructed using the data retrieved (Figure 4-5). Piper diagrams graphically represent the relative percentages of anions and cations in water samples. The cation percentages are plotted on the left triangle and the anion percentages on the right triangle. A projection of these cation and anion presentations onto the central diamond presents the chemical signature of the major ion composition of the water

Most of the samples obtained in November 2022 represent a sodium bicarbonate chemical signature which follows the typical dynamic groundwater flow evolution. A few of the samples (W14, TBH6, TBH9 and TBH21) represent sodium chloride type, meaning these boreholes are in areas with chloride enrichment. The above two types of hydrochemical signatures are mainly indicative of possible atmospheric deposition of sodium and chloride within the coastal region and sea water intrusion.

One sample represents a calcium magnesium bicarbonate type water (TBH14) implying recently recharged water.

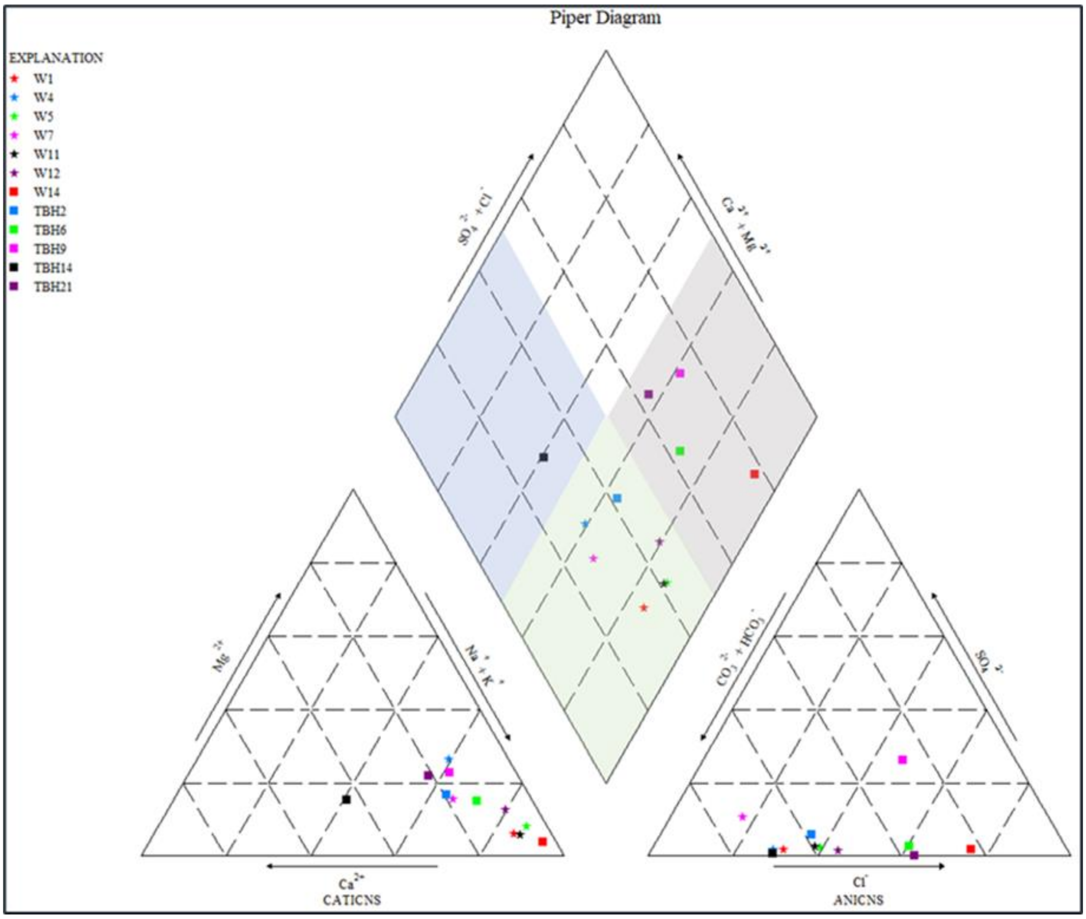


Figure 4-5 - Piper diagram aquifer characterisation

4.6 GROUNDWATER POTENTIAL CONTAMINANTS

A geochemical study (WSP, 2024b) was conducted a s part of the Environmental Authorisation Application Process for the Mining of the Tronox Port Durnford Resource. The investigation comprised of a risk assessment, waste classification and waste assessment. The report on this investigation is provided separately.

WSP (2024b) developed the source terms for modelling. They concluded that the mineral phases present in the MSP and RSF tailings were all inert and very slow weathering. None of the samples were acid generating. Model source terms for the RSF tailings indicates that aluminium (Al) and manganese (Mn) are constituent of environmental risk concern during the mine operational phase, Zn and Pb at post-closure phase. In the backfill material, the constituents of concern are Cu and Cd, and to a lesser extent, aluminium and zinc.

Samples of the MSP tailings, gypsum waste and Residue Storage Facility (RSF) tailings were obtained from Fairbreeze Mine and submitted for analysis. Based on the analysis, the Constituents of Potential Concern (CoPC's) in the RSF sand tailings sample were generally measured at low concentrations.

The geochemistry study (WSP, 2024b) compared the source terms based on ASLP leach test results to aquatic guidelines (DWAF, 1996) and coastal marine guidelines (DEA, 2018). They concluded that:

- RSF operational phase:
  - Source terms generally comply with the aquatic and marine guidelines, but the averaged concentrations of Mn (1.32 mg/L) and Al (0.03 mg/L) exceed the aquatic guideline.
- RSF closure phase:
  - Cd exceeds both the aquatic and marine guidelines.
  - Cu exceeds the aquatic guidelines.
  - Pb and Zn both exceed the marine guidelines.
- Sand tailings (backfill) operational and closure phases:
  - Cu exceeds both the aquatic and marine guidelines.
  - Zn exceeds the aquatic guidelines.
  - Al and Cr exceed the marine guidelines.

The CoPC were also compared with the background values of the shallow and deeper primary aquifers and is shown in Figure 4-3. The background values were taken from the ambient values from the hydrocensus data (Figure 4-2).

The three elements selected for contaminant transport modelling included total dissolved solids (TDS), Al, and Mn. TDS needs to be modelled as the estuary is highly sensitive to changes in salinity. TDS cannot change by >15% from the normal cycles of the water body. Al and Mn were selected due to the environmental risk concern during the operational phase.

Table 4-3 – Constituents of potential concern

COPC	Aquatic target water quality guideline	Marine target water quality guideline	Ambient (shallow aquifer)	Ambient (deeper aquifer)	RSF operational	RSF post closure	Backfill operational and post closure
Al	0.01	n/a	<0.03	<0.02	0.36	0.0003	0.033
Cd	0.00015	0.00012	<0.02	<0.02	-	**0.0002**	0.0002
Cu	0.0003	0.003	<0.02	<0.02	-	0.0014	**0.00035**
Fe	n/a	n/a	<0.11	<0.02	0.7	0.02	0.0424
Pb	0.0002	0.002	<0.03	<0.03	-	0.0025	0.0025
Mn	0.18	n/a	0.03-0.04	<0.13	1.32	0.012	0.0061
TDS	<15% change	n/a	182-296	242-296	210.58	67.15	7.293
Zn	0.002	0.02	<0.02	<0.03	-	0.034	0.0119

5 AQUIFER CHARACTERISATION

5.1 GROUNDWATER VULNERABILITY

Groundwater vulnerability gives an indication of how susceptible an aquifer is to contamination. Figure 5-1 shows the national groundwater vulnerability ratings underlying the project area. This is based on the DRASTIC method which includes the following parameters: Depth to water table; Recharge (net); Aquifer media; Soil media; Topography; Impact of the vadose (unsaturated) zone; conductivity (hydraulic). The groundwater underlying the project area from west to east has a medium to very high vulnerability rating.

5.2 AQUIFER CLASSIFICATION

WRC (1995) categorizes aquifers into four main classes, Table 5-1. According to Aquifer classification of South Africa Map[8], the site is underlain by minor aquifers (Figure 5-2) which are moderately yielding aquifers with variable water quality. These aquifers only yield significant groundwater volumes during the raining season when high rainfall and recharge to the aquifer occurs (GCS, 2020).

---

[8] DWAF (2012). Aquifer Classification of South Africa

Table 5-1 - Aquifer classification system (WRC, 1995)

Aquifer Class	Description
Sole Source Aquifer System	An aquifer which is used to supply 50% or more of domestic water for a given area, and for which there are no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.
Major Aquifer System	Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (less than 150 mS/m).
Minor Aquifer System	These can be fractured or potentially fractured rocks which do not have high primary permeability, or other formations or variable permeability. Aquifer extent may be limited and water variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow for rivers.
Non-Aquifer System	These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer as unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.
Special Aquifer System	An aquifer designated as such by the Minister of Water Affairs after due process.

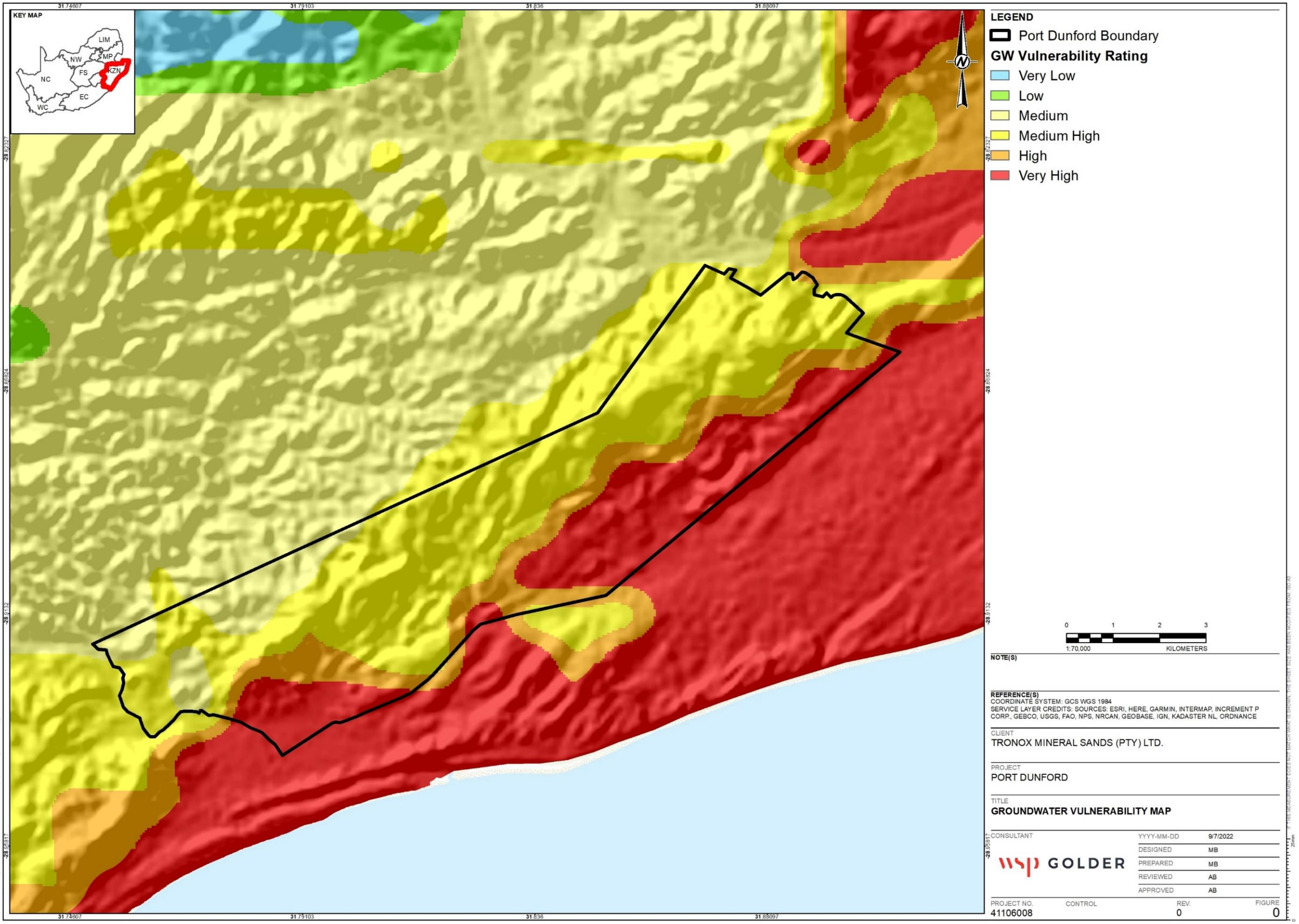


Figure 5-1 - Aquifer vulnerability map

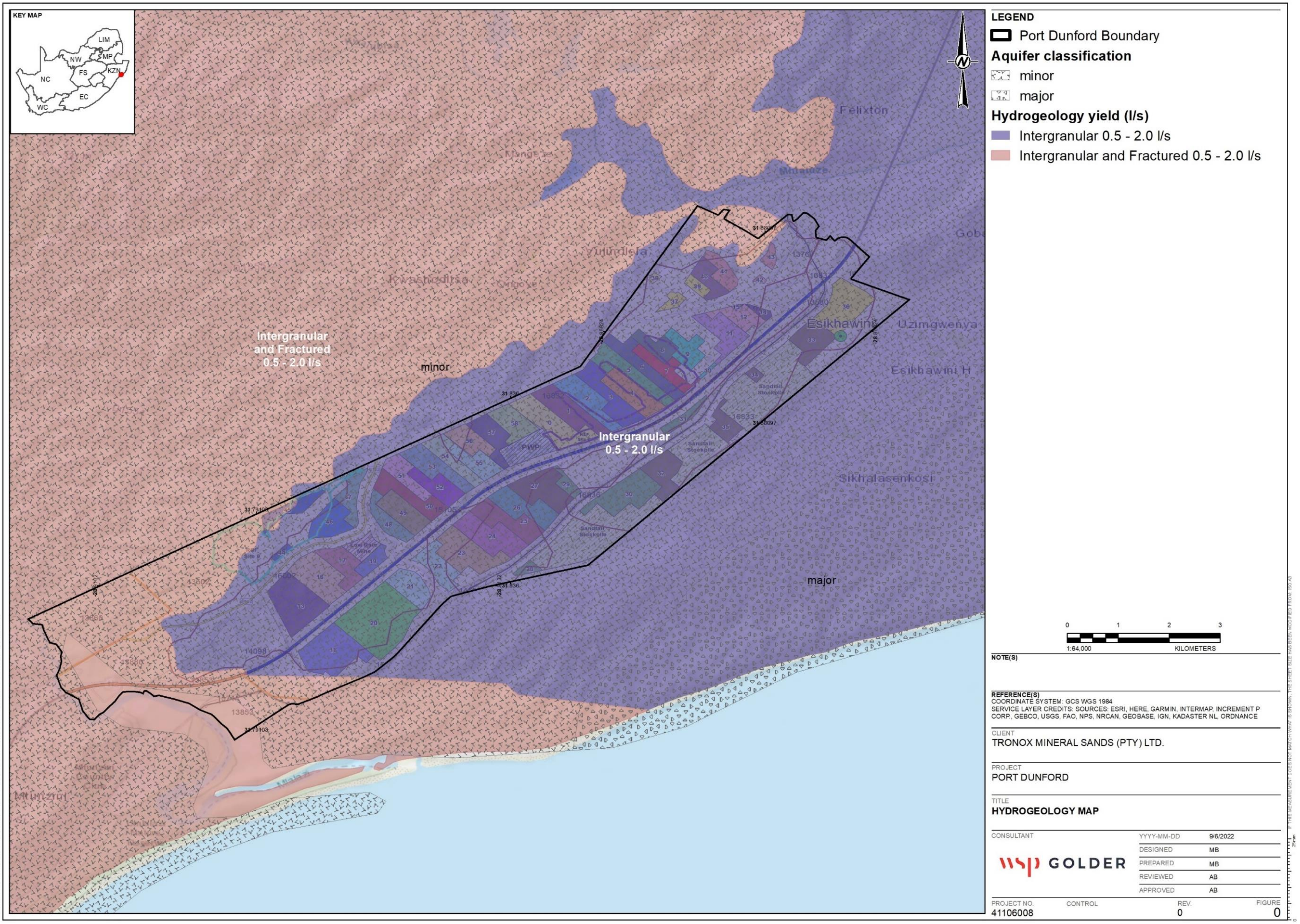


Figure 5-2 - Aquifer classification and yield map

5.3 AQUIFER PROTECTION CLASSIFICATION

Aquifer protection classification is based on the aquifer vulnerability classification, threat posed to the aquifer by land use and aquifer system management classification. These attributes are multiplied with the aquifer rating system to obtain the Groundwater Quality Management index (GQM), which is used to determine the level of groundwater protection, as shown in Table 5-2 and Table 5-3. The project area is underlain by minor aquifer system (2 points) which is highly vulnerable to contamination (3 points). Using aquifer vulnerability and aquifer class, a medium level of groundwater protection is calculated.

Table 5-2 - Ratings for the Groundwater Quality Management Classification System

Aquifer system management classification		Aquifer vulnerability classification	
Class	**Points**	**Class**	**Points**
Sole source aquifer system	6	High	3
Major aquifer system	4	Medium	2
Minor aquifer system	2	Low	1
Non-aquifer system	0		
Special aquifer system	0–6		

Table 5-3 - Appropriate Level of groundwater protection required based on Groundwater Management Classification

GQM Index	Level of protection
<1	Limited protection
1–3	Low level of protection
3–6	Medium level of protection
6–10	High level of protection
>10	Strictly non-degradation

6 GROUNDWATER MODELLING

The section below describes the translation of the conceptual model into a numerical groundwater flow and mass transport model.

6.1 CONCEPTUAL MODEL

The conceptual site model (CSM) depicted in Figure 6-1 and is described here:

- The shallow and deeper intergranular primary aquifer is unconfined and hosted in undifferentiated coastal deposits of the Maputaland Group and alluvium deposited within Mlalazi and Mhlathuze River systems. It contains:
  - Calcareous sand, dunes and reddish sandy soil of the Sibayi, KwaMbonambi and Berea-type in the upper 20 m. The hydraulic conductivity of the shallow aquifer is between 0.1 and 10 m/d. Yields are generally below 2 L/s.
  - Cross-bedded sand and local calcarenite or fossiliferous mudrock of the Kosi Bay and Port Durnford formations from 20 to >100 m deep.
- The secondary intergranular and fractured aquifer is hosted within mainly argillaceous rocks of the Karoo Supergroup and mainly meta-arenaceous rocks of the Natal Metamorphic Province. The weathered and intergranular portion of the aquifer is 10 to 15 m thick, whilst the fractured portion is roughly 150 to 170 m thick. The hydraulic conductivity of the secondary aquifer is between 0.001 and 0.1 m/d and yields range from 0.1 L/s to 1.5 L/s.
- Based on information gathered during the hydrocensus, groundwater levels range from artesian conditions to 59 mbgl across the area. Shallower water levels are observed near the rivers and in the down gradient areas closer to the coast where primary aquifers are assumed to be locally present. The deeper water levels, located in the topographically higher areas, is assumed to be part of the same the primary aquifer. This is supported by the similar water chemistry in both aquifers and the relative water levels observed in both.
- Groundwater flow from the site is generally towards the east and south-east, in the direction of the Mzingwenya River, the Amanzamnyama and Mlalazi Rivers, and the Indian Ocean. West of the mining area, water drains towards the north-west (Mhaltuze River) and south-west (KwaGugushe River).
- The baseline groundwater quality in the area is generally good with marginal to poor quality noted in some boreholes on the eastern MRA boundary (TBH6 and TBH7) and locally on the south-western boundary in the shallow aquifer (W14 and TPB14) due to elevated iron and manganese concentrations.
- The site is currently occupied by forestry activities and will return these operations upon completion of mining and subsequent rehabilitation.
- GCS (2020) noted that groundwater dependent ecosystems are a common feature along the north-eastern coastline of KwaZulu-Natal. Textural characteristics (including the clay content) can lead to locally perched aquifer conditions resulting in the formation of springs within the shallow aquifer.
- Wetlands east of the project site, mainly along the drainage channels feeding Lake Cubhu and around Kraal Hill, are fed by shallow groundwater from perched aquifers formed by underlying clay rich dune sands.
- The Mlalazi estuary south-west of the site is also fed by shallow groundwater in the area.

- A combination of topography and textural characteristics of the geological formations influence the baseflow component of the project area.

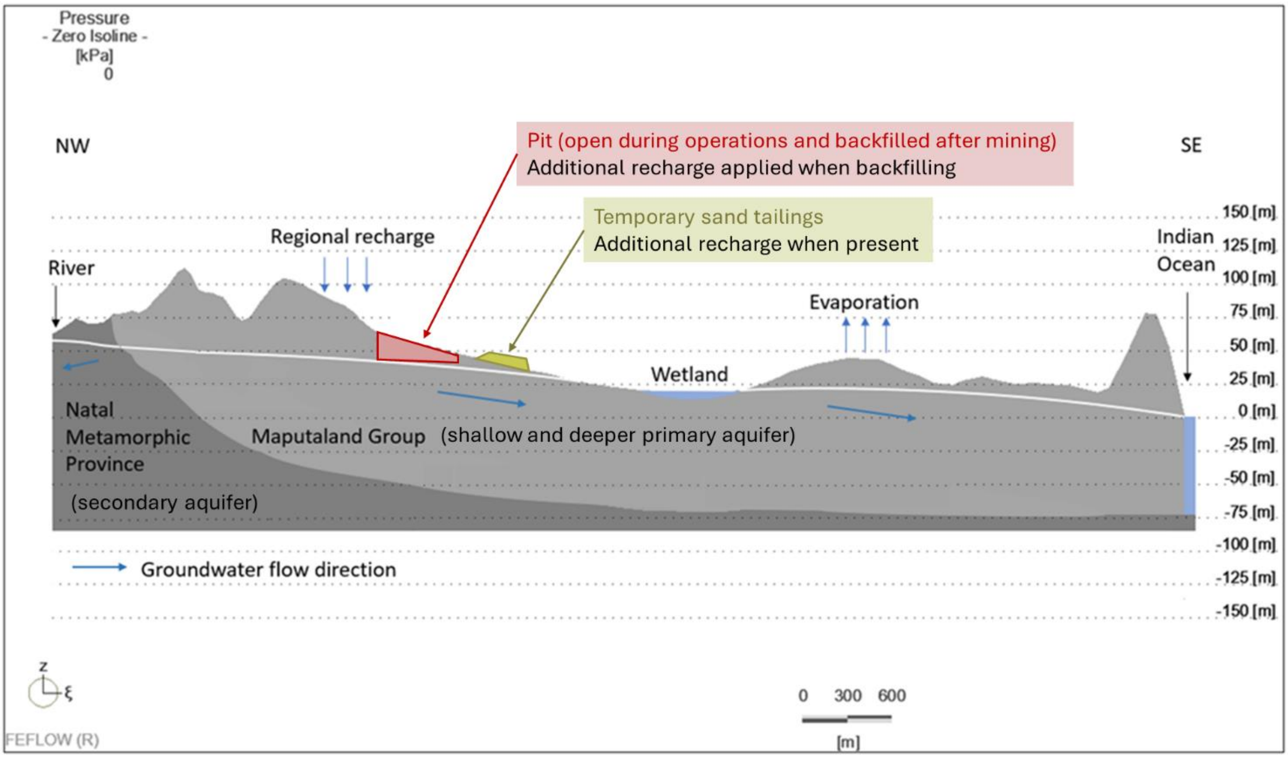


Figure 6-1 - Conceptual site model (white line indicating water level)

6.2 GROUNDWATER ELEVATION AND GRADIENT

Groundwater levels were discussed under Section 4.4. The groundwater elevations within the project area vary from 8 to 86 mamsl and the average groundwater gradient is approximately 0.01 m.

6.3 NUMERICAL MODEL

As discussed above, FEFLOW was used for the development of the numerical groundwater model. The model construction is as discussed in Section 7.4, 7.5 and 7.6.

6.3.1 SOFTWARE MODEL CHOICE

The code selected for conducting the modelling of the study area is FEFLOW® (Diersch, 2014) developed by the WASY Institute for Water Resources Planning and Systems Research, Ltd. Berlin, Germany. FEFLOW® is an interactive groundwater modelling system for three and two-dimensional, aerial, and cross-sectional, fluid density-coupled, thermohaline or uncoupled, variably saturated, transient, or steady state flow, mass, and heat transport in subsurface water resources with or without one or multiple free surfaces.

FEFLOW® can be efficiently used to describe the spatial and temporal distribution of groundwater contaminants, to estimate the duration and travel times of pollutants in aquifers, to plan and design remediation strategies and interception techniques, and to assist in designing alternatives and effective monitoring schemes.

6.3.2 MODEL SET-UP AND BOUNDARIES

The model area was conceptualized large enough to cover the location of the key stresses on the groundwater system. The model boundaries should also be far enough to not affect the modelling simulations. The current groundwater model boundary is large enough to account for all the influences. The model boundaries consider the topography, rivers and Indian Ocean. The Mhlatuze River, KwaGugushe River, Msasandla River and Mlalazi River were included in the model boundary. The model area is depicted in Figure 6-2 and spans area of approximately 126 km^2.

The rivers and wetlands were set as seepage faces which allow the model to remove water when the water level is higher than the river elevation, but it cannot add water when the water level is below the river.

6.3.3 GEOMETRIC STRUCTURE OF THE MODEL

6.3.3.1 Model Structure

The numerical model encompasses the project area covering a total area of approximately 126 km^2 (approximately 7 km × 17 km). A finite element network (grid) was designed to provide a high resolution of the numerical solution, while at the same time accommodating the large model area. The finite element grid is based on a super element mesh constructed across the area. The super element mesh contains the main important features of the conceptual model, e.g., the surface expression of the main hydro lithological aquifer units, rivers/drainage and mining infrastructure.

The mesh contains 85 031 elements per layer (425 155 elements in total for 5 layers) and 42 722 nodes per slice (256 332 nodes in total for 6 slices). The mesh quality was considered good with:

- Interior holes: 0.
- Obtuse-angled triangles: 0.1% > 120º and 6.3% > 90º.
- Delaunay-violating triangles: 1.0%.

The mesh (Figure 6-3) was refined in the mining area so that the nodes are approximately 50 m apart.

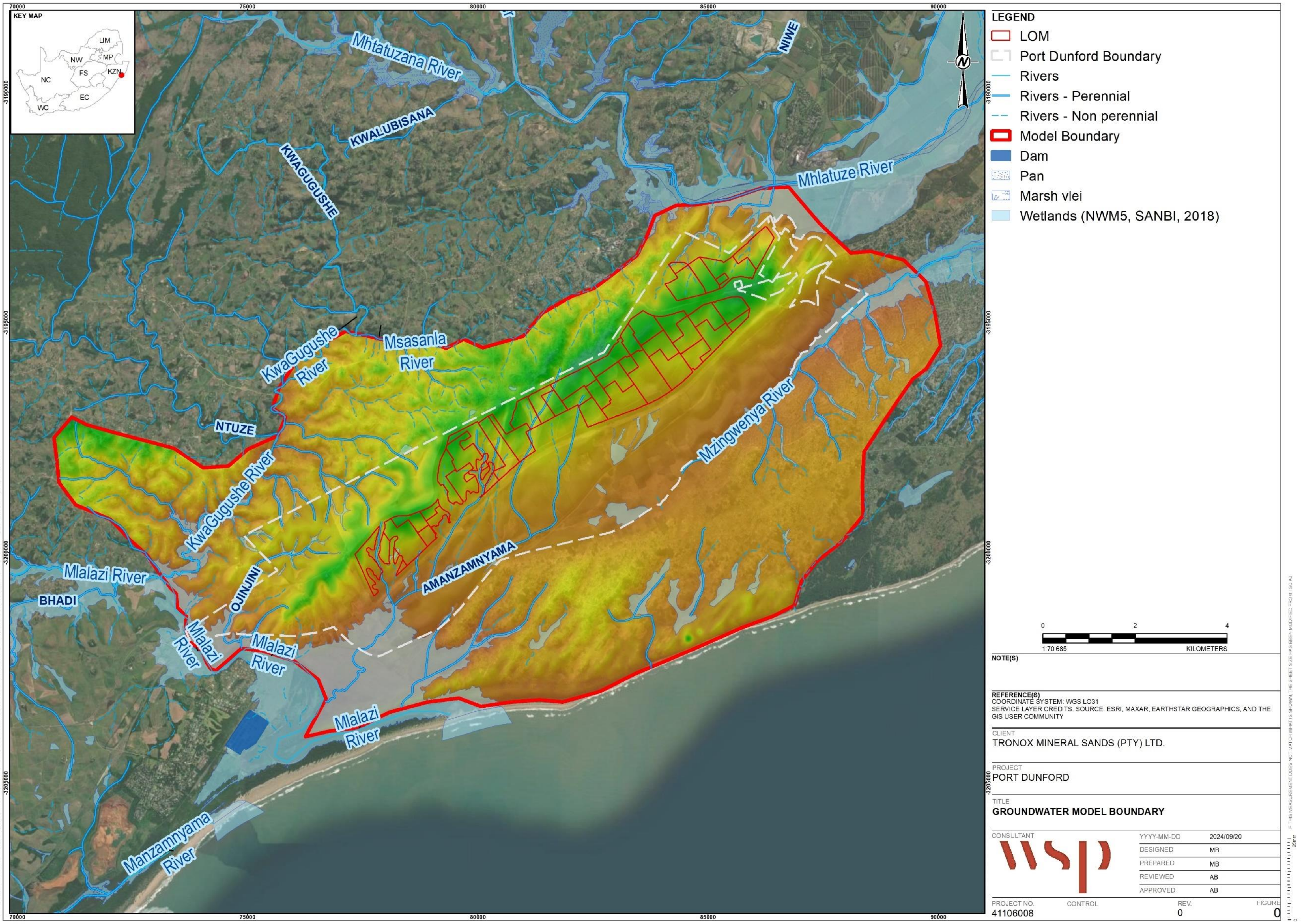


Figure 6-2 - Model Boundary

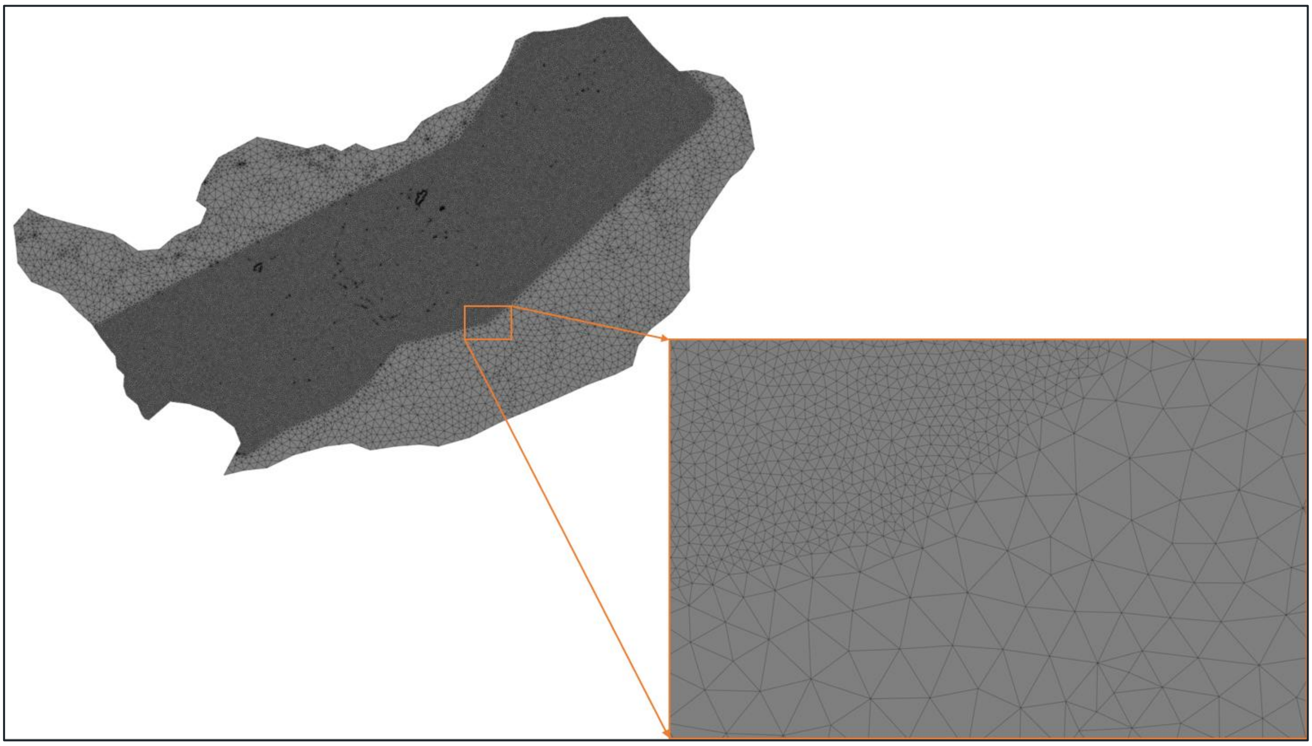


Figure 6-3 - Model mesh indicating refinement in the site boundary

6.3.3.2 Model Layers

The study area is represented by a five-layered model based on existing data. The model domain was assumed to extend vertically to encompass the proposed mine pits and their depths. The model was setup such that the base of the pits is represented by the base of Layer 2 (Slice 3).

Table 6-1 presents the model layers and average thickness.

Table 6-1 – Model layers

Model layer	Layer number	Layer thickness (m)
Maputaland Group	Layers 1 to 3 where present	20
Base of mining	Base of layer 2	25
Ecca Group	Layers 1 to 3 where present	70
Natal Group	Layers 1 to 3 where present	40
Natal Metamorphic Province	Layers 1 to 3 where present and entire layers 4 and 5	10

6.3.4 MODEL ASSUMPTIONS & LIMITATIONS

Groundwater models are simplified mathematical representations of complex natural systems. Because of this, there are limits to the accuracy with which groundwater systems can be simulated.

6.3.4.1 Mining assumptions

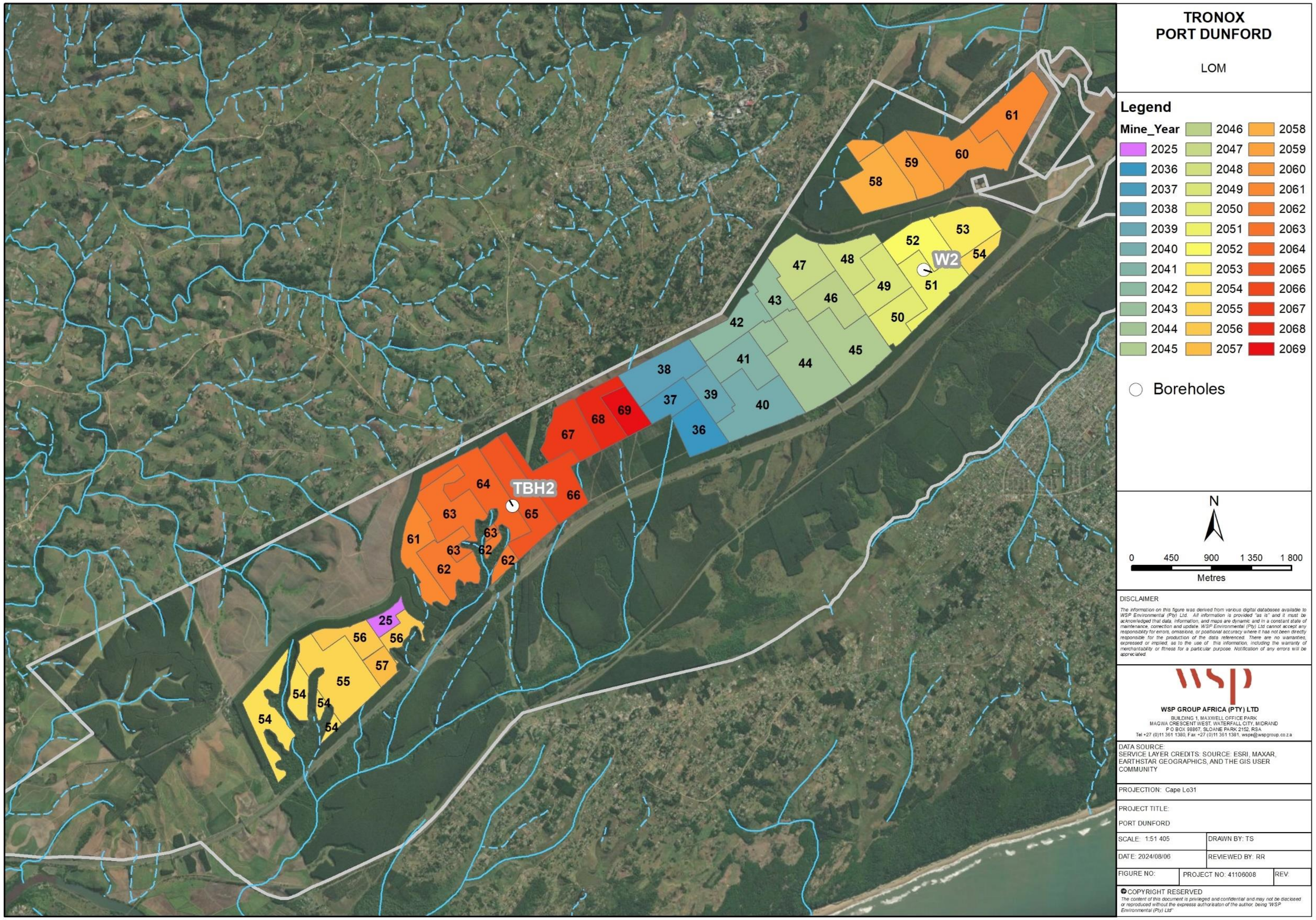
Certain assumptions need to be made to simulate the mining sequence, the backfilling after mining, and then adding RSF C on top of the mining area.

The model timeline is based on the mine schedule received in March 2024 (Refer Section 1 and Figure 7-2) as follows:

- The steady state model represents pre-mining conditions (Refer Section 7.8)
- The operational model runs from January 2024 to January 2069, a forty five-year period.
- The post closure model starts January 2070 and runs for 100 years until January 2170.

The following assumptions were made to apply the mining and backfilling to the groundwater model:

- Dewatering is limited to the mining block; therefore, dewatering will be activated in the model at the start of mining, and it will be de-activated one year later. There is one exception where dewatering for mining block 2025 will be active from 2025 to 2035 since this area is earmarked for low-rate mining over 10 years.
- Backfilling:
  - For all mining blocks, except 2025, backfilling will commence 2 years after the start of mining.
  - Backfilling in mining block 2025 will commence in 2059.
- Deposition:
  The deposition schedule used in the model (based on data received in March 2024), however, the schedule was adjusted slightly to make sure that deposition starts one year after mining. The modelling schedule for deposition is presented in Figure 6-4
  The RSF material will be deposited as a slurry with 28% solids and 72% water which will be entered into the model as additional recharge as follows:
  - RSF 9 will be filled from 2036 to 2046 according to the spatial data received.
  - RSF C area will be filled from 2069 to 2070 at the end of mining.
  - The coarse sand tailings will be deposited as a slurry with 50% solids and 50% water which will be entered into the model as additional recharge. The sand tailings deposition areas will be active from 2036 to 2068 with the following assumptions based on the spatial location:
    - Sand tailings A1 to A3: 2036 to 2055. Assumed all areas will be active for this entire period.
    - Sand tailings North: 2054 – 2055, two years after mining of the northern mining blocks.
    - Sand tailings 4:2056 to 2058, two years after mining of the south-western mining blocks. Mining block 2025 will be filled in 2059.
    - Sand tailings 5:2060 to 2063, two years after mining.
    - Sand tailings 3:2063 to 2068, two years after mining.



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DATA SOURCE:
SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

PROJECTION: Cape Lo31

PROJECT TITLE:

PORT DUNFORD

SCALE: 1:51 405
DRAWN BY: TS
DATE: 2024/08/06
REVIEWED BY: RR
FIGURE NO:
PROJECT NO: 41106008
REV:

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Figure 6-4 - Mine plan used for modelling

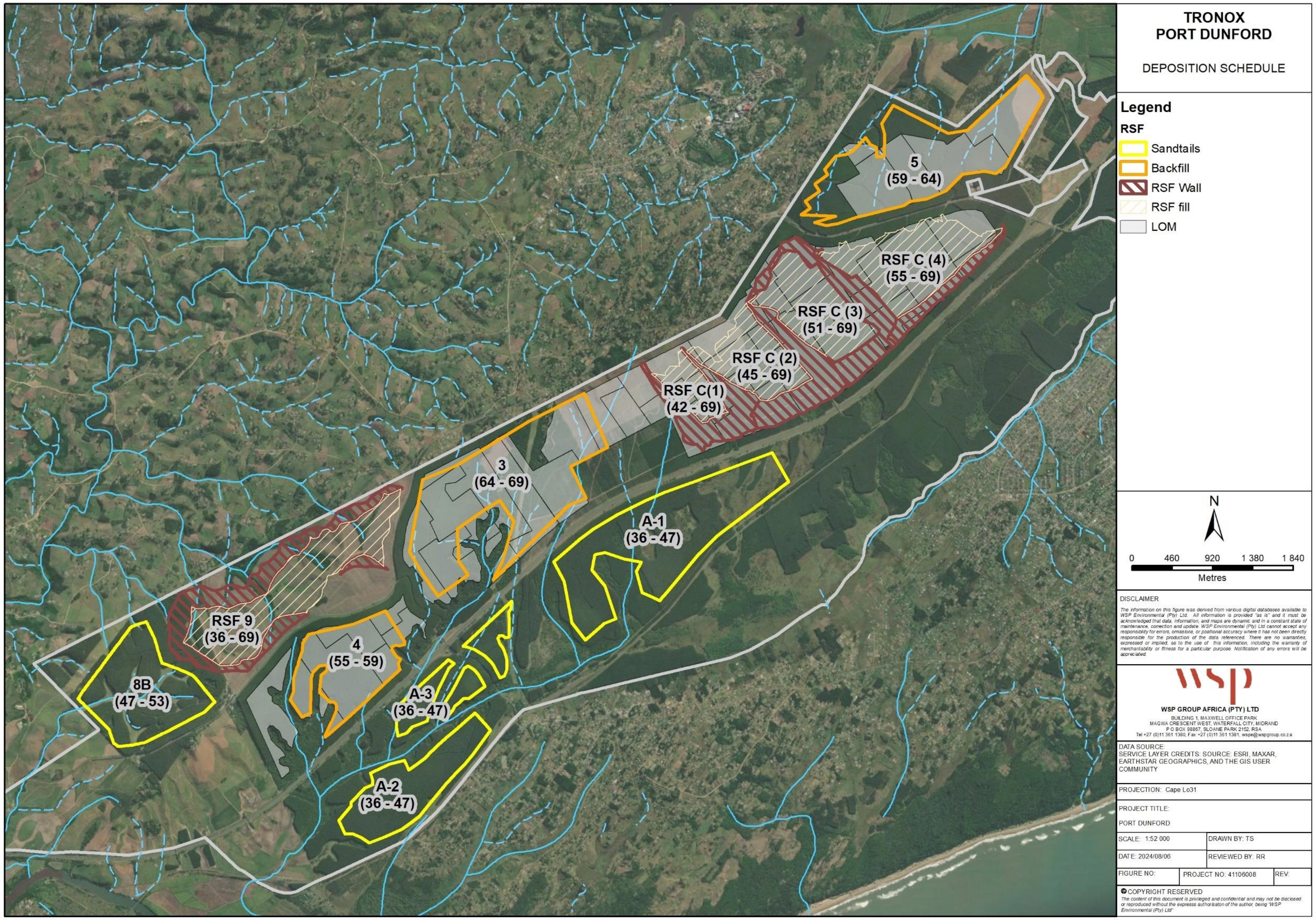

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Figure 6-5 - Deposition plan used for modelling

6.3.4.2 General Assumptions

Calibration depends on the interaction between water levels, abstraction, hydraulic conductivity, and recharge. There is a level of uncertainty in each of these. The uncertainties are described below:

- Uncertainty will always be present due to aquifer heterogeneity.
- Some uncertainty arises from measurement errors.
- The model is a simplification / approximation of reality.
- The following assumptions were made in the numerical model:
  - No aquifer tests were conducted by GCS (2020) or WSP during the current project, therefore the aquifer parameters used in the model were estimated based on literature and previous experience.
  - Geological structures were not included in the model as the locations and properties of these were unknown.
  - The regional recharge was kept constant at before and after mining as the area is currently occupied by forestry and it is understood that it will return to forestry after mining.
  - The model does not account for pumping activity in the surrounding boreholes, and it is assumed that the contaminant plume is not influenced by any pumping activity. Although wells fitted with pump were identified during the hydrocensus survey, no information on their usage and pumping rates is available.
  - Facilities such as dams and stockpiles were excluded from the model as these are assumed to be controlled storage units, located in concrete bunded/ lined areas, where leaks and subsequent impacts to the groundwater are not anticipated to occur.
  - The source terms used in the groundwater model, were based on results from the geochemical study for the RSF and the backfill material.

6.4 GROUNDWATER SOURCES AND SINKS

The shallow and deeper primary aquifer is a source of water for rivers, lakes and most wetlands in dryer periods and is recharged by these systems in wet periods (GCS, 2020).

6.4.1 SOURCES

The data gathered from this investigation was processed and interpreted in the subsequent tasks.

- Sources include the RSF feed and backfill material. The RSF 9 is located on the SW of the site boundary, close to borehole TBH8, while RSF C is located on the NE of the site boundary. Backfill 3 is located on the SW of the mine site, near RSF 9, Backfill 4 is located in the centre of the site, NE of RSF 9 and Backfill 5 is located NE of the of RSF C. Monitoring close to possible contaminant sources (this can be achieved by replacing boreholes W2 and W7 after mining).
- Pathways include monitoring along identified contamination plumes (W5, W11 and TBH1). It also includes the surface water (streams), groundwater and RSF of which can transport the waste material from the sources to the receptors.
  - The Mzingwenya River (P_SW1).
  - The Amanzamnyama River (P_SW2).
  - Tributary of the KwaGugushe River (P_SW3).
  - Tributary of the Mhlatuze river (P_SW4)

In accordance with the conceptual model, the coastal sand deposits have higher recharge that the inland lithologies. The model recharge was calibrated at:

- 306 mm/a (25% of MAP) for the coastal sands
- 12.24 mm/a (1% of MAP) for the remaining lithologies

Other sources include the deposition of sand tailings containing 55% water and the RSF's containing 72% water during deposition. The location of these sources is shown in Figure 6-6.

Please note that contaminant sources are discussed in section 6.6.4.

6.4.2 SINKS

The rivers, wetlands, and mining areas act as sinks as water is removed during mining. In the absence of detailed pumping rates, the model was calibrated against the existing water levels and groundwater abstraction from local boreholes excluded as a sink in the model on the assumption that it minimally affects the regional aquifers.

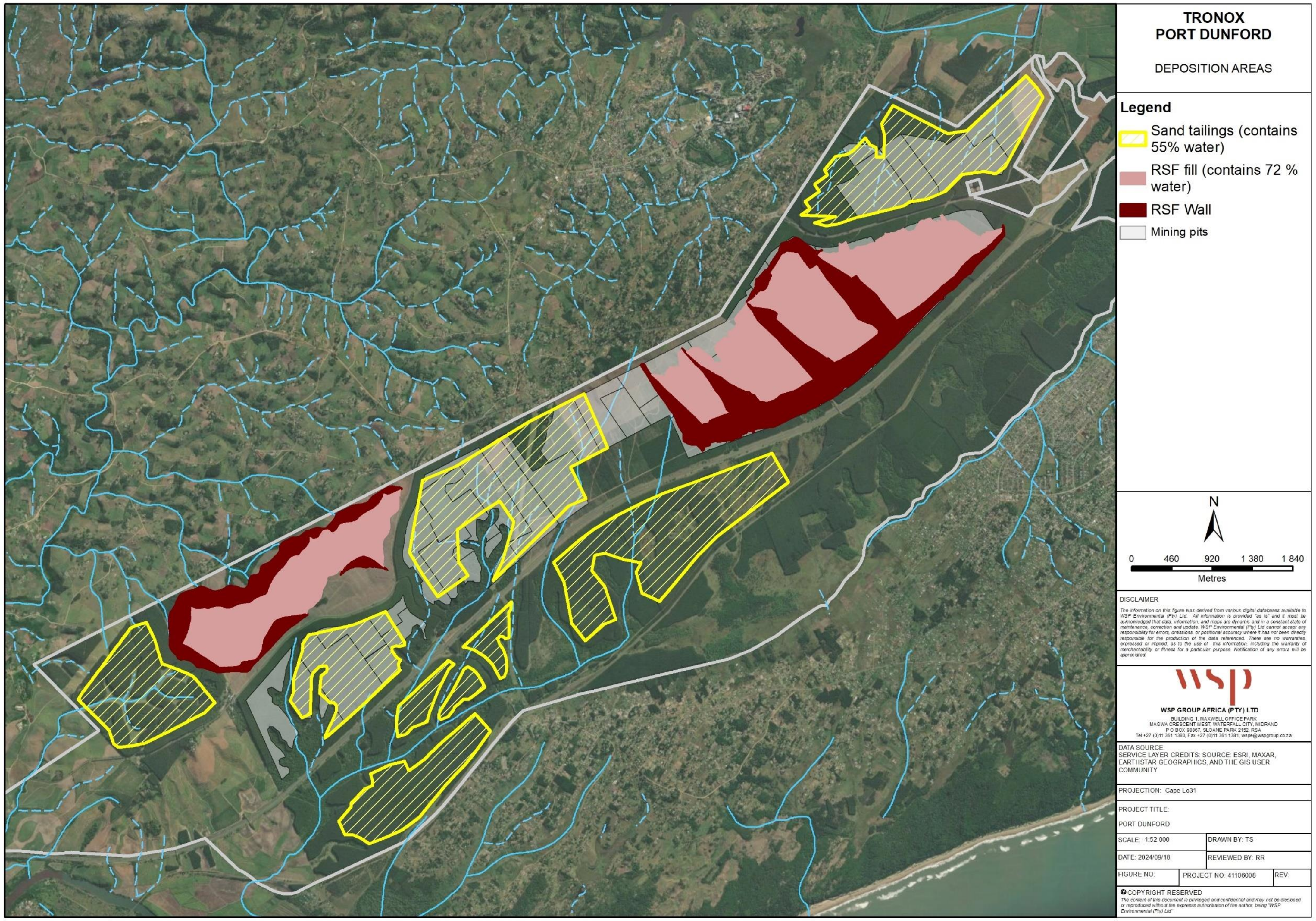

Figure 6-6 - Additional sources of water

6.5 MODEL CALIBRATION

The groundwater flow direction generally follows the topography with the flow direction either to the north-west or south-east towards the Indian Ocean and/or the rivers. The groundwater levels measured during the November 2022 hydrocensus conducted by WSP were used to calibrate the steady state model.

Two boreholes did not calibrate well:

- W12 which is situated to the west of the mining area in the Natal Metamorphic Group and therefore not important for water levels in and around the mine and was removed for calibration. The measured water levels for 2020 (~25 mbgl) are very different from the 2017 data when 0.9 mbgl were reported.
- W7, which borders the mining area in the north-west, at a topographical high elevation of 102 mamsl and close to the contact between the lithologies of the Natal Metamorphic Province and the Maputaland Group. The measured water levels from two hydrocensus surveys differ greatly with a water level of 18.5 mbgl measured in 2017 and 36.5 mbgl in 2020.

The root mean square error (RMSE) was 4.9 m and the normalised root mean square error (NRMSE) was 10.8%. The simulated steady state calibration is indicated in Figure 6-7 and Figure 6-8, while Figure 6-9 shows the simulated head at steady state (prior to mining).

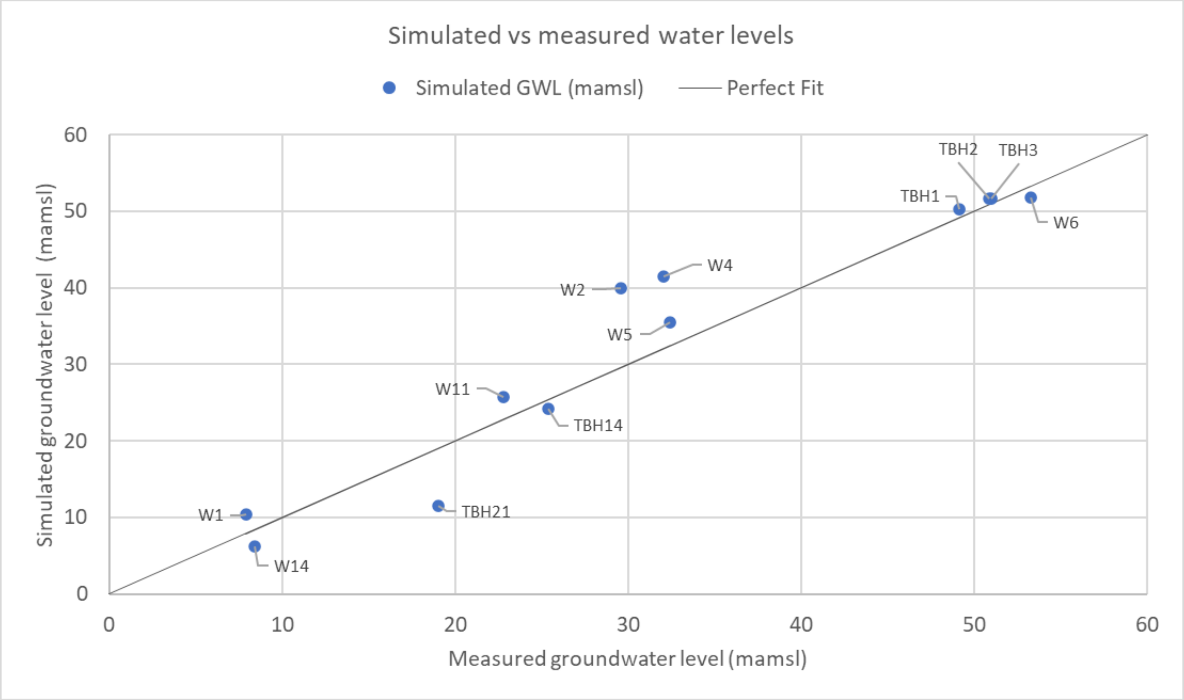

Figure 6-7 - Simulated versus measured water levels scatter plot

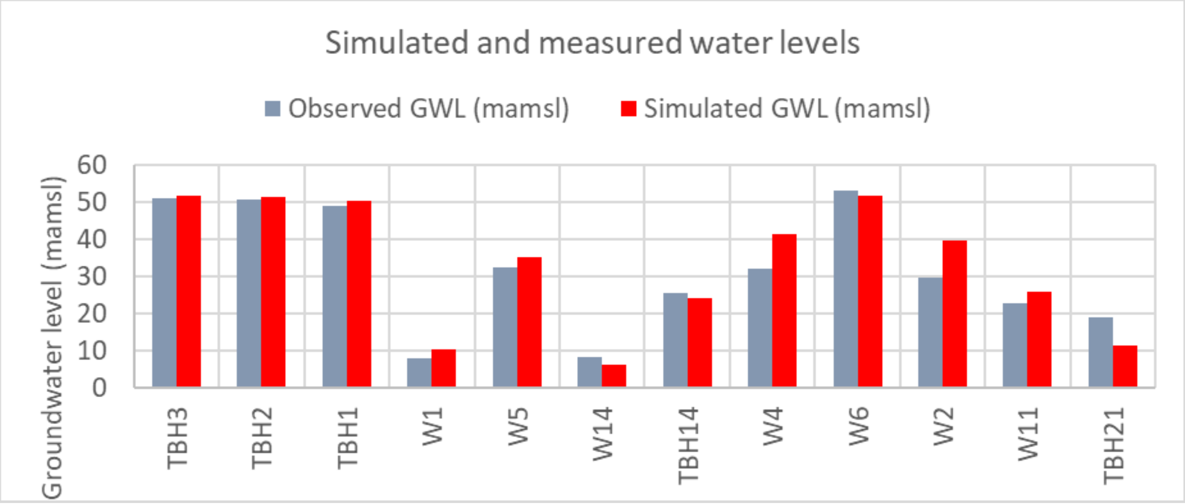

Figure 6-8 - Simulated versus measured water levels bar graph

6.5.1 CALIBRATED MODEL PARAMETERS

In accordance with the conceptual model, the coastal sand deposits have higher recharge than the other areas. The model recharge was calibrated at:

- 306 mm/a (25% of MAP) for the coastal sands
- 12.24 mm/a (1% of MAP) for the remaining lithologies

The calibrated aquifer parameters are presented in Table 6-2. These compare to the range provide for the baseline for the primary aquifer (Maputaland Group) of 0.1 – 10m/d and secondary aquifer (Natal/Ecca) of 0.1-0.001m/d.

Table 6-2 – Calibrated aquifer parameters

Maputaland Group			Natal Metamorphic Province			Ecca Group, Karoo Supergroup			Natal Group		
K (m/d)	SS (m^{-1})	n_e	K (m/d)	SS (m^{-1})	n_e	K (m/d)	SS (m^{-1})	n_e	K (m/d)	SS (m^{-1})	n_e
1	9.93E-05	0.03	0.001	1.04E-06	0.03	0.02	1.03E-05	0.03	0.1	1.03E-05	0.03

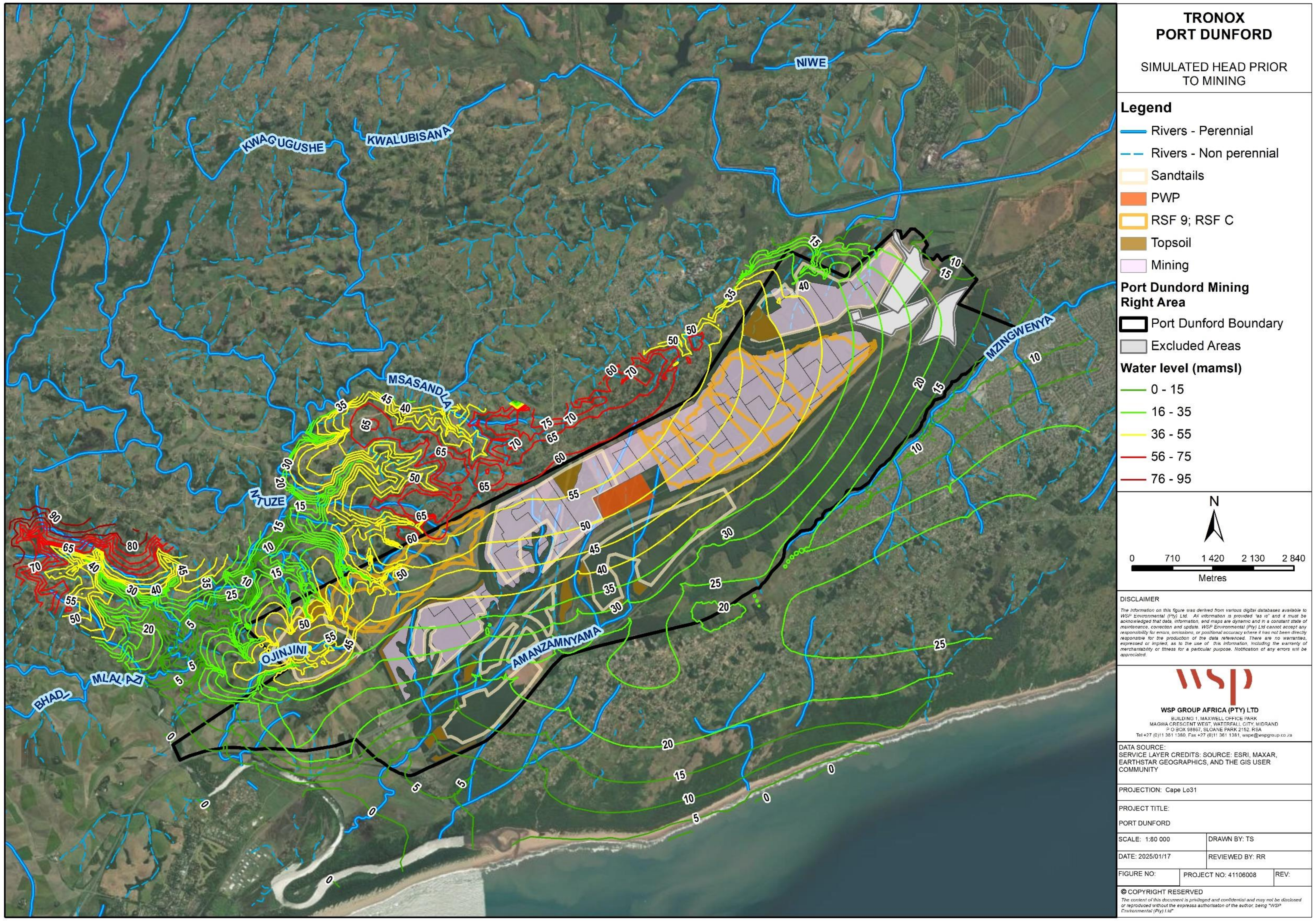

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Figure 6-9 – Simulated water level prior to mining

6.6 RESULTS OF THE MODEL

6.6.1 PRE-MINING

The mining conditions were simulated for the pre-mining scenario with the groundwater flow directions described above. The steady state model represents pre-mining conditions (Figure 6-9).

6.6.2 DURING MINING

The operational model runs from January 2024 to January 2069, a forty five-year period.

Figure 6-10 to Figure 6-17presents the drawdown at various intervals during the mine operations. During operations, the water levels are decreased due to mining activity (showing a drawdown) and increased due to deposition of wet sand tailings (showing a water level recovery).

It should be noted that the water level mound that forms on the sand tailings area 8B in 2050 (Figure 6-10) is likely due to the backfill area being situated on Natal Metamorphic Province geology which has lower hydraulic conductivity, slowing down the backfill slurry from seeping into the ground below. It is therefore important to add cut-off trenches to remove excess water from area 8B or find another way to manage the excess water.

Figure 6-18 and Figure 6-19 presents the drawdown at various intervals during the mine operations and the effect on Wetlands 2, 1 and 5. Water levels remain consistently above surface in Wetland 2, indicating that this is likely unimpacted by the RSF operations. An initial drawdown and subsequent recovery are observed in Wetlands 1 and 5 indicating that the impact of the mining is transient (2063 – 2068).

Figure 6-20 shows the final water level at the end of mining and Figure 6-21 shows the post closure water level which stays constant from two years after mining onward.

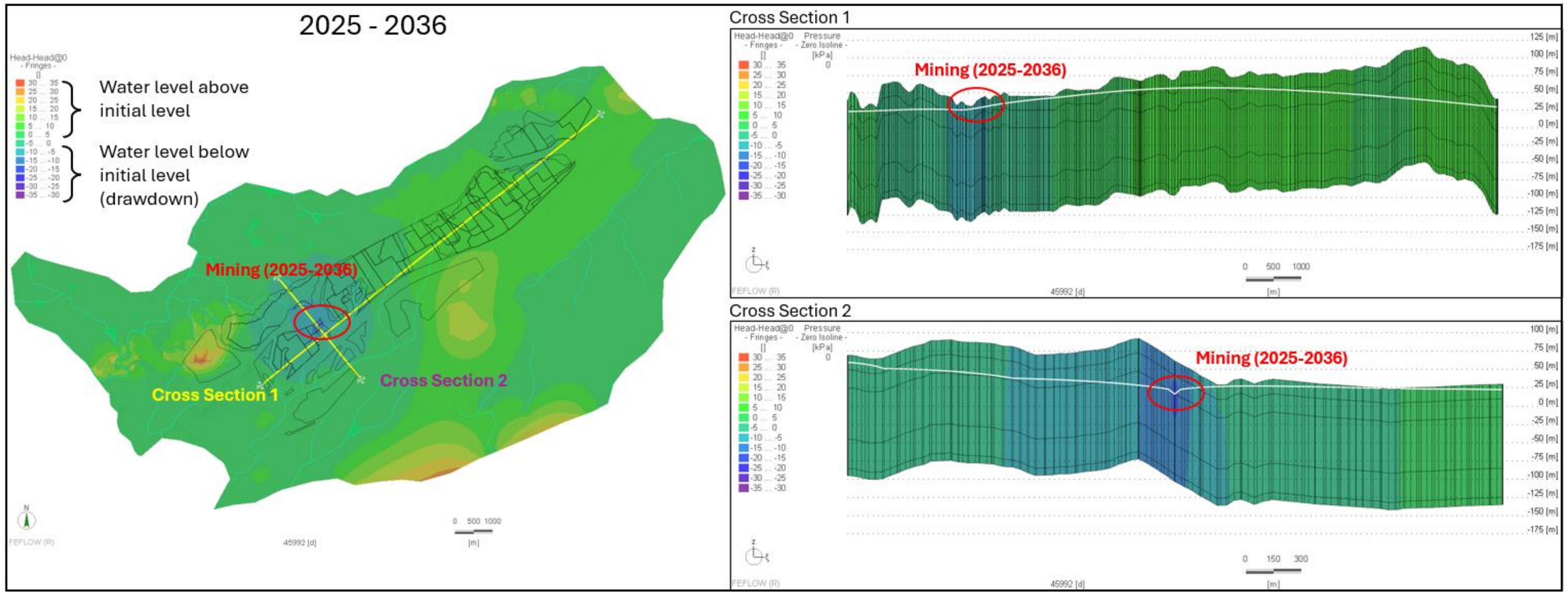


Figure 6-10 - Simulated drawdown 2025 – 2035

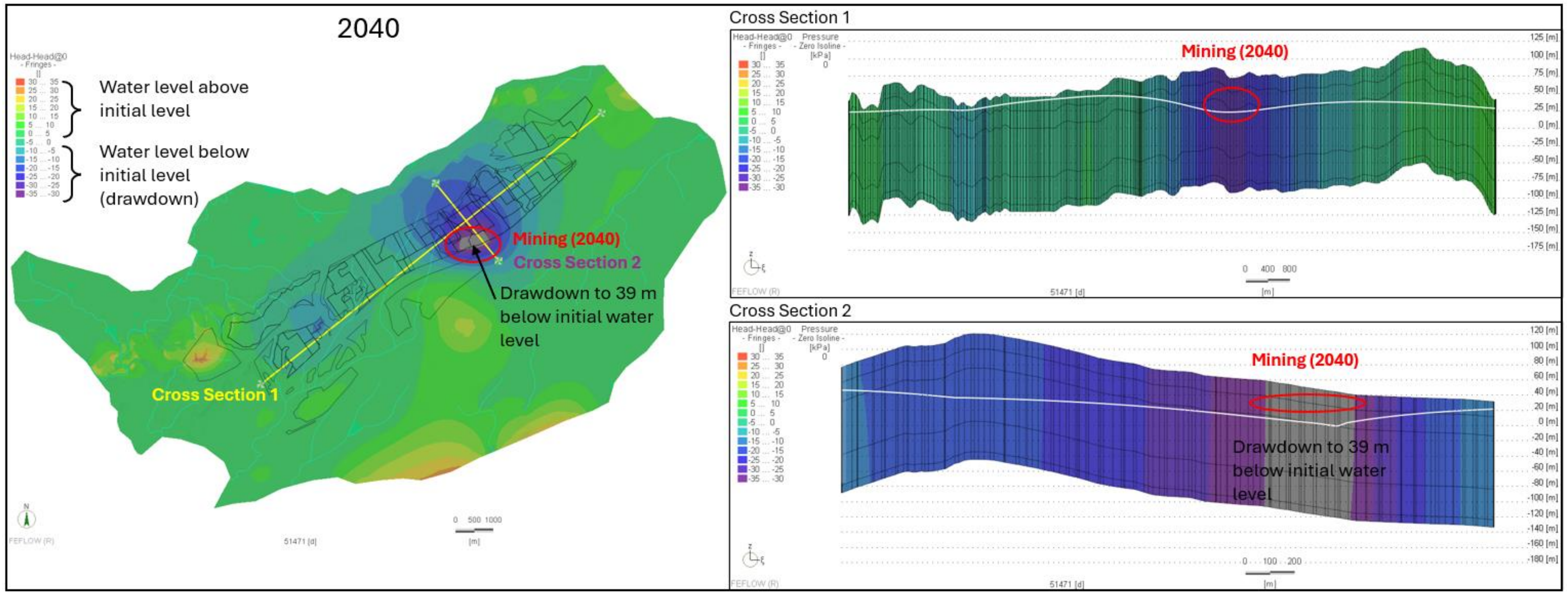


Figure 6-11 - Simulated drawdown 2040

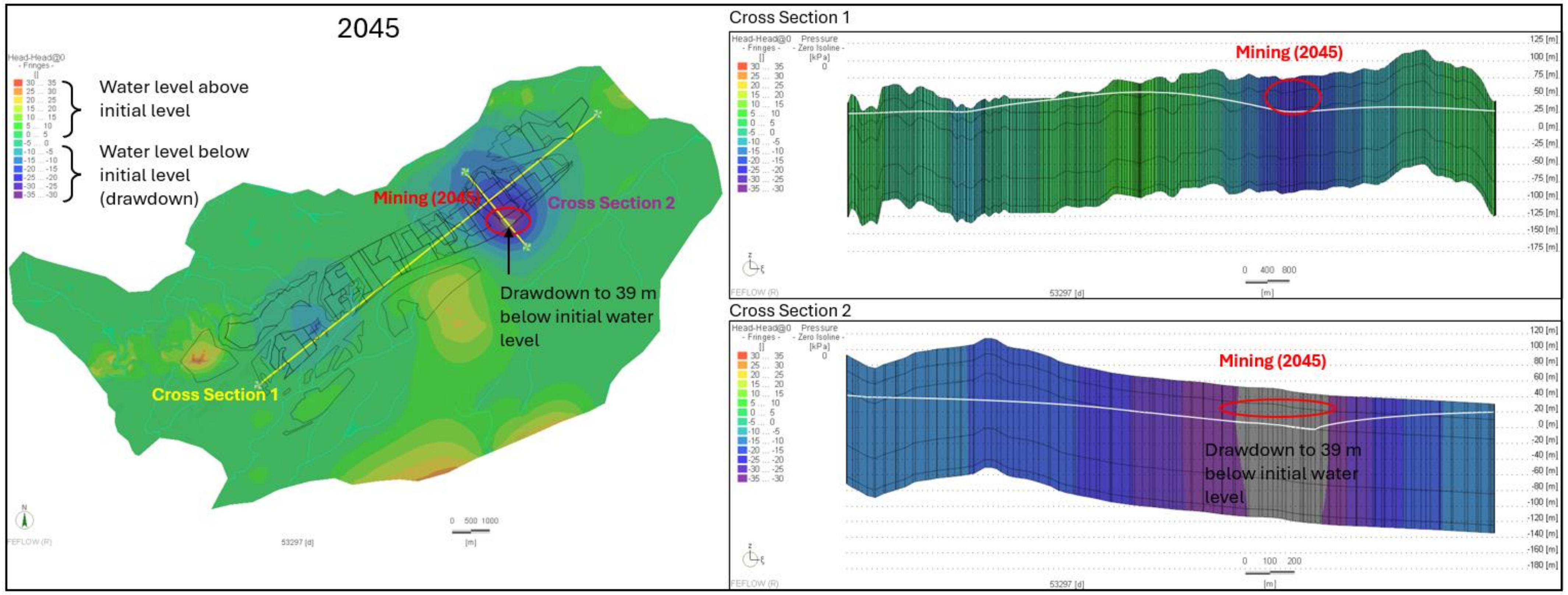


Figure 6-12 - Simulated drawdown 2045

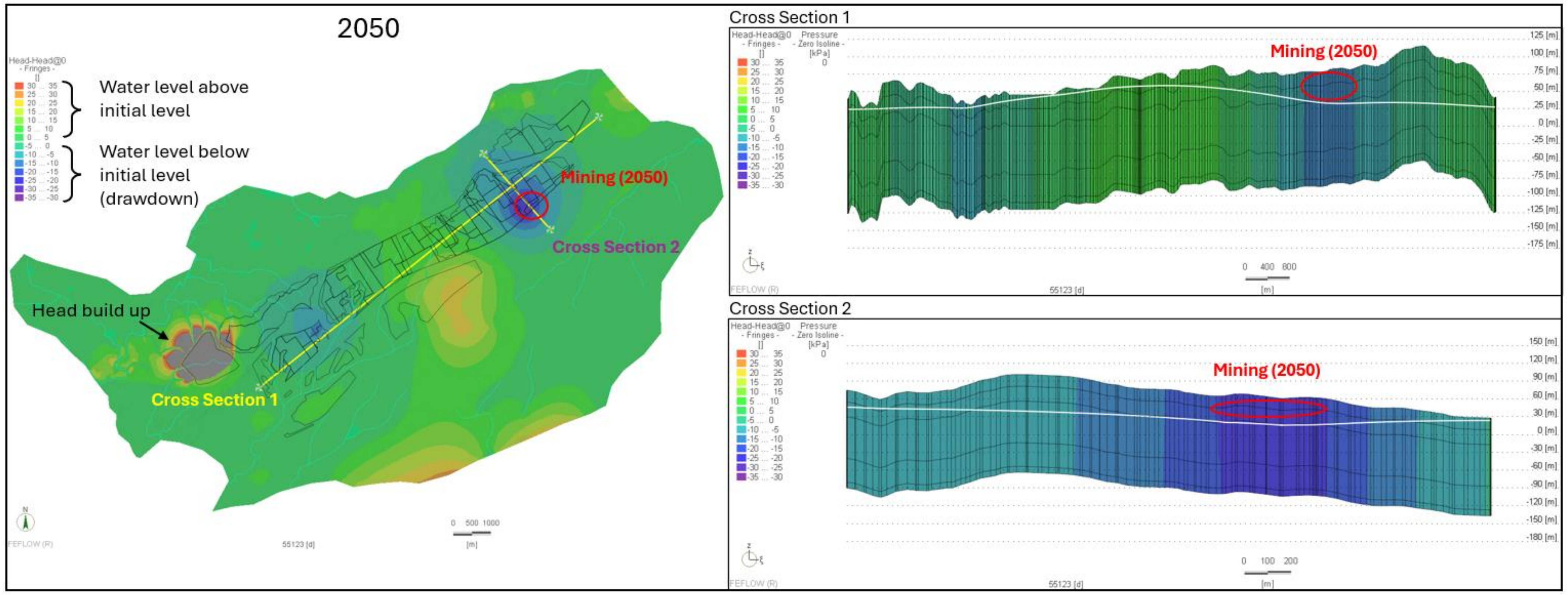


Figure 6-13 - Simulated drawdown 2050

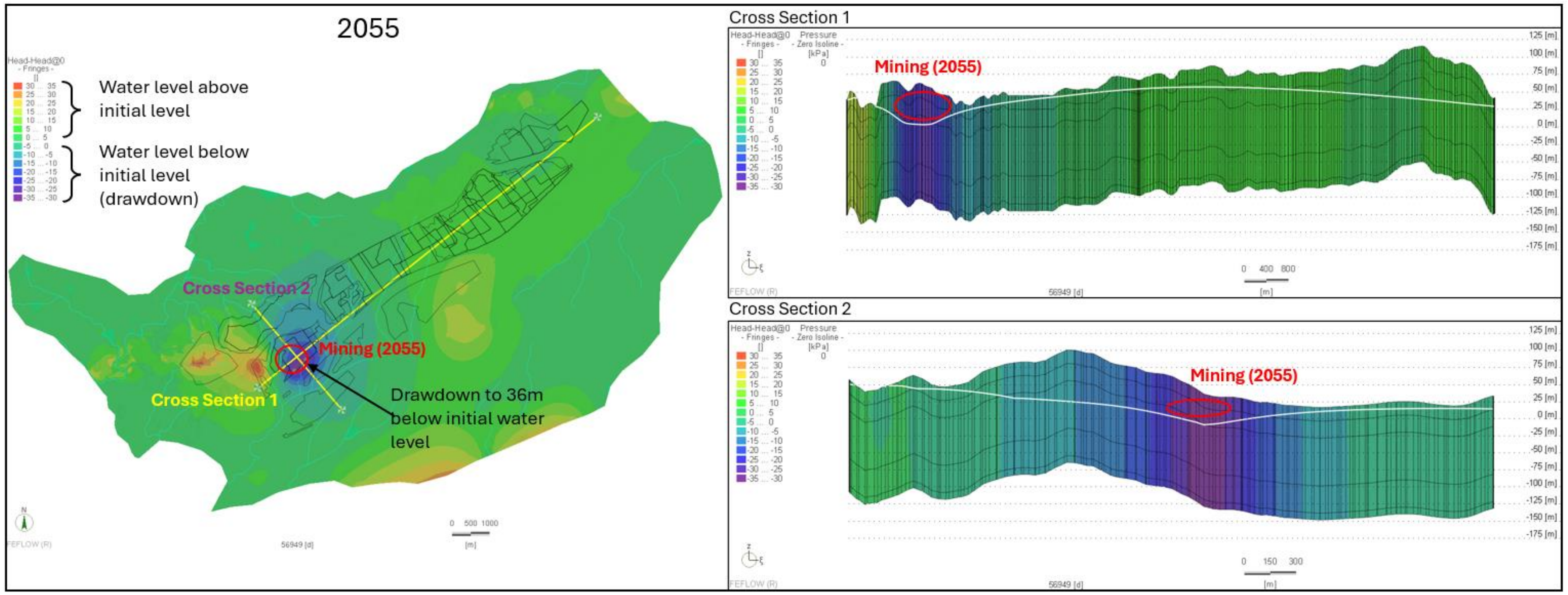


Figure 6-14 - Simulated drawdown 2055

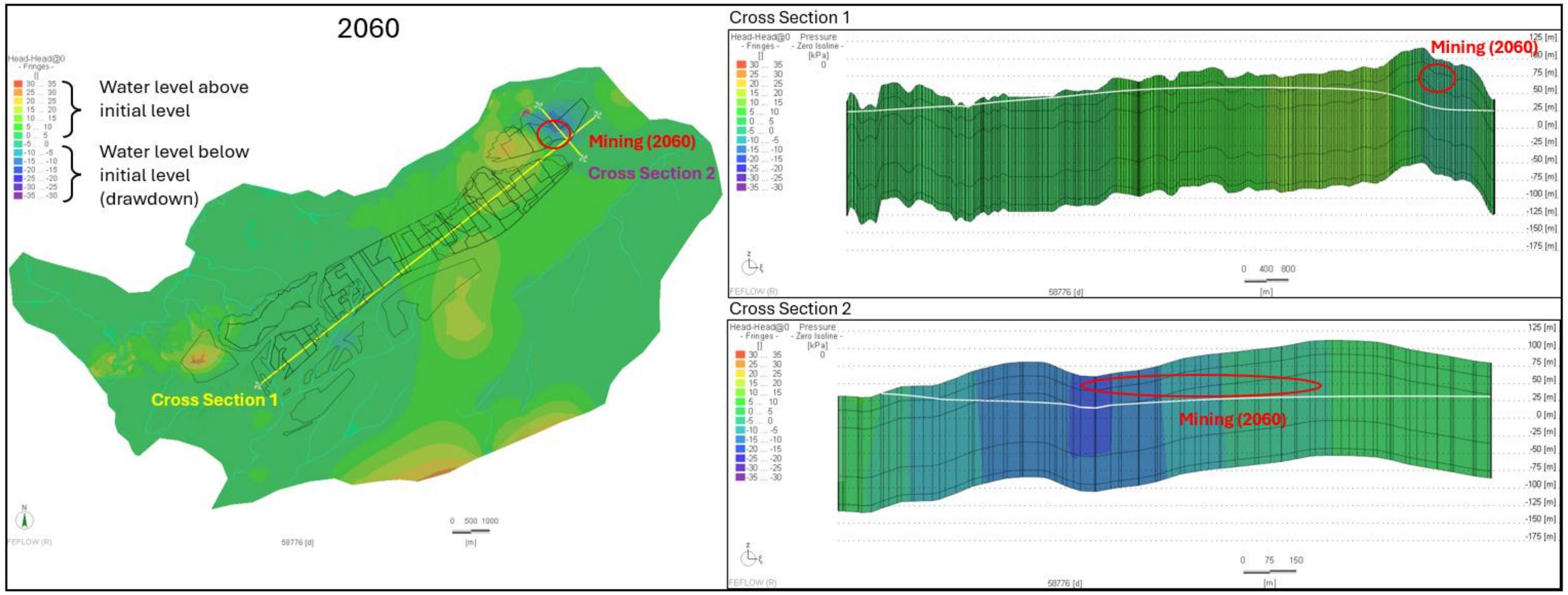


Figure 6-15 - Simulated drawdown 2060

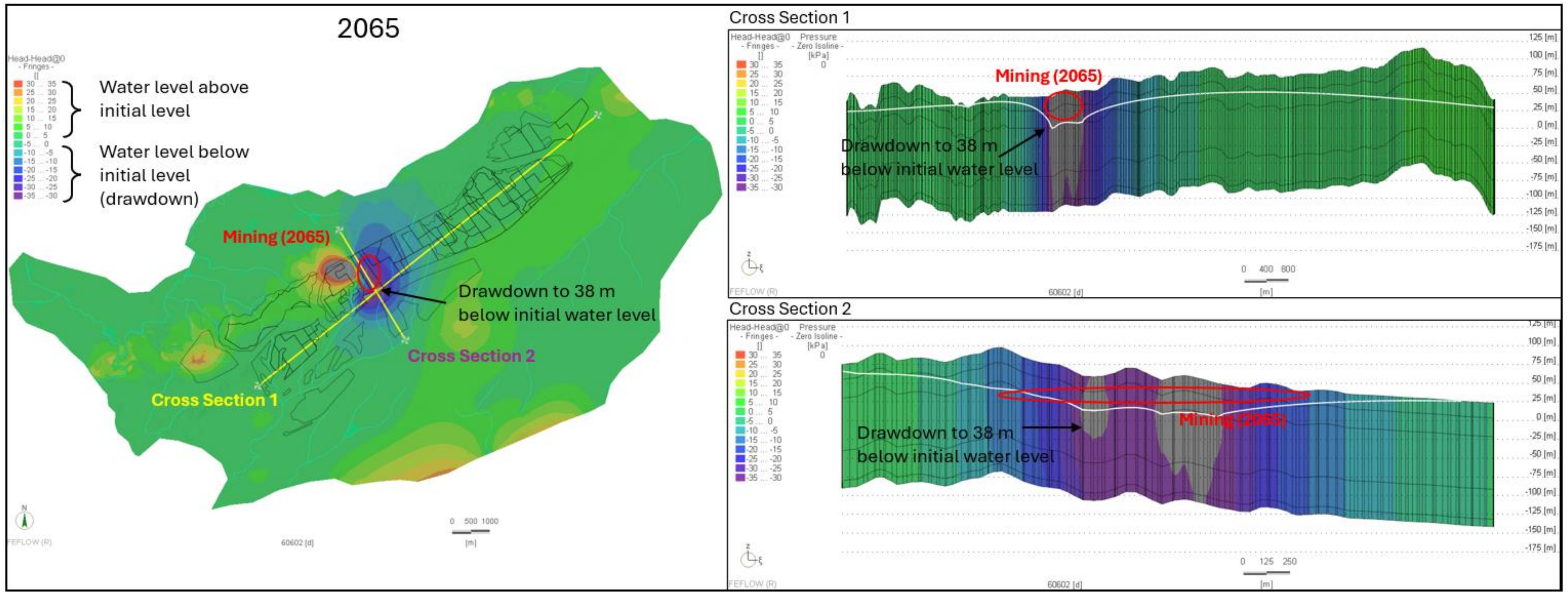


Figure 6-16 - Simulated drawdown 2065

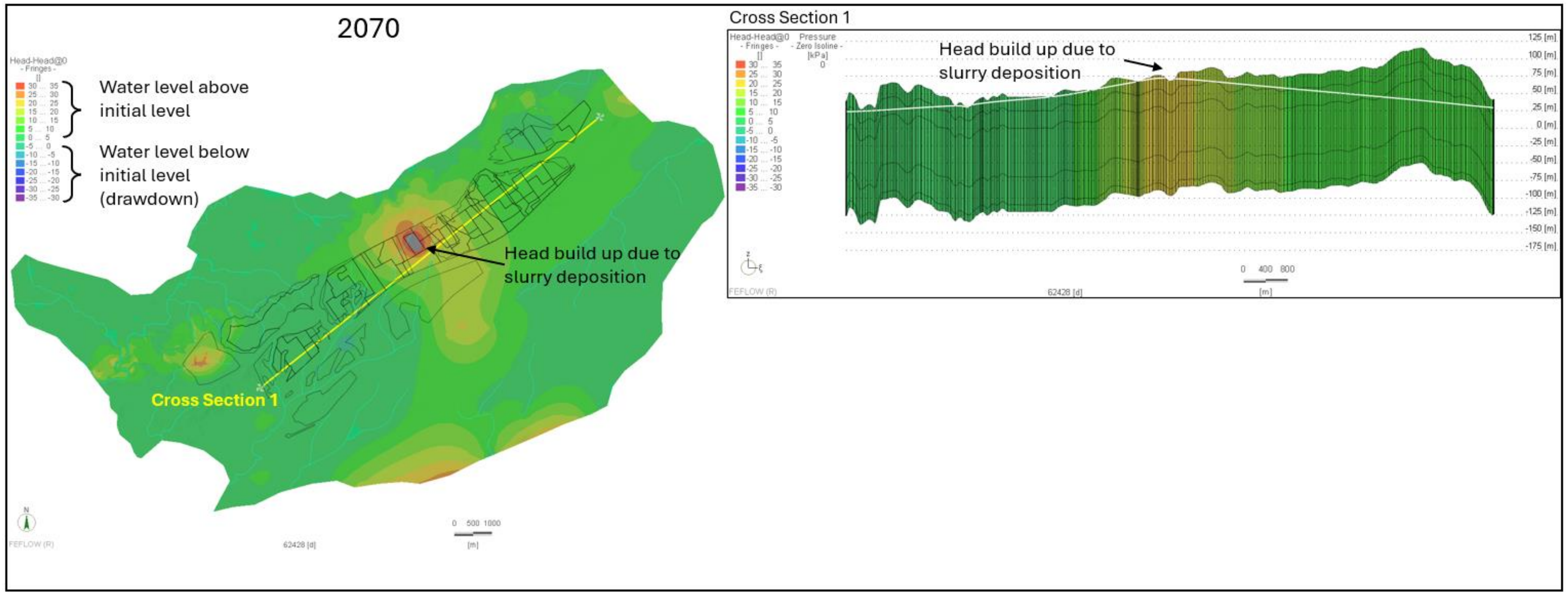


Figure 6-17 - Simulated drawdown 2070

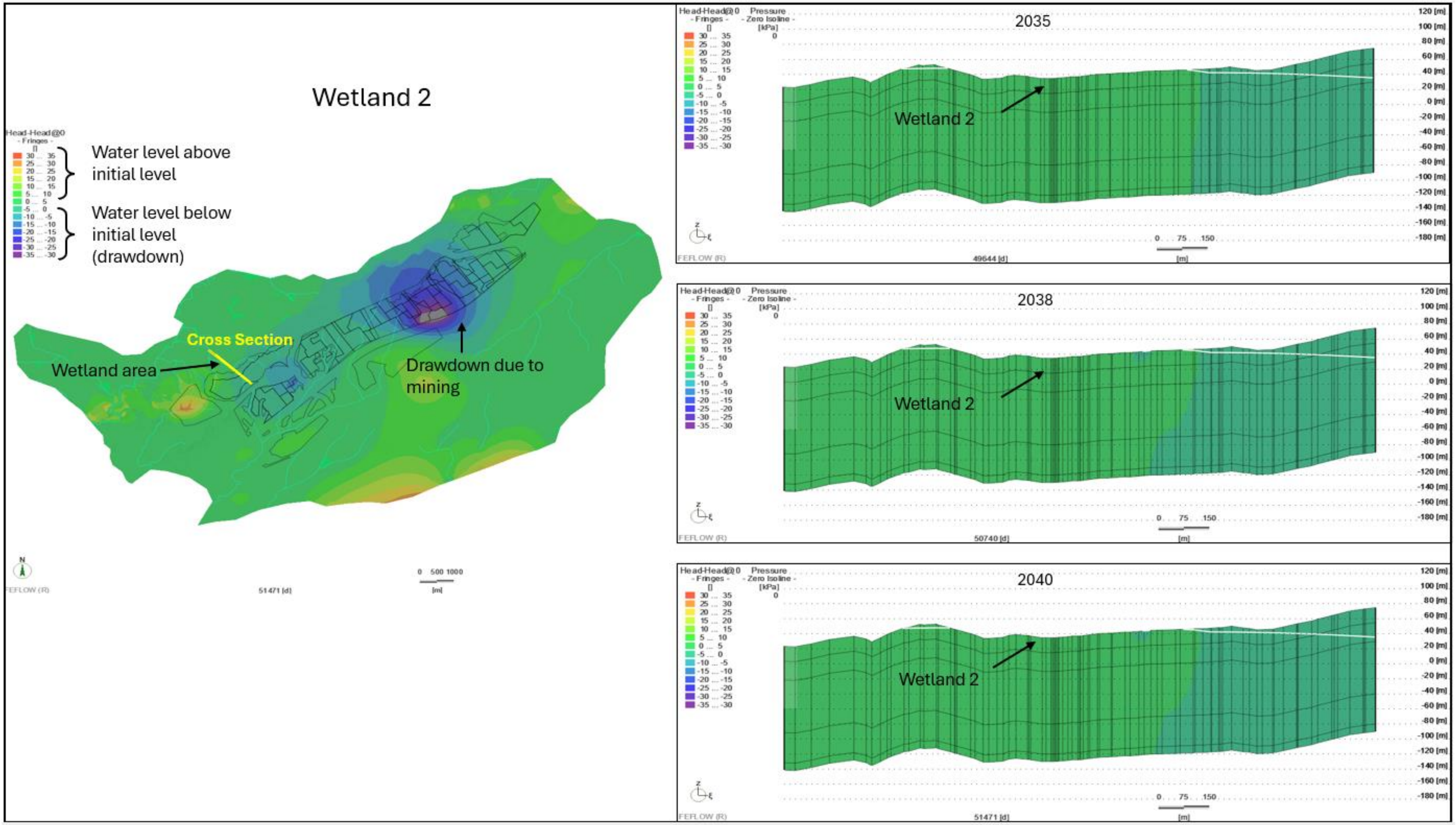


Figure 6-18 – Simulated drawdown in Wetland 2

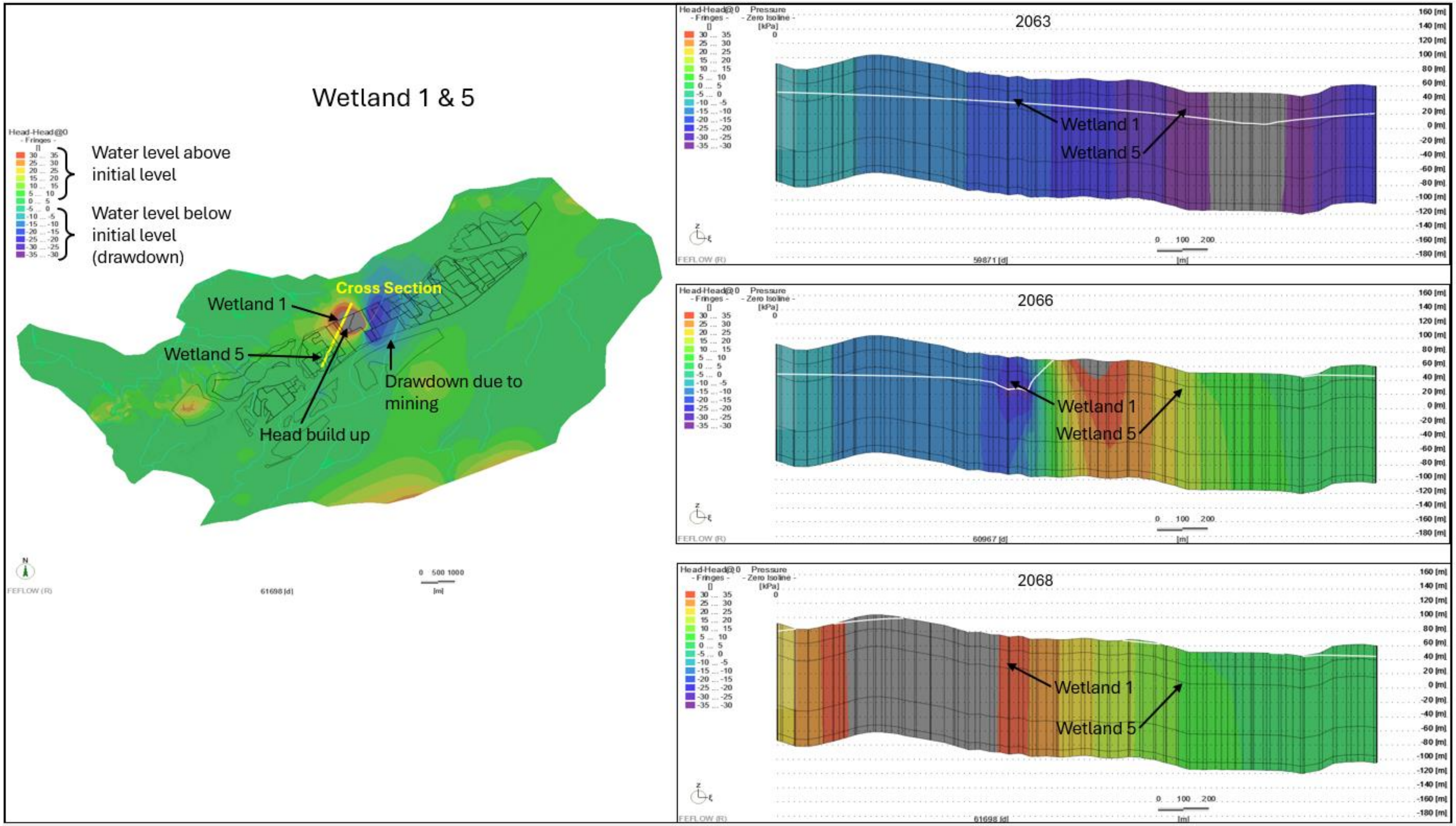
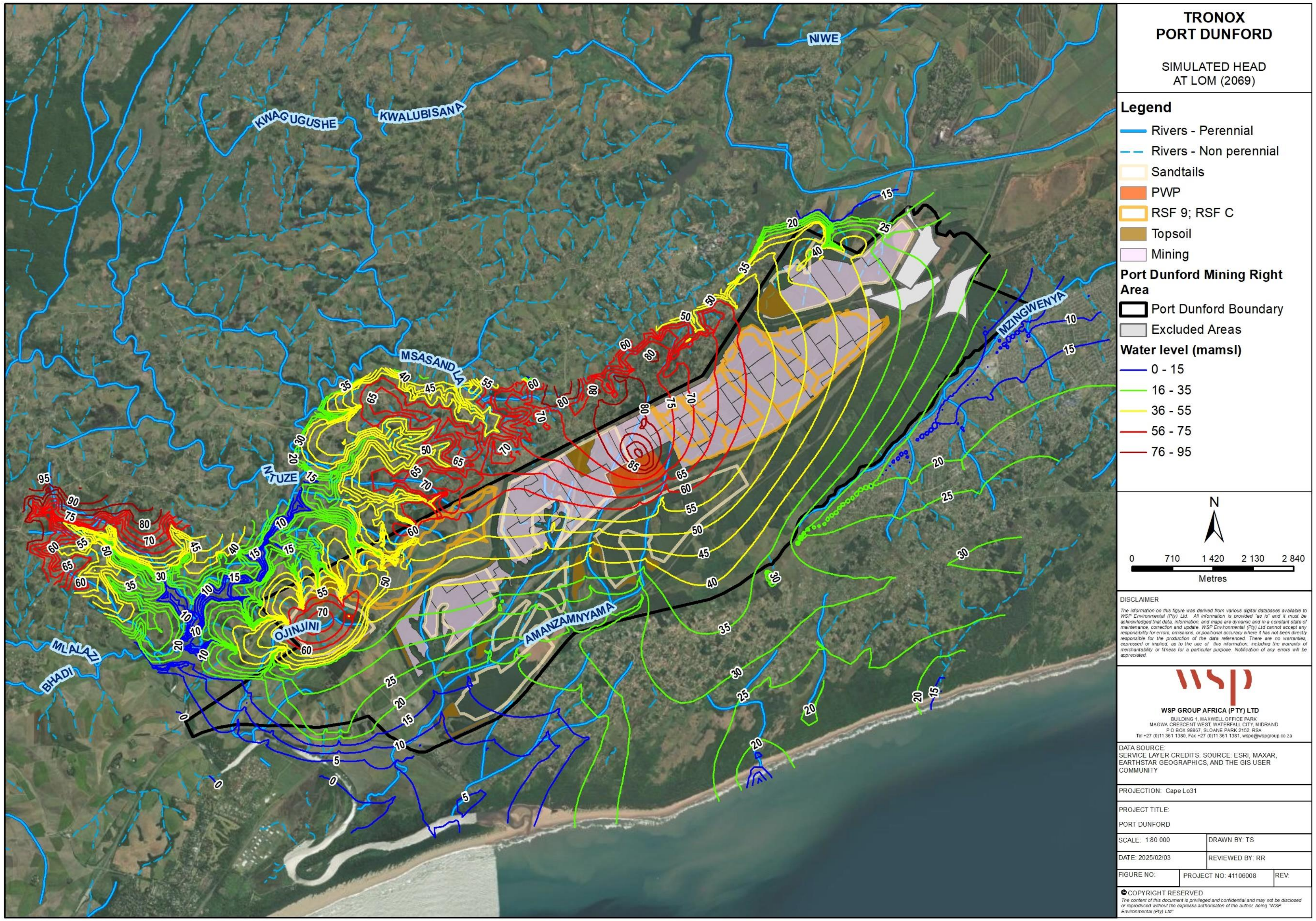


Figure 6-19 – Simulated drawdown in Wetland 1 and 5



DISCLAIMER

The information on this figure was derived from various digital databases available to WSP Environmental (Pty) Ltd. All information is provided "as is" and it must be acknowledged that data, information, and maps are dynamic and in a constant state of maintenance, correction and update. WSP Environmental (Pty) Ltd cannot accept any responsibility for errors, omissions, or positional accuracy where it has not been directly responsible for the production of the data referenced. There are no warranties, expressed or implied, as to the use of this information, including the warranty of merchantability or fitness for a particular purpose. Notification of any errors will be appreciated.

Figure 6-20 – Simulated water level (mamsl) at LOM (2069)

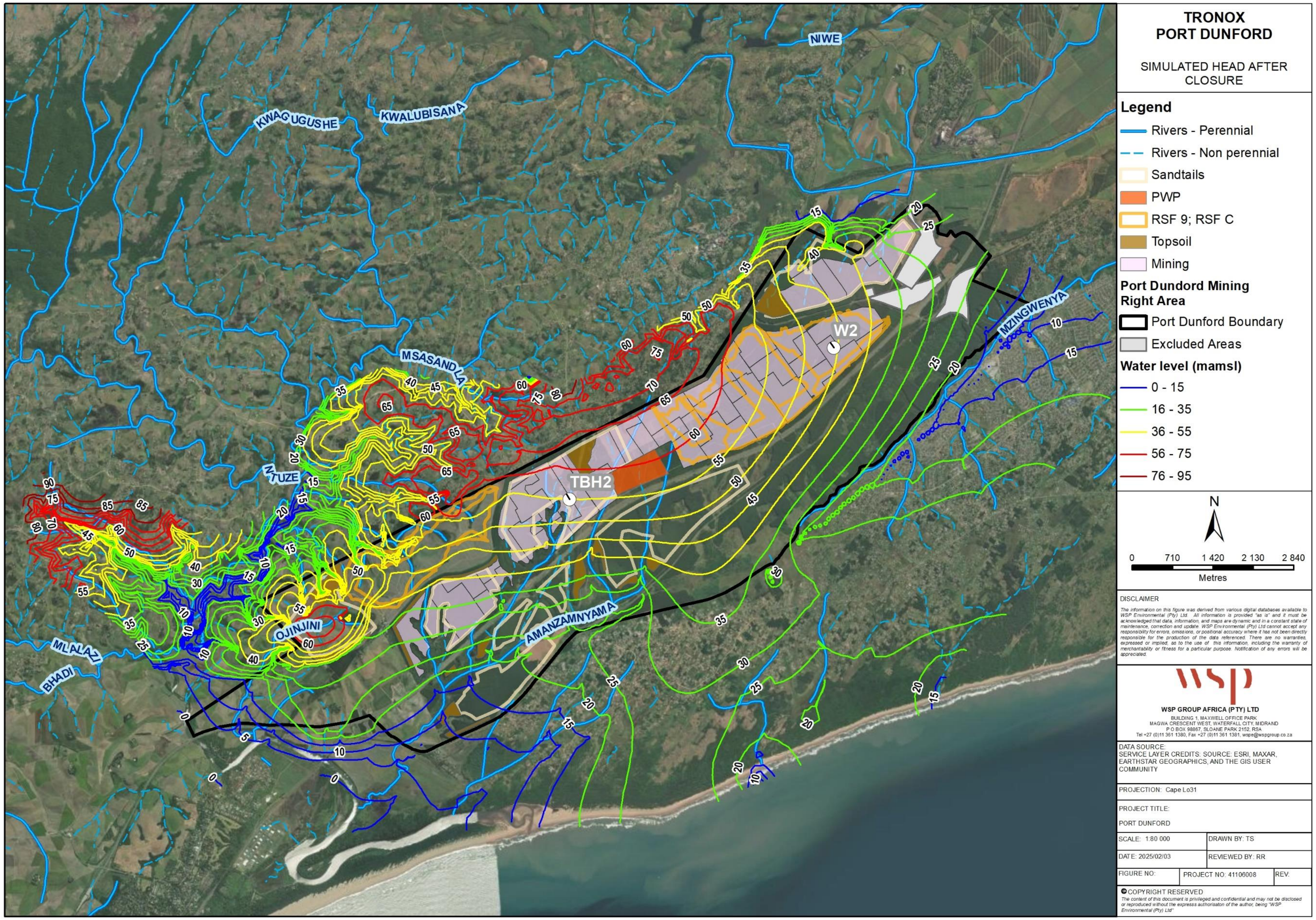


Figure 6-21 – Simulated water level (mamsl) 10 years after closure

To be able to show mine inflows with and without deposition, two scenarios were run:

- Mining only.
- Mining and deposition.

Two boreholes indicated in Figure 6-22 were selected to show water levels over time for the two scenarios. The water levels are shown in Figure 6-22 for TBH2 and in Figure 6-23 for W2.

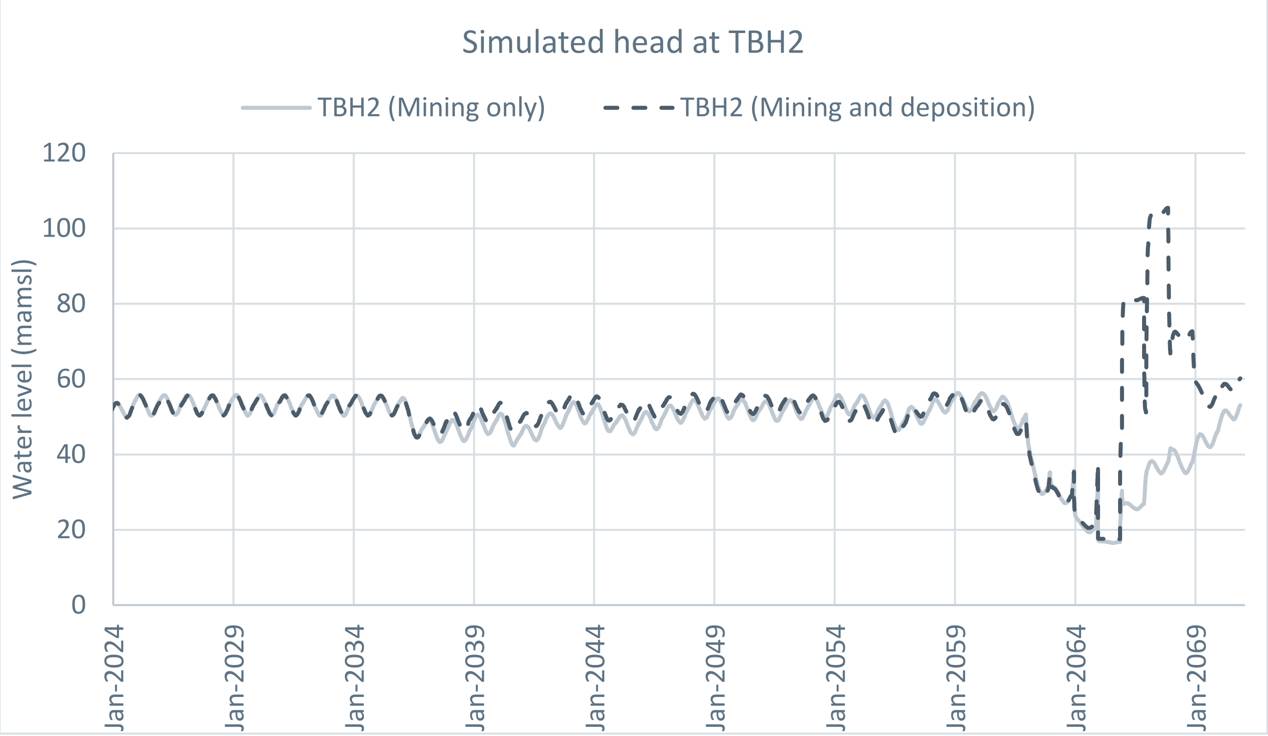


Figure 6-22 - Simulated head at TBH2

TBH2 is located in an area that will be mined in 2064. Figure 6-22 shows how the water levels stay relatively constant (with some seasonal fluctuation) until 2062. The nearby mining of 2062 and 2063 starts to affect the water levels at TBH2 and the water levels reach a minimum during 2064 as expected. From 2065 the water levels gradually increase for the "mining only" scenario, while it increases drastically with the "mining and deposition" scenario due to the additional water that is added with the sand tailings as backfill. The excess water from backfill is expected to accumulate on surface and may need to be managed.

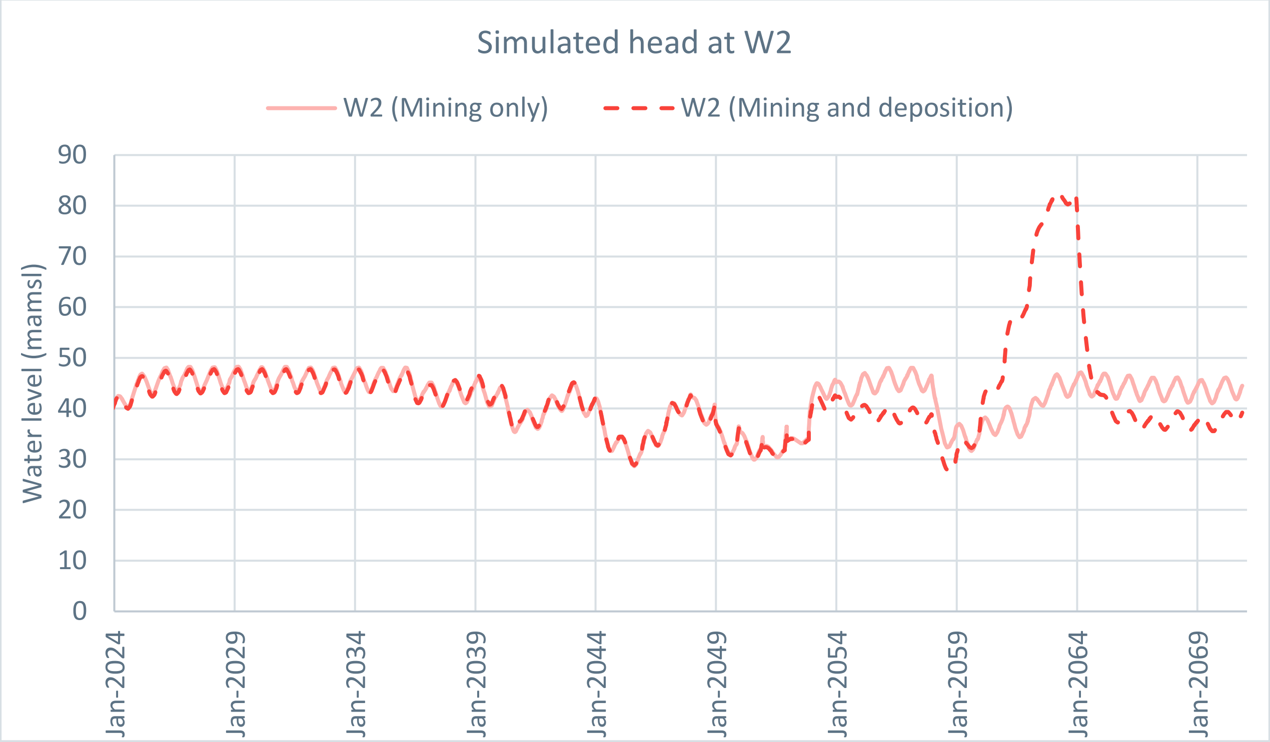


Figure 6-23 - Simulated head at W2

W2 is located in an area that will be mined in 2051. Figure 6-23 shows how the water levels are affected by nearby mining from all sides. There are several cycles with drawdown and recovery. The main feature of this graph is the difference between the two scenarios when RSF C Phase 4 becomes active in 2059. The effect of the RSF is reduced in 2059 and 2060 due to mining (dewatering) in the North block but reaches a maximum in January 2064. The excess water from backfill is expected to accumulate on surface and may need to be managed.

6.6.2.1 Groundwater ingress

The mining cycle supplied by Tronox was used to guide the setup of the operational model. Dewatering in each of the pits was simulated by applying time-constrained seepage faces to the planned pit floors. According to the mining cycle supplied by Tronox, the seepage faces in the pits were generally active for two years and then removed, to simulate backfilling after mining. The seepage faces in the Site C RSF pits were activated for four years to simulate the gradual transition of the pit into the RSF according to the operation schedule provided by Tronox.

Fluid flux boundary conditions were calculated and applied to all deposition areas according to the operation schedule. The deposition areas include the sand tailings areas (A1, A2, A3, and 8B), the backfill areas (3, 4, and 5) and the two RSF areas. The simulated ingress reported for the mining areas is presented in Table 6-3 and Figure 6-24.

In the first 10 years of low-rate mining, the simulated ingress is approximately 3 500 m^3/d. Thereafter the average simulated ingress for the “mining only” scenario is 8 911 m^3/d. By including the additional water from backfilling and residue deposition the total ingress rises to 51 311 m^3/d in 2065.

Table 6-3 – Simulated ingress in m^3/d

Year	Mining Only	Mining and Deposition
2025	3 375	3 310
2026	3 554	3 471
2027	3 513	3 474
2028	3 548	3 476
2029	3 532	3 476
2030	3 524	3 475
2031	3 531	3 475
2032	3 520	3 476
2033	3 521	3 474
2034	3 520	3 475
2035	3 521	3 473
2036	12 181	12 100
2037	7 777	8 870
2038	6 594	7 877
2039	8 847	10 489
2040	16 740	19 183
2041	8 288	9 737
2042	4 201	5 195
2043	8 066	9 047
2044	17 220	18 651
2045	13 517	14 707
2046	7 858	8 854
2047	4 671	5 330
2048	6 705	7 185
2049	9 490	10 001
2050	10 862	11 629
2051	8 485	9 060
2052	5 688	6 108
2053	3 503	3 546
2054	14 335	14 790
2055	10 408	17 178
2056	10 175	20 597
2057	9 406	28 391
2058	5 935	5 913
2059	4 959	8 145
2060	4 310	10 469
2061	14 139	24 458
2062	12 604	12 793
2063	8 313	8 594
2064	10 161	17 357
2065	11 083	51 311
2066	8 935	51 045
2067	5 772	46 231
2068	7 696	49 779
2069	4 054	24 579

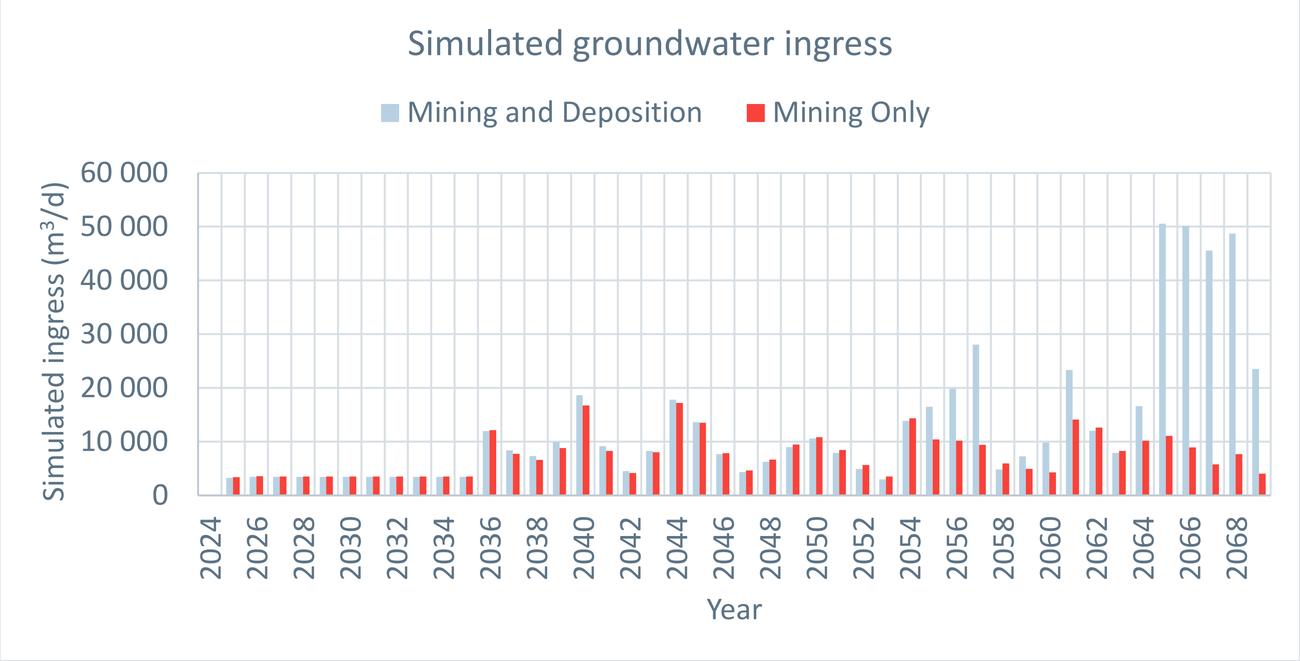


Figure 6-24 – Simulated ingress into the pits

6.6.2.2 Sensitivity analysis

A sensitivity analysis was performed on the operational model by changing the hydraulic conductivity (K), recharge (by 20%) and specific storage (SS) values (inputs) in the model and observing the changes in simulated pit ingress over time (output).

The result of the analysis is plotted in Figure 6-25 below. The results show that model is generally more sensitive to changes in recharge and less sensitive to changes in specific storage. Generally, however, changes observed in the pit ingress were not substantial.

Please note that the sensitivity analysis was conducted on a previous version of the mine plan, and therefore the results are slightly different from the inflows simulated using the latest mine plan.

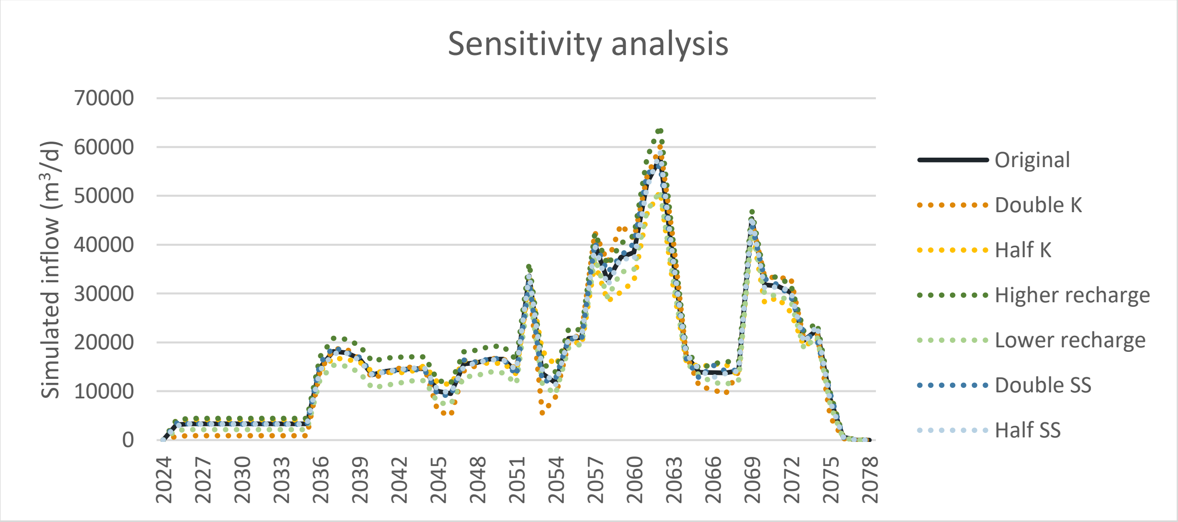


Figure 6-25 – Sensitivity analysis results

6.6.2.3 Baseflow into surface water features

The groundwater contribution as baseflow into four major surface water features/areas was analysed over time using the model. Figure 6-26 shows the baseflow contributions over time. Based on the results of the operational model, it is evident that the baseflow contribution is reduced as the mining activity progresses across the site. However, increases in baseflow is observed as a result of the wet backfill or deposition of sand tailings. The following is noted:

- **The KwaGugushe, Msasandla, and Ojinjini Rivers** (west of the mining area) shows insignificant reduction in baseflow. More significant is the increase in in baseflow due to the wet backfill / sand tailings. The increase in baseflow from 2047 to 2053 is due to the wet sand tailings in area 8B. The increase in baseflow between 2065 and 2068 is due to the backfilling in the central mining area (backfill area 3).
- **Baseflow to the Mhlathuze River** (north of the mining area) is limited as the model area contributing to the Mhlathuze catchment is insignificant. The baseflow reduces from 2036 and the largest effect is seen in 2058 to 2061 during mining of the north block. However, the wet backfill has a counter effect and from 2061 to 2064 there is a large increase in baseflow.
- **Baseflow to the Mzingwenya River and the wetlands south of Lake Cubhu** (north-east of the mining area) is limited. The baseflow reduces from 2036 to the end of mining. However, from 2062 to 2064 there is an increase in baseflow. This can be monitored in future at boreholes W1 and W5.
- **Baseflow to the Amanzamnyama and Mlalazi Rivers and estuary** (south of the mining area) shows insignificant reduction in baseflow from 2036. From 2054 to 2058 and again from 2062 to 2065 the baseflow reduction is significant. Increase in baseflow due to deposition is evident for the following periods:
  - From 2037 to 2052 – due to deposition of sand tailings A1, A2 and A3.
  - From 2056 to 2058 – due to backfill in area 4.
  - From 2066 to 2067 – due to backfill in area 3.

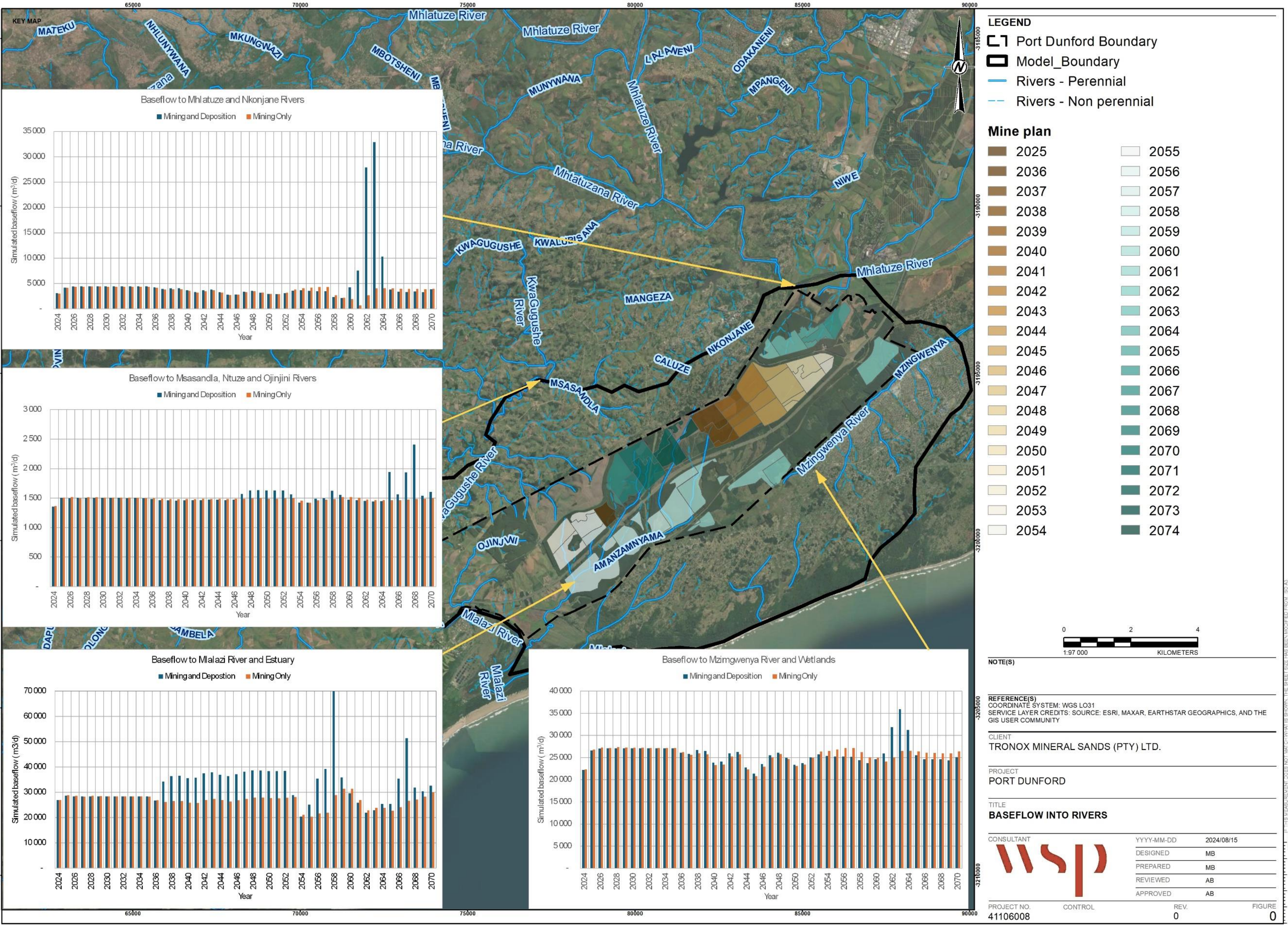


Figure 6-26 - Baseflow into surface water features

6.6.3 POST CLOSURE

The post closure model starts January 2070 and runs for 100 years until January 2170.

6.6.3.1 Groundwater levels

The post closure model was run for a period of 100 years after operations. The model shows that the groundwater levels recover within two years after completion of mining. This new “steady state” water level is similar to pre-mining conditions as shown in Table 6-4.

6.6.4 CONTAMINANT TRANSPORT

The contaminants of potential concern were discussed in section 5.6. The three elements selected for contaminant transport modelling included total dissolved solids (TDS), Al, and Mn. TDS needs to be modelled as the estuary is highly sensitive to changes in salinity. Al and Mn were selected due to the environmental risk concern during the operational phase. The operational values were applied in the model. For post-closure, no additional or adjusted source terms were applied as the model continues with the operational plume and diluting it as recharge enters the model.

Table 6-4 – Source terms applied to the model (mg/L)

	TDS	Al	Mn
RSF (operational)	**210**	**0.36**	**1.32**
Backfill	**7.3**	**0.033**	**0.06**

The concentrations were applied as mass flux boundary conditions to the RSFs and mining pits from the time of deposition/backfill, according to the operational schedules discussed in section 8.8. A mass flux is in essence the recharge multiplied by the concentration and is entered into the model with a unit of $g/m^2/d$. The aquifer background concentrations were based on the average of the measured concentrations during the hydrocensus which was 203.8 mg/L TDS, 0.35 mg/L Al, and 0.34 mg/L Mn.

Due to high recharge in the sand aquifer and the additional water added to the system with the backfill and/or residue, the concentration in the aquifer attenuated. This is the opposite of what is generally expected from contamination sources. Therefore, the residue and backfill material are not strictly sources of contamination. However, monitoring should be put in place to check if there are any change in quality over time. When these diluted plumes reach the rivers and wetlands it is further reduced with the effect that minimal impacts are observed.

Figure 6-27 shows a cross section through RSF C and the Mzingwenya River as illustration to indicate how the concentrations build up in the base rock (NMP). There seems to be a build-up of contaminants in the rivers, however, this is a numerical artefact which is not real. Figure 6-28 shows the simulated TDS concentration over time in the three main rivers. Figure 6-29 and Figure 6-30 show the simulated Al and Mn concentrations over time in the three main rivers.

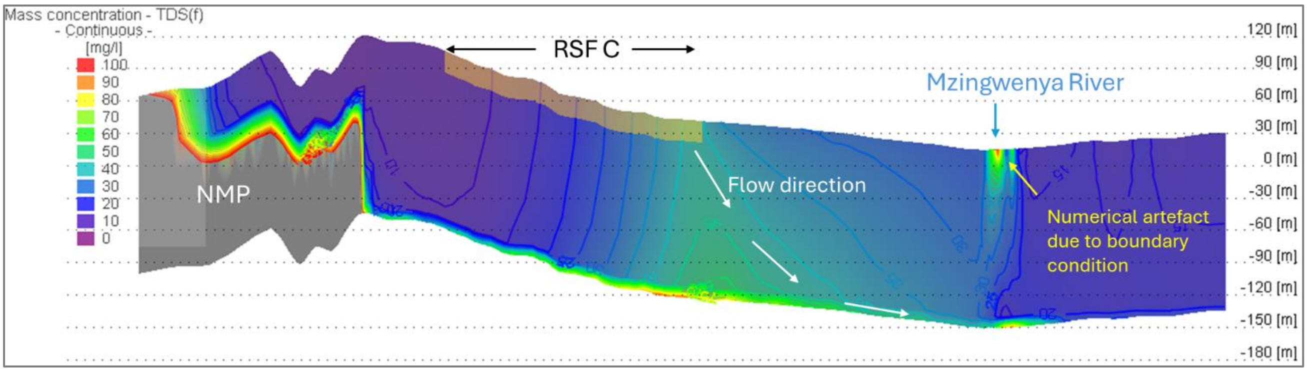


Figure 6-27 – Illustration of concentration

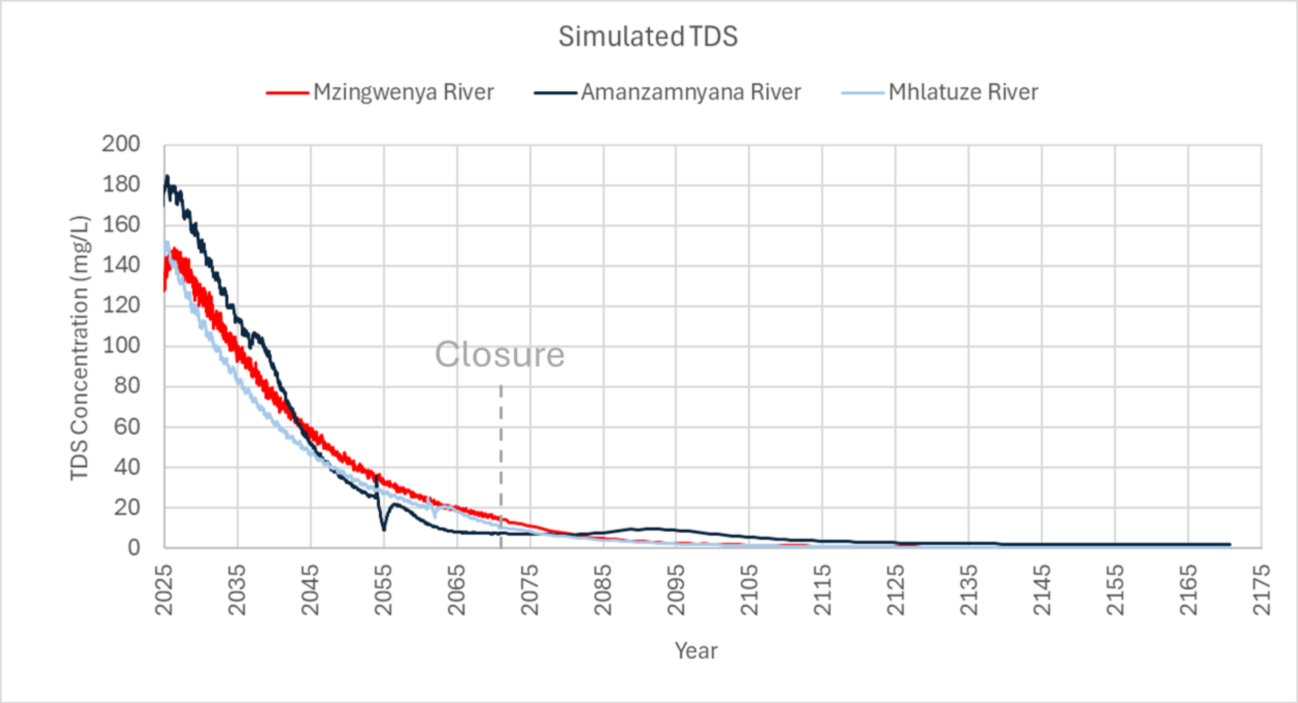


Figure 6-28 - Simulated TDS in Rivers

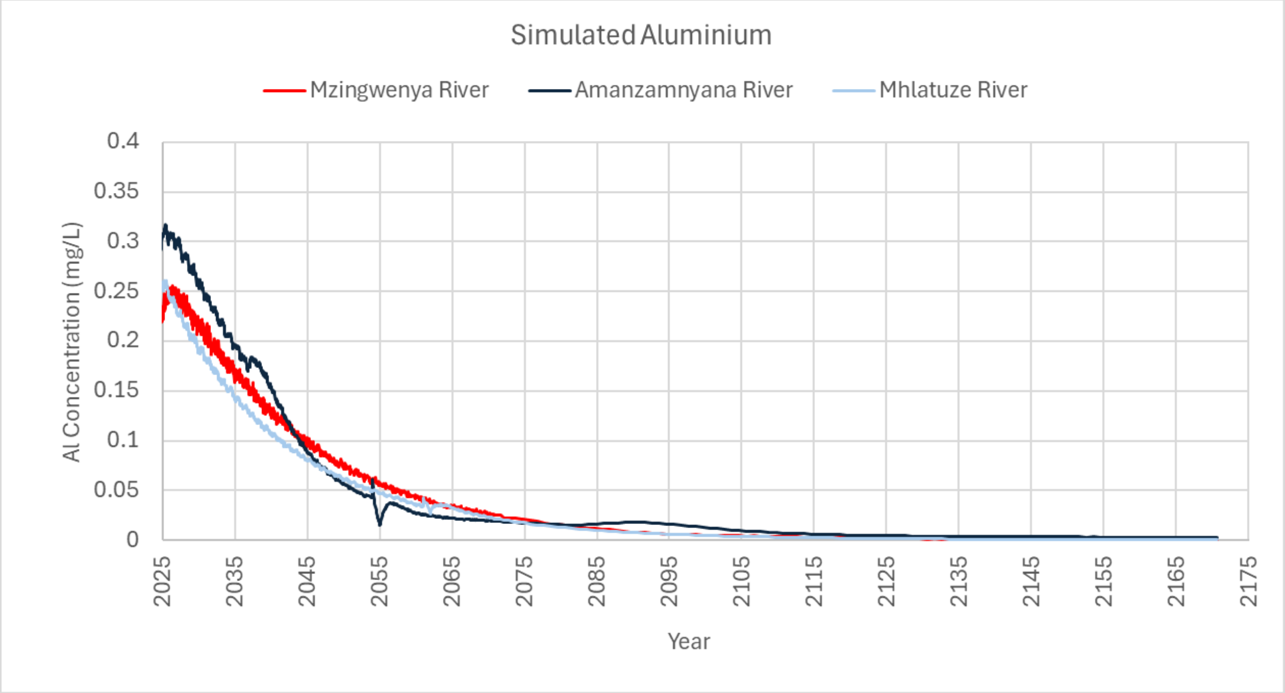


Figure 6-29 - Simulated Aluminium in Rivers

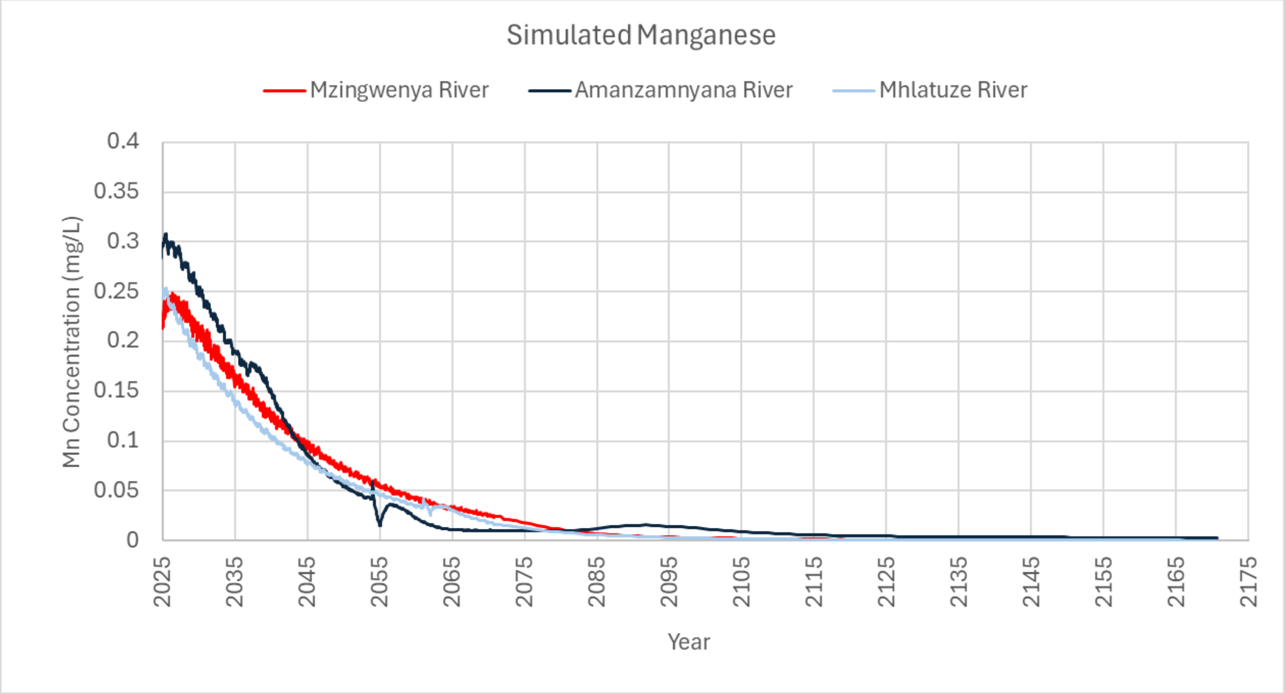


Figure 6-30 - Simulated Manganese in Rivers

From the figures above it is clear that the concentration in the rivers will gradually reduce over time. This dilution effect is a result of the addition of water during backfilling (50% water) and the RSF material which is deposited as a slurry with 72% water.

7 GEOHYDROLOGICAL IMPACTS

Based on the site hydrogeological understanding, project infrastructure requirements and site conditions at each stage of the project development, a groundwater impact assessment was carried out for the project.

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts.

As required by the EIA Regulations (2014) as amended, the determination and assessment of impacts will be based on the following criteria:

- Nature of the Impact
- Significance of the Impact
- Consequence of the Impact
- Extent of the impact
- Duration of the Impact
- Probability of the impact
- Reversibility:
  - can be reversed
  - may cause irreplaceable loss of resources and
  - can be avoided, managed or mitigated

7.1 METHODOLOGY FOR ASSESSING IMPACT SIGNIFICANCE

The Impact Assessment methodology is described in Appendix C. The significance rating table is presented in Table 7-1.

7.2 CONSTRUCTION PHASE

Not relevant to this application. No new infrastructure developments foreseen, except general maintenance to existing infrastructures.

7.3 OPERATIONAL PHASE

The following impact on the local aquifer system is foreseen due to the abstraction:

- Water level fluctuations driven by climate variation(s), viz. deeper levels during drier seasons, however, under normal wet/dry climate conditions water levels will oscillate above and below an average water level depth. Lowering of water levels is temporary with quick recovery during backfilling, therefore the impact is limited.

7.3.1 IMPACTS ON GROUNDWATER QUANTITY

The groundwater quantity will be reduced in localised mining areas for short periods after which backfilling with coarse slurry containing 50% water will quickly recover any drawdown. Therefore, the impact on groundwater quantity is considered to be minimal.

The coarse sand tailings dumps will remain for a period of time during which the recharge to the aquifer may increase. The coarse sand tailings deposition area 8B will leach most of the water as toe seepage which will have to be managed by digging trenches around it and collecting the water. Toe seepages may also occur to a lesser extent in the other coarse sand tailings deposition areas.

The potential impact and their detailed mitigation measures before and after operation due to dewatering activities are as follows:

- Lowering of water levels around the mine due to mine dewatering, which may impact on surface or groundwater users and wetlands during operation.
- Backfilling into the pits following operation adds water to the aquifer. This reduces the dewatering impact as it minimises the cone of depression and potential impacts on users and the surface resources.

7.3.2 IMPACTS ON GROUNDWATER QUALITY

Quality impacts are observed from the existing facilities as listed in the impact assessment in Table 7-1.

- Deterioration of groundwater quality during operation
  - Impact without mitigation at **RSF9:** Contamination of groundwater because of deposition of material into RSF 9 as mining progresses. This is however mitigated salinity of the residue was shown by the geochemistry study to be lower than the ambient groundwater quality.
  - Impact without mitigation at **RSFC:** Contamination of groundwater because of deposition of material into RSF C as mining progresses. RSF C is located on an already disturbed area (mining pits). The possible contamination impact is mitigated by the low salinity of the residue which is shown by the geochemistry study to be lower than the ambient groundwater quality.
  - Impact without mitigation in the **Backfill areas 3, 4, & 5:** Contamination of groundwater because of deposition of material into pits as mining progresses. This is mitigated by the low salinity of the residue which is shown by the geochemistry study to be lower than the ambient groundwater quality. Furthermore, backfilling is active for a short period.

Boreholes lost during operation in the backfill areas should be replaced to confirm that the anticipated impact is low and to monitor the change in quality over time.

7.3.3 IMPACTS ON SURFACE WATER

The main receptors are the receiving surface water streams and wetlands.

7.3.4 GROUNDWATER MANAGEMENT

Groundwater management is carried out as a continuous improvement basis. The site area is within the Mhlathuze water management area (WMA). Routine monitoring is required to check if there are any impacts on the water quality in the rivers.

7.4 DECOMMISSION PHASE AND POST CLOSURE PHASE

Backfilling is concurrent with mining. A rehabilitation plan to ensure the land can be returned for use by forestry will be developed.

- Dewatering after closure
  - Recovery of water levels (positive). Area will return to forestry after closure.
- Deterioration of groundwater quality after closure
  - The potential impacts at **RSF 9** (without mitigation are potentially negative) due to the backfill material potentially contaminating groundwater. This is mitigated by the low salinity of the residue which is shown by the geochemistry study to be lower than the ambient groundwater quality. The facility will be covered with topsoil and returned to forestry.
  - The potential impact at **RSFC** (without mitigation) are potentially negative due to the possibility of contamination of groundwater from the deposition of material into RSF C as mining progresses. This is mitigated by the low salinity of the residue which is shown by the geochemistry study to be lower than the ambient groundwater quality. Facility will be covered with topsoil and returned to forestry.
  - The potential impact from the **Backfill areas 3, 4, & 5** is potentially negative without mitigation due to the possibility of contamination of groundwater because of deposition of material into pits as mining progresses. This is mitigated by the low salinity of the backfill and since the affected areas will be covered with topsoil and returned to forestry.

7.5 CUMULATIVE IMPACTS

All the impacts have been evaluated as the total (cumulative) impact in the section above. Impacts on the Wildlife Trust Rehabilitation area south of the coarse sand tailings dump area A2, will be low.

Table 7-1 - Significance rating table

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Groundwater	Lowering of water levels around the mine due to mine dewatering, which may impact on surface or groundwater users	Operation (mining)	Negative	Easy	3	2	1	2	4	**32**	**N3**	2	2	3	3	3	**30**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 2:	Groundwater	Recovery of water levels (positive). Area will return to forestry after closure.	Decommissioning and Closure	Positive	Easy	0	2	3	2	5	**35**	**P3**	0	2	3	2	5	**35**	**P3**
					Significance	**P3 - Moderate**							**P3 - Moderate**						
Impact 3:	Groundwater	Contamination of groundwater because of deposition of material into RSF 9 as mining progresses.	Operation (RSF 9)	Negative	Easy	2	2	3	5	5	**60**	**N3**	1	1	3	5	2	**20**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 4:	Groundwater	Contamination of groundwater because of deposition of material into RSF 9 as mining progresses.	Decommissioning and Closure (RSF 9)	Negative	Easy	2	2	3	2	5	**45**	**N3**	1	1	3	2	3	**21**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 5:	Groundwater	Contamination of groundwater because of deposition of material into RSF C as mining progresses.	Operation (RSF C)	Negative	Easy	2	2	3	5	5	**60**	**N3**	1	1	3	5	2	**20**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 6:	Groundwater	Contamination of groundwater because of deposition of material into RSF C as mining progresses.	Decommissioning and Closure (RSF C)	Negative	Easy	2	2	3	2	5	**45**	**N3**	1	1	3	2	3	**21**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 7:	Groundwater	Contamination of groundwater because of deposition of material into pits as mining progresses.	Operation Backfill areas 3,4, & 5	Negative	Easy	2	2	3	5	5	**60**	**N3**	1	1	3	5	2	**20**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						
Impact 8:	Groundwater	Contamination of groundwater because of deposition of material into pits as mining progresses.	Decommissioning and Closure (Backfill areas 3,4, & 5)	Negative	Easy	2	2	3	2	5	**45**	**N3**	1	1	3	2	3	**21**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						

8 GROUNDWATER MONITORING SYSTEM

8.1 GROUNDWATER MONITORING NETWORK

8.1.1 SYSTEM RESPONSE MONITORING NETWORK

The groundwater monitoring boreholes should be distributed across the site, strategically situated to allow observation of groundwater quality fluctuation upgradient, within and downgradient of the potential contamination sources. The monitoring program must be used to guide environmental management decision making, including taking remedial measures when water quality guidelines are exceeded.

During the hydrocensus survey, several boreholes were identified both within the site boundary and outside of this. It is understood that the “W” named boreholes are previously installed monitoring wells. The TBH boreholes could potentially also serve as monitoring boreholes. It is anticipated that some of the boreholes will be destroyed by mining activities. Figure 8-1 shows the recommended monitoring boreholes and is based on:

- Existing boreholes that will not be destroyed by mining (W1, W5, W7, W11, W12, W14, TBH6, TBH 8 and TBH9).
- Boreholes that should be replaced if destroyed during mining (W3 and W6, these positions have been moved to outside the mining area).
- Additional proposed boreholes (P_BH1 to P_BH4).

The placement of these boreholes was selected to capture any potential plume development and to see what the water quality of the groundwater leaving the Por Durnford MRA is.

Five surface water monitoring points are also recommended:

- The Mzingwenya River (P_SW1).
- The Amanzamnyama River (P_SW2).
- Tributary of the KwaGugushe River (P_SW3).
- Tributary of the Mhlatuze river (P_SW4).
- Ojinjini River (P_SW5).

The geographic coordinates of the proposed monitoring points are presented in Table 8-1.

DISCLAIMER

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Figure 8-1 - Existing and proposed boreholes

Table 8-1 – Proposed system response monitoring network

Monitoring Points	Name	Longitude	Latitude	Description
Groundwater	W1	31° 53' 31.754" E	28° 52' 26.472" S	Existing
	W3	31° 51' 21.109" E	28° 51' 48.281" S	Replacement
	W5	31° 51' 37.620" E	28° 53' 13.920" S	Existing
	W6	31° 50' 39.003" E	28° 53' 24.193" S	Replacement
	W11	31° 49' 32.520" E	28° 54' 39.024" S	Existing
	W12	31° 47' 19.176" E	28° 54' 5.472" S	Existing
	W14	31° 48' 9.360" E	28° 55' 56.712" S	Existing
	TBH5a	31° 46' 43.464" E	28° 55' 14.916" S	Existing
	TBH6	31° 54' 27.072" E	28° 51' 4.212" S	Existing
	TBH8	31° 52' 40.800" E	28° 51' 42.840" S	Existing
	TBH9	31° 49' 39.000" E	28° 52' 55.380" S	Existing
	P_BH4	31° 47' 56.255" E	28° 55' 26.486" S	Proposed
	P_BH3	31° 48' 54.591" E	28° 54' 18.792" S	Proposed
	P_BH2	31° 52' 57.468" E	28° 52' 21.482" S	Proposed
	P_BH1	31° 52' 43.129" E	28° 51' 6.155" S	Proposed
	W7	31° 48' 55.152" E	28° 53' 21.948" S	Existing
Surface water	P_SW1	31° 53' 38.747" E	28° 52' 28.272" S	Proposed
	P_SW2	31° 48' 3.431" E	28° 55' 41.302" S	Proposed
	P_SW3	31° 47' 17.788" E	28° 53' 57.135" S	Proposed
	P_SW4	31° 52' 15.609" E	28° 50' 55.661" S	Proposed
	P_SW5	31° 46' 3.519" E	28° 55' 21.598" S	Proposed

8.1.2 MONITORING FREQUENCY

Monitoring should be carried out quarterly within the existing network during Phase 1. This is crucial to establish a seasonal baseline. To reduce costs this can be done by analysing a reduced set of parameters such as pH, EC, iron and manganese. It is important to also measure the water levels quarterly to establish the seasonal trend.

During Phase 2 mining, quarterly should continue with all monitoring parameters listed in section 8.2. If trends remain stable or are decreasing, monitoring can be reduced to bi-annual. The monitoring must be incorporated into the groundwater monitoring programme.

A database must be established, water quality fluctuation trends interpreted, exceedances be highlighted, and this data must be used to inform management decisions on the groundwater status quo thereafter. Based on this analysis, the monitoring frequency may be amended as considered necessary.

8.2 MONITORING PARAMETERS

The analytical suite for water samples should include pH and EC (and /or Total Dissolved Solids) with annual analyses of pH, EC, TDS, nitrate, sulfate, total alkalinity, and metals.

8.3 MONITORING BOREHOLES

A map showing the existing monitoring network is summarized in in Figure 8-1.

9 GROUNDWATER ENVIRONMENTAL MANAGEMENT PROGRAMME

9.1 CURRENT GROUNDWATER CONDITIONS

The current groundwater quality is shown in section 5.6, and these can be seen as baseline conditions before mining commences. The quality of is generally good.

9.2 PREDICTED IMPACTS OF FACILITY (MINING)

The water quality of the backfill and residue material is generally better than the background water quality. Together with the additional water, the model predicts a plume of dilution causing the groundwater quality to improve. This remains to be proven by future monitoring.

9.3 MITIGATION MEASURES

9.3.1 LOWERING OF GROUNDWATER LEVELS DURING FACILITY OPERATION (MINING)

No groundwater users have been identified in the area; therefore, the impact is limited to surface water resources. Backfilling into the pits will add water to the aquifer which reduces the duration of the impact. This minimises the cone of depression and impact on surface resources.

9.3.2 RISE OF GROUNDWATER LEVELS POST FACILITY OPERATION (MINING)

The model shows that the groundwater levels recover within two years after completion of mining. This new “steady state” water level is similar to pre-mining conditions. This is a positive impact.

9.3.3 SPREAD OF GROUNDWATER POLLUTION POST FACILITY OPERATION (MINING)

Salinity of the residue was shown by the geochemistry study (WSP, 2024b) to be lower than the ambient groundwater quality. Backfilling is active for a short period.

Due to the generally good water quality of the backfill and residue material the contamination plume causes dilution and results better water quality than before mining.

Lost boreholes in the backfill areas should be replaced as a mitigatory measure to check if there is any change in quality over time.

10 POST CLOSURE MANAGEMENT PLAN

Mondi is currently leasing most properties under the prospecting rights for commercial forestry purposes. Mondi will move out of the area and the plan is that they will re-establish forestry plantations after mining.

10.1 REMEDIATION OF STORAGE FACILITIES

In the draft scoping report for Port Durnford Mine, WSP (2024a) mentions the following actions for the decommissioning phase:

- Plant to be demolished and materials to be removed.
- Termination of all services to the area.
- Rehabilitation of all areas to be completed sufficiently to meet relevant commitments of the closure plan.

10.2 REMEDIATION OF ENVIRONMENTAL IMPACTS

Environmental impacts were shown to be minimal. After closure all the mining and backfilling areas will be topsoiled and returned to forestry.

10.3 REMEDIATION OF WATER RESOURCES IMPACTS

The impacts on water resources were shown to be minimal. The backfilled areas and RSF’s will be covered with topsoil and returned to forestry after closure.

11 CONCLUSIONS AND RECOMMENDATIONS

The objective of the groundwater study was to establish the baseline geohydrological conditions on site and understand the potential impact of the proposed Port Durnford mining activities on the groundwater and surface water resources.

Model results show that the reduction in baseflow is mostly insignificant and that the backfilling with wet slurry allows for quick recovery of the drawdown during mining. Due to high recharge in the sand aquifer and the additional water added to the system with the backfill and/or residue, the concentration in the aquifer is attenuated. This is the opposite of what is generally expected from contamination sources. Therefore, the residue and backfill material are not strictly sources of contamination. However, monitoring should be put in place to check if there are any change in quality over time. When these diluted plumes reach the rivers and wetlands it is further reduced with the effect that minimal impacts are observed.

Water level and water quality impacts on the aquifer and receptors were found to be moderate before mitigation and low with mitigation. Water level drawdown is of short duration and backfilling (mitigation) with wet slurry allows the water levels to recover quickly. Contamination of the aquifer is limited due to the benign quality of the residue and backfill material. The model shows that the groundwater levels recover within two years after completion of mining. This new “steady state” water level is similar to pre-mining conditions. This is a positive impact. Salinity of the residue was shown by the geochemistry study (WSP, 2024b) to be lower than the ambient groundwater quality. The better water quality together with additional water added in the backfill and residue has a dilution effect on the water quality in the aquifer.

Impacts on the Wildlife Trust Rehabilitation area south of the coarse sand tailings dump area A2, will be low. A monitoring plan was recommended (Section 9) and should be put in place to check if there are any change in water level or quality over time.

Specific mention needs to be made to the following:

- There are two wetland areas that were excluded from the original mine plan. In these areas, the drawdown due to mining will be for the operational period, after which the water level will recover. It is however uncertain how the coarser backfill sand will affect the wetlands in the long-term.
- Sand tailings dump 8B is situated directly above the Natal Metamorphic Province geology which has a lower hydraulic conductivity. Therefore, water cannot infiltrate easily into the aquifer. Modelling showed that there will be accumulation of water during its operational time from 2047 to 2053. This additional water will need to be managed by digging trenches around it and collecting the water. Monitoring of water levels in the Ojinjini River is recommended.
- Toe seepages may also occur to a lesser extent in the other coarse sand tailings deposition areas. This needs to be monitored and managed as above if necessary.
- It is recommended that the ratio of solids to water for the coarse sand deposition as well as the fines (RSF) be confirmed during the feasibility study. It is important to also understand the water recovery after deposition and the losses due to evaporation.

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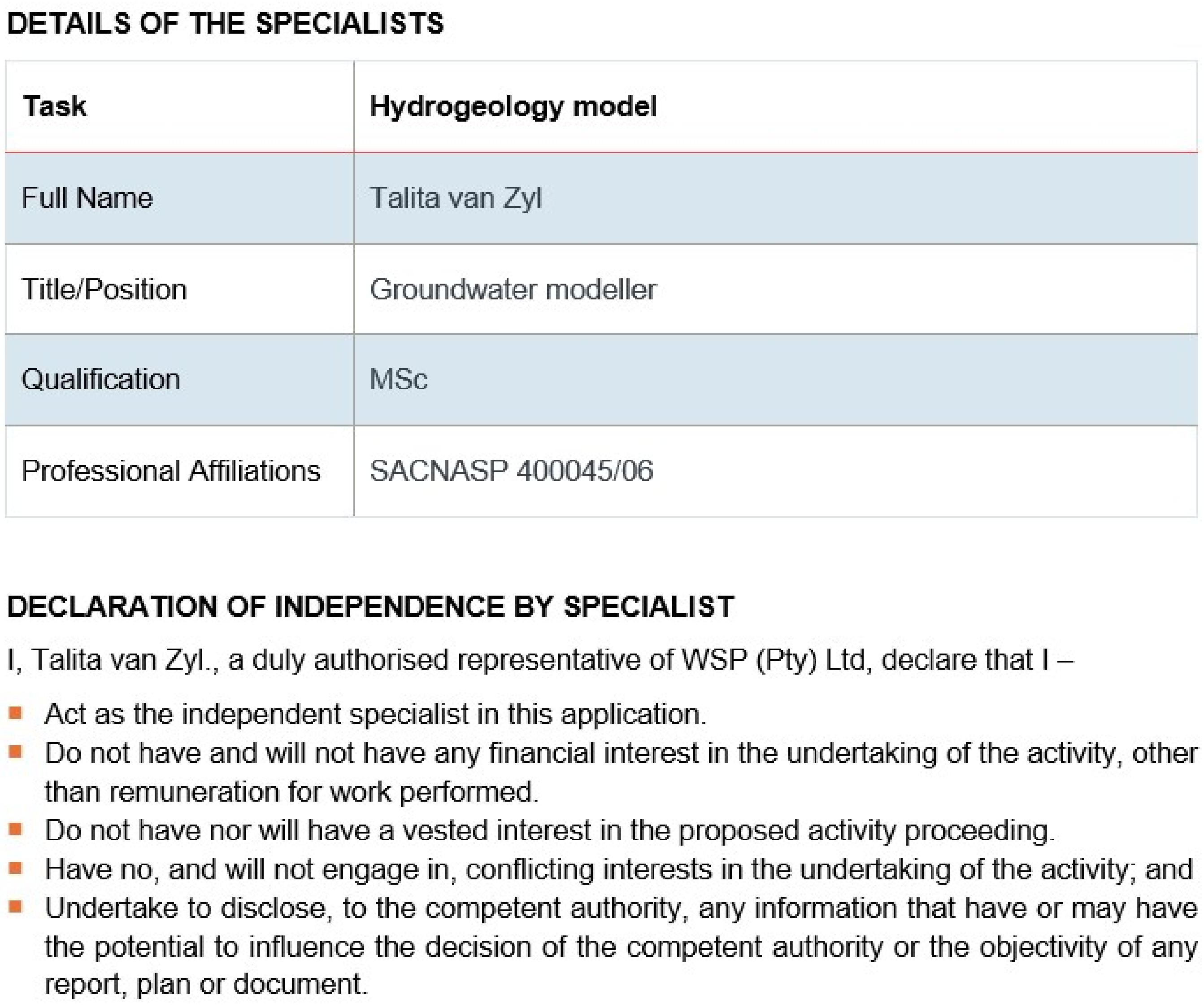
DETAILS AND DECLARATION OF THE SPECIALIST



DETAILS OF THE SPECIALISTS

Task	**Hydrogeology model**
Full Name	Talita van Zyl
Title/Position	Groundwater modeller
Qualification	MSc
Professional Affiliations	SACNASP 400045/06

DECLARATION OF INDEPENDENCE BY SPECIALIST

I, Talita van Zyl., a duly authorised representative of WSP (Pty) Ltd, declare that I –

- Act as the independent specialist in this application.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed.
- Do not have nor will have a vested interest in the proposed activity proceeding.
- Have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document.

Appendix A

2022 HYDROCENSUS FIELD NOTES AND BOREHOLE PHOTOS

Hydrocensus Form

WSP Group Africa (Pty) Ltd
P O Box 6001, Halfway House, 1685, South Africa
Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	2831DD00131				
Village/Farm:	Mondi Farm	**Date:**	**/10/2022**		
GPS Co-ordinates:	Latitude 25.97568				
(WGS 1984)	Longitude 032.58957				
1:50 000 Map No.					
Elevation:		(mamsl)			
Topography:					
Geology:					
General location and accessibility:					
Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	6.18	Diameter:	150
WL: (m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.32 (m)	SWL: (m below ground level)	
Water sample collected:	~~Yes~~/[✓ No] N Time: 9:38	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	TBH3	
Village/Farm:		Date: **/10/2022**
GPS Co-ordinates:	Latitude 28.89145°	
(WGS 1984)	Longitude 031.82434°	
1:50 000 Map No.		

Elevation: 57 (mamsl)

Topography: Flat Lying

Geology:

General location and accessibility: Accessible

Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / [✓ No]

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	81.80	Diameter:	150
WL:(m below measuring point)	–	Yield: (Reported/measured)	/
Height: (measuring point above ground level)	0 (m)	SWL: (m below ground level)	8.84
Water sample collected:	Yes / [✓ No] Time: 10:06	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:		(l/s)	
Pumping Period:		(hrs/day)	
Diameter of Discharge Pipe:		(mm) (Estimated)	
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	TBH2	
Village/Farm:	Mandi	Date: 8 /10/2022
GPS Co-ordinates:	Latitude 28.89146°	
(WGS 1984)	Longitude 031.82438°	
1:50 000 Map No.		

Elevation: 57 (mamsl)

Topography: Flat lying

Geology:

General location and accessibility: Accessible.

Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes [✓ No]

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	65.70	Diameter:	150
WL: (m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.27 (m)	SWL: (m below ground level)	9.18
Water sample collected:	Yes / [✓ No] Time: 10:07	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	TBH1	
Village/Farm:		Date: **/10/2022**
GPS Co-ordinates:	Latitude 28.89338	
(WGS 1984)	Longitude 031.82102	
1:50 000 Map No.		

Elevation: 44 (mamsl)

Topography:

Geology:

General location and accessibility:

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole		Tel no:	
BH Depth:	33.10		Diameter:	150
WL:(m below measuring point)			Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.14	(m)	SWL: (m below ground level)	3.82
Water sample collected:	Yes [✓ No]	Time: 10:36	Field pH and EC taken	pH:
Volume collected				EC: mS/m
Water use:				

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	W1	
Village/Farm:		Date: 9 /10/2022
GPS Co-ordinates:	Latitude 28.07402	
(WGS 1984)	Longitude 031.89 224	
1:50 000 Map No.		

Elevation: #	44	(mamsl)
Topography: Flat lying		
Geology:		
General location and accessibility:		

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	12.74	Diameter:	150
WL:(m below measuring point)	2.69	Yield: (Reported/measured)	
Height: (measuring point above ground level) 0.60	(m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No Time: 9:51	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	W5				
Village/Farm:		Date: 9 /10/2022			
GPS Co-ordinates:	Latitude 28.88717				
(WGS 1984)	Longitude 031.86041				
1:50 000 Map No.					
Elevation:	36	(mamsl)			

Topography: Flat lying

Geology: Adjacent to swamp wetland area.

General location and accessibility:

Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:		
BH Depth:			Diameter:	200
WL:(m below measuring point)	3.54 m		Yield: (Reported/measured)	
Height: (measuring point above ground level)		(m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No	Time: 10:15	Field pH and EC taken	pH:
Volume collected				EC: mS/m
Water use:				

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:			Recorded by:		
Existing BH No. (if visible)	W13				
Village/Farm:			**Date:**	**/10/2022**	
GPS Co-ordinates:	Latitude 28.90704				
(WGS 1984)	Longitude 031.80481				
1:50 000 Map No.					
Elevation: 111			(mamsl)		
Topography: On hill within forrest.					
Geology:					
General location and accessibility: Adjacent to road in Mondi Forest					
Photo:	Yes / No	Test pumping of existing strong yielding borehole		Yes / No	

BOREHOLE INFORMATION

Owner:	Community borehole		Tel no:	
BH Depth:	>100m		Diameter:	200mm
WL: (m below measuring point)	—		Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.35	(m)	SWL: (m below ground level)	
Water sample collected:	Yes [✓ No]	Time: 11:29	Field pH and EC taken	pH:
Volume collected				EC: mS/m
Water use:	Dry			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	W14				
Village/Farm:		**Date:**	**/10/2022**		
GPS Co-ordinates: (WGS 1984)	Latitude 28.93239 Longitude ~~6~~31.80258				
1:50 000 Map No.					
Elevation:	4	(mamsl)			
Topography:					
Geology:					
General location and accessibility:					
Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	20.95	Diameter:	200
WL:(m below measuring point)	2.70	Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.50 (m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No Time: 11:44	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Telephone: + (27) (0)11 254-4800
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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH11				
Village/Farm:		**Date:**	**/10/2022**		
GPS Co-ordinates:	Latitude				
(WGS 1984)	Longitude				
1:50 000 Map No.					
Elevation:		(mamsl)			
Topography:					
Geology:					
General location and accessibility:	Likely ~~dest~~ destroyed. couldn't locate				
Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes / No Time:	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Telephone: + (27) (0)11 254-4800
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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH 12				
Village/Farm:		**Date:**	**/10/2022**		
GPS Co-ordinates:	Latitude 28.93206°				
(WGS 1984)	Longitude 031.83714°				
1:50 000 Map No.					
Elevation:	26	(mamsl)			
Topography:					
Geology:					
General location and accessibility:	Blocked.				
Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes [✓ No] Time: 12:32	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	TBH13	
Village/Farm:		Date: **/10/2022**
GPS Co-ordinates:	Latitude 28.92756	
(WGS 1984)	Longitude 031.83699.	
1:50 000 Map No.		

Elevation:	29.	(mamsl)

Topography: On Coastal dunes

Geology:

General location and accessibility: Difficult to access destroyed.

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level) (m)		SWL: (m below ground level)	
Water sample collected:	Yes [✓ No]	Time: 12:50	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH14				
Village/Farm:	Mondi	**Date:**	**/10/2022**		
GPS Co-ordinates:	Latitude 28-91486				
(WGS 1984)	Longitude 031.82590-				
1:50 000 Map No.					

Elevation: 21 (mamsl)

Topography: flat lying saturated area

Geology:

General location and accessibility: adjacent to tramline in swamp area.

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	1.97	Diameter:	170
WL:(m below measuring point)	0.16	Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No Time: 13 07	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	W9				
Village/Farm:	Mondi	**Date:**	**/10/2022**		
GPS Co-ordinates:	Latitude 28.90648				
(WGS 1984)	Longitude 031.83956				
1:50 000 Map No.					

Elevation: 21 (mamsl)

Topography: Flat lying area

Geology:

General location and accessibility: adjacent to road, completely destroyed

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level) (m)		SWL: (m below ground level)	
Water sample collected:	Yes [✓ No] Time: 13:26	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:			Recorded by:		
Existing BH No. (if visible)	TBH6				
Village/Farm:			Date:	**/10/2022**	
GPS Co-ordinates:	Latitude 28.85128				
(WGS 1984)	Longitude 031.90754				
1:50 000 Map No.					
Elevation:	48		(mamsl)		
Topography:					
Geology:					
General location and accessibility:					
Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole		Tel no:	
BH Depth:	—		Diameter:	
WL: (m below measuring point)	—		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)		SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No	Time: 14:13	Field pH and EC taken	pH:
Volume collected				EC: mS/m
Water use:				

PUMPING EQUIPMENT

Pump Type: Hand Pump		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	2831DD00129	Inaccessible (cannot locate)
Village/Farm:	Not Located	**Date: 8 /10/2022**

GPS Co-ordinates:	Latitude	
(WGS 1984)	Longitude	
1:50 000 Map No.		

Elevation: (mamsl)

Topography:

Geology:

General location and accessibility:

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes / No Time:	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:		(l/s)	
Pumping Period:		(hrs/day)	
Diameter of Discharge Pipe:		(mm) (Estimated)	
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH10				
Village/Farm:		**Date:**	**/10/2022**		
GPS Co-ordinates: (WGS 1984)	Latitude 28,91631				
	Longitude 031.76503				
1:50 000 Map No.					
Elevation:	23	(mamsl)			
Topography:					
Geology:					
General location and accessibility:	Destroyed				
Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:			
BH Depth:		Diameter:			
WL:(m below measuring point)		Yield: (Reported/measured)			
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)			
Water sample collected:	Yes / [✓ No]	Time: 10:50	Field pH and EC taken	pH:	
Volume collected				EC:	mS/m
Water use:					

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	TBH 5 + 5a	
Village/Farm:		**Date:** **/10/2022**
GPS Co-ordinates:	Latitude	
(WGS 1984)	Longitude	
1:50 000 Map No.		

Elevation:	(mamsl)
Topography:	
Geology:	
General location and accessibility:	Behind locked farm gates. No access

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes / No Time:	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	W12	
Village/Farm:		Date: **/10/2022**
GPS Co-ordinates:	Latitude 28.90149	
(WGS 1984)	Longitude 031.78862	
1:50 000 Map No.		

Elevation: 57		(mamsl)
Topography:		
Geology:		
General location and accessibility:		

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	~~[illegible]5.00~~ 57.20	Diameter:	200
WL:(m below measuring point)	25.00	Yield: (Reported/measured)	
Height: (measuring point above ground level) 0.45	(m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No	Time: 11:19	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

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Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	TBH15	
Village/Farm:		Date: **/10/2022**
GPS Co-ordinates:	Latitude 28.88267	
(WGS 1984)	Longitude 031 76535.	
1:50 000 Map No.		

Elevation: 79. (mamsl)

Topography:

Geology:

General location and accessibility: Removed

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes / [✓ No] Time: 11:59	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:	
Existing BH No. (if visible)	TBH16		
Village/Farm:		**Date:**	**/10/2022**
GPS Co-ordinates:	Latitude 28.88308		
(WGS 1984)	Longitude 031.75885		
1:50 000 Map No.			
Elevation:	73	(mamsl)	
Topography:			
Geology:			
General location and accessibility:	Broken Pump.		
Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL: (m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes [✓ No] Time: 12:04	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	W7	
Village/Farm:	Mondi	**Date: /10/2022**
GPS Co-ordinates:	Latitude 28.88943	
(WGS 1984)	Longitude 031.81531	
1:50 000 Map No.		

Elevation: 108	(mamsl)
Topography: On the hillside adjacent to to forrest	
Geology:	
General location and accessibility:	

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole		Tel no:	
BH Depth:	63.73		Diameter:	200
WL:(m below measuring point)	19.19.		Yield: (Reported/measured)	
Height: (measuring point above ground level)		(m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No	Time: 12:24	Field pH and EC taken	pH:
Volume collected				EC: mS/m
Water use:				

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd
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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	W4	
Village/Farm:		**Date:** **/10/2022**
GPS Co-ordinates:	Latitude 28.87189	
(WGS 1984)	Longitude 031.86835.	
1:50 000 Map No.		
Elevation:	73	(mamsl)
Topography:		
Geology:		
General location and accessibility:		

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	62.46	Diameter:	200
WL: (m below measuring point)	38.66	Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.60 (m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No Time: 15:07	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd
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Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	W3.				
Village/Farm:		Date: **/10/2022**			
GPS Co-ordinates:	Latitude 28.86645				
(WGS 1984)	Longitude 031.85545				
1:50 000 Map No.					
Elevation:	78	(mamsl)			
Topography: Side of hill adjacent to Mondi forrest					
Geology:					
General location and accessibility: Adjacent to Mondi Forrest					
Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	~~210m~~ 87.44	Diameter:	200
WL:(m below measuring point)	Dry.	Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.56 (m)	SWL: (m below ground level)	
Water sample collected:	Yes / [✓ No] Time: 15:19.	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	W6				
Village/Farm:		Date: // /**10/2022**			
GPS Co-ordinates:	Latitude 28.88597				
(WGS 1984)	Longitude 031.83893				
1:50 000 Map No.					
Elevation: 65m		(mamsl)			
Topography: Undulating surface					
Geology:					
General location and accessibility:					
Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No		

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	200
WL:(m below measuring point)	38.66	Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	~~Yes~~ / [✓ No] Time: 10:09.	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH4				
Village/Farm:		Date: 11/10/2022			
GPS Co-ordinates:	Latitude 28.89508				
(WGS 1984)	Longitude 031.82931				
1:50 000 Map No.					

Elevation: 45 (mamsl)

Topography: Undulating surface in ravine ~~btn~~ between mondi forest

Geology:

General location and accessibility: Locked.

Photo:	Yes / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	
WL:(m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level)	(m)	SWL: (m below ground level)	
Water sample collected:	Yes / [✓ No] Time: 10:18	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

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Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	WZ	
Village/Farm:		Date: 11 /11/2022
GPS Co-ordinates:	Latitude 28.86715	
(WGS 1984)	Longitude 031.87173	
1:50 000 Map No.		

Elevation: 90 (mamsl)

Topography: Slightly slopping area withine the mendi forest.

Geology:

General location and accessibility:

Photo: [✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	76.42	Diameter:	200
WL: (m below measuring point)	59.10	Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.55 (m)	SWL: (m below ground level)	
Water sample collected:	Yes / [✓ No] Time: 10:34	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

P O Box 6001, Halfway House, 1685, South Africa

Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:			Recorded by:		
Existing BH No. (if visible)	TBH8				
Village/Farm:			Date: 11 /10/2022		
GPS Co-ordinates: (WGS 1984)	Latitude 28.86188				
	Longitude 031.87807				
1:50 000 Map No.					
Elevation:	120		(mamsl)		
Topography: Top of hill ~~or~~ adjacent to water pump station.					
Geology:					
General location and accessibility: The well was locked with a rusted bolt ~~that~~ I battled to open.					
Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole		Yes / No	

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:		Diameter:	200
WL: (m below measuring point)		Yield: (Reported/measured)	
Height: (measuring point above ground level) (m)		SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No Time: 10:53	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd
P O Box 6001, Halfway House, 1685, South Africa
Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH7				
Village/Farm:	Mondi + Transnet.	Date: 11 /10/2022			
GPS Co-ordinates:	Latitude 28.85327				
(WGS 1984)	Longitude 031.88891				
1:50 000 Map No.					

Elevation: 37 (mamsl)

Topography: Slightly undulating surface adjacent to the rail line + Mondi forest.

Geology:

General location and accessibility: Dry

Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	10.44	Diameter:	200
WL: (m below measuring point)	~~0.44~~ —	Yield: (Reported/measured)	
Height: (measuring point above ground level)	0 (m)	SWL: (m below ground level)	
Water sample collected:	Yes [✓ No] Time: 11:24	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd
P O Box 6001, Halfway House, 1685, South Africa
Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**

Hydrocensus No:		Recorded by:
Existing BH No. (if visible)	W11	
Village/Farm:	Mondi	Date: 11 /10/2022
GPS Co-ordinates:	Latitude 28.91088	
(WGS 1984)	Longitude 031. 82568	
1:50 000 Map No.		

Elevation: 34	(mamsl)
Topography:	
Geology:	
General location and accessibility:	

Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No

BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	26.18	Diameter:	200
WL:(m below measuring point)	1.92	Yield: (Reported/measured)	
Height: (measuring point above ground level)	0.53 (m)	SWL: (m below ground level)	
Water sample collected:	[✓ Yes] / No Time: 11:51	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type:		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

Hydrocensus Form

WSP Group Africa (Pty) Ltd

P O Box 6001, Halfway House, 1685, South Africa

Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:			Recorded by:		
Existing BH No. (if visible)	TBH 21				
Village/Farm:			**Date:**	**/10/2022**	
GPS Co-ordinates:	Latitude 28.92814				
(WGS 1984)	Longitude 031.86408				
1:50 000 Map No.					
Elevation:	24		(mamsl)		
Topography: On dunes ~~board~~ bordering the local comunity adjacent to open watersystem					
Geology:					
General location and accessibility:					
Photo:	Yes / No	Test pumping of existing strong yielding borehole		Yes / No	

BOREHOLE INFORMATION

Owner:	Community borehole		Tel no:		
BH Depth:	3.97		Diameter:	110	
WL: (m below measuring point)	1.32		Yield: (Reported/measured)		
Height: (measuring point above ground level)		(m)	SWL: (m below ground level)		
Water sample collected:	[✓ Yes] No	Time: 12:32.	Field pH and EC taken	pH:	
Volume collected				EC:	mS/m
Water use:					

PUMPING EQUIPMENT

Pump Type:			Driven By:	
Pump Depth:	(m)		Horse Power:	
Discharge:			(l/s)	
Pumping Period:			(hrs/day)	
Diameter of Discharge Pipe:			(mm) (Estimated)	
Condition of facility				
Use:				
Estimated yield:				

Hydrocensus Form

WSP Group Africa (Pty) Ltd
P O Box 6001, Halfway House, 1685, South Africa
Telephone: + (27) (0)11 254-4800
Facsimile: + (27) (0)11 315-0317

Project Description:	**Tronox Port Dunford**	Project No.:	**41106008**	Phase	**008**
Hydrocensus No:		Recorded by:			
Existing BH No. (if visible)	TBH17				
Village/Farm:	Kwashodlisa.	Date:	11 /10/2022		
GPS Co-ordinates: (WGS 1984)	Latitude 28.85741				
	Longitude 031.80899.				
1:50 000 Map No.					

Elevation: 84 (mamsl)

Topography: low lying area between adjacent hills

Geology:

General location and accessibility: Broken Pump in the bushes.

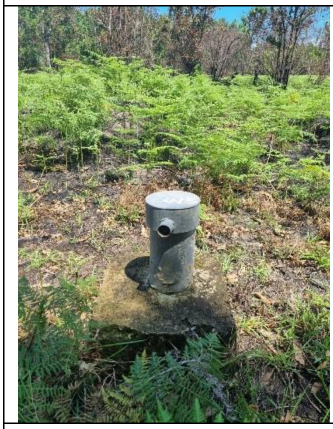
Photo:	[✓ Yes] / No	Test pumping of existing strong yielding borehole	Yes / No

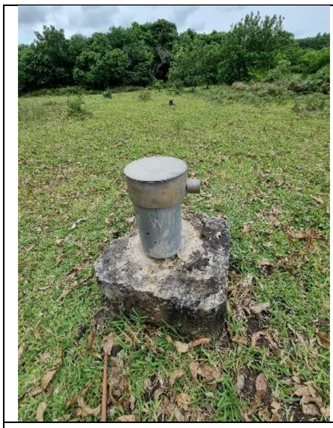
BOREHOLE INFORMATION

Owner:	Community borehole	Tel no:	
BH Depth:	—	Diameter:	—
WL: (m below measuring point)	—	Yield: (Reported/measured)	
Height: (measuring point above ground level) (m)		SWL: (m below ground level)	
Water sample collected:	Yes / [✓ No] Time: 15:30	Field pH and EC taken	pH:
Volume collected			EC: mS/m
Water use:			

PUMPING EQUIPMENT

Pump Type: Pump.		Driven By:	
Pump Depth:	(m)	Horse Power:	
Discharge:	(l/s)		
Pumping Period:	(hrs/day)		
Diameter of Discharge Pipe:	(mm) (Estimated)		
Condition of facility			
Use:			
Estimated yield:			

	
View of W1	View of W2
	
View of W3	View of W4
	
View of W5	View of W6
	
View of W7	View of W9

	
View of W11	View of W12
	
View of W13	View of TBH1
	
View of TBH2	View of TBH3
	
View of TBH4	View of TBH 5a and 5b surroundings

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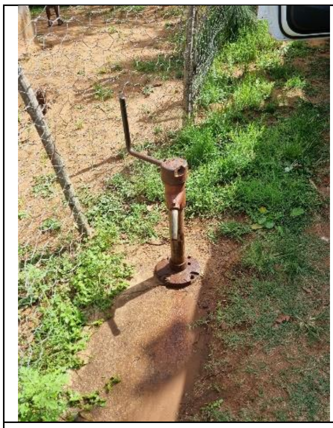
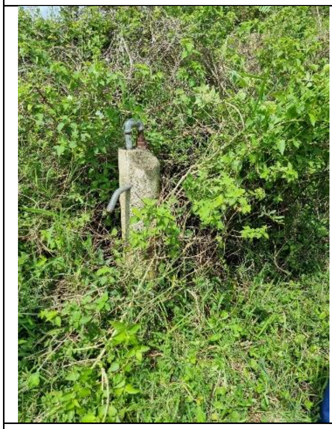
<tr><td></td><td></td></tr>
<tr><td>View of TBH6</td><td>View of TBH7</td></tr>
<tr><td></td><td></td></tr>
<tr><td>View of TBH8</td><td>View of TBH9</td></tr>
<tr><td></td><td></td></tr>
<tr><td>View of TBH10</td><td>View of TBH12</td></tr>
<tr><td></td><td></td></tr>
<tr><td>View of TBH13</td><td>View of TBH14</td></tr>
</table>

View of TBH15

View of TBH16



View of TBH17

View of TBH18 surroundings

View of TBH19

View of TBH20 surroundings

View of TBH21

Appendix B

PREVIOUS HYDROCENSUS RESULTS (GCS 2020)

	Sample ID	ANS 241:2015	Class 0	Class 1	Class 2	Class 3	Class 4	Ambient	TBH10	W14	W5	W1	Ambient	TBH21	TBH19	Ambient	TBH5A	TBH2	TBH7	TBH6	W4
												SE boundary in sensitve wetland			outside and to the south						
Aquifer								Shallow					Coastal			Deeper					
Water level (mbg)									1	2.2	3.78	3.03		0.41					13.5		23.15
									Jul-20	Jul-20	Jul-20	Jul-20		Jul-20	Jul-20		Jul-20	Jul-20	Jul-20	Jul-20	Jul-20
									W13B	W13B	W12F	W12F		W12F	W12F		W13B	W13B	W12F	W12F	W12F
pH	pH units	5-9.7	7-9.5	9.5-10	10-10.5	10.5-11	>11	6.8-9.3	7.9	9.3	9.1	8.3	7.1-7.6	7.1	7.6	7.9-8.2	8.2	**6.8**	**5.6**	8.4	8.5
Electrical Conductivity @25C	mS/m	170 (A)	<70	70-150	150-370	370-520	>520	31-51	59.6	43.7	31.1	51.2	68-105	105	68	44-60	43.7	36.4	48.3	31.2	37
TDS	mg/l	1200 (A)	<450	450-1000	1000-2400	2400-3400	>3400	182-296	296	230	182	296	370-556	"556	"370	242-296	242	182	254	174	186
Nitrate as N	mg/l	11 (AH)	<6	"6-10	"10-20	20-40	>40	0.1-0.4	-0.04	-0.04	-0.04	-0.04	<0.14	-0.04	0.14	<0.04	-0.04	0.36	-0.04	-0.04	-0.04
Sulphate	mg/l	250 (A), 500 (AH)	<200	200-400	400-600	600-1000	>1000	0.3-5	2.14	0.28	0.44	0.42	0.4-33	32.8	0.39	2-5	5.21	4.82	0.43	0.26	0.74
Chloride	mg/l	300 (A)	<100	100-200	200-600	600-1200	>1200	39-99	79	99	41	53	145-173	145	173	73-79	73	39	121	71	52
Fluoride	mg/l	1.5 (CH)	<0.7	0.7-1.0	1.0-1.5	1.5-3.5	>3.5	0.1-0.5	0.21	0.45	0.31	0.17	<0.3	-0.03	0.33	0.1-0.2	0.12	0.16	-0.03	-0.03	0.21
Phosphorus	mg/l	-	-	-	-	-	-														
Total Cyanide	mg/l	0.2 (AH)	-	-	-	-	-														
Total Alkalinity as CaCO3	mg/l	-	-	-	-	-	-	22-160	166	22	80	160	30-231	231	30	52-166	52	110	4	22	96
Calcium	mg/l	-	-	-	-	-	-	1-33	12.8	1.4	1.6	7.81	10-57	57	10.4	12-13	13.4	17.7	9.24	2.64	5.29
Magnesium	mg/l	-	<70	70-100	100-200	200-400	>400	0.3-7.1	17.7	0.29	2.23	2.68	17-30	30	17.5	13-18	13	5.38	8.31	4.78	3.36
Sodium	mg/l	200 (A)	<70	70-100	100-200	200-400	>400	33-79	76	79	53	79	75-92	92	75	43-76	43	42	24	33	33
Potassium	mg/l	-	<25	25-50	50-100	100-500	>500	2-10	4.58	2.82	3.94	9.68	2-3	2.4	2.84	4-5	3.95	3.99	3.12	2.33	7.34
Aluminium	mg/l	0.3 (O)	-	-	-	-	-	<0.03	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	0.03	-0.02	-0.02	-0.02
Arsenic	mg/l	0.01 (CH)	<0.01	0.01-0.05	0.05-0.2	0.2-2	>2	<0.04	-0.04	-0.04	-0.04	-0.04	<0.04	-0.04	-0.04	<0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Cobalt	mg/l	-	-	-	-	-	-	<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Chromium	mg/l	0.05 (CH)	-	-	-	-	-	<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Copper	mg/l	2 (CH)	0-0.5	0.5-1	"1-2	"2-15	>15	<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Iron	mg/l	0.3 (A), 2 (CH)	<0.5	0.5-1	"1-5	"5-10	>10	<0.11	0.02	-0.02	-0.02	-0.02	<0.04	-0.02	0.04	(<0.02-20 in	-0.02	0.11	20	0.53	-0.02
Manganese	mg/l	.1 (A), 0.4(CH	<0.1	0.1-0.4	0.4-4	"4-10	>10	0.03-0.04	0.13	-0.02	-0.02	0.04	0.2-0.5	0.24	0.50	(<0.02-0.76 in	-0.02	-0.02	0.90	0.51	-0.02
Nickel	mg/l	0.07 (CH)	-	-	-	-	-	<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Lead	mg/l	0.01 (CH)	-	-	-	-	-	<0.03	-0.03	-0.03	-0.03	-0.03	<0.03	-0.03	-0.03	<0.03	-0.03	-0.03	0.04	-0.03	-0.03
Barium	mg/l	0.7 (CH)	-	-	-	-	-	<0.02	0.02	-0.02	-0.02	-0.02	0.03-0.1	0.03	0.1	0.02-0.1	0.06	-0.02	0.50	0.08	-0.02
Boron	mg/l	2.4 (CH)	-	-	-	-	-	<0.03	-0.02	-0.02	-0.02	0.04	<0.02	-0.02	-0.02	<0.02	-0.02	0.03	0.10	-0.02	-0.02
Strontium	mg/l	-	-	-	-	-	-	0.04-0.2	0.06	-0.02	-0.02	0.07	0.1-0.3	0.29	0.12	<0.1	0.12	0.09	0.11	0.03	0.04
Tin	mg/l	-	-	-	-	-	-	<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Vanadium	mg/l	-	-	-	-	-	-	<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Zinc	mg/l	5 (A)	<3	>5	10	20	>20	<0.02	0.03	-0.02	-0.02	-0.02	0.3-3	0.3	3.25	<0.03	-0.02	-0.02	0.05	0.93	-0.02
Zirconium	mg/l							<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Antimony	mg/l	0.02 (CH)						<0.009	-0.009	-0.009	-0.009	-0.009	<0.009	-0.009	-0.009	<0.009	-0.009	-0.009	-0.009	-0.009	-0.009
Beryllium	mg/l							<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Bismuth	mg/l																				
Cadmium	mg/l	0.003 (CH)						<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Lithium	mg/l							<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Mercury	mg/l	0.006 (CH)						<0.002	-0.002	-0.002	-0.002	-0.002	<0.002	-0.002	-0.002	<0.002	-0.002	-0.002	-0.002	-0.002	-0.002
Molybdenum	mg/l							<0.11	-0.11	-0.11	-0.11	-0.11	<0.11	-0.11	-0.11	<0.11	-0.11	-0.11	-0.11	-0.11	-0.11
Selenium	mg/l	0.04 (CH)						<0.07	-0.07	-0.07	-0.07	-0.07	<0.07	-0.07	-0.07	<0.07	-0.07	-0.07	-0.07	-0.07	-0.07
Silver	mg/l							<0.01	-0.01	-0.01	-0.01	-0.01	<0.01	-0.01	-0.01	<0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Tellurium	mg/l																				
Thallium	mg/l							<0.02	-0.02	-0.02	-0.02	-0.02	<0.02	-0.02	-0.02	<0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Titanium	mg/l							<0.03					<0.03			<0.03					
Class								0	1 (Mn)	1 (Mn)	0	0	0	1 (Mn)	2 (Mn)	0	0	0	4 (Fe)	1 (Mn, Fe)	0

Appendix C

METHODOLOGY FOR ASSESSING IMPACT SIGNIFICANCE

METHODOLOGY FOR ASSESSING IMPACT SIGNIFICANCE

Impacts will be assessed in terms of the following criteria:

Nature

This is a description of what causes the effect, what will be affected and how it will be affected as described in **Table 9-1**.

Table 9-1 – Nature or type of impact

Nature or Type of Impact	Definition
Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts that arise directly from activities that form an integral part of the Project (e.g. new infrastructure).
Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road or rail traffic resulting from the operation of Project).
Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
Cumulative	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

Physical extent

Table 9-2 – Physical extent rating of impact

Score	Description
1	the impact will be limited to the site;
2	the impact will be limited to the local area (local study area);
3	the impact will be limited to the region;

Score	Description
4	the impact will be national; or
5	the impact will be international;

Duration

The duration, wherein it is indicated whether the lifetime of the impact will be as described in **Table 9-3**.

Table 9-3 – Duration rating of impact

Score	Description
1	Of a very short duration (0 to 1 years)
2	Of a short duration (2 to 5 years)
3	Medium term (5–15 years)
4	Long term (> 15 years)
5	Permanent (this is considered permanent if the impact will be experienced post mine closure)

Reversibility

An impact is either reversible or irreversible. This considers how long it takes before impacts on receptors cease to be evident and is described in **Table 9-4**.

Table 9-4 – Reversibility of Impact

Score	Description
1	The impact is immediately reversible.
3	The impact is reversible within 2 years after the cause or stress is removed; or
5	The activity will lead to an impact that is in all practical terms permanent.

Magnitude

The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned (Table 9-5).

Table 9-5 – Magnitude rating of impact

Score	Description
0	Small and will have no effect on the environment.
1	Minor and will not result in an impact on processes (to be defined by individual specialist fields).
2	Low and will cause a slight impact on processes.
3	Moderate and will result in processes continuing but in a modified way.
4	High (processes are altered to the extent that they temporarily cease).
5	Very high and results in complete destruction of patterns and permanent cessation of processes.

Probability

The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale of 1 – 5 (**Table 9-6**).

Table 9-6 – Probability Rating of Impact

Score	Description
1	Very improbable (probably will not happen).
2	Improbable (some possibility, but low likelihood).
3	Probable (distinct possibility).
4	Highly probable (most likely).
5	Definite (impact will occur regardless of any prevention measures).

The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;

- The status, which is described as either positive, negative or neutral;

- The degree to which the impact can be reversed;
- The degree to which the impact may cause irreplaceable loss of resources; and
- The degree to which the impact can be mitigated.

The significance is determined by combining the above criteria in the following formula:

Significance = (Extent + Duration + Reversibility + Magnitude) x Probability

[S= (E+D+R+M) ×P]

Where the symbols are as follows:

Symbol	Criteria	Description
S	Significance Weighting	-
E	Extent	**Table 9-2**
D	Duration	**Table 9-3**
M	Magnitude	**Table 9-5**
P	Probability	**Table 9-6**

The significance weightings for each potential impact are as follows:

Overall Score	Significance Rating (Negative)	Significance Rating (Positive)	Description
< 30 points	Low	Low	Where this impact would not have a direct influence on the decision to develop in the area
31 - 60 points	Medium	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60 points	High	High	Where the impact must have an influence on the decision process to develop in the area

Appendix D

DOCUMENT LIMITATIONS

DOCUMENT LIMITATIONS

This document has been provided by WSP Group Africa Pty Ltd ("WSP") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in WSP's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of WSP's Services are as described in WSP's proposal, and are subject to restrictions and limitations. WSP did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by WSP in regard to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry WSP was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. WSP's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed WSP to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

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