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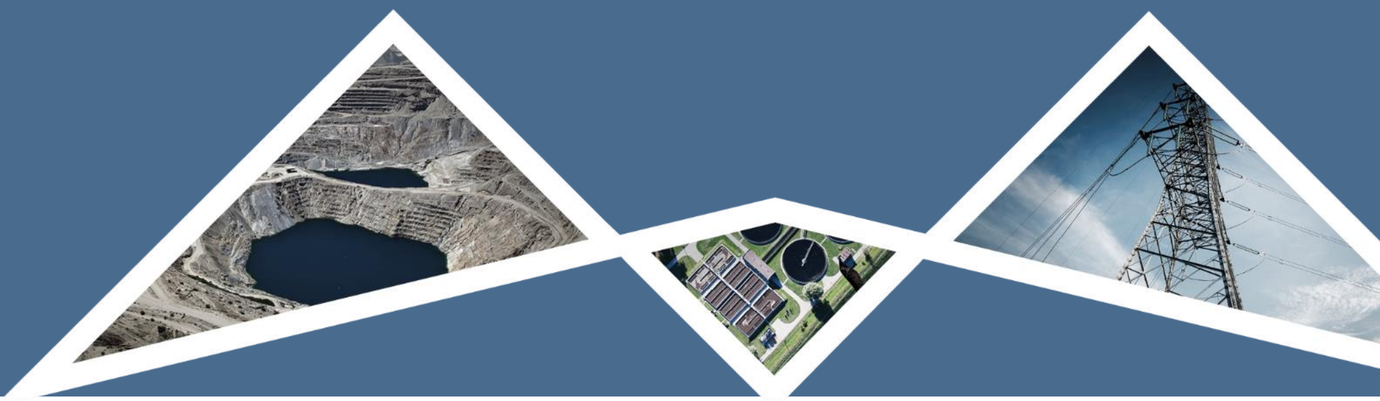
CONTAMINATED LAND ASSESSMENT REPORT

HARMONY ST HELENA CLOSURE PLAN



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REVISION AND AMENDMENTS

REVISION DATE:	REV #	DESCRIPTION
DATE	ORIGINAL DOCUMENT	

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1 INTRODUCTION

Environmental Impact Management Services (EIMS) (Pty) Ltd was appointed by Harmony Gold Mining Company Limited (referred to as Harmony hereafter) to conduct a contaminated land assessment which forms part of a Basic Assessment in support of an Environmental Authorisation for decommissioning as well as application for a closure certificate of the St Helena 10 shaft from the Department of Mineral Resources (DMR). The Harmony St Helena 10 Shaft is located just south of Welkom on the remaining extent of the farm Ongegund No.13 in the Majhabeng Local Municipality within the Lejweleputswa District Municipality in the Free State Province (Figure 1). The centre of the proposed site is at: 26°44'42.18"E; 28° 3'31.59"S.

This assessment compared 12 soil samples of the site against the DEA contaminated land Soil Screening Values (SSVs), promulgated under the National Environmental Management: Waste Act (Act 59 0f 2008) to determine if any contamination was present.

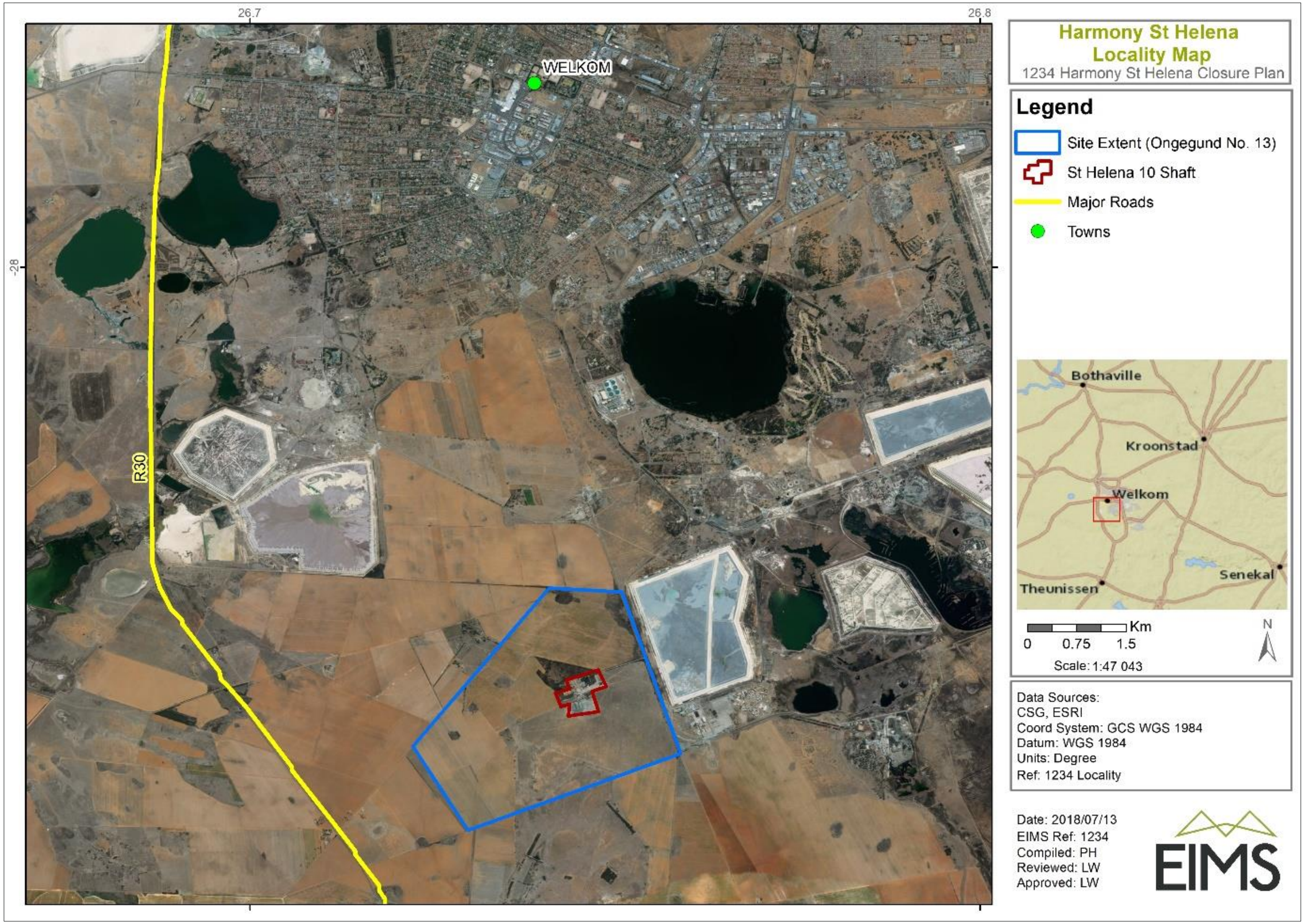

Figure 1: Harmony St Helena Shaft 10 Locality.

2 SITE DESCRIPTION

This section provides a background description of the site area to more accurately relate any contamination to either natural conditions or possible influence from mining activities.

2.1 CLIMATE

Climate around Welkom represents that of low-altitude semiarid steppe regions. This region is characterised by a warm-temperate summer rainfall climate *(Weatherbase, 2018)*. According to the *Soil Assessment for the Closure of the St Helena Shaft, Harmony* report done by The Biodiversity Company in 2018 high summer temperatures are common for this region with severe frost occurring throughout the winter. The average annual temperature around the Welkom area, taken from 20 yearly records, is 16°C and the average annual precipitation over a 38-year period is 600mm. The average monthly temperature and precipitation for the above-mentioned time frames can be seen in Figure 2 *(Weatherbase, 2018)*.

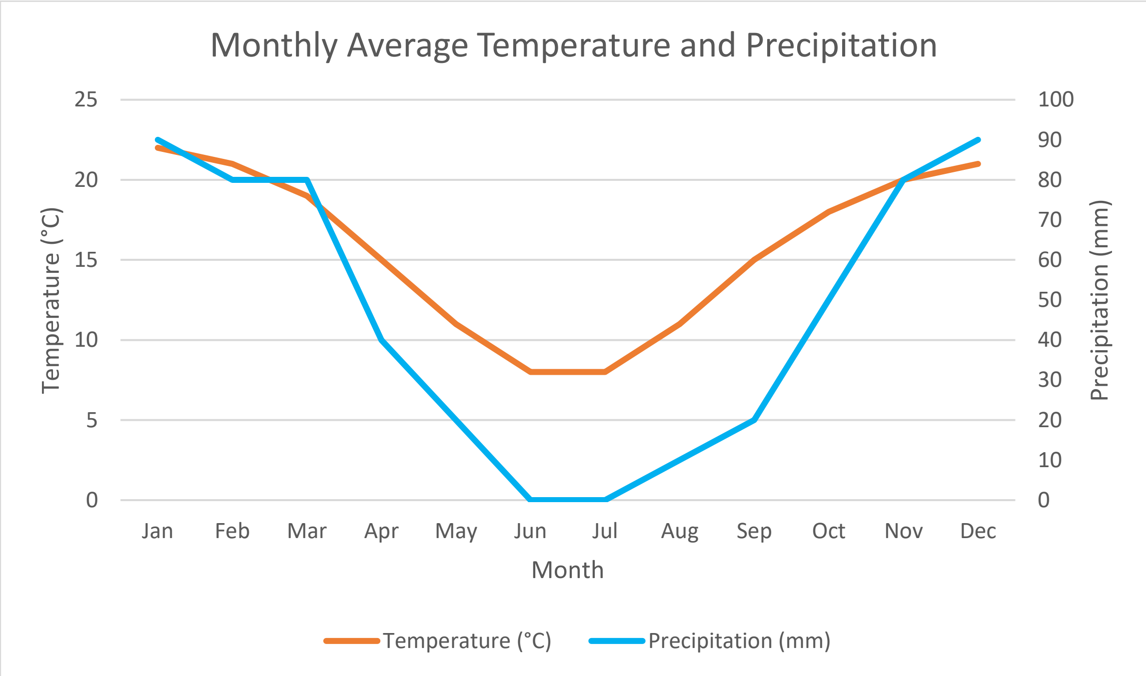

Figure 2: Monthly average temperature and precipitation in the Welkom area *(Weatherbase 2018)*.

2.2 TOPOGRAPHY

The landscape surrounding the Harmony St Helena 10 Shaft is fairly even. The site extent varies between 1345 masl and 1355 masl (Figure 3). According to the *Soil Assessment for the Closure of the St Helena Shaft, Harmony* report done by The Biodiversity Company in 2018 the project area slope varies between 0% and 3%. The western parts of the project area are west and south-west facing with the northern parts facing north to north-west.

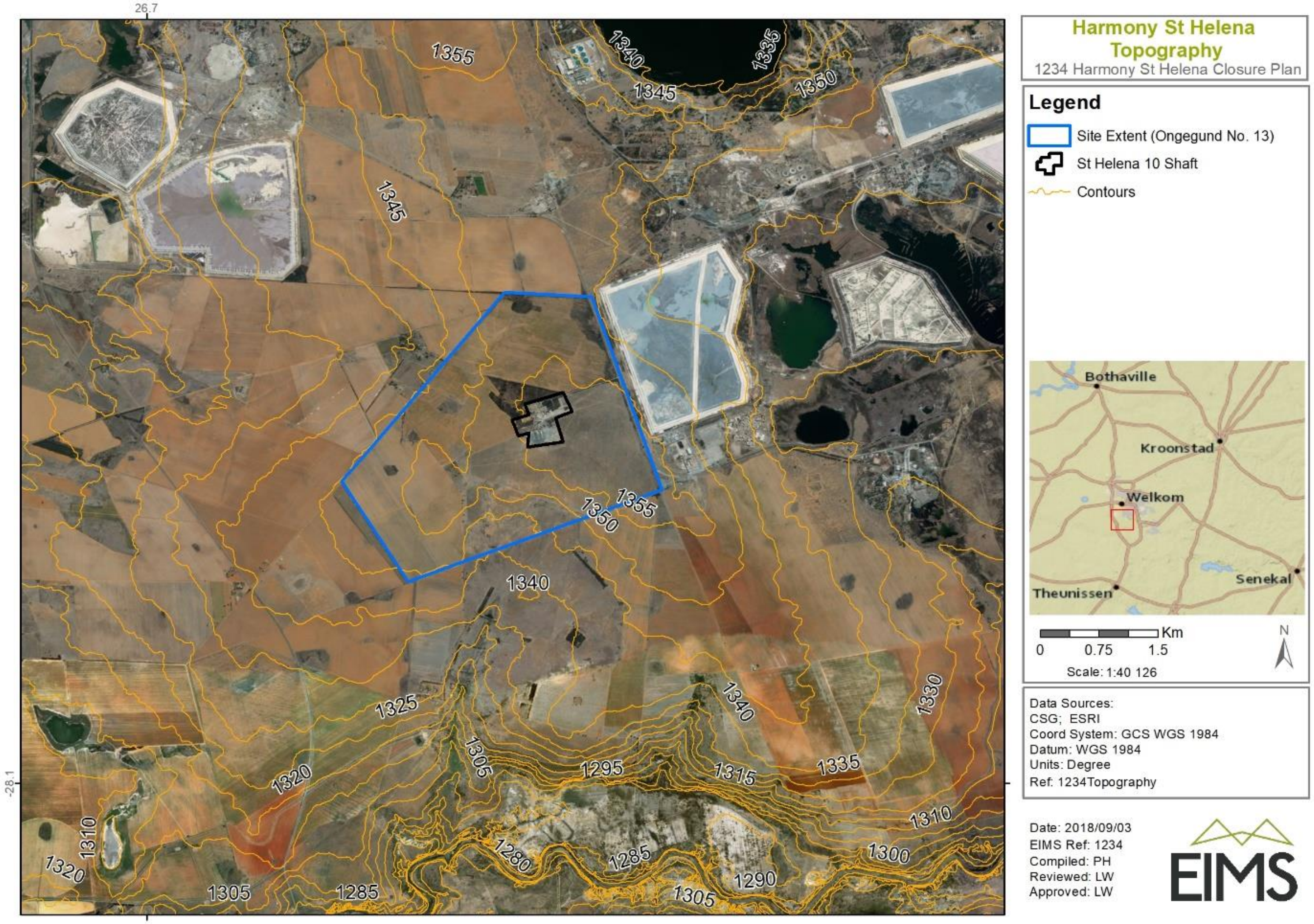

Figure 3: Topography around the site extent.

2.3 SOILS

According to the land type database *(Land Type Survey Staff, 1972 - 2006)* the project falls within the Bd20 land type. This land type consists of plinthic catena, upland duplex and margalitic soils which occur rare. Eutrophic, red soils are not widespread throughout the project area.

2.4 VEGETATION

The site is dominated by the Vaal-Vet Sandy Grassland vegetation type and intersects with the Highveld Alluvial (Aza5) vegetation type (Figure 4). The Vaal-Vet Sandy Grassland vegetation type is distributed throughout North-West and the Free State and stretches from south of Lichtenburg to Klerksdorp, Bothaville, Leeudoringstad as well as Brandfort. The latitude suited for this vegetation type is between 1 260 meters above sea level to 1 360 meters above sea level *(Mucina & Rutherford, 2006)*. The vegetation type features in areas dominated by plains with scattered and undulating hills. These areas mainly comprise of low-tussock grasslands with Themeda triandra being one of the most important features of this vegetation type. Overgrazing and erratic rainfall have however ensured that Themeda triandra is often replaced with Elionurus muticus, Aristida congesta and Cymbopogon pospischilii *(Mucina & Rutherford, 2006)*.

The conservation status of the Vaal-Vet Sandy Grassland vegetation type is endangered with only 0.3% of it being protected within the Bloemhof Dam, Sandveld, Schoonspruit, Wolwespruit, Soetdoring and Faan Meintjes nature reserves *(Mucina & Rutherford, 2006)*.

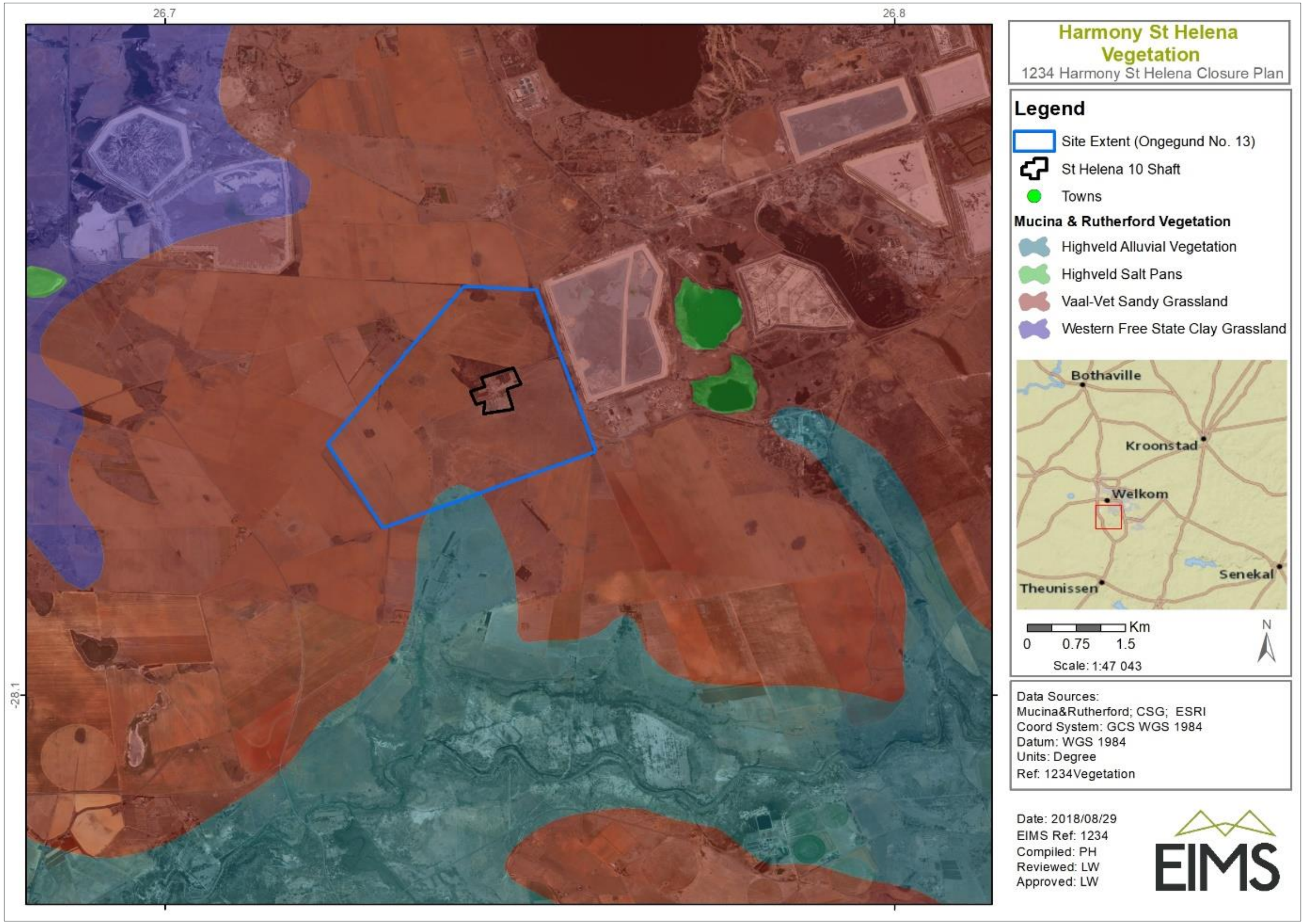

Figure 4: Harmony St Helena surrounding vegetation.

2.5 SURFACE WATER FEATURES

Not much surface water features occur within the site extent. The Sand River is found to the south of the St Helena Shaft and numerous wetlands are to the north-east of the site (Figure 5).

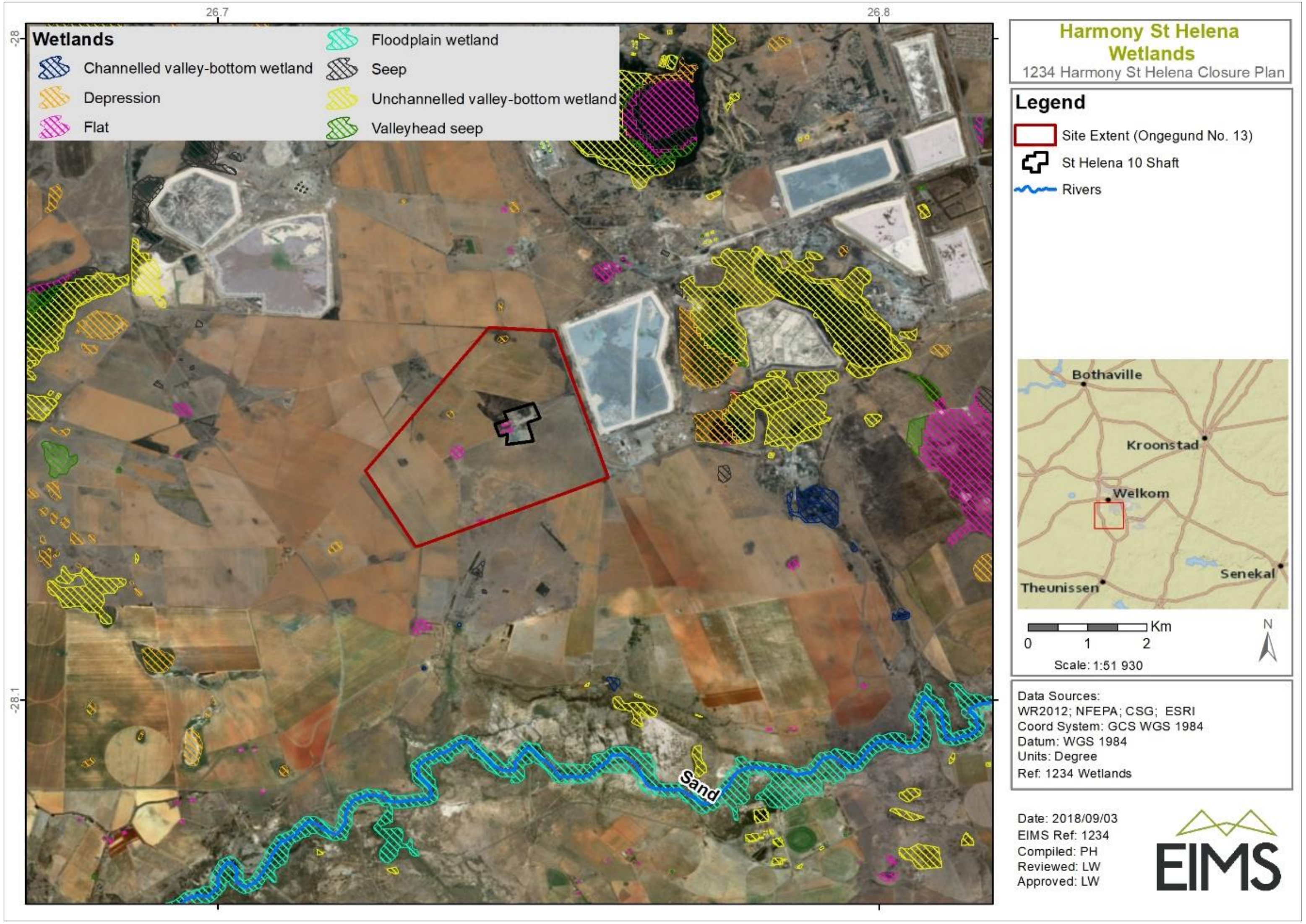

Figure 5: Surface Water Features surrounding the St Helena shaft area.

2.6 GEOLOGY AND HYDROGEOLOGY

According to the *Groundwater Assessment St Helena 10 Shaft* report done by Solutions[H^+] in 2018, the Karoo Supergroup rocks form the surface and near-surface geology of the assessment area. The top of the Ventersdorp Supergroup lies approximately 550 m below surface while the Witwatersrand Supergroup rocks, which host the Welkom gold deposits, lie more than 1 000 m below surface. The Groundwater assessment considered only the Karoo aquifer. According to the *National Aquifer Classification System of Parsons (1995)*, the Karoo aquifer in the St Helena 10 Shaft assessment area is described as a Minor aquifer system: "These can be fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are both important for local supplies and in supplying base flow for rivers".

The groundwater quality, according to the *Groundwater Assessment*, is generally good due to the dynamic recharge from rainfall. However, the Karoo siltstones were deposited in a marine environment and salinity is known to leach from these rocks. Further, this aquifer is vulnerable to contamination from surface sources including seepage from mine infrastructure such as tailings dams, waste rock dumps, process water pans and evaporation dams. Groundwater levels typically follow the topography in the region. The assessment area topography suggests two directions of groundwater flow:

- West-northwest at a gradient of 0.0035 towards a series of pans
- South-southwest at a gradient of 0.0047 towards a small tributary of the Sand River

Groundwater usage in the area occurs on agricultural holdings and is predominantly for small-scale irrigation and livestock watering. A smaller amount is used for domestic purposes *(Groundwater Assessment Report)*.

3 METHODOLOGY

A site visit was conducted on the 19th of July 2018 to obtain soil samples at 12 predetermined locations within the St Helena 10 Shaft Boundary. The samples were couriered to UIS Organic Laboratory, a SANAS accredited company, for analysis. After analysis a desktop review of the data was conducted.

3.1 SAMPLING PROCEDURE

- While onsite the necessary PPE (safety boots, gloves, reflective jacket and a hard hat) as required by the mine was worn.
- A basic 800m by 700m grid with 12 sampling points evenly distributed was generated within the Harmony St Helena 10 Shaft boundary beforehand. On site some of the site locations were changed from that of the original grid to be more representative of the pre-existing mining activities/ infrastructure or due to inaccessibility for hand drilling. Figure 6 indicates the sample locations onsite.
- Soil samples were taken at 0.5m at each site with use of a hand auger. The samples were placed in 1L glass jars and stored in cool boxes.
- The samples were delivered to UIS Organic Laboratory for analysis

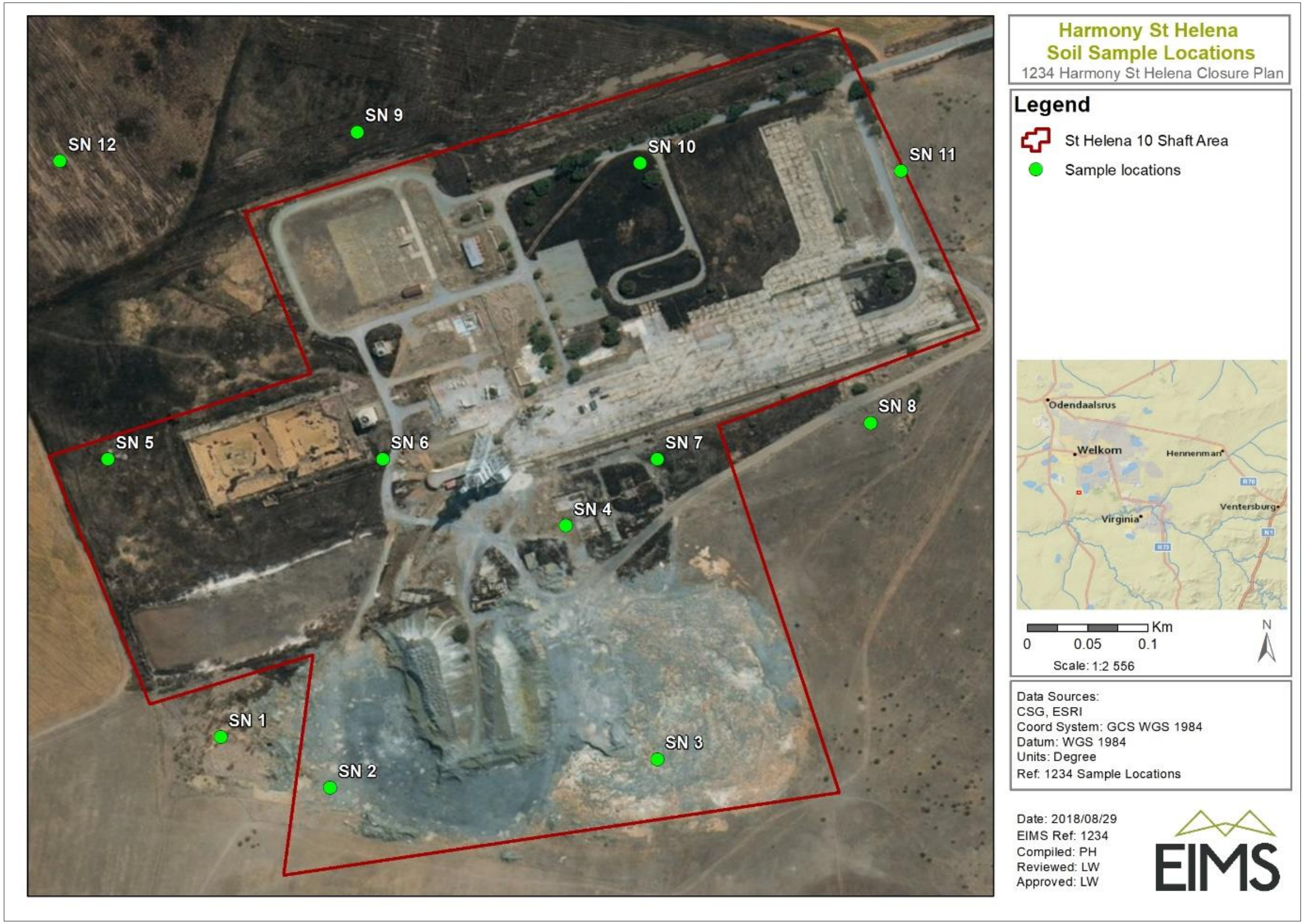

Figure 6: Soil sample locations.

3.2 DESKTOP REVIEW AND ASSESSMENT

- The site background information regarding satellite imagery, topography, soil, vegetation, surface water features, geology and hydrogeology was reviewed.
- The lab results were compared against the DEA contaminated land Soil Screening Values.
- The data was spatially studied to locate any patterns in the lab results.
- A desktop environmental risk assessment was done to evaluate any significant impact.
- The potential for any remedial or rehabilitation strategies were investigated.

4 ASSUMPTIONS AND LIMITATIONS

- SN6 was sampled at 0.3m due to refusal;
- Some sites were changed from their original grid positions due to either being to far/ irrelevant to the scope of the sampling or because of refusal due to bedrock;
- The information contained in this report was sourced from information and data supplied by third parties that is assumed to be complete, valid and true;
- This report is based on information available at the time of the site assessment. EIMS will not be liable for any loss or damage which may arise directly or indirectly because of such changes;
- No representation or warranty, expressed or implied, is or will be made in relation to, and no responsibility or liability is or will be accepted by EIMS in relation to the findings of this report.

5 RESULTS

The results section comprises of the consolidated lab results and the impact assessment done to evaluate if land contamination due to mining activities are significant.

5.1 LAB RESULTS

The results obtained from the site visit were compared against the DEA contaminated land Soil Screening Values (SSVs), promulgated under the National Environmental Management: Waste Act (Act 59 0f 2008) to determine if any contamination was present. Where a contaminant for a site exceeds any of the SSV values the result are highlighted in red.

Table 1: Lab results compared to the DEA contaminated land Soil Screening Values.

Parameter	Site												Screening Values				
	SN 1	SN 2	SN 3	SN 4	SN 5	SN 6	SN 7	SN 8	SN 9	SN 10	SN 11	SN 12 (Ref)	SSV 1 (All Land-Uses Protective of the Water Resources)	SSV 2 (Informal Residential)	SSV 2 (Standard Residential)	SSV 2 (Commercial/ Industrial)	Protection of Ecosystem Health
Metals and Metalloids																	
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.80	23.00	47.00	150.00	580.00
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	7.50	15.00	32.00	260.00	37.00
Chromium (III)	28.69	49.33	31.84	28.17	30.02	90.28	31.46	27.83	61.39	38.23	26.16	26.21	46000.00	46000.00	96000.00	790000.00	n/a
Chromium (VI)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.50	6.50	12.00	40.00	260.00
Cobalt	7.33	5.71	BDL	BDL	BDL	6.62	BDL	BDL	17.01	BDL	BDL	BDL	300.00	300.00	630.00	5000.00	22000.00
Copper	8.81	18.70	12.43	12.13	11.20	9.60	4.74	11.67	23.27	16.95	10.94	8.23	16.00	1100.00	2300.00	19000.00	16.00
Lead	6.95	12.93	BDL	5.32	7.79	15.93	5.95	5.66	18.58	5.30	6.43	BDL	20.00	110.00	230.00	1900.00	100.00
Manganese	140.80	130.10	12.32	33.24	79.45	83.76	46.36	47.80	224.50	50.48	99.72	41.14	740.00	740.00	1500.00	12000.00	36000.00
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.00	1.00	1.00	6.50	4.10
Nickel	9.37	16.38	BDL	4.93	5.75	14.23	6.54	BDL	25.95	6.40	6.50	4.90	91.00	62.00	1200.00	10000.00	1400.00
Vanadium	18.54	36.01	13.95	14.44	17.85	60.73	17.79	14.25	77.53	28.58	18.92	16.72	150.00	150.00	320.00	2600.00	n/a
Zinc	20.66	25.90	15.26	19.09	21.62	25.66	35.32	29.77	51.84	15.61	18.95	12.18	240.00	9200.00	19000.00	150000.00	240.00
Alkanes																	
C7-C9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2300.00	2300.00	2400.00	23000.00	n/a
C10-C14	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	440.00	440.00	500.00	4400.00	n/a
C15-C36	BDL	33.00	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	45000.00	45000.00	91000.00	740000.00	n/a
MAHs																	
Benzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.27	1.30	1.40	10.00	81.00
Toluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	25.00	110.00	120.00	1100.00	170.00
Ethylbenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	26.00	57.00	60.00	540.00	1700.00
Xylenes	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	45.00	91.00	95.00	880.00	260.00
Aromatics																	
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	28.00	28.00	32.00	290.00	28.00
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.20	920.00	1900.00	15000.00	5.30
Benzo(a)pyrene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.34	0.34	0.71	1.70	280.00
Petroleum Additives																	

Parameter	Site												Screening Values				
	SN 1	SN 2	SN 3	SN 4	SN 5	SN 6	SN 7	SN 8	SN 9	SN 10	SN 11	SN 12 (Ref)	SSV 1 (All Land-Uses Protective of the Water Resources)	SSV 2 (Informal Residential)	SSV 2 (Standard Residential)	SSV 2 (Commercial/ Industrial)	Protection of Ecosystem Health
MTBE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.03	360.00	370.00	5800.00	810.00
Organics																	
Carbon Tetrachloride	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.24	0.25	0.26	4.00	62.00
Chlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	610.00	610.00	1200.00	10000.00	960.00
Chloroform	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.10	0.10	0.10	1.70	11.00
2 Chlorophenpol	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	140.00	150.00	320.00	2600.00	140.00
1.2 Dichlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	88.00	2700.00	5800.00	47000.00	1400.00
1.4 Dichlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	26.00	1100.00	1200.00	19000.00	520.00
1.2 Dichloroethane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.23	0.23	0.24	3.70	2400.00
1.1 Dichloroethene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	9.50	9.50	10.00	150.00	n/a
1.2.3 Trimethylbenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.28	53.00	55.00	860.00	n/a
1.2 Dichloroethene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.36	610.00	1200.00	10000.00	18.00
1.3.5 Trimethtlbenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.26	300.00	640.00	5300.00	n/a
Trichlorobenzenes (Total)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.07	310.00	650.00	5300.00	0.14
Nitrobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.80	2.80	2.90	45.00	710.00
1.1.2.2 Tetrachloroethane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.32	0.32	0.33	5.00	190.00
2.4.6 Trichlorophenol	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4.00	210.00	320.00	1700.00	n/a
Vinyl Chloride	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.00	0.10	0.10	1.50	n/a
PCBs	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.61	1.70	3.60	11.00	n/a
Cyanide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	14.00	610.00	1200.00	10000.00	20.00
Soil Screening Values for Anions													Soil screening level				
Chlorides	1872.00	26.20	39.40	24.20	174.00	94.00	129.00	111.00	95.60	90.00	295.00	123.00	12000.00				
Fluorides	20.40	BDL	BDL	5.50	19.00	25.80	12.00	19.00	BDL	23.00	19.00	18.00	30.00				
Nitrates-nitrite	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	120.00				
Sulphates	245.00	2992.00	907.70	76.60	1214.00	474.00	490.00	355.00	680.00	244.00	1763.00	497.00	4000.00				

5.2 SIGNIFICANCE RATING IMPACT ASSESSMENT

The impact assessment methodology can be consulted in appendix B, which describes how the results in Table 2 were obtained.

Table 2: Significance rating impact assessment.

<table>
<tr><th>Impact Name</th><th colspan="5">Impacts on land contamination</th></tr>
<tr><th>Alternative</th><th colspan="5">0</th></tr>
<tr><th>Phase</th><th colspan="5">Rehab and closure</th></tr>
<tr><th colspan="6">Environmental Risk</th></tr>
<tr><th>Attribute</th><th>Pre-mitigation</th><th>Post-mitigation</th><th>Attribute</th><th>Pre-mitigation</th><th>Post-mitigation</th></tr>
<tr><td>Nature of Impact</td><td>-1</td><td>-1</td><td>Magnitude of Impact</td><td>1</td><td>1</td></tr>
<tr><td>Extent of Impact</td><td>2</td><td>2</td><td>Reversibility of Impact</td><td>1</td><td>1</td></tr>
<tr><td>Duration of Impact</td><td>3</td><td>3</td><td>Probability</td><td>2</td><td>2</td></tr>
<tr><td colspan="5">Environmental Risk (Pre-mitigation)</td><td>-3.50</td></tr>
<tr><td colspan="6">Mitigation Measures</td></tr>
<tr><td colspan="6">None required.</td></tr>
<tr><td colspan="5">Environmental Risk (Post-mitigation)</td><td>-3.50</td></tr>
<tr><td colspan="5">Degree of confidence in impact prediction:</td><td>Low</td></tr>
<tr><th colspan="6">Impact Prioritisation</th></tr>
<tr><td colspan="5">Public Response</td><td>1</td></tr>
<tr><td colspan="6">Low: Issue not raised in public responses</td></tr>
<tr><td colspan="5">Cumulative Impacts</td><td>2</td></tr>
<tr><td colspan="6">Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.</td></tr>
<tr><td colspan="5">Degree of potential irreplaceable loss of resources</td><td>1</td></tr>
<tr><td colspan="6">The impact is unlikely to result in irreplaceable loss of resources.</td></tr>
<tr><td colspan="5">Prioritisation Factor</td><td>1.17</td></tr>
<tr><td colspan="5">Final Significance</td><td>-4.08</td></tr>
</table>

6 DISCUSSION

Future development plans for the Harmony St Helene 10 Shaft area after rehabilitation are unknown, thus the primary receptors of any contamination present on-site cannot be determined. Copper minimally exceeds the SSV1 (land uses protective of the water resources) and protection of ecosystem health values at sites SN2, SN9 and SN10.

Copper naturally occurs within the environment at an average amount of 50 parts per million (ppm) but could also occur because of anthropogenic activities such as mining, industries that smelt and refine copper for productional use, combustion of fossil fuels and it is widely used in agricultural practices. Copper can enter the air because of combustion of fossil fuels and it usually ends up in soils as it settles after a rainfall event.

Copper is an essential nutrient for humans and animals as well as plants in small amounts with certain important metabolic functions. Only when high amounts of copper are ingested does some effects like nausea, vomiting or abdominal pain occur. Liver and kidney damage can occur after excessive ingestion of Copper over a long period of time.

The environmental significance rating for contaminated land is classified as low, and no detrimental environmental effects with regards to contaminated land are expected.

7 CONCLUSION AND RECOMMENDATIONS

With regards to the minimal exceedance of copper at sites SN2, SN9 and SN10 only and the localised distribution of the contaminant at these sites, no noticeable contamination impacts on the environment are expected. It is also uncertain whether the contaminant naturally occurs at these sites or if it were due to production activities. No other contaminants were present.

When considering the above together with the negligible significance of potential soil contamination impacts it is clear that no soil contamination mitigation is required. Thus, no rehabilitation recommendations are made with regards to contaminated land.

8 REFERENCES

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Appendix A: UIS Organic Laboratory Results

Method of Assessing Impacts:

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). Please note that the impact assessment must apply to the identified Sub Station alternatives as well as the identified Transmission line routes.

Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\mathbf{C = \frac{(E+D+M+R)}{4} \times N}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 3.

Table 3: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),

Aspect	Score	Definition
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 4.

Table 4: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 5: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 6Table 6.

Table 6: Significance Classes

Environmental Risk Score	
Value	**Description**
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

Impact Prioritisation:

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 7: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.

	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 7. The impact priority is therefore determined as follows:

Priority = PR + CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to Table 8).

Table 8: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 9: Final Environmental Significance Rating

Environmental Significance Rating	
Value	**Description**
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).