Hydrological Assessment for a Proposed Stormwater Channel, Ventilation Shafts, Fuel Distribution Facility and Electrical Infrastructure at the Dwarsrivier Chrome Mine

Project Number:

ENG058

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DECLARATION OF INDEPENDENCE

I, Andy Pirie declare that:

- I act as an independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have the expertise in conducting the specialist study relevant to this application, including knowledge of the various acts, regulations and any guidelines that have relevance to the proposed project;
- I will comply with the acts, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the study;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; and
- All the particulars furnished by me are true and correct.

Andy Pirie
Senior Hydrologist
Pr.Sci.Nat (reg no. 114988)

ACRONYMS AND ABBREVIATIONS

BPG	Best Practice Guideline
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
GIS	Geographical Information Systems
GN704	Government Notice No. 704 - Regulations on the Use of Water for Mining and Related Activities aimed at the Protection of Water Resources
ha	hectares
km	Kilometres
LoM	Life of Mine
m	metres
MAE	Mean Annual Evaporation
mamsl	metres above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mm	millimetres
MRA	Mining Right Area
NWA	National Water Act, 1998 (Act No. 36 of 1998)
Pr.Sci.Nat.	Professional Natural Scientist
RWD	Return Water Dam
SACNASP	South African Council for Natural Scientific Professions
TDS	Total Dissolved Solids
WMA	Water Management Areas
WR2012	Water Resources of South Africa, 2012 Study
WUL	Water Use Licence
WULA	Water Use Licence Application

EXECUTIVE SUMMARY

Hydrospatial (Pty) Ltd was appointed by EnviroGistics (Pty) Ltd, to undertake a hydrological assessment as part of an Environmental Authorisation process, for the following two proposed projects at the Dwarsrivier Chrome Mine (hereafter referred to as “DCM” or the “Mine”):

- Project 1: Stormwater channel upgrade. This project relates to the upgrade of a stormwater channel to divert clean water runoff around the North Shaft infrastructure area, which is currently being expanded. The separation and management of clean and dirty stormwater is an operational requirement for all mining operations within South Africa. The channel will be trapezoidal in shape and will be grassed with Mayford Biosome Bushveld Reclamation Mixture. The length of the channel will be approximately 610 metres (m), with a height of 1 m and a width of 10 m. A berm with a height of 1 m and a crest width of 1 m, will be constructed on the western side of the channel, and will be grassed with the same mixture. The diverted clean stormwater runoff will discharge into the Springkaanspruit. The channel has been sized to convey a flow rate of 9 m^3/s. The design drawing of the channel is provided in Appendix A.
- Project 2: Establishment of ventilation shafts, fuel distribution facility and electrical infrastructure. The following infrastructure is proposed as part of this project:
    - Two (2) ventilation shafts (surface area of approximately 0.2 ha each);
    - Fuel distribution facility (emulsion, oil and diesel) (approximately 0.1 ha);
    - Substation, including four (4) generators with transformers and a diesel tank (surface area of approximately 0.5 ha); and
    - Two (2) 33 kV powerlines (approximately 200 m and 500 m in length).

DCM has been mining chromite ore from the LG6 seam since 1999. Between 1999 and 2005, ore was mined using opencast methods. The six (6) opencast pits have subsequently been mined out and backfilled, with the exception of the South and North Pit portals from which access is gained to the underground workings. The current mine plan extends the life of the operations to the year 2042.

The scope of work included the following:

- Provide a baseline (pre-development) hydrological description of the proposed projects;
- Assess whether any of the proposed infrastructure lies within the GN704 regulated zones (i.e. 1:100 year floodline and 100 m watercourse buffer);
- Assess the surface water risks/impacts and provide mitigation measures; and
- Development of monitoring plans for surface water quality and stormwater infrastructure.

The following provides a summary of the key findings of the study:

- In terms of the GN704 regulated zones, it was found that all of the proposed infrastructure except for the fuel distribution facility falls within the 100 m watercourse buffer; and
- The impact/risk assessment showed that all of the risks would have a medium significance pre-mitigation and a low significance post-mitigation.

The following is recommended:

- It is recommended that the proposed infrastructure that falls within the 100 m watercourse buffer, is motivated to be exempted from GN704;
- The powerline support infrastructure should be placed outside of the floodlines. Should this be done, then it is recommended that it is motivated to be exempted from GN704;
- The mitigation measures provided in Table 5-7 should be implemented; and
- The monitoring plans provided under section 6 should be implemented.

Should the above be adhered to, then from a surface water perspective, the proposed projects can commence.

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1 INTRODUCTION AND BACKGROUND

Hydrospatial (Pty) Ltd was appointed by EnviroGistics (Pty) Ltd to undertake a hydrological assessment for the following two proposed projects at the Dwarsrivier Chrome Mine (hereafter referred to as “DCM” or the “Mine”):

- Project 1: Stormwater channel upgrade; and
- Project 2: Ventilation shafts, fuel distribution facility and electrical infrastructure

DCM has been mining chromite ore from the LG6 seam since 1999. Between 1999 and 2005, ore was mined using opencast methods. The six (6) opencast pits have subsequently been mined out and backfilled, with the exception of the South and North Pit portals from which access is gained to the underground workings. The current mine plan extends the life of the operations to the year 2042.

This report has been prepared for EnviroGistics (Pty) Ltd who have been appointed to undertake the Environmental Authorisation process for the above-mentioned projects.

1.1 Project Location

The Mine is situated in the Limpopo Province of South Africa, 23 kilometres (km) south-west of the town of Steelpoort. Figure 1-1 indicates the Dwarsrivier Mining Right Area (MRA) and the location of the proposed projects.

1.2 Project Description

The following provides a summary of the proposed projects which are shown on Figure 1-2 and Figure 1-3.

1.2.1 Project 1: Stormwater Channel Upgrade

This project relates to the upgrade of a stormwater channel to divert clean water runoff around the North Shaft infrastructure area, which is currently being expanded. The separation and management of clean and dirty stormwater is an operational requirement for all mining operations within South Africa. The channel will be trapezoidal in shape and will be grassed with Mayford Biosome Bushveld Reclamation Mixture. The length of the channel will be approximately 610 metres (m), with a height of 1 m and a width of 10 m. A berm with a height of 1 m and a crest width of 1 m, will be constructed on the western side of the channel, and will be grassed with the same mixture. The diverted clean stormwater runoff will discharge into the Springkaanspruit. The channel has been sized to convey a flow rate of 9 m^3/s. The design drawing of the channel is provided in Appendix A.

1.2.2 Project 2: Ventilation Shafts, Fuel Distribution Facility and Electrical Infrastructure

The following infrastructure is proposed as part of this project:

- Two (2) ventilation shafts (surface area of approximately 0.2 ha each);
- Fuel distribution facility (emulsion, oil and diesel) (approximately 0.1 ha);

- Substation, including four (4) generators with transformers and a diesel tank (surface area of approximately 0.5 ha); and
- Two (2) 33 kV powerlines (approximately 200 m and 500 m in length).

1.3 Legislation and Guidelines

The following key legislative requirements and guidelines are relevant to this study:

- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Regulations on the Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (published under Government Notice 704 (GN R704) in Government Gazette 20119, 4 June 1999);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated Environmental Impact Assessment (EIA) 2014 regulations;
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- Department of Water and Sanitation (DWS) Best Practice Guideline (BPG) documents, particulalry BPG G1: Storm Water Management.

1.4 Site Investigation

A site investigation of the proposed project areas was undertaken on 8 March 2023.

1.5 Details of the Specialist

The study was undertaken by Andy Pirie who is a senior hydrologist at Hydrospatial (Pty) Ltd. Andy graduated with a Master of Science (M.Sc.) in Water Resource Management (cum laude). He is registered as a Professional Natural Scientist (Pr.Sci.Nat) (registration number: 114988) in Water Resources Science with the South African Council for Natural Scientific Professions (SACNASP). Work experience includes rainfall – runoff modelling, floodline determinations, stormwater management plans, water and salt balance modelling, setup of water monitoring networks and programmes, analysis of surface water quality and quantity, and surface water specialist studies for environmental impact assessments and water use licence applications. Andy has more than 10 years' experience and has worked on projects in South Africa, Cameroon, Senegal, Mali, Democratic Republic of the Congo, Botswana, Zambia and Namibia. His curriculum vitae is provided in Appendix B.

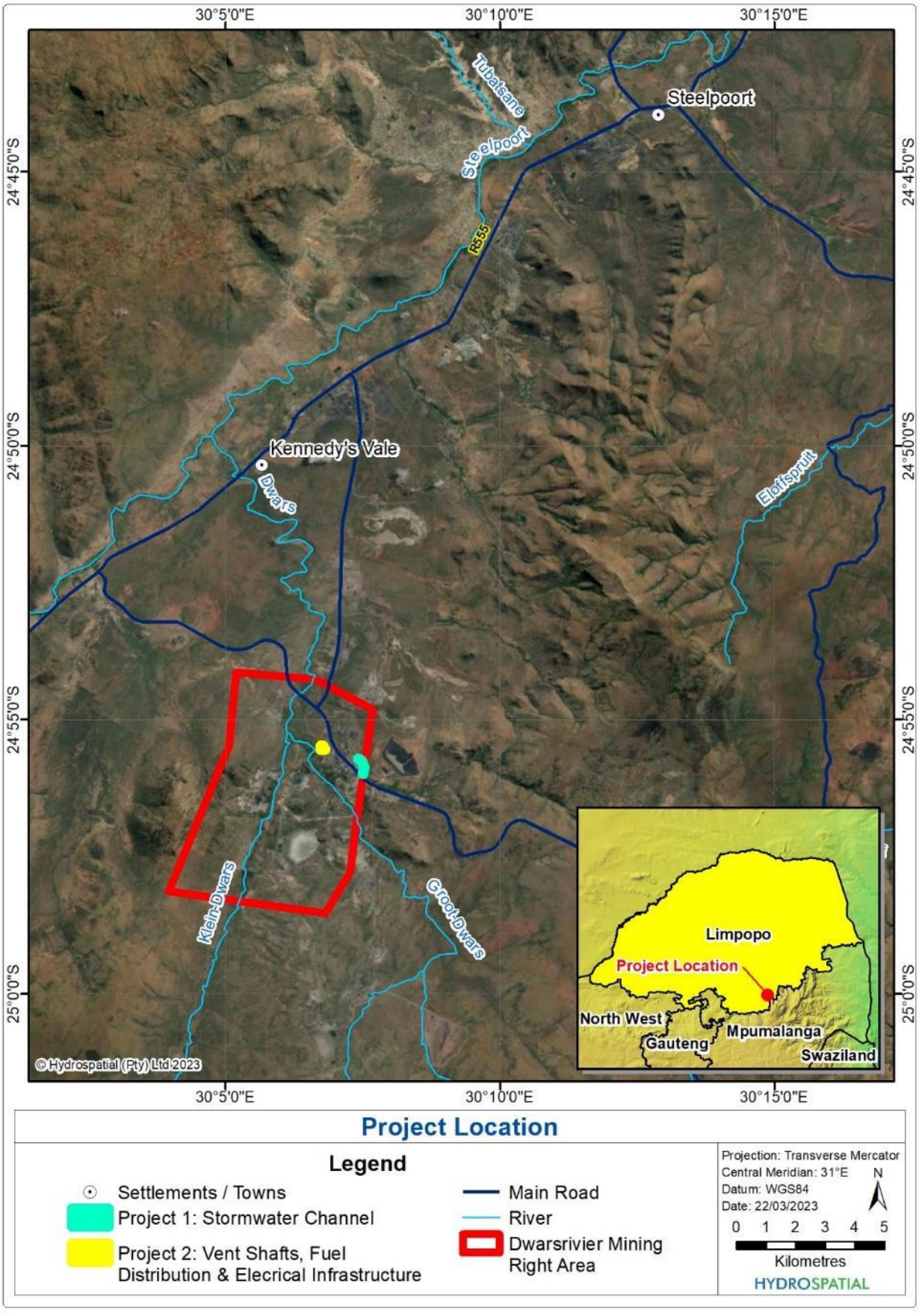

Figure 1-1: Location of the proposed projects

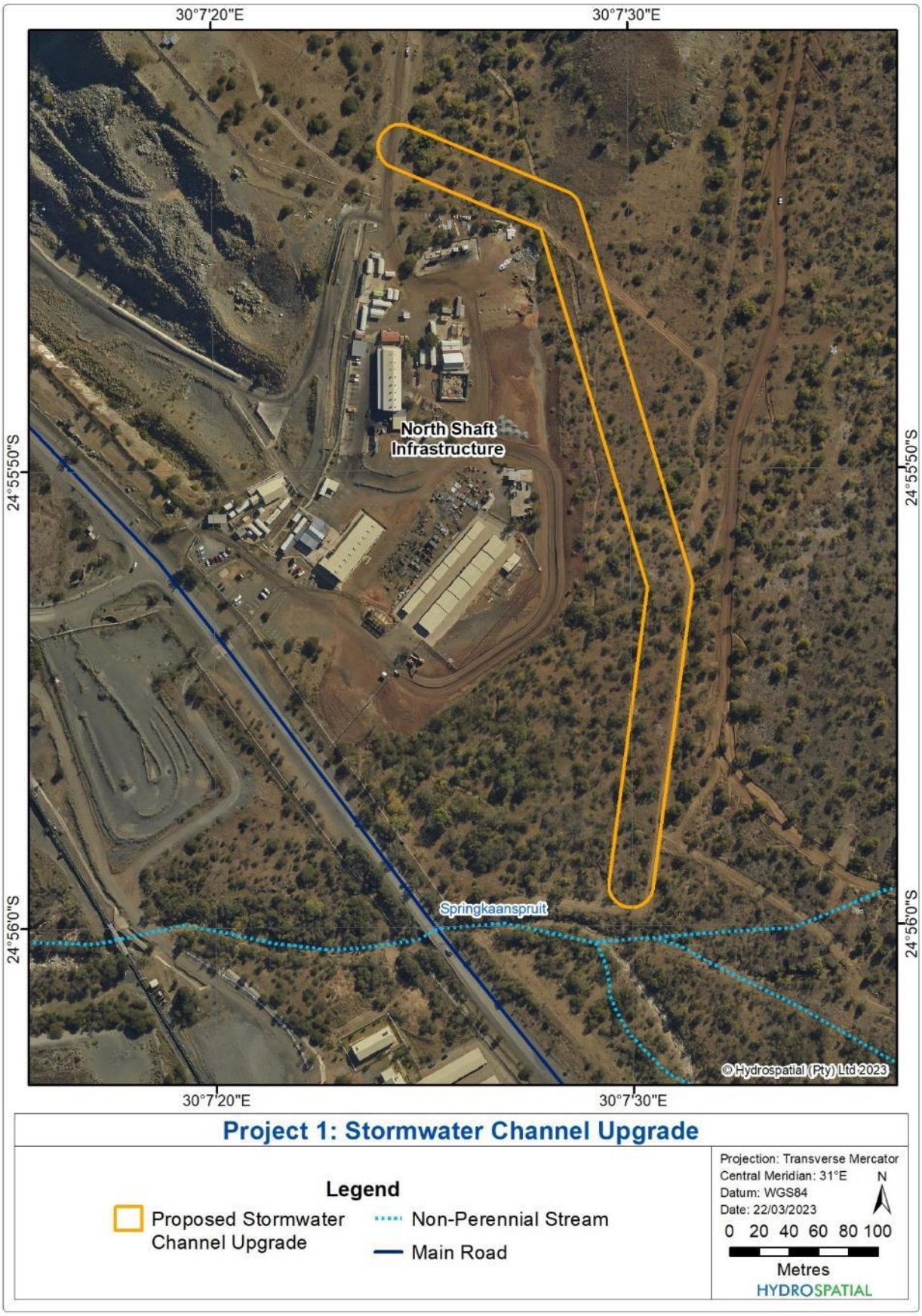

Figure 1-2: Project 1: Stormwater channel upgrade

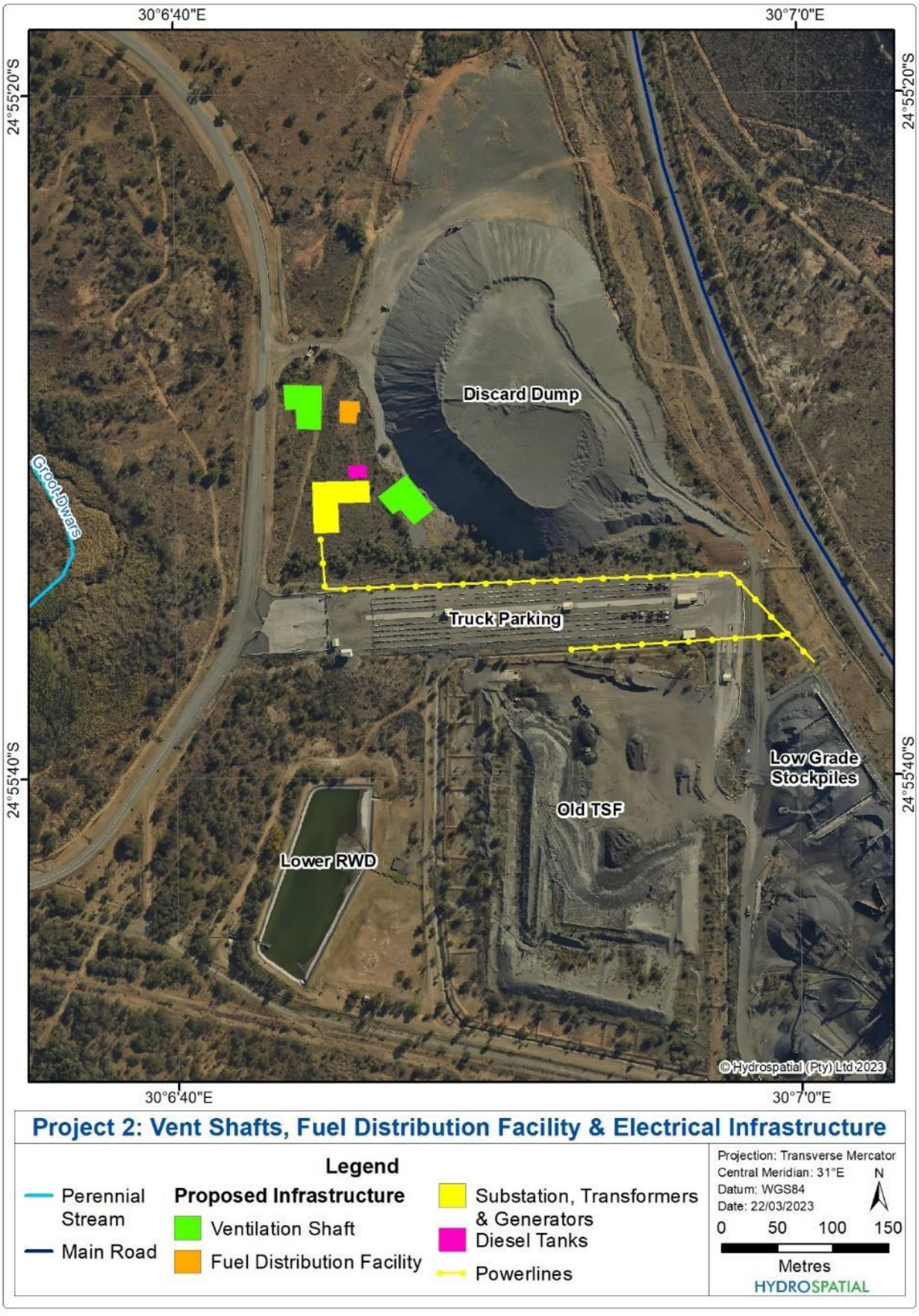

Figure 1-3: Project 2: Ventilation shafts, fuel distribution facility and electrical infrastructure

2 SCOPE OF WORK

The scope of work included the following:

- Provide a baseline (pre-development) hydrological description of the proposed projects;
- Assess whether any of the proposed infrastructure lies within the GN704 regulated zones (i.e. 1:100 year floodline and 100 m watercourse buffer);
- Assess the surface water risks/impacts and provide mitigation measures; and
- Development of monitoring plans for surface water quality and stormwater infrastructure.

3 BASELINE HYDROLOGY

3.1 Hydrological Setting

3.1.1 Climate

3.1.1.1 Rainfall

The proposed projects are located within quaternary catchment B41G, and therefore, the monthly rainfall for B41G was adopted to represent the rainfall for the study area, and was obtained from the Water Resources of South Africa Study 2012 (WR2012) (Table 3-1). The Mean Annual Precipitation (MAP) for the study area is 650 mm, with the wettest months occurring from November to January, and the driest months from June to August.

3.1.1.2 Evaporation

Monthly Symon's Pan (S-Pan) evaporation data was obtained from the WR2012 database for quaternary catchment B41G. In order to obtain natural open water body evaporation, S-Pan evaporation is multiplied by an evaporation factor. This is due to water temperatures in the S-Pan being higher than that of natural open water bodies, resulting in higher evaporation rates. Table 3-2 provides the monthly evaporation for the project area. Evaporation is highest over the months of October to March, and lowest over May to August.

Table 3-1: Monthly rainfall for quaternary catchment B41G

Month	Monthly Rainfall (mm)
January	111.5
February	88.3
March	75.5
April	41.8
May	14.8
June	6.2
July	5.2

Month	Monthly Rainfall (mm)
August	5.8
September	20.6
October	60.0
November	111.7
December	108.7
TOTAL	**650**

Table 3-2: Monthly evaporation for quaternary catchment B41G

Month	Symons Pan Evaporation (mm)	Evaporation Factor	Open Water Evaporation (mm)
January	165.0	0.84	138.6
February	137.6	0.88	121.0
March	135.8	0.88	119.5
April	104.4	0.88	91.9
May	87.9	0.87	76.5
June	71.4	0.85	60.7
July	78.2	0.83	64.9
August	103.5	0.81	83.8
September	134.1	0.81	108.6
October	161.7	0.81	131.0
November	152.6	0.82	125.1
December	168.0	0.83	139.4
TOTAL	**1500**	**N/A**	**1261**

3.1.1.3 Temperature and Wind

Average monthly wind and temperature was obtained from the Loclim programme (FAO, 2005). The method selected to obtain the wind and the temperature data is based on the nearest neighbour method for the ten closest stations to the project area (Table 3-3). Temperatures are highest over October to March, with wind generally being highest between September to November.

Table 3-3: Temperature and wind speed for the projects

Month	Average Temperature (ºC)	Minimum Temperature (ºC)	Maximum Temperature (ºC)	Average Wind Speed (km/hour)
January	20	14.3	26.1	6.48
February	19.7	14.3	23.8	6.48
March	18.7	13.3	24.3	6.12
April	16.7	10	24.3	5.4
May	13.5	5.5	22.2	6.12
June	11	2.2	20	7.2
July	10.8	2.7	20	7.2
August	13.1	4.4	22.2	7.92
September	15.6	7.8	24.3	9.72
October	18	10.6	25.5	9.72
November	18.7	12.8	25.5	9.72
December	19.7	13.8	26.1	7.92

3.1.2 Regional Catchments and Drainage

The proposed projects are located in quaternary catchment B41G which is situated within the Olifants Water Management Area (WMA). A number of non-perennial drainage lines drain the mountain ridges and hills within of the MRA. These non-perennial drainage lines are ephemeral in nature (only flowing for short periods of time in response to high rainfall) and drain into the Klein and Groot Dwars Rivers. The Klein Dwars River flows through the centre of the MRA in a north-easterly direction, whilst the Groot Dwars River flows in a north-westerly direction. These two rivers form a confluence near the north of the MRA, forming the Dwars River, which flows into the Steelpoort River 8.5 km north-west of the MRA. The Steelpoort River flows into the Olifants River, 40 km north-east of the town of Steelpoort. The Olifants River is a tributary of the Limpopo River, which flows into the Indian Ocean near the town of Xai-Xai in Mozambique.

3.1.3 Topography and Site-Specific Drainage

The topography of the Dwarsrivier MRA can is undulating with numerous mountain ridges and valleys (Figure 3-2). A mountain ridge runs along the western boundary of the MRA, where a maximum elevation of approximately 1 630 metres above mean sea level (mamsl) is reached. From this ridge, the elevation drops off to approximately 900 mamsl near the confluence of the Klein and Groot Dwars Rivers. A number of hills are located along the eastern portion of the MRA.

Project 1 is drained in a south-westerly direction towards the Springkaanspruit (Figure 3-3). The elevation varies from 967 mamsl at the north-eastern corner of the channel, to 955 mamsl where the channel discharges into the Springkaanspruit.

Project 2 drains primarily in a westerly direction towards the Groot-Dwars River (Figure 3-4). A westerly flowing non-perennial drainage channel runs between Project 2 and the truck parking area (Figure 3-1). This channel drains a small area of approximately 0.44 km^2 to the east of the main regional road (Lydenburg road) near the North Tailings Storage Facility (TSF). During the site visit, it was noted that this channel is highly ephemeral and would rarely flow. The only proposed infrastructure located within the catchment of this non-perennial channel are the powerlines and a very small portion of the substation infrastructure. The elevation at Project 2 varies from 927 mamsl near the toe of the discard dump, to 918 mamsl in the west along the road.

Mild slopes of between 3 % to 10 % occur at both projects.

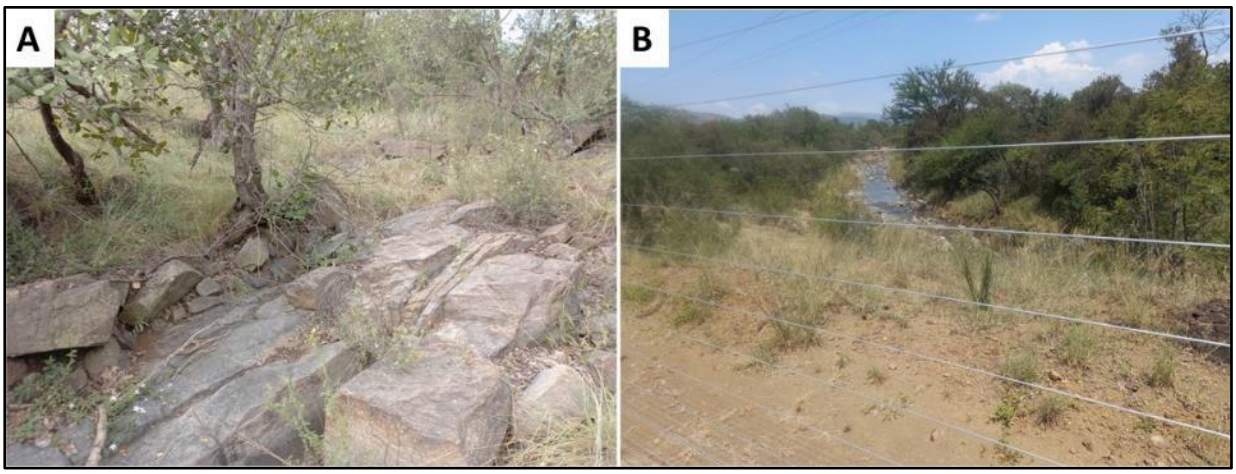

Figure 3-1: A – Non-perennial drainage channel between Project 2 and the truck parking area; and B – discharge point of the proposed stormwater channel into the Springkaanspruit

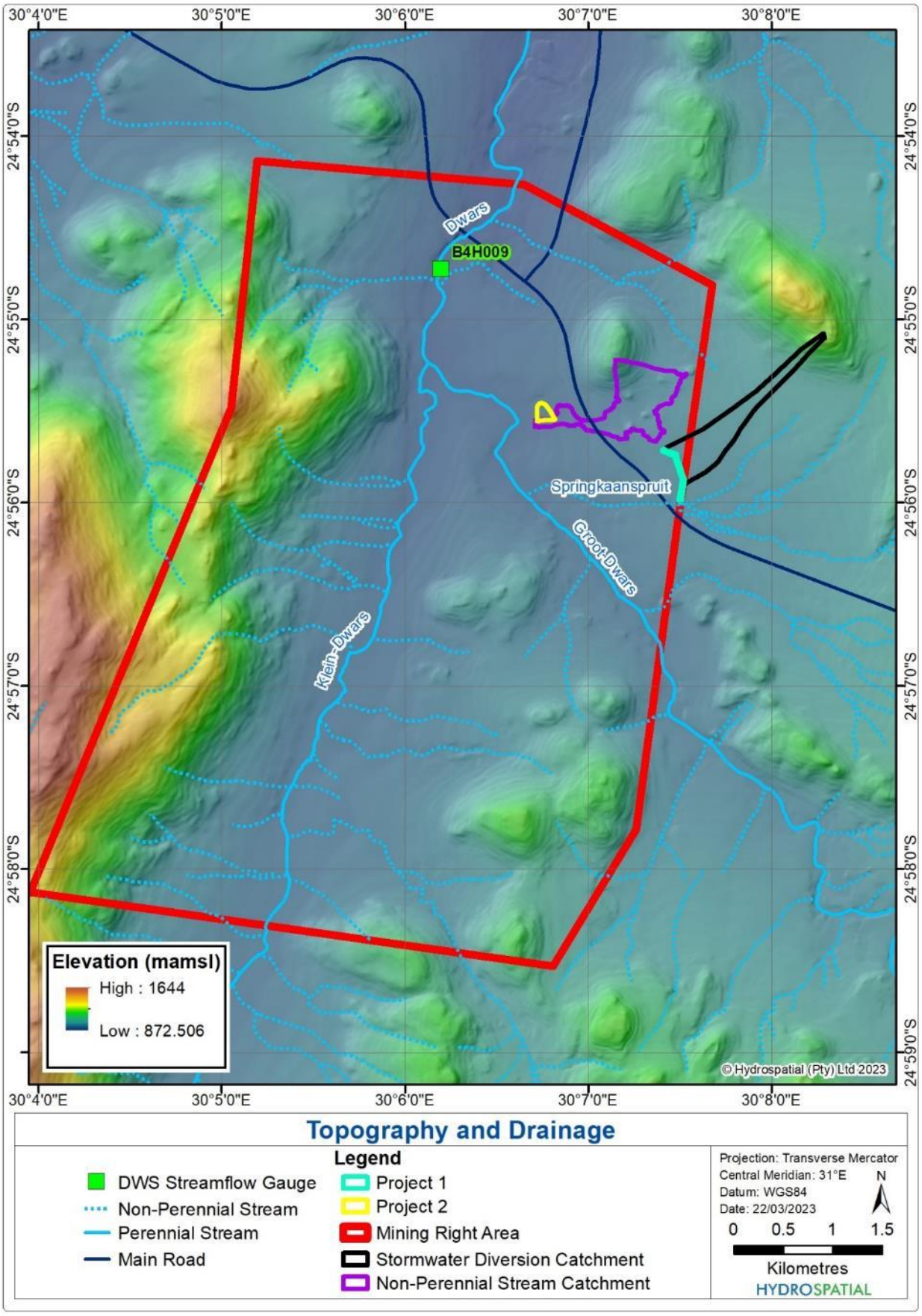

Figure 3-2: Topography and drainage

Figure 3-3: Project 1: Site specific topography and drainage

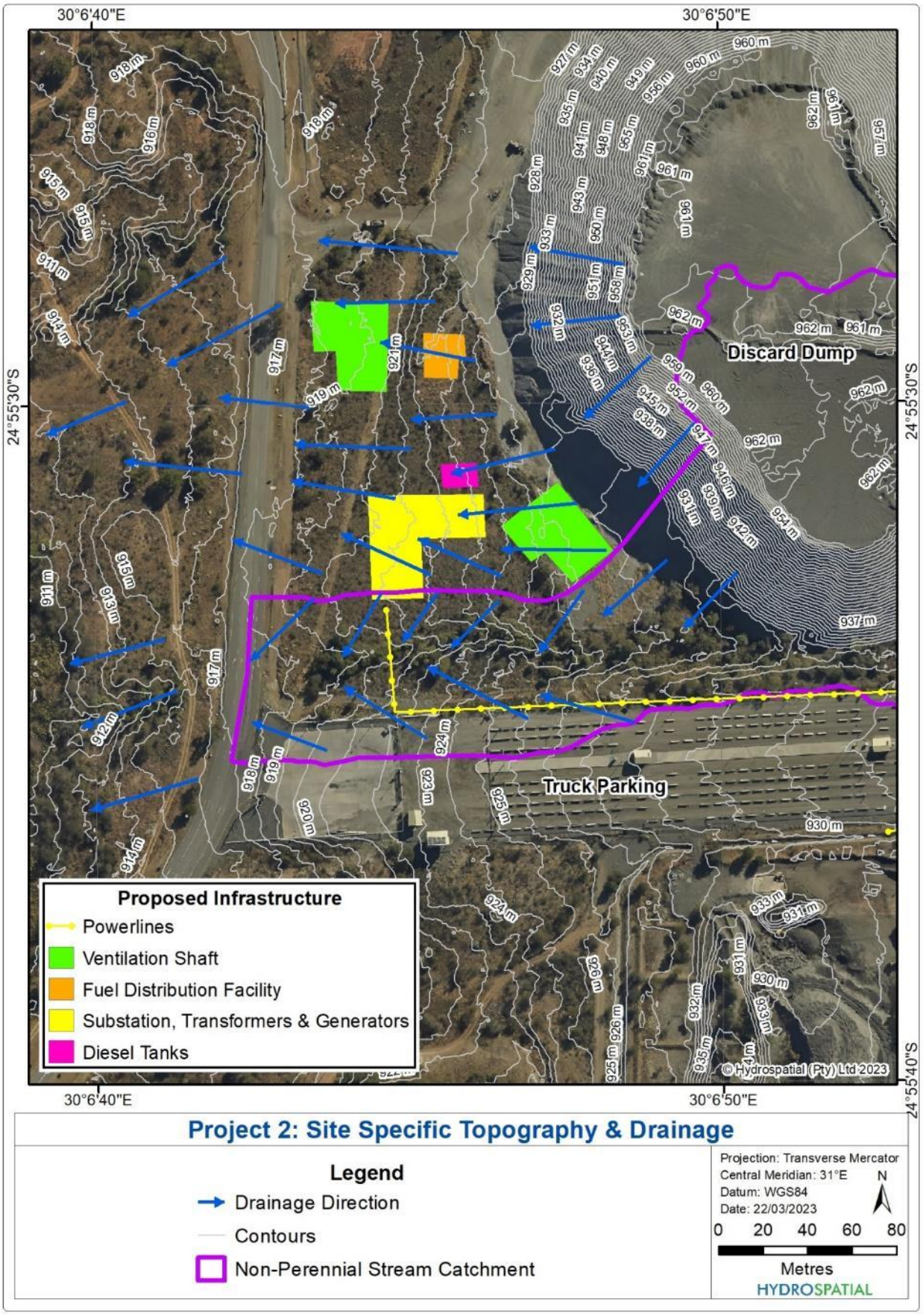

Figure 3-4: Project 2: Site specific topography and drainage

3.1.4 Vegetation and Land Cover

The proposed project areas consist mostly of natural vegetation associated with the Sekhukhune Mountain Bushveld vegetation type, which is characterised by open and closed broad leafed savannah on hills and mountain slopes (Mucina & Rutherford, 2006).

3.1.5 Soils

The SOTER database indicates that the majority of the Dwarsrivier MRA comprises of strongly weathered acid soils with low base saturation, classified as Luvisols with the remaining portions classified as Lithic Leptosols. The soils within the MRA are generally shallow.

3.1.6 Surface Water Use

Surface water use within the region is mostly used for mining and agricultural purposes.

3.2 Surface Water Runoff

The non-perennial drainage lines within the MRA are ephemeral, and runoff will only be generated when sufficient rainfall is received. The Groot Dwars and Klein Dwars are perennial rivers and will generally flow throughout year, barring dry years, when they may potentially stop flowing. The non-perennial drainage channel immediately to the south of Project 2, was noted to be highly ephemeral on the site visit, as there were no signs of any flow having occurred, despite high rainfall having been received in the recent past. The upstream portion of the catchment of this non-perennial channel (area to the east of the North TSF), has been diverted towards the Springkaanspruit, and therefore, only a small catchment area of approximately 0.44 km^2 reports to this channel. Any runoff generated in the upper part of the catchment (around the North TSF), will report to a culvert beneath the main regional road (Lydenburg road), and then down to another culvert located beneath the tar road immediately south-west of Project 2. From there, runoff will report to the Groot-Dwars River. All of the proposed infrastructure, except for the powerlines, are located outside of the 1:100 year floodlines.

Monthly flows for river gauging station B4H009 was downloaded from the DWS hydrological services website for the period October 1966 to January 2019. B4H009 is located on the Dwars River below the confluence of the Klein and Groot Dwars Rivers, near the northern boundary of the MRA (Figure 3-2). The mean monthly flows are indicated in Figure 3-5. The highest flows occur over the months of December to March, whilst the low flows occur over the months of June to October. According to the WR2012 study, quaternary catchment B41G has a Mean Annual Runoff (MAR) of 25.46 million cubic metres (m^3).

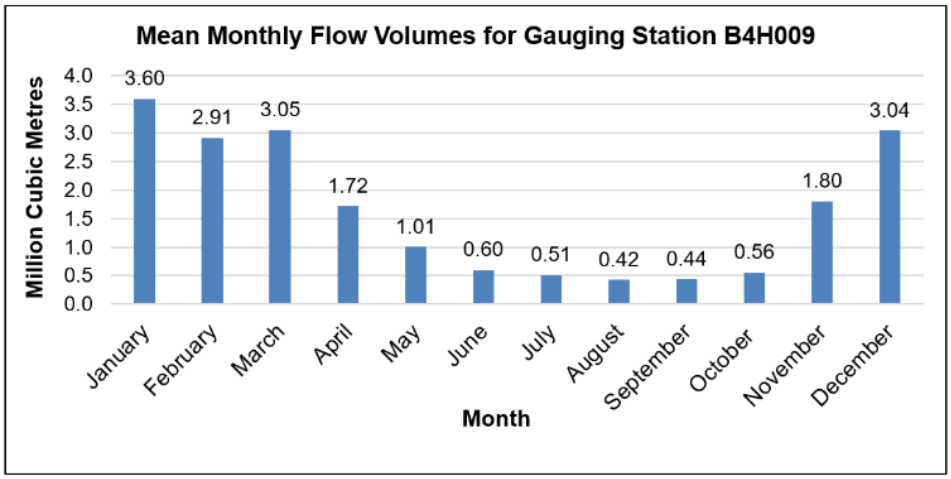

Figure 3-5: Mean monthly flows for DWS streamflow gauging station B4H009

3.3 Surface Water Quality

Surface water quality data was obtained from the Dwarsrivier Chrome Mine Monthly Environmental Water Quality Data Report for February 2023 (Aquatico, 2023). The instream monitoring points were used to describe the surface water quality status of the receiving environment. Details of the monitoring points are summarised in Table 3-4 and their locations are shown on Figure 3-6.

Table 3-4: Instream surface water quality monitoring points

Monitoring Point	Location Description	Latitude	Longitude	Monitoring Frequency
S1	Groot Dwars River upstream of operations	-24.94224	30.12034	Monthly
S2	Klein Dwars Rivier (Helipad Bridge north of Landing Strip)	-24.92921	30.10105	Monthly
S3	Groot Dwars River before confluence with Groot Dwars River and Springkaanspruit (Clinic Bridge)	-24.92833	30.1084	Monthly
S4	After confluence of Groot Dwars and Klein Dwars (Main Public Road Bridge)	-24.91199	30.10325	Monthly
S5	First stream next to DRM6 (Klein Dwars)	-24.94315	30.12238	Monthly
SP1	Bridge crossing Springkaanspruit (Upstream of Operation)	-24.93336	30.12379	Monthly
SP2	Springkaanspruit on mine premises (Close to Main Sewage Plant)	-24.93351	30.11982	Monthly
SP3	Springkaanspruit on mine premises (Downstream at mine perimeter)	-24.93299	30.11686	Monthly
SP4	Klein Dwarsriver (Downstream of Truck Parking Area)	-24.94138	30.12976	Monthly
SP5	Groot Dwarsrivier (Bridge to Thorncliff Mine)	-24.9553	30.12781	Monthly

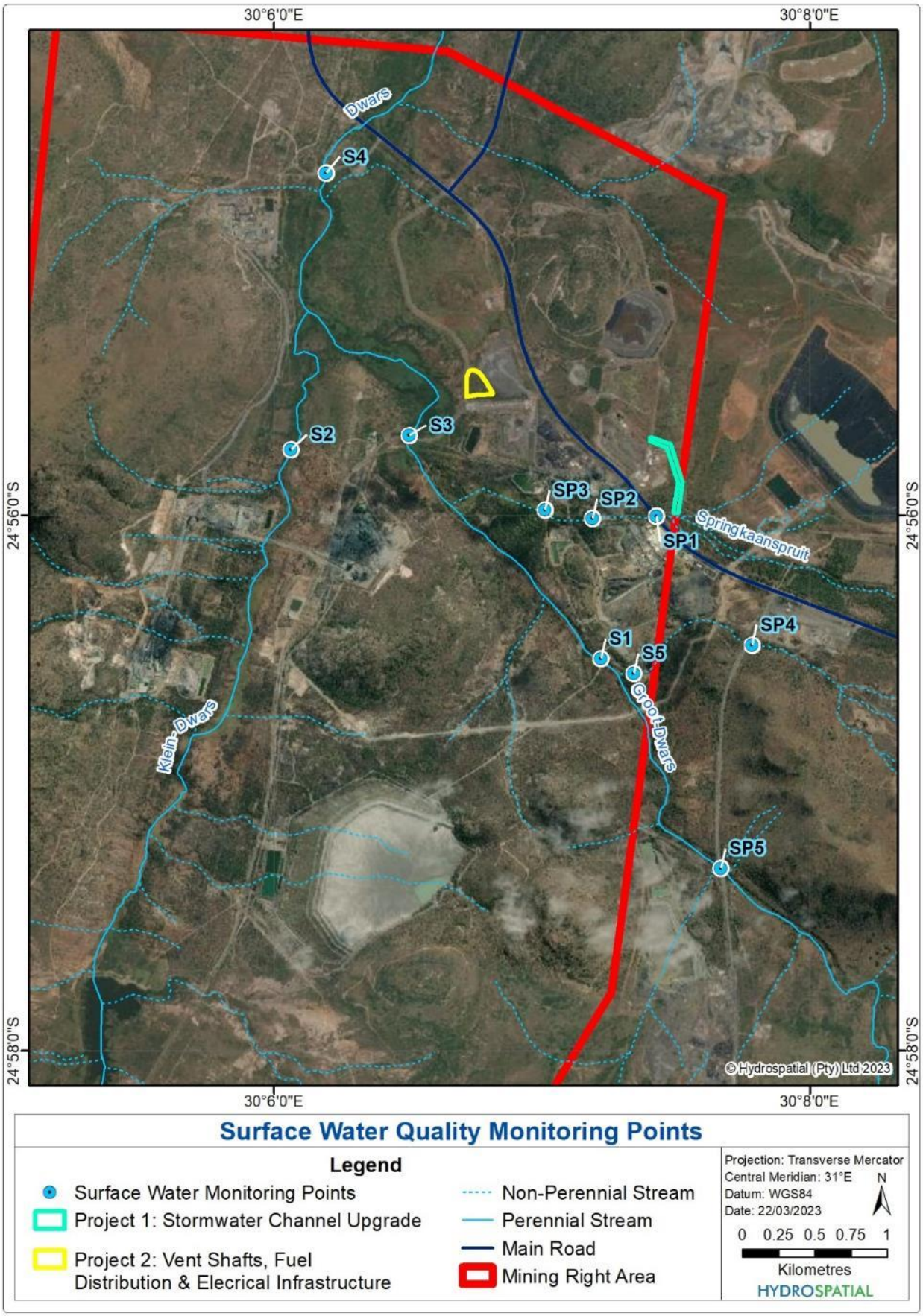

Figure 3-6: Surface water quality monitoring points

The water quality for sampling undertaken by Aquatico on 13 and 14 February 2023 is provided in Figure 3-7 and Figure 3-8. The water quality was compared to the following limits:

- Assessment 1: Average water quality between August 2018 and December 2021; and
- Assessment 2: Proposed Classes of Water Resources for Catchments of the Olifants in terms of Section 13(1)(A) and (b) of the National Water Act (Act No.46 of 1998) for the Steelpoort EWR Site (RU66 - IUA6).

The closest monitoring points to Project 1 are SP1 – SP3, which are located downstream of Project 1 on the Sprinkaanspruit. In terms of Project 2, S3 is located upstream on the Groot-Dwars River, whilst S4 is located downstream on the Dwars River. The water quality at these monitoring points is summarised below:

- The pH was alkaline (pH > 7) at all monitoring points but exceeded the limit at SP2, SP3 and S3;
- Total Dissolved Solids (TDS) exceeded the limit of 204 mg/l at the monitoring points along the Springkaanspruit, and was particularly high at SP1 with a concentration of 2 436 mg/l. The high TDS is most likely due to upstream mining related activities in the Springkaanspruit catchment. TDS was within the limit at S3 and S4;
- Calcium, magnesium, sodium, potassium, total alkalinity, chloride and sulphate all exceeded limits at the monitoring points along the Springkaanspruit, but were within limits at S3 and S4;
- Flouride, nitrite, nitrate, ammonium and ammonia were particularly elevated at SP1 and much less so at the other monitoring points;
- The metals were all within the limits except for manganese at SP1; and
- Total suspended solids were high at SP2 and SP3, but were within the limit at the other monitoring points.

PROJECT NAME			Dwarsrivier Chrome Mine					
ASSESSMENT SET 1			Upstream Groot Dwars Baseline (SP5)					
ASSESSMENT SET 2			Resource Quality Objective Steelpoort River (EWR 10 - RU66 - IUA6)					
VARIABLE	UNITS	ASSESSMENT 1	ASSESSMENT 2	MONITORING LOCALITIES				
				SP1	SP2	SP3	SP4	SP5
pH @ 25°C	pH	8.41	-	7.84	8.61	8.64	8.27	7.7
Electrical conductivity(EC) @ 25°C	mS/m	30.2	-	296	62.7	60.2	30.1	38.8
Total Dissolved solids @ 180°C	mg/l	204	-	2436	622	478	216	268
Calcium (Ca)	mg/l	28.2	-	148	33.5	32.7	23.3	35.5
Magnesium (Mg)	mg/l	20.9	-	117	68.8	68.3	18.5	27.7
Sodium (Na)	mg/l	7.79	-	188	11.6	10	9.32	10.2
Potassium (K)	mg/l	1.27	-	31.5	1.94	1.69	1.15	1.34
Total Alkalinity	mg $CaCO_3$/l	142	-	189	354	356	119	199
Chloride (Cl)	mg/l	6.74	-	195	12.7	10.4	7.53	7.22
Sulphate (SO_4)	mg/l	18.1	-	207	50.3	45.8	18.8	18.8
Fluoride (F)	mg/l	0.132	2	0.336	<0.263	<0.263	<0.263	<0.263
Nitrite (NO_2) as N	mg/l	0.067	-	17.8	0.258	0.077	0.23	0.11
Nitrate (NO_3) as N	mg/l	2.12	-	216	2	0.195	6.64	2.63
Nitrate as NO_3	mg/l	9.37	-	954	8.84	0.863	29.4	11.6
Un-ionized Ammonia as N	mg/l	-	-	1.07	0.081	0.017	0.06	<0.005
Ammonium (NH_4) as N	mg/l	0.207	-	29.8	0.438	0.088	0.597	0.079
Hexavalent chromium (Cr6+)	mg/l	0.001	0.068	<0.002	<0.002	<0.002	<0.002	<0.002
E.coli	CFU/100ml	111	-	33	520	300	260	700
Total coliform	CFU/100ml	1300	-	78	2800	2400	500	1400
TotalViableCount	CFU/ml	19000	-	88500	80000	45000	4333	36500
Iron (Fe)	mg/l	0.025	-	<0.004	<0.004	<0.004	<0.004	<0.004
Manganese (Mn)	mg/l	0.001	0.68	0.074	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	mg/l	0.002	-	<0.003	<0.003	<0.003	<0.003	<0.003
Total Chromium (Cr)	mg/l	-	-	<0.010	0.068	0.018	<0.010	<0.010
Copper (Cu)	mg/l	0.003	0.0049	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/l	0.003	0.144	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium (Cd)	mg/l	0.001	0.0016	<0.002	<0.002	<0.002	<0.002	<0.002
Lead (Pb)	mg/l	0.002	0.0058	<0.004	<0.004	<0.004	<0.004	<0.004
Total suspended solids (TSS)	mg/l	55	-	46	256	154	42	19
Temperature	°C	-	-	24.8	24.8	24.8	24.8	24.7
Ammonia (NH_3) as NH_3	mg/l	0.023	-	36.2	0.532	0.107	0.725	0.096
HNO3- Microwave digestion	mg/l	-	-	<8000	<8000	<8000	<8000	<8000
Total Inorganic Nitrogen	mg/l	2.39	-	263	2.69	0.36	7.47	2.82
Total oxidised nitrogen as N	mg/l	2.39	-	233	2.25	0.272	6.87	2.74

Value exceeds the assessment set 1

Figure 3-7: Water quality results (Aquatico, 2023)

DATA TABLE:								
PROJECT NAME			Dwarsrivier Chrome Mine					
ASSESSMENT SET 1			Upstream Klein Dwars (S2) Baseline					
ASSESSMENT SET 2			Resource Quality Objective Steelpoort River (EWR 10 - RU66 - IUA6)					
VARIABLE	UNITS	ASSESSMENT 1	ASSESSMENT 2	MONITORING LOCALITIES				
				S1	S2	S3	S4	S5
pH @ 25°C	pH	8.08	-	8.27	8.14	8.14	7.97	Dry
Electrical conductivity(EC) @ 25°C	mS/m	40.8	-	29.3	30.2	27.2	23.6	
Total Dissolved solids @ 180°C	mg/l	267	-	244	226	206	186	
Calcium (Ca)	mg/l	41.3	-	21.8	20.3	20	20.1	
Magnesium (Mg)	mg/l	22.8	-	15.4	14.7	14.5	13	
Sodium (Na)	mg/l	18.2	-	8.5	7.61	7.64	7.95	
Potassium (K)	mg/l	2.74	-	1.03	1.12	1.11	1.36	
Total Alkalinity	mg $CaCO_3$/l	199	-	106	103	104	102	
Chloride (Cl)	mg/l	12.1	-	5.5	5.14	4.77	5.45	
Sulphate (SO_4)	mg/l	15	-	16.4	13.6	14.7	13.9	
Fluoride (F)	mg/l	0.145	2	<0.263	0.426	<0.263	<0.263	
Nitrite (NO_2) as N	mg/l	0.173	-	0.225	0.185	0.182	0.17	
Nitrate (NO_3) as N	mg/l	2.74	-	6.5	4.6	4.47	3.27	
Nitrate as NO_3	mg/l	-	-	28.8	20.3	19.8	14.5	
Un-ionized Ammonia as N	mg/l	-	-	0.074	0.034	0.036	0.021	
Ammonium (NH_4) as N	mg/l	-	-	0.736	0.521	0.543	0.405	
Hexavalent chromium (Cr6+)	mg/l	0.001	0.068	<0.002	<0.002	<0.002	<0.002	
E.coli	CFU/100ml	220	-	230	1200	500	200	
Total coliform	CFU/100ml	620	-	1120	2100	2600	800	
TotalViableCount	CFU/ml	30000	-	13760	142000	37500	90500	
Iron (Fe)	mg/l	0.002	-	<0.004	<0.004	<0.004	<0.004	
Manganese (Mn)	mg/l	0.005	0.68	<0.001	<0.001	<0.001	<0.001	
Chromium (Cr)	mg/l	0.002	-	<0.003	<0.003	<0.003	<0.003	
Total Chromium (Cr)	mg/l	-	-	<0.010	<0.010	<0.010	0.033	
Copper (Cu)	mg/l	0.002	0.0049	<0.002	<0.002	<0.002	<0.002	
Zinc (Zn)	mg/l	0.003	0.144	<0.002	<0.002	<0.002	<0.002	
Cadmium (Cd)	mg/l	0.001	0.0016	<0.002	<0.002	<0.002	<0.002	
Lead (Pb)	mg/l	0.002	0.0058	<0.004	<0.004	<0.004	<0.004	
Total suspended solids (TSS)	mg/l	202	-	30	89	108	200	
Temperature	°C	-	-	24.7	24.9	24.8	24.8	
Ammonia (NH_3) as NH_3	mg/l	0.03	-	0.894	0.633	0.659	0.492	
HNO3-Microwave digestion	mg/l	-	-	<8000	<8000	<8000	<8000	
Total Inorganic Nitrogen	mg/l	3.33	-	7.46	5.3	5.19	3.84	
Total oxidised nitrogen as N	mg/l	-	-	6.72	4.78	4.65	3.44	

Value exceeds the assessment set 1

Figure 3-8: Water quality results – continued (Aquatico, 2023)

4 GN704 REGULATED ZONES

4.1 Purpose

According to regulation 4 of GN704, no person in control of a mine or activity may –

(a) Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding

boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked; and

(b) Carry on any underground or opencast mining or prospecting or any other operation or activity under or within the 1:50 year floodline or within a horizontal distance of 100 m from any watercourse or estuary, whichever is the greatest.

The purpose of this section is to determine whether any of the proposed infrastructure falls within the GN704 regulated zones, which include the 1:100 year floodlines and 100 m watercourse buffer.

4.2 Regulated Zones

The GN704 regulated zones are shown on Figure 4-1 and Figure 4-2, for Project 1 and Project 2, respectively. Table 4-1 indicates whether the proposed infrastructure falls within the regulated zones and whether a GN704 exemption should be applied for in terms of regulation 3.

Table 4-1: Proposed infrastructure location with regards to GN704 regulated zones

Proposed Infrastructure	Located in Regulated GN704 Zone		GN704 Exemption Required
	1:100 Year Floodline	100 m Watercourse Buffer	
Stormwater channel upgrade	No	Yes	Yes
Two ventilation shafts	No	Yes	Yes
Fuel distribution facility (emulsion, oil and diesel)	No	No	No
Substation, including four (4) generators with transformers and a diesel tank	No	Yes	Yes
Two 33 kV powerlines	Yes	Yes	Yes

4.3 Recommendations

The following is recommended:

- All of the proposed infrastructure except for the powerlines, are located outside of the 1:100 year floodlines. It is recommended that this infrastructure is motivated to be exempted from GN704; and
- The powerline support infrastructure should be placed outside of the floodlines. Should this be done, then it is recommended that it is motivated to be exempted from GN704.

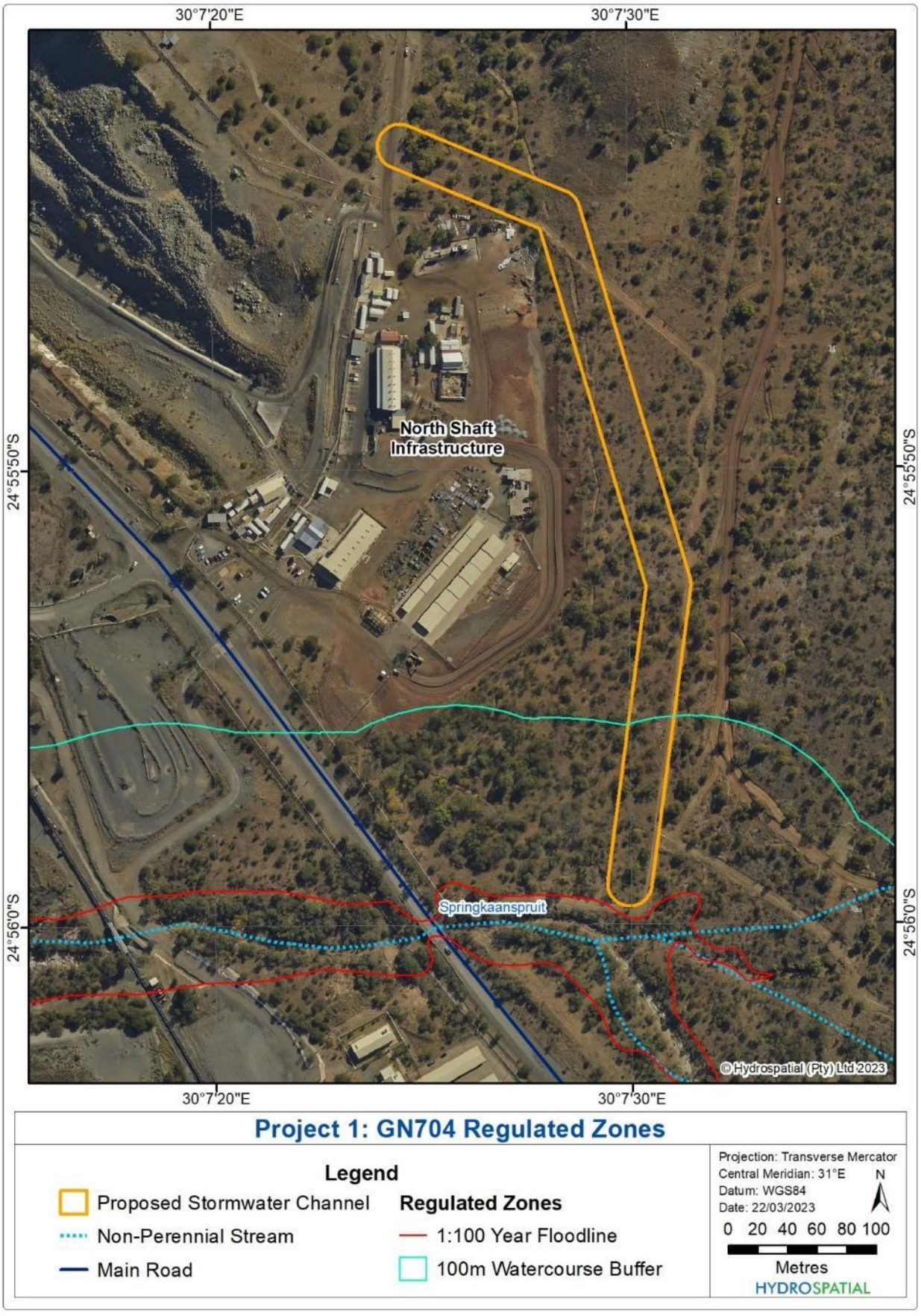

Figure 4-1: GN704 regulated zones for Project 1

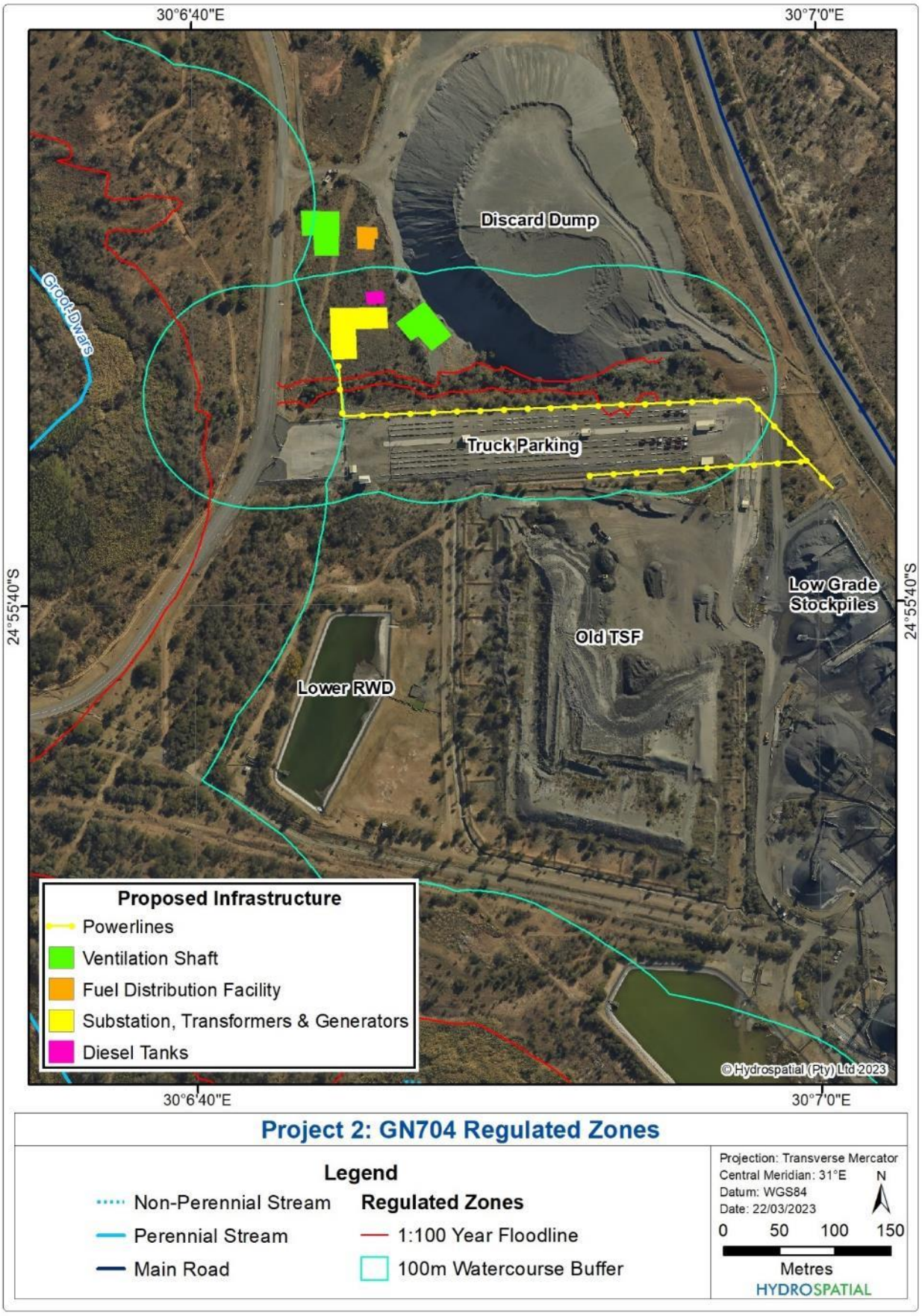

Figure 4-2: GN704 regulated zones for Project 2

5 SURFACE WATER IMPACT/RISK ASSESSMENT

5.1 Methodology

The impact/risk assessment methodology used to rate the potential surface water impacts pre- and post-mitigation is provided below. The evaluation of impacts is conducted in terms of the criteria detailed in Table 5-1 to Table 5-6. The various impacts of the project are discussed in terms of impact status, extent, duration, probability and intensity. Impact significance is the sum of the impact extent, duration, probability and intensity, and a numerical rating system is applied to evaluate impact significance. Therefore, an impact magnitude and significance rating is applied to rate each identified impact in terms of its overall magnitude and significance in Table 5-6. The various components of impact methodology are discussed below.

5.1.1 Impact Status

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. The nature of the impact can be described as negative, positive or neutral (Table 5-1).

Table 5-1: Impact status

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment.	P
Neutral	No cost or benefit to the receiving environment.	-
Negative	A cost to the receiving environment.	N

5.1.2 Impact Extent

The extent of an impact is considered as to whether impacts are either limited in extent or affects a wide area. Impact extent can be site-specific (within the boundaries of the development area), local, regional or national and/or international (Table 5-2).

Table 5-2: Extent of the impact

Rating	Description	Quantitative Rating
Low	**Site-specific**; occurs within the site boundary.	1
Medium	**Local**; extends beyond the site boundary; affects the immediate surrounding environment (i.e. up to 5 km from the project site boundary).	2
High	**Regional**; extends far beyond the site boundary; widespread effect (i.e. 5 km and more from the project site boundary).	3
Very High	**National and/or international**; extends far beyond the site boundary; widespread effect.	4

5.1.3 Impact Duration

The duration of the impact refers to the time scale of the impact or benefit (Table 5-3).

Table 5-3: Duration of the impact

Rating	Description	Quantitative Rating
Low	**Short-term**; quickly reversible; less than the project lifespan; 0 – 5 years.	1
Medium	**Medium-term**; reversible over time; approximate lifespan of the project; 5 – 17 years.	2
High	**Long-term**; permanent; extends beyond the decommissioning phase; >17 years.	3

5.1.4 Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring (Table 5-4).

Table 5-4: Probability of the impact

Rating	Description	Quantitative Rating
Improbable	Possibility of the impact materialising is negligible; chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; chance of occurrence 10 – 49.9%.	2
Highly Probable	It is expected that the impact will occur; chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; chance of occurrence >90%.	4
Definite and Cumulative	Impact will occur regardless of any prevention measures; chance of occurrence >90% and is likely to result in in cumulative impacts.	5

5.1.5 Impact Intensity

The intensity of the impact is determined to quantify the magnitude of the impacts and benefits associated with the proposed project (Table 5-5).

Table 5-5: Intensity of the impact

Rating	Description	Quantitative Rating
Maximum Benefit	Where natural, cultural and / or social functions or processes are positively affected resulting in the maximum possible and permanent benefit.	+5
Significant Benefit	Where natural, cultural and / or social functions or processes are altered to the extent that it will result in temporary but significant benefit.	+4
Beneficial	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified, beneficial way.	+3

Rating	Description	Quantitative Rating
Minor Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally benefited.	+2
Negligible Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly benefited.	+1
Neutral	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are not affected.	0
Negligible	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly affected.	-1
Minor	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally affected.	-2
Average	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified way.	-3
Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will temporarily cease.	-4
Very Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will permanently cease.	-5

5.1.6 Impact Significance

The impact magnitude and significance rating is utilised to rate each identified impact in terms of its overall magnitude and significance (Table 5-6).

Table 5-6: Impact magnitude and significance rating

Impact	Rating	Description	Quantitative Rating
Positive	**High**	Of the highest positive order possible within the bounds of impacts that could occur. +	+12 to -16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort	+6 to -11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of	+1 to –5

Impact	Rating	Description	Quantitative Rating
		achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming	
No Impact	No Impact	Zero Impact	
Negative	**Low**	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	-1 to -5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required	-6 to -11
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	-12 to -17

5.2 Impact/Risk Assessment and Mitigation Measures

The impact description, impact ratings pre- and post-mitigation, and mitigation measures are provided in Table 5-7.

Table 5-7: Impact/risk assessment and mitigation measures

Phase	Activity	Impact Description	Pre-Mitigation					Mitigation/Management Measures & Recommendations	Post-Mitigation				
			Extent	Duration	Probability	Intensity	Significance		Extent	Duration	Probability	Intensity	Significance
Construction Phase	Removal of vegetation for the development of the proposed projects.	Erosion of exposed soils leading to siltation and sedimentation of downslope watercourses.	Local (2)	Medium-term (2)	Probable (2)	Average (-3)	Medium (-6 to -11)	Vegetation clearance should be kept to an absolute minimum. Temporary erosion measures should be employed at exposed areas. Exposed areas should be vegetated as soon as possible.	Site-specific (1)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Construction Phase	Use of heavy machinery, trucks and vehicles for construction purposes.	Potential hydrocarbon spillages washed into downslope watercourses.	Local (2)	Medium-term (2)	Probable (2)	Average (-3)	Medium (-6 to -11)	Machinery, trucks and vehicles must be well maintained and serviced regularly as per a recommended service guide. Refuelling must be undertaken over hard park bunded areas that adequately sized to capture and contain spillages. Machinery and vehicles should be parked on appropriately lined areas. Drip trays must be employed under stationary machinery. Spillages should be reported immediately, and spill kits should be readily available at all times.	Site-specific (1)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Construction Phase	Alteration and disturbance of the non-perennial channel due to powerline support structures placed in the floodline.	Alteration in natural flow pattern and erosion and siltation of non-perennial channel	Local (2)	Long-term (3)	Highly Probable (3)	Average (-3)	Medium (-6 to -11)	The powerline support structures should be placed outside of the floodline.	Site-specific (1)	Medium-term (2)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Operational Phase	Incorrect sizing and design of stormwater channel.	Spills of clean water into dirty areas with a frequency of more than once in 50 years.	Local (2)	Long-term (3)	Probable (2)	Average (-3)	Medium (-6 to -11)	The stormwater channel sizing and design was checked and was deemed to be adequate to divert the 1:50 year clean runoff.	Site-specific (1)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)

Phase	Activity	Impact Description	Pre-Mitigation					Mitigation/Management Measures & Recommendations	Post-Mitigation				
			Extent	Duration	Probability	Intensity	Significance		Extent	Duration	Probability	Intensity	Significance
Operational Phase	Erosion of the stormwater channel.	Damage to the functioning of the channel and siltation of the Springkaanspruit.	Local (2)	Long-term (3)	Probable (2)	Average (-3)	Medium (-6 to -11)	The stormwater channel is proposed to be grassed which will assist to prevent erosion. Grassing must be undertaken immediately after construction. Energy dissipation measures such as rock riprap should be employed along steep sections and at the exit of the channel. Regular monitoring of the channel should be undertaken, specifically in the wet season and after large storm events. The channel should be repaired immediately if damaged.	Site-specific (1)	Medium-term (2)	Improbable (1)	Negligible (-1)	Low (-1 to -5)
Operational Phase	Spills from the fuel distribution facility and diesel tanks.	Hydrocarbon spillages washed into downstream watercourses.	Local (2)	Long-term (3)	Probable (2)	Average (-3)	Medium (-6 to -11)	The fuel distribution facility (emulsion, oil and diesel) and diesel tanks much be appropriately lined and bunded with sufficient storage capacity for spills. Refuelling must be undertaken over hard park bunded areas that adequately capture and contain spillages. Spillages should be reported immediately and spill kits should be readily available at all times.	Site-specific (1)	Short-term (1)	Probable (2)	Negligible (-1)	Low (-1 to -5)
Operational Phase	Draining of the ventilation shaft fans.	The ventilation shaft fans generally require to be drained from time to time. It is possble that the water quality may be of a poor nature and not fit to be discharged into the environment.	Local (2)	Long-term (3)	Probable (2)	Average (-3)	Medium (-6 to -11)	It is proposed that the water from the ventilation shaft fans should be captured and contained in a lined sump or JoJo tank and disposed in one of the return water dams.	Site-specific (1)	Short-term (1)	Improbable (1)	Negligible (-1)	Low (-1 to -5)

Phase	Activity	Impact Description	Pre-Mitigation					Mitigation/Management Measures & Recommendations	Post-Mitigation				
			Extent	Duration	Probability	Intensity	Significance		Extent	Duration	Probability	Intensity	Significance
Closure, Decommisioning & Rehabilitation Phase	Removal of infrastructure and rehabilitation of disturbed areas.	The removal of infrastructure and rehabilitation activities can potentially result in exposed soils leading to erosion and sedimentation.	Local (2)	Long-term (3)	Probable (2)	Average (-3)	Medium (-6 to -11)	Temporary erosion measures should be employed at exposed areas until vegetated. The topography should be returned to its former state (as far as practically possible). Exposed areas should be vegetated as soon as possible.	Site-specific (1)	Medium-term (2)	Improbable (1)	Negligible (-1)	Low (-1 to -5)

6 MONITORING PLANS

6.1 Surface Water Quality

In order to monitor the surface water quality upstream and downstream of the proposed infrastructure, the following monitoring points are proposed to be added to the current monitoring programme:

- Springkaanspruit immediately upstream of Project 1; and
- Groot-Dwars River immediately downstream of Project 2.

The parameters that form part of the current monthly monitoring programme are adequate for these proposed monitoring points.

6.2 Stormwater Channel

The proposed stormwater channel should be visually inspected for erosion and siltation after any large storm events. Should eroded or silted areas be noted, then immediate action must be undertaken to repair or maintain the channel. Inspections should be recorded and should include the following:

- Date of inspection;
- Condition of the channel;
- Photographs of any eroded or silted areas;
- Actions taken to fix erosion or to remove silt; and
- Photographs post action taken.

7 CONCLUSIONS AND RECOMMENDATIONS

The following provides a summary of the key findings of the study:

- In term of the GN704 regulated zones, it was found that all of the proposed infrastructure except for the fuel distribution facility falls within the 100 m watercourse buffer; and
- The impact/risk assessment showed that all of the risks would have a medium significance pre-mitigation and a low significance post-mitigation.

The following is recommended:

- It is recommended that the proposed infrastructure that falls within the 100 m watercourse buffer, is motivated to be exempted from GN704, as all except for the powerlines are located outside of the 1:100 year floodline;
- The powerline support infrastructure should be placed outside of the floodlines. Should this be done, then it is recommended that it is motivated to be exempted from GN704;
- The mitigation measures provided in Table 5-7 should be implemented; and
- The monitoring plans provided under section 6 should be implemented.

Should the above be adhered to, then from a surface water perspective, the proposed projects can commence.

8 REFERENCES

Aquatico. 2023. Dwarsrivier Chrome Mine Monthly Environmental Water Quality Data Report for February 2023.

Food and Agriculture Organisation (FAO) of the United Nations. 2005. New LocClim - Local Climate Estimator.

Water Resources of South Africa. 2012 (WR2012). WRC Project No. K5/2143/1.

APPENDIX A: STORMWATER CHANNEL DESIGN

APPENDIX B: CURRICULUM VITAE