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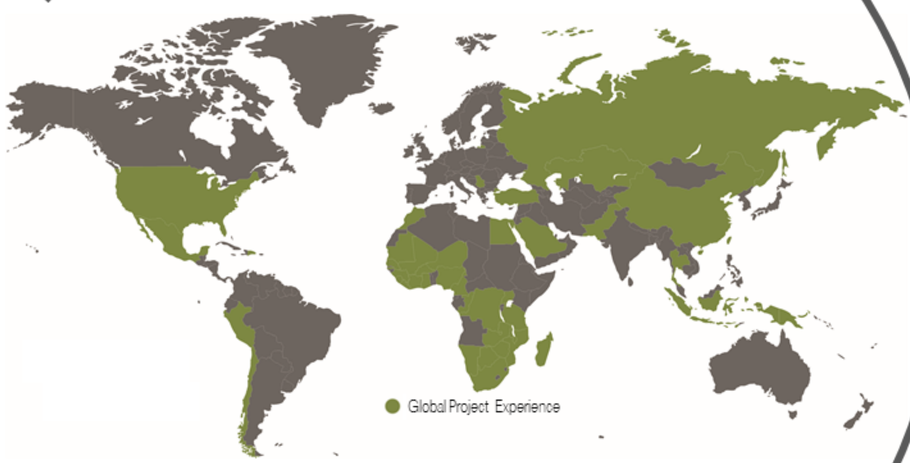

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Environmental Authorisation Process for the Expansion of the Copper Sunset Mining Right Area

Surface Water Specialist Study

Prepared for:
Copper Sunset Sands (Pty) Ltd

Project Number:
COP6679

May 2021

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Report Type:	Surface Water Specialist Study
Project Name:	Environmental Authorisation Process for the Expansion of the Copper Sunset Mining Right Area
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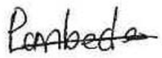
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
    - I declare that there are no circumstances that may compromise my objectivity in performing such work;
    - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- 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;
- All the particulars furnished by me in this form are true and correct; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



09 February 2021

Signature of the Specialist *Date*

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EXECUTIVE SUMMARY

Copper Sunset Sands (Pty) Ltd (hereinafter Copper Sunset) has an approved Mining Right (DMRE Ref. No. FS30/5/1/1/2/164 MR) and Environmental Management Programme (EMPr), in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), for the mining of sand on the Farm Bankfontein No. 9. The Mining Right was approved in 2008 and amended in 2011, 2016 and 2017 to incorporate additional areas into the Mining Right Area (MRA). The applicant now intends to expand its MRA to incorporate adjacent properties to extend the Life of Mine (LoM). The proposed extension of the MRA amounts to approximately 1642 ha (Bankfontein) and 1153.6 ha (Zandfontein), for the mining of sand.

Digby Wells Environmental (hereinafter Digby Wells) has been appointed by Copper Sunset as the independent Environmental Assessment Practitioner (EAP) to conduct the required environmental authorisation process to expand their existing and approved MR for the mining of sand over the proposed areas. This surface water assessment was done to support the authorisation process of the mine extension.

The surface water assessment included a description of the hydrological setting of the study area within which the proposed Copper Sunset extension project is located. Baseline water quality assessment was undertaken, as well as floodlines delineation and surface water impact assessment.

The Mining Right Boundary of the Copper Sunset Operations stretches across quaternary catchments C22F, C22G and C22K within the Vaal Water Management Area (WMA 5). The catchment area is drained by the Vaal River. The dominant land use in the catchment includes agriculture, extensive gold and coal mining, power generation, industrial activities and urban development. The urban development consists of cities, towns and dense settlements.

Peak flows calculated using the Rational Method (Alternative 3) for the 1:50-year and 1:100-year events are indicated to be 1427.75 m^3/s and 1922.45 m^3/s for the Vaal River and 322.52 m^3/s and 451.83 m^3/s for the Taaibosspruit. These peak flows were used for hydraulic modelling as input flows within the HEC-RAS 6 model. Modelled floodlines indicate that the existing and proposed Copper Sunset infrastructure including the areas to be mined are outside the floodwater way for both the 1:50-year and 1:100-year flood events. Placement of any future additional infrastructure should be outside the modelled 1:100-year floodlines from the edge of both the Vaal River and the Taaibosspruit to avoid impacting on water resources and to prevent infrastructure inundation.

Potential environmental risks associated with the proposed project pertain to soil erosion which may lead to siltation and sedimentation of nearby surface waterbodies and potential contamination due to hydrocarbon and hazardous chemical spillages and leaks. The project is not likely to result in significant impacts of the receiving Vaal and Taaibosspruit Rivers. It is recommended that water quality monitoring be done on an ongoing basis so as to ensure that any elevated contaminants are detected early and corrective actions applied as necessary.

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Appendix A: Impact Assessment Methodology

ACRONYMS, ABBREVIATIONS AND DEFINITION

BPGs	Best practice guidelines
DEM	Digital Elevation Model
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
DSM	Digital Surface Model
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme Report
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MIPI	Midgley and Pitman
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Area
LoM	Life of Mine
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
RM3	Rational Method Alternative 3
S&EIR	Scoping and Environmental Impact Reporting
SDF	Standard Design Flood
SS	Suspended Solids
TDS	Total Dissolved Solids
WMA	Water Management Area
WRC	Water Research Commission

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page iii
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page iii
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
cA	And indication of the quality and age of the base data used for the specialist report;	Section 6
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7.5 & 7.6
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.1 and 7.3
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 6
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	Section 7.4
(g)	an identification of any areas to be avoided, including buffers;	Section 7.4
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 7-7 in Section 7.4
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7.5
(k)	any mitigation measures for inclusion in the EMPr;	Section 7.5
(l)	any conditions/aspects for inclusion in the environmental authorisation;	N/A
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 12

Legal Requirement		Section in Report
	whether the proposed activity, activities or portions thereof should be authorised; and	
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 12
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Copper Sunset Sands (Pty) Ltd (hereinafter Copper Sunset) has an approved Mining Right (DMRE Ref. No. FS30/5/1/1/2/164 MR) and Environmental Management Programme (EMPr), in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), for the mining of sand on the Farm Bankfontein No. 9. The Mining Right was approved in 2008 and amended in 2011, 2016 and 2017 to incorporate additional areas into the Mining Right Area (MRA).

The existing operations are situated on the Farm Bankfontein No. 9, the Remaining Extent (RE) of the Farm Zandfontein No. 259, a Portion of the RE of the Farm Bankfontein No. 9 and a Portion of the Farm Rietfontein No. 152, situated in the Free State Province. The project area defines the farm portions directly affected by the proposed mining developments while the study area describes is defined as the directly and indirectly affected farm portions that formed part of the surface water assessment.

Copper Sunset currently holds the following Environmental Authorisations (EAs) and Environmental Management Programmes (EMPrs), which are applicable to the Mining Right boundary:

- The original EMPr associated with the application for a MR on the Farm Bankfontein No. 9, approved in 2008 (DMRE Ref. No. FS30/5/1/1/2/164 MR dated 28/04/2009);
- The 2011 EA and EMPr associated with the construction of a washing plant, a Return Water Dam (RWD), a settling dam and brick building (DMRE Ref. No. FS30/5/1/2/3/2/1 (164) EM dated 19/09/2011);
- The 2015 and 2016 EA and EMPr associated with the incorporation of additional areas into the MRA (DMRE Ref. No. FS30/5/1/2/3/2/1 (164) EM dated 08/03/2016 and 20/12/2016); and
- The 2017 EMPr associated with incorporation of additional areas into the MR (DMRE Ref. No. FS30/5/1/2/2 (164) MR dated 30/05/2018).

The applicant now intends to expand its MRA to incorporate adjacent properties to extend the Life of Mine (LoM). The intent is to expand the current mining operations to include additional portions of the Remaining Extent (RE) of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259. The proposed extension of the MRA amounts to approximately 1642 ha (Bankfontein) and 1153.6 ha (Zandfontein), for the mining of sand.

The extension of the existing MRA triggers activities incorporated in Listing Notice 1 and Listing Notice 2 of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 04 December 2014 as amended), promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The Listed Activities require a Scoping and Environmental Impact Reporting (S&EIR) process to be undertaken as part of the authorisation process.

Digby Wells Environmental (Digby Wells) has been appointed by Copper Sunset as the independent Environmental Assessment Practitioner (EAP) to conduct the required environmental authorisation process to expand their existing and approved MR for the mining of sand over the proposed areas. Wetlands have been identified within the expansion areas. A Water Use Licence Application (WULA) will be submitted to the Department of Water and Sanitation (DWS) to obtain the required permissions to mine the wetland areas.

Additionally, it is recommended that as part of this application all Environmental Authorisations (EAs) and EMPrs are consolidated into one EMPr that is applicable to the approved MR and the new areas being applied for. Therefore, the following processes will be conducted:

- A Section 102 amendment application process as per the MPRDA to amend the MR boundary;
- A S&EIR process to authorise the new Listed Activities as per the NEMA;
- An IWULA process in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) to mine the wetland areas found within the expansion area; and
- A Regulation 31 amendment process to consolidate the EAs and EMPrs into one consolidated report as per the NEMA.

2. Project Locality

The Copper Sunset study area is located within Viljoensdrif, a coal-mining village, under the jurisdiction of the Metsimaholo Local Municipality, which is located in the Fezile Dabi District Municipality, Free State Province near the Vaal River and Lethabo Power Station. Table 2-1 provides the location of the mine in relation to the nearest towns.

Table 2-1: Project Locality

Town	Distance from Copper Sunset	Direction from Town
Vereeniging	8km	South
Vanderbijlpark	10km	South-East
Sasolburg	13km	North-East

Figure 2-1 provides the Local Setting map for the project area.

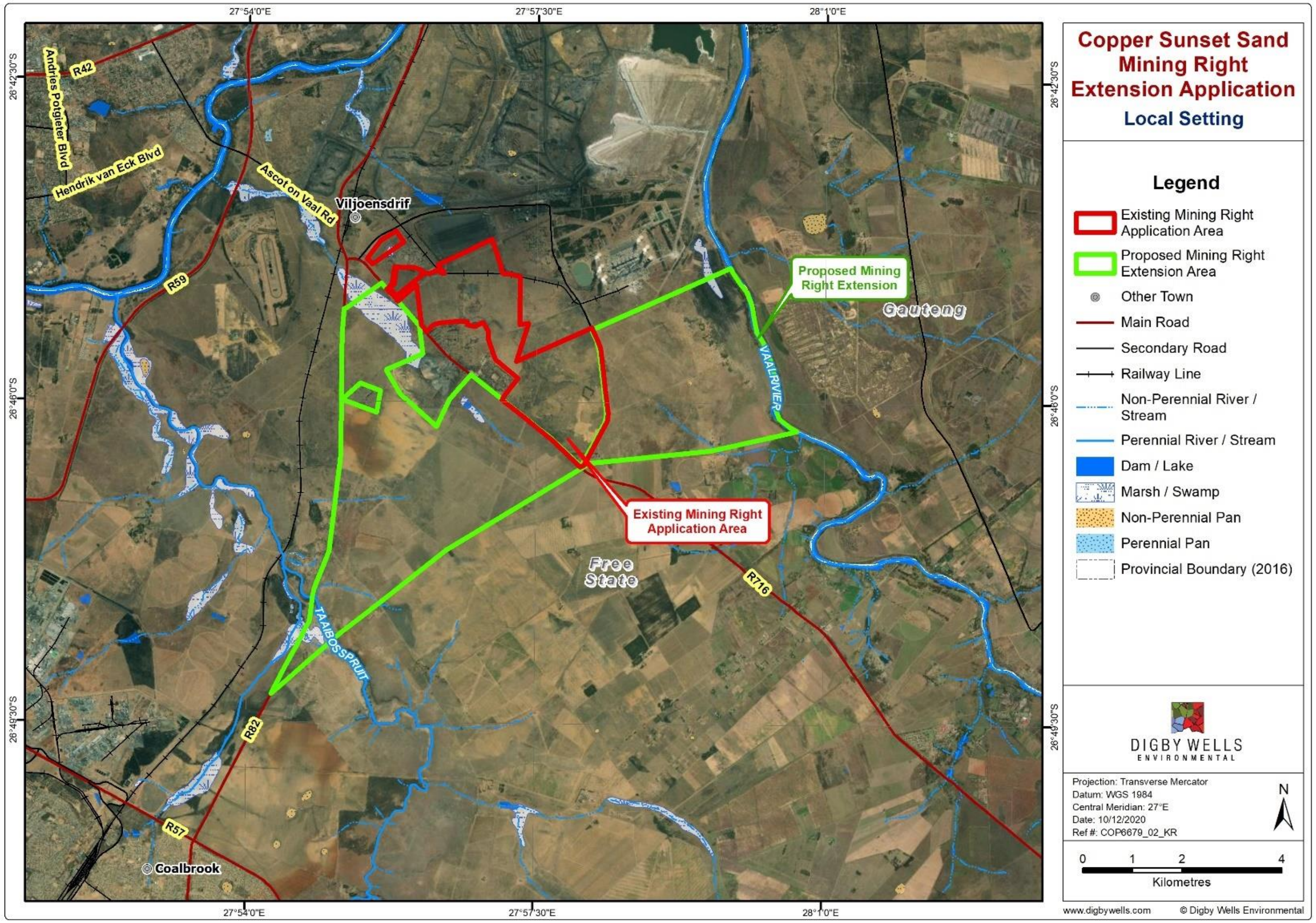

Figure 2-1: Local Setting

3. Description of the Activities to be Undertaken

Copper Sunset began sand mining in 2009. There is currently approximately nine months remaining of the Life of Mine. Therefore, Copper Sunset wishes to expand the MRA to include additional portions of the RE of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259. The properties are located within Seriti's MRA. The intention of the Application is to maximise the mineral resource and to further extend the LoM.

The current mining infrastructure will be utilised for the expansion area., However, mobile offices will be established at the entrance to the new mining areas. Two new mobile offices each approximately 1ha will be established, one and each mining area when mining commences in these areas. The mobile office areas will include the following:

- Mobile offices;
- Hydrocarbon storage tank (14,000 L) with associated bund. Machinery will be refuelled in the area;
- Waste storage area;
- Parking area for the storage of mobile infrastructure; and
- A generator and solar panels to provide electricity.

The sand deposit lies between 0.4 – 5 m below the surface. Strip mining will be utilised to recover the resource, with the sand mined in strips of 30 – 35 m in width and 0.4 - 5 m in depth. The length of the strips is dependent on the area to be mined but approximate lengths are 180 – 600 m. The mining method to be applied includes:

- Stripping and stockpiling of topsoil;
- Construction of a temporary haul road (20 m wide and length will be approximately 10 km);
- Mining of the sand resource including screening;
- Backfilling of the mined excavations with stockpiled topsoil; and
- Concurrent rehabilitation.

Figure 3-1 provides an indication of the area where the proposed offices locations will be placed as well as and the area to be mined.

3.1. Resource Deposit

Copper Sunset is applying for an extension to their MRA to include adjacent farms to continue mining general sand (90% plaster and 10% building sand) and clay. Copper Sunset intends to supply a number of clients with building and plaster sand for use mainly in the construction industry.

The deposit extends over an area of 2821.5 ha. The deposit is known to have an average thickness of 5 m. The current mining rate for Copper Sunset is approximately 2 000 m^3 per day for all sand products. This is expected to continue, and at this rate the proposed extension area will extend the LoM for Copper Sunset by approximately 20 years.

3.2. Establishment Phase

During the establishment phase of the proposed project, the following activities will be undertaken:

- Site Clearance in the form of vegetation and topsoil removal with a bulldozer. Topsoil will be stockpiled along the mined-out strip; and
- Construction of a temporary haul road (20 m width) to gain access to the sand mining area. The haul road will move as mining progresses through life of mine.

No permanent infrastructure will be constructed on site for the sand mining operation. All machinery will be mobile.

A mobile office will be placed at the entrance to the new mining area and space will be available to park mining equipment not in use. Mobile screening plants will be established on site. Portable toilets, a portable diesel bowser and water bowser will also be utilised.

3.3. Operational Phase

The mine will make use of a fleet of tipper trucks, front-end loaders, excavators, water trucks, tractor and bulldozers. The commencement of mining in the extension areas will initially be on the sand deposit on the eastern portion of the RE of Bankfontein No. 9 RE (Eastern Block), thereafter on the western portion of the RE of Bankfontein No. 9 RE (Western Block) and lastly on a portion of the RE of Zandfontein No. 259.

During the operational phase of the proposed project, the following activities will be undertaken:

- Strip mining will take place in sequences of 30 – 50 m wide to extract the sand by means of light weight excavators;
- A screening process will be utilised where required should sand become contaminated with unusable particles;
- The customer trucks (100-200 trucks per day) will enter via the haul road into the mining area. The haul road will be constructed as a loop to allow continuous flow of traffic. The mined-out sand / screened sand will be placed directly onto the customers trucks;
- The refuelling of equipment will take place at the mobile office areas within the expanded mining area;

- Water will be abstracted from an authorised borehole, located at the existing Copper Sunset MRA. This borehole is authorised by the Department of Water and Sanitation (DWS) under Water Use Licence (WUL) No. 08/C22F/AG/2315 granted 18 September 2013. It is anticipated that water will only be required for potable water and dust suppression on the expansion area. The amount of water used will remain within the limits of the existing license; and
- No mining will take place within a 100 m buffer from the edge of the Vaal River.

3.4. Rehabilitation Phase

Sand mining will cease once the resource has been extracted. Concurrent rehabilitation will be implemented during the sand mining process.

- The areas which have been mined out will be backfilled with waste material from the screening plant which will be covered with topsoil stockpiled during the operational phase.
- The area will be levelled and contoured to mimic pre- mining natural topography in order to avoid ponding of water. The overall site topography is anticipated to be slightly diminished because of the removal of sand.
- The area will then be allowed to naturally re-vegetate. Where vegetation is not establishing well, an indigenous seed mix will be utilised to improve vegetation establishment.

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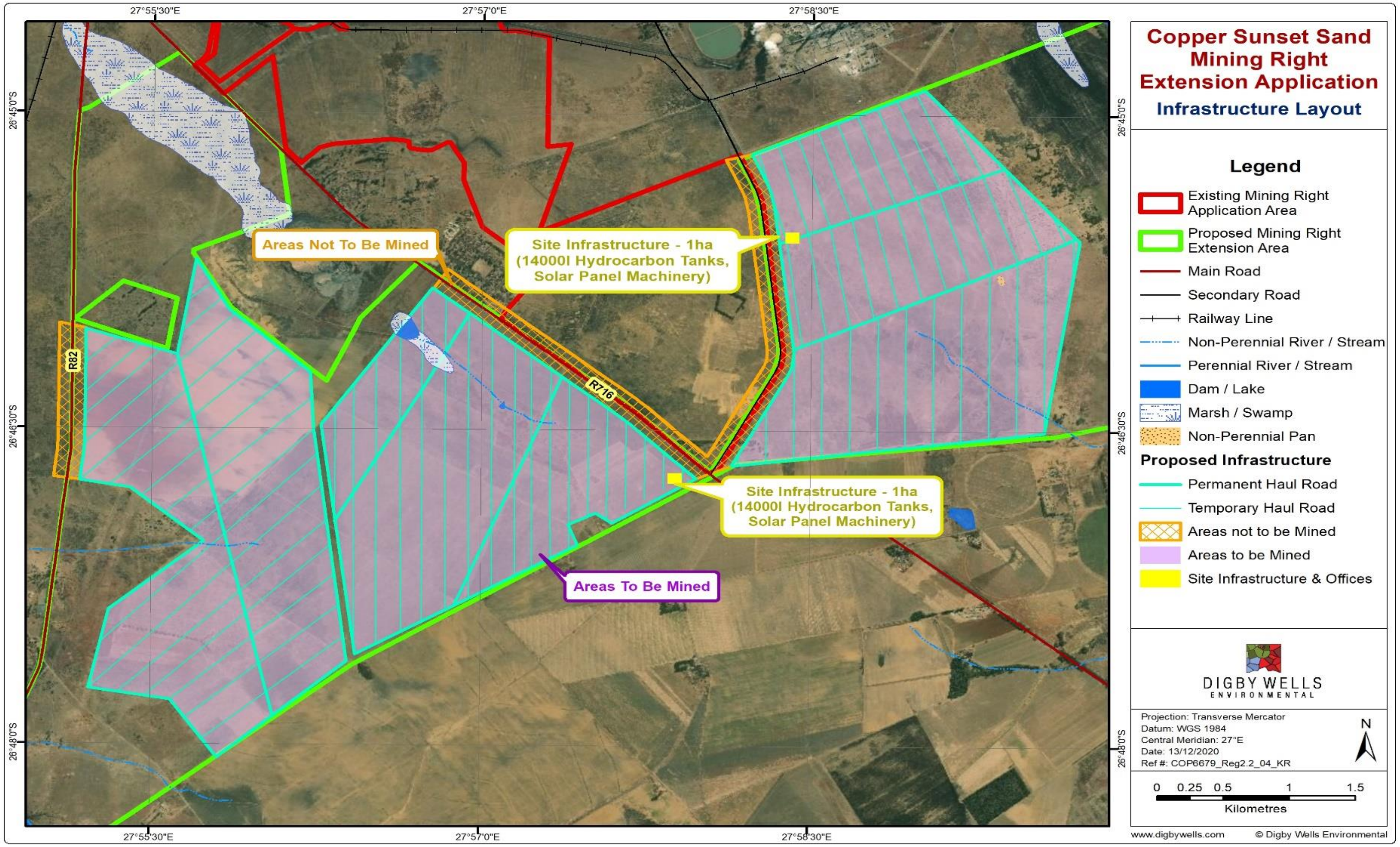


Figure 3-1: Proposed Mine Layout

4. Relevant Legislation, Standards and Guidelines

Table 4-1 below summarises the legal framework applicable to this surface water impact assessment. The assessment includes the establishment, operational, decommissioning and closure for the proposed mining activities in the Copper Sunset Mine.

Table 4-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) All water uses listed in terms of Section 21 of the National Water Act (NWA) need to be licenced, unless it is a permissible water use in terms of Section 22 of the NWA	The proposed activities at the Copper Sunset Mine do not constitute as permissible water use in terms of Section 21 of the NWA. Therefore, a Water Use Licence (WUL) for Section 21 is required.
NWA (36 of 1998): GN 704 of the Department of Water Affairs and Forestry, (DWAF) (now Department of Water and Sanitation, (DWS). Regulations on use of water for mining and related activities aimed at the protection of water resources. No person in control of a mine or activity may 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 waterlogged, undermined, unstable or cracked. Additionally, no person in control of a mine or activity may Place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or Use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.	The proposed activities include mining activities that require floodline delineation to ensure that no infrastructure or residue is placed within the specified floodline delineations as per the regulations.
National Environmental Management Act, 1998 (Act No 107 of 1998) and EIA Regulations (as amended in 2017) The Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA), as amended was set in place in accordance with Section 24 of the Constitution. Certain environmental	The sand mining Project proposed by Copper Sunset triggers Listed Activities in accordance with the EIA regulations, 2014 (as amended) and therefore requires environmental authorisation prior to being

Legislation, Regulation, Guideline or By-Law	Applicability
principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The EIA Regulation, 2014 was published under GN R 982 on 4 December 2014 (EIA Regulations) and came into operation on 08 December 2014. Together with the EIA Regulations, the Minister also published GN R 983 (Listing Notice No. 1), GN 984 (Listing Notice No. 2) and GN R 985 (Listing Notice No. 3) in terms of Sections 24(2) and 24D of the NEMA, as amended. The EIA Regulations have been made applicable to prospecting and mining activities.	undertaken. The Listed Activities have been included in Table 7-3. The EA application was submitted on 14 December 2020. This EIA Report will be informed by the requirements of the NEMA and Regulations thereunder.

5. Assumptions, Limitations and Exclusions

The following assumptions, limitations and exclusions are applicable for this study

- The historical data used to represent the climate data for the study area is from 1920 to 2009 which is considered adequate for the purposes of this study;
- The floodlines delineation provided in this study are indicative floodlines, hence can only be used for environmental purposes and not for detailed engineering designs; and
- The stormwater management scope and water balance have been excluded in the study due to the nature of the proposed project as there is no expected mixing of clean and dirty water areas given that there will be effective implementation of the proposed mitigation measures.

6. Methodology

The management of water resources is legislated under the National Water Act (Act 36 of 1998) (NWA) as amended in the Regulation GN R 704 which specifies the use of water in mining. In managing the surface water resources, the Department of Water affairs (DWA) now the Department of Water and Sanitation (DWS) has promulgated a series of Best Practice Guidelines (BPGs) that guide the use of water in mining. These legislative frameworks are taken into account when considering the specialist surface water assessment.

6.1. Baseline Hydrology

Rainfall and runoff data obtained from the database of the Water Resources Commission of South Africa 2012 study (WRC, 2015) was analysed to determine the Mean Annual Precipitation (MAP), Mean Annual Evaporation (MAE) and the Mean Annual Runoff (MAR) for the Copper Sunset region. Historical rainfall-runoff data from 1920 to 2009 (89 years) was adequate to determine mean hydro-meteorological parameters for the study area. These analyses were useful to provide insight into the general rainfall-runoff and evaporation dynamics for the region, which informed the surface water impact assessment study. A previous surface water report was reviewed for additional baseline information.

6.2. Water Quality Assessment

The overall objective of a water quality monitoring programme is to establish a surface monitoring database that would represent surface water qualities up and down-gradient of the mining area prior to the commencement of mining or the proposed new activities. Other objectives of the water monitoring programme include:

- Serving as an early detection system to allow remedial and mitigation measures for the protection of the receiving environment;
- Identify sources and/or areas of pollution and the extent thereof which may constitute legal implications or liabilities associated with risks of contaminants migrating off site;
- Assess the compliance with the WUL Limits; and
- Recommend management plans to minimise or avoid any mine-related impact on the surface water environment.

The selected water quality monitoring points are presented in the table below.

Table 6-1: Locality of the Surface Water Quality Monitoring Points within the Copper Sunset Study Area

Sample Name	Latitude	Longitude	Description of Localities
SW1	-26.782831°	28.027708°	Upstream of the proposed extension area situated in the Vaal River.
SW2	-26.684973°	27.989028°	Downstream of the proposed extension area situated in the Vaal River.
SW3	-26.682614°	27.938520°	Downstream of the proposed extension area in the Vaal River before the confluence with the Klip River.

Sample Name	Latitude	Longitude	Description of Localities
SW4	-26.770964°	27.884409°	Downstream of the proposed extension area within the Taaibosspruit.
SW5	-26.815469°	27.922450°	Upstream of the proposed extension area within the Taaibosspruit.

6.3. Floodline Assessment

6.3.1. Catchment Delineation

Catchments delineation was undertaken in Global Mapper using a Digital Elevation Model (DEM) generated from 5 m contours (National Geospational Institute, 2013) augmented by Advanced Land Observing Satellite (ALOS) World 3D – 30m (AW3D30) global digital surface model (DSM) data (JAXA, 2015) for the study area. The ALOS dataset is stored in a raster GeoTIFF format referenced to the Hartebeesthoek 94 Datum (WGS84 ellipsoid).

6.3.2. Peak Flows and Flow Routing

Widely used and recommended methods including the Rational Method Alternative 3 (RM3), Standard Design Flood (SDF) and the Midgley & Pitman (MIPI) were used to calculate the 1:50-year and 1:100-year peak flows for delineated catchments at the project site (SANRAL, 2013). Design rainfall depths were determined using the Design Rainfall Programme for South Africa and the modified Hershfield equation as input to the RM3 and SDF methods, respectively.

6.3.2.1. *Flow Routing*

Attenuated flows leaving the Vaal Dam were integrated with calculated peaks at the outlet of the downstream catchment from the dam. The flow discharge at the catchment outlet is the sum of (1) the discharge from the upstream catchment, QR, that is reduced with respect to its natural condition due to water storage, and (2) the contribution of the intermediate/lateral catchment, QL, whose drainage area is $AL = A-AR$. Based on Instantaneous Unit Hydrograph (IUH) approach, total discharge at the catchment outlet is given by $Q(t) = QR(t - \tau R)+QL(t)$, where the upstream contribution QR is delayed to account for the time required for water to travel along the main channel at a constant channel velocity, that is $\tau R = LR/v$ (see Figure 6-1). The peak value of the upstream contribution, and consequently that of the total discharge, is reduced with respect to the natural condition; the relative reduction depends on the geomorphological and kinematic features of the catchment and of the reservoir characteristics, including its position along the mainstream (Volpi et al., 2018).

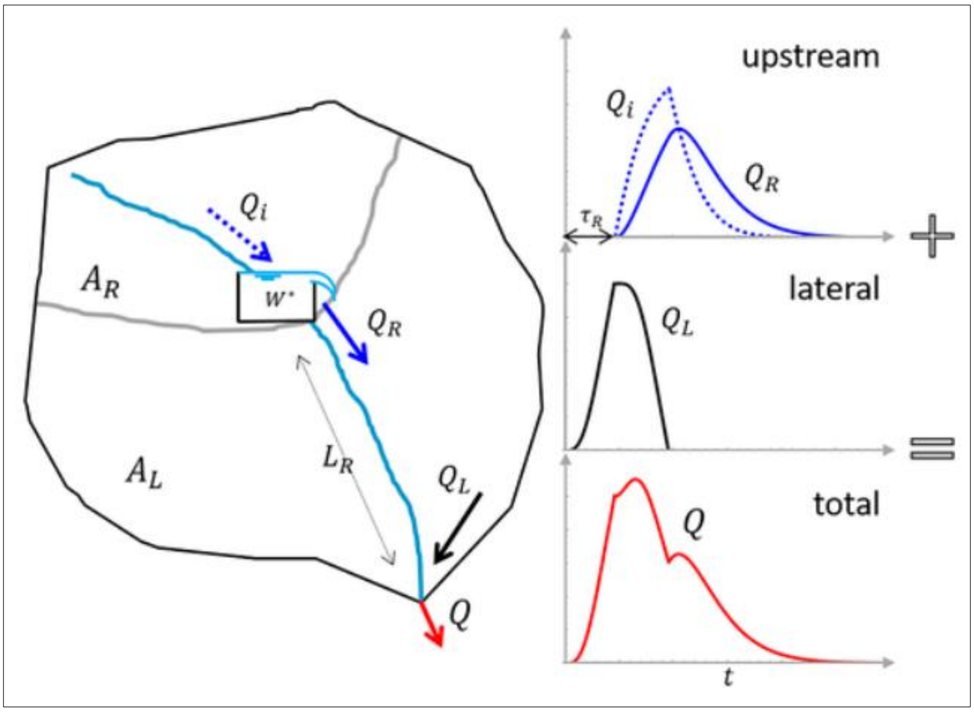


Figure 6-1: Schematic Representation of Discharge Routing after a Reservoir (Volpi et al., 2018)

Where:

AR is the upstream catchment area; AL is the downstream catchment area; Qi is the inflow to the reservoir, that is, the discharge from the upstream catchment; QR is the outflow from the reservoir; QL is the lateral inflow to the river, that is, the discharge from the downstream catchment; Q is the total river discharge; W is the volume of the reservoir; and τR is the temporal delay (T) due to the distance from the reservoir to the catchment outlet. The right panels depict how the contributions coming from the upstream catchment after the reservoir has been built (compared to that in natural condition) and the downstream catchment combines at the outlet (Volpi et al., 2018).

6.3.3. Hydraulic Modelling

Hydraulic modelling was conducted in HEC-RAS 6 which allows pre-processing within the in-built RAS Mapper module. A Digital Terrain Model (DTM) was generated from the 5m DEM to make the topographic data compatible with RAS Mapper. The pre- processing involved generation of the channel geometry, including the river network, banks, flow paths and cross sections.

The HEC-RAS model simulates total energy of water by applying basic principles of mass, continuity, and momentum as well as roughness factors between all cross sections (US Army Corps of Engineers, 1995). A height is calculated at each cross-section, which represents the level to which water will rise at that section, given the calculated initial peak flows for the 1:50-year and 1:100-year events on all river sections.

Analyses are performed by modelling flows at the sub-catchment outlet of stream or channel sections first, moving upstream. Manning's Roughness Coefficient (n) for the channel was set at 0.6, and that for riverbanks was determined to be 1.3 representing rivers with rocks, weeds, reeds in the channel, with brush and trees on the banks (Chow, 1959).

Please note that the study only determined indicative floodlines, hence can only be used for environmental purposes and not for detailed engineering designs.

6.4. Surface Water Impact Assessment

The potential surface water (quality and quantity) impacts that may arise from the proposed project activities have been identified based on the established baseline conditions. Once potential impacts were identified, an adopted numerical environmental significance rating process that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental impact/risk was utilised. The detailed surface water impact assessment methodology is presented in Appendix A.

7. Findings and Discussion

This Section details the findings of the EIA Phase of the surface water assessment.

7.1. Baseline Hydrology

The Mining Right Boundary of the Copper Sunset Operations stretches across three different quaternary catchments, namely C22F, C22G and C22K (Figure 7-1) within the Vaal Water Management Area (WMA 5). The catchment area is drained by the Vaal River. The water quality in the Vaal River catchments varies from poor in the highly developed areas to good in the less developed areas (Digby Wells & Associates, 2010). The land use in the catchment includes agriculture, extensive gold and coal mining, power generation, industrial activities and urban developments (Digby Wells & Associates, 2010). The industrial activities include mineral processing plants, steel industry, petrochemical industries, fertiliser manufacture, pulp and paper and light industry located in and around the urban centres. The urban development consists of cities, towns and dense settlements (Digby Wells & Associates, 2010).

7.2. Climate

The MAP for quaternary catchments C22F, C22G and C22K is 655 mm, 613 mm and 644 mm, respectively (WRC, 2015). The combined average MAP for the three quaternary catchments is likely to be distributed as indicated in Figure 7-2. The normal rainfall (70% of events) for the wettest month (January) will likely not exceed 132 mm, while 90% of the events during the wettest month will likely not exceed 169 mm. This implies that the region experiences moderate to high rainfall.

The MAR depth for the area was calculated to be 27.72 mm. This runoff accounts for approximately 4% of the MAP for the area. The 90^{th} (extreme flow) and 70^{th} (normal flow) percentiles of runoff during the month of January are 11.9 mm and 4.4 mm, respectively. The

MAR for quaternary catchments C22F, C22G and C22K is likely to be distributed as indicated in Figure 7-3.

The MAE for quaternary cathments C22F, C22G and C22K is 1 650 mm, 1 600 mm and 1 625 mm, respectively (WRC, 2015). The region experiences higher evaporation than precipitation, giving rise to dry winters and wet summers with a negative natural water balance. The average monthly distribution of potential evaporation and rainfall for the quaternary catchments can be seen in Figure 7-4.

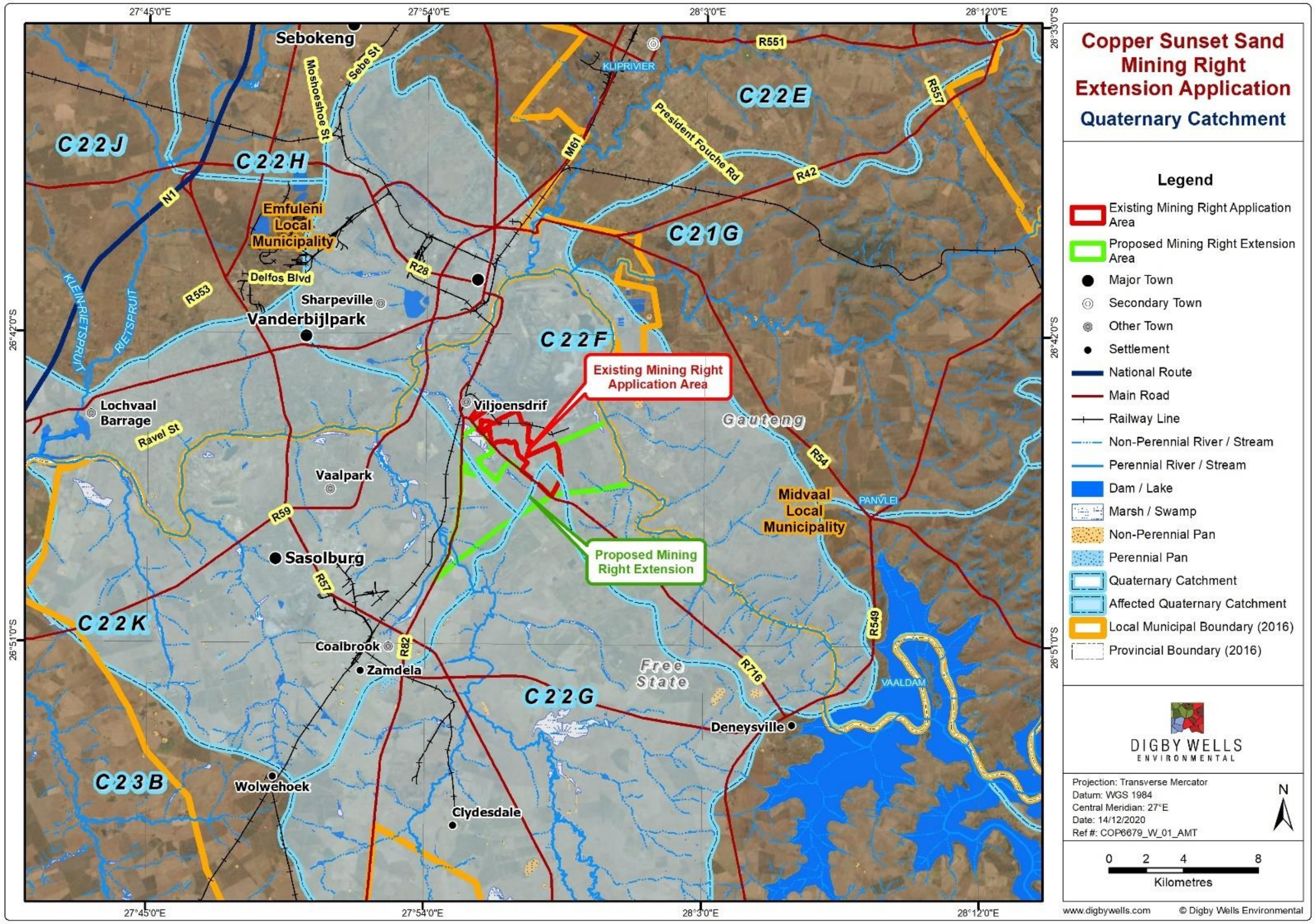
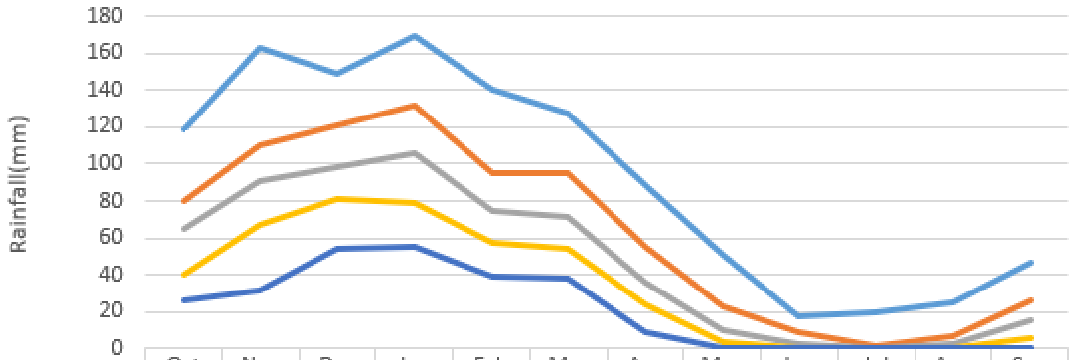
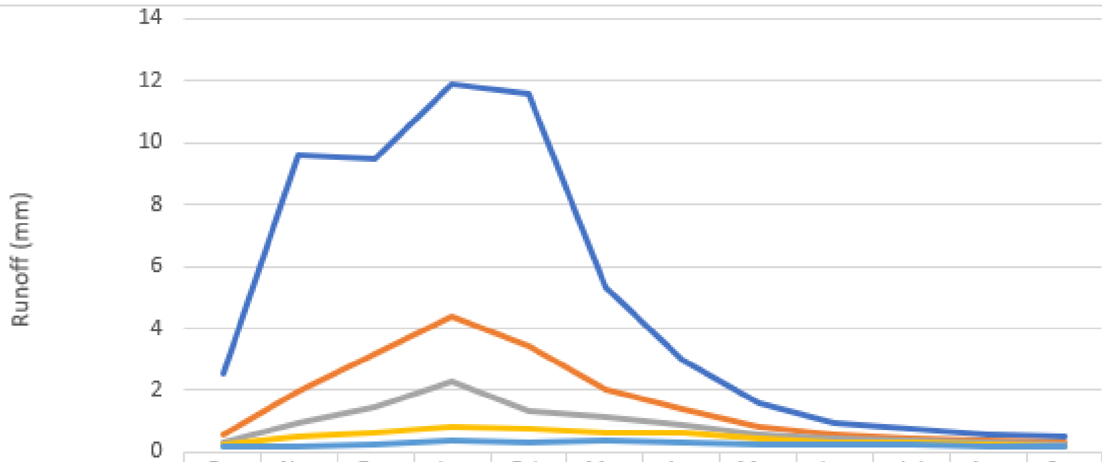


Figure 7-1: Hydrological Setting of the Copper Sunset Operations



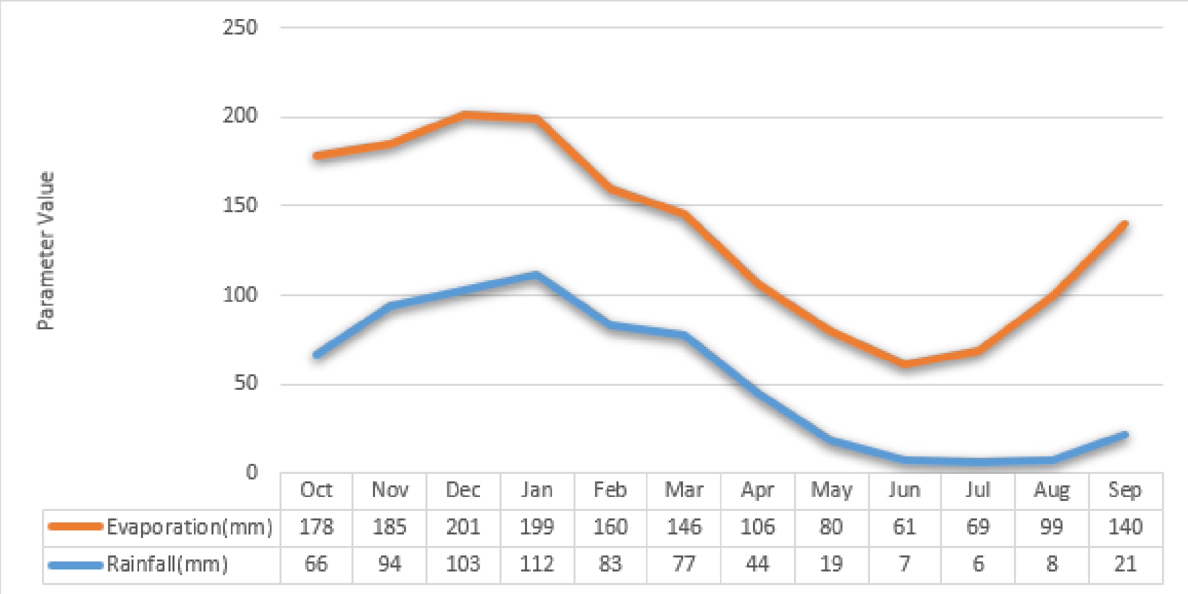
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
90 Percentile	119	163	149	169	141	127	89	52	17	19	25	46
70 Percentile	80	110	120	132	96	95	56	23	9	2	7	27
50 Percentile	65	90	98	106	75	72	36	10	3	0	2	15
30 Percentile	40	67	81	79	57	54	25	3	0	0	0	6
10 Percentile	26	32	54	56	39	38	9	0	0	0	0	0

Figure 7-2: Average Monthly Rainfall for Quaternary Catchments C22F, C22G and C22K



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
90 Perecentile	2.5	9.6	9.5	11.9	11.6	5.4	3.0	1.6	0.9	0.7	0.6	0.5
70 Percentile	0.6	2.0	3.2	4.4	3.4	2.0	1.4	0.8	0.6	0.4	0.4	0.3
50 Percentile	0.3	0.9	1.5	2.3	1.3	1.1	0.9	0.6	0.4	0.4	0.3	0.3
30 Percentile	0.2	0.5	0.6	0.8	0.8	0.6	0.6	0.4	0.3	0.3	0.3	0.2
10 Percentile	0.2	0.2	0.3	0.4	0.3	0.4	0.3	0.2	0.2	0.2	0.2	0.2

Figure 7-3: Average Monthly Runoff for Quaternary Catchments C22F, C22G and C22K



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation(mm)	178	185	201	199	160	146	106	80	61	69	99	140
Rainfall(mm)	66	94	103	112	83	77	44	19	7	6	8	21

Figure 7-4: Average Monthly Runoff for Quaternary Catchments C22F, C22G and C22K

7.3. Water Quality Assessment

The water quality data of the selected monitoring points (Figure 7-5) was benchmarked against the Department of Water and Sanitation (DWS) target water quality guidelines for domestic use, aquatic ecosystems, livestock watering and irrigation (Table 7-1).

Based on the water quality results, the baseline water quality is generally acceptable and has slight exceedances in relation to the guideline values. Slight exceedances in Aluminium and Iron were observed at monitoring points SW1, SW2, SW4 and SW5. A slight exceedance of Zinc was observed at all monitoring points, while Calcium was elevated at SW3. Iron and aluminium are among the most abundant elements in the earth's crust and natural waters contain variable amounts of these elements depending on the underlying geology. The presence of the slightly elevated aluminium and iron in streams is likely from industrial activities within the region.

The results indicate only minimal impact on water resources as a result of human activities as evidenced by relatively low values of Total Dissolved Solids (TDS) and Suspended Solids (SS).

These results should be used as baseline data against which potential impacts on surface water quality as a result of the proposed mining activities may be assessed. This is especially important since the proposed additional Mining Right Area on the Eastern side of the study Area is close to the Vaal River, while the Western portion traverses the Taaibosspruit River. Therefore, any contamination from the mine area may be transported via these streams if adequate management of stormwater is not effectively implemented.

Furthermore, if possible, representative baseline data for the wet and dry season should be obtained as water quality may be seasonally variable.

Table 7-1: Baseline Surface Water Quality within the Copper Sunset Study Area

Parameter	DWS Domestic Use	DWS Aquatic Ecosystem	DWS Livestock Watering	DWS Irrigation	SW1	SW2	SW3	SW4	SW5
	mg/L (unless otherwise stated)								
pH, at 25˚C *(pH meter units)*	6.0 - 9.0	NS	NS	6.5 - 8.4	8	7.8	7.5	7.0	7.0
Electrical Conductivity, *(mS/m)*	<70	NS	NS	NS	18	19	70	12.4	11.2
Total Dissolved solids (TDS)	<450	NS	<1000	NS	140	140	448	154	140
Aluminium	<0.15	<0.01	<5	<5	0.315	0.312	< 0.100	1.85	0.512
Ammonia	NS	NS	NS	NS	<0.1	0.3	1.1	0.1	1.1
Arsenic	≤200	0.01	≤1	0.1	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Barium	NS	NS	NS	NS	0.048	0.046	0.030	0.056	0.065
Beryllium	NS	NS	NS	0.1	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Bismuth	NS	NS	NS	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Boron	NS	NS	<5	<0.5	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Cadmium	<0.005	<0.00015	<0.01	<0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Calcium	<32	NS	<1000	NS	14	15	51	7	8
Cerium	NS	NS	<5	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Caesium	NS	NS	<5	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chloride	<100	NS	<1500	<100	8	9	44	12	11
Chromium	<0.05	0.007	<1	<0.1	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Cobalt	NS	NS	<1	<0.05	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	<1	<0.0003	<0.5	<0.2	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluoride	<1	<0.75	<2	<2	<0.2	<0.2	0.2	0.2	0.2
Iron	<0.1	NS	<10	<5	0.292	0.235	0.058	1.23	0.386
Lead	<0.01	<0.0002	<0.1	<0.2	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Lithium	NS	NS	NS	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Magnesium	<30	NS	<500	NS	7	7	19	4	4
Manganese	<0.05	<0.18	<10	<0.02	< 0.025	< 0.025	< 0.025	0.039	<0.025
Mercury	<1	0.04	<1	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Molybdenum	NS	0.04	0.01	0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nickel	NS	NS	<1	<0.2	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nitrate	≤6	NS	<200	100	0.6	0.6	2.9	0.4	1.8
Total Phosphate, as P	NS	NS	NS	NS	0.3	0.2	1.1	0.5	0.6
Potassium	<50	NS	NS	NS	3.0	3.2	8.7	5.7	5.6
Selenium	<0.02	<0.002	<0.05	<0.02	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Silicon	NS	NS	NS	NS	5.1	5.0	5.3	< 0.010	< 0.010
Silver	NS	NS	NS	NS	< 0.010	0.010	< 0.010	< 0.010	< 0.010
Sodium	<100	NS	<2000	<70	8	9	51	9	8
Strontium	NS	NS	NS	NS	0.071	0.071	0.113	0.038	0.040
Sulphate	<200	NS	<1000	NS	22	25	137	14	12
Suspended Solids at 105º	NS	NS	NS	<50	50	38	37	93	103
Tin	NS	NS	NS	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Titanium	NS	NS	NS	NS	0.029	0.036	0.026	0.121	0.195
Uranium	0.070 - 0.284	NS	NS	0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Vanadium	<0.1	NS	<1	<0.1	< 0.010	< 0.010	< 0.010	<0.010	0.010
Zinc	<3	<0.002	<20	<1	0.048	0.037	0.029	<0.010	0.011
KEY:									

Parameter	DWS Domestic Use	DWS Aquatic Ecosystem	DWS Livestock Watering	DWS Irrigation	SW1	SW2	SW3	SW4	SW5
	mg/L (unless otherwise stated)								
Exceeds either the DWS standards for domestic, aquatic ecosystem, livestock watering and irrigation water uses									
No Standard							NS		

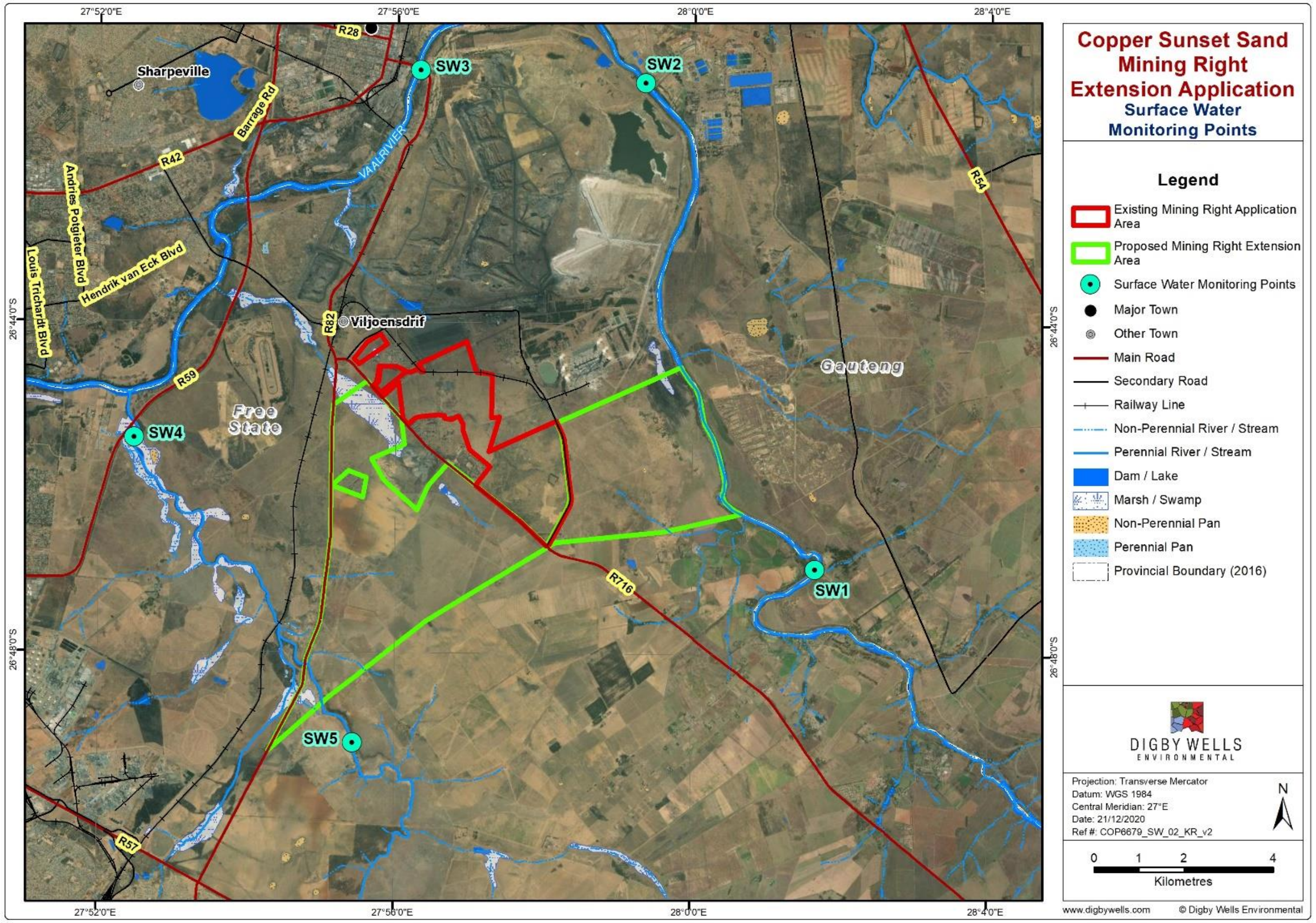


Figure 7-5: Locality Map of the Surface Water Quality Monitoring Points

7.4. Floodlines Assessment

7.4.1. Delineated Catchments and Peak Flows

Two catchments were delineated (Figure 7-6) to cover the existing and proposed extension of the Copper Sunset MRA. Results from the RM3 method were used in hydraulic modelling since these were representative of the area due to site-specific runoff coefficients which were generated using an in-built RM3 module. The MIPI results helped in the selection of suitable peak flows because these were of the same order of magnitude to the RM3 method. The SDF results were deemed an over-estimate of peak flows for the site possibly due to high regionalised runoff coefficients.

Calculated peak flows which account for the combined contribution of the catchment downstream of the Vaal Dam and attenuated releases from the Vaal Dam are presented in Table 7-2.

Table 7-2: Peak flows for the Vaal River and Taaibosspruit adjacent to Copper Sun Set Sand Mine

Catchment	Method					
	RM3		SDF		MIPI	
	1:50yr	1:100yr	1:50yr	1:100yr	1:50yr	1:100yr
	(m^3/s)					
Vaal River	1427.75	1922.45	3452.37	4395.28	2321.85	2956.13
Taaibosspruit	322.52	451.83	473.75	623.19	498.81	653.34

7.4.2. Floodlines

Modelled floodlines indicate that the existing and proposed Copper Sunset infrastructure including the areas to be mined are outside the floodwater way for both the 1:50-year and 1:100-year flood events (see Figure 7-7). Placement of any future additional infrastructure should be outside the modelled 1:100-year floodlines from the edge of both the Vaal River and the Taaibosspruit to avoid impacting on water resources and to prevent infrastructure inundation.

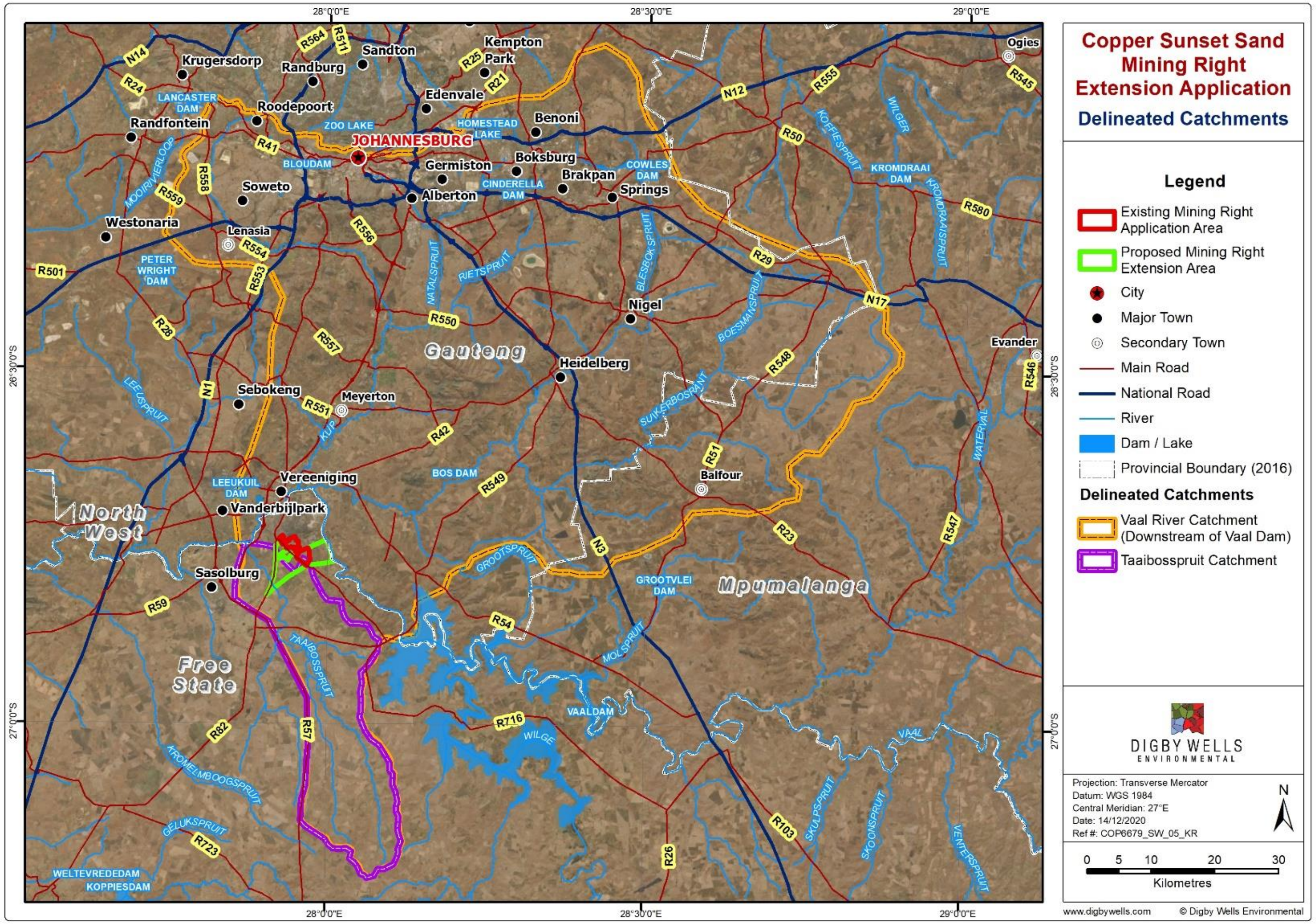


Figure 7-6: Delineated Catchments for Rivers Adjacent to Copper Sunset Sand Mine

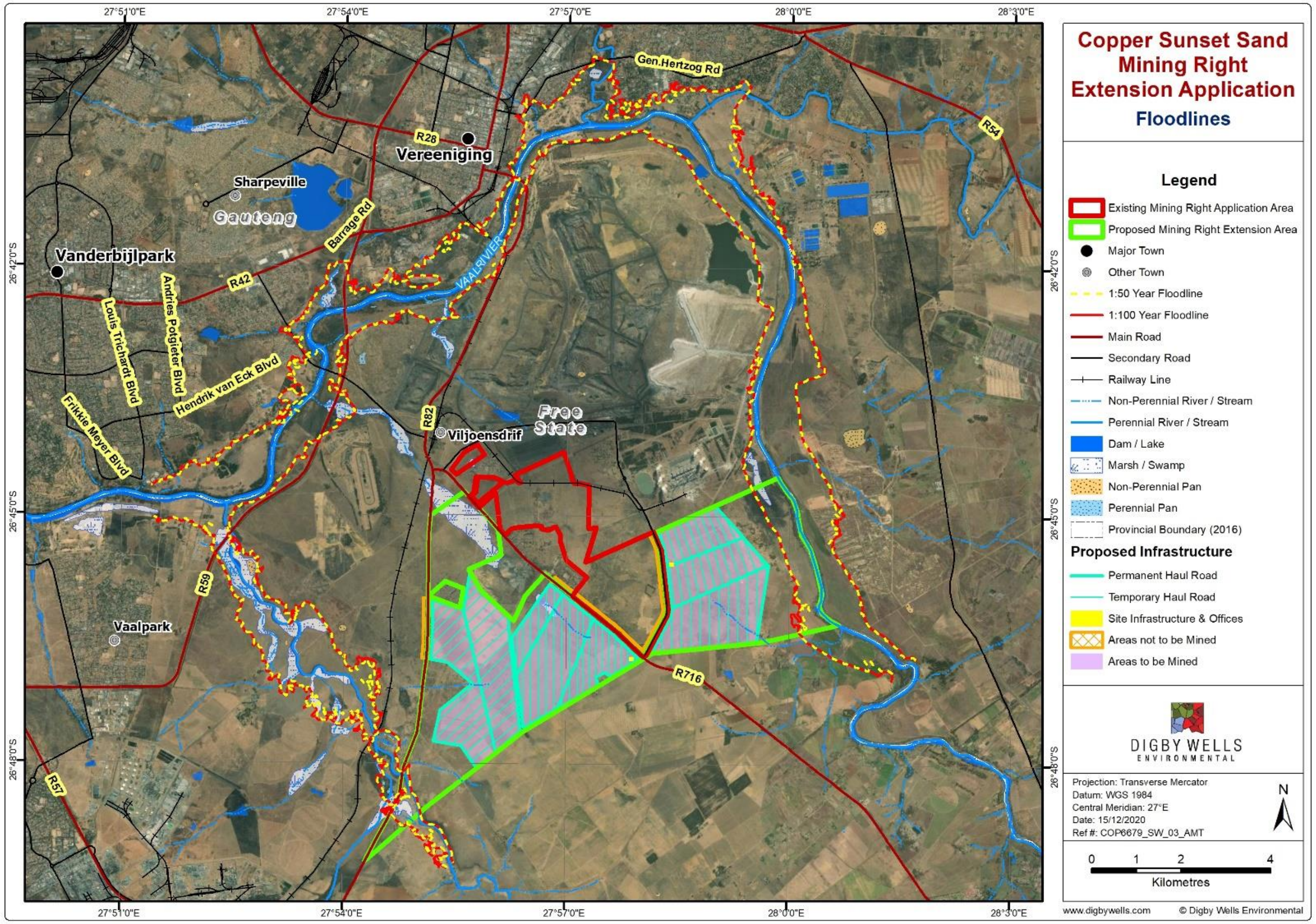


Figure 7-7: Floodlines for the 1:50-year and 1:100-year Flood Events

7.5. Surface Water Impact Assessment

This section rates the significance of the potential impacts pre-mitigation and post-mitigation. The impacts below are a result of both the environment in which the activity takes place, as well as the activity itself. The impacts associated with the proposed project includes the NEMA EIA Regulations, 2014 (as amended) Listed Activities, as well as the mining and associated activities to take place at the study area. The methodology utilised to assess the significance of the potential impacts is described in Appendix A. The following activities will be assessed as discussed in Table 7-3.

Table 7-3: Summary of Project Activities

Activity No.	Activity
Establishment Phase	• Site clearance and soil disturbance; • Placement of infrastructure (mobile offices, bunded hydrocarbon storage tank (14,000 L), waste storage and parking area); • Establishment of a haul road / tracks; and • Stockpiling of topsoil.
Operational Phase	• Mining of sand resources including screening (if required); • Transportation of sand; • Refuelling of machinery within the mining area; and • Handling of general and hazardous waste.
Closure and Rehabilitation Phase	• Backfilling of the mined excavations with topsoil and waste from the screening plants; • Dismantling and removal of infrastructure; and • Rehabilitation (topsoil cover, ripping and vegetation establishment).

7.5.1. Establishment Phase

Activities during the establishment phase that may have potential impacts (Table 7-4) on the surface water resources are described and the appropriate management/mitigation measures are provided below.

Table 7-4: Interactions and Impacts of Activity

Interaction	Impact
Site clearance and vegetation removal	Siltation and sedimentation of surface water resources leading to deteriorated water quality if not appropriately managed.
Placement of the mobile offices and other infrastructure	Surface water contamination due to handling of hydrocarbons and other chemicals.
Establishment of a haul road / tracks; and erosion of soil from topsoil stockpiles	Siltation and sedimentation of surface water resources leading to deteriorated water quality if not appropriately managed.

7.5.1.1. *Impact Description: Sedimentation and siltation of nearby watercourses*

Clearing or removal of vegetation leaves the soils prone to erosion during rainfall events, and as a result runoff from these areas will be high in suspended solids increasing turbidity in the natural water resources.

Also, dust generated during the establishment activities and caused by increased vehicle movements can also be deposited into the local water courses, thereby contributing to the accumulation of suspended solids in the water course, leading to the siltation of these water bodies.

7.5.1.2. *Impact Description: Surface water contamination leading to deterioration of water quality*

Handling of general and hazardous waste including spillages of hydrocarbons such as oils, fuels and grease have potential to contaminate nearby water resources when washed off into rivers, streams and pans.

7.5.1.3. *Management Objectives*

Management objectives during the establishment phase are mainly to minimize the potential contamination of receiving waterbodies as a result of siltation, hydrocarbon spillages, and hazardous chemical leaks associated with the establishment activities.

7.5.1.4. *Management Actions*

- Clearing of vegetation must be limited to the development footprint, and the use of any existing access roads must be prioritised to minimise creation of new ones;
- Dust suppression on the haul roads and other cleared areas must be undertaken on regular basis to prevent or limit dust generation;
- Hydrocarbon and hazardous waste storage facilities must be appropriately bunded to ensure that leakages can be contained. Spill kits should be in place and workers should be trained in the use of spill kits, to contain and immediately clean up any leakages or spills;

- Vehicles should regularly be maintained as per the developed maintenance program. This should also be inspected daily before use to ensure there are no leakages underneath;
- Drip trays must be used to capture any oil leakages. Servicing of vehicles and machinery should be undertaken at designated hard park areas. Any used oil should be disposed of by accredited contractors; and
- Implementation of a stormwater management to separate clean and dirty water areas, if dirty water is generated.

7.5.1.5. *Impact Ratings*

The following tables rate the impacts for the establishment phase:

Table 7-5: Impact Significance Rating for the Establishment Phase

Dimension	Rating	Motivation	Significance
Impact: Sedimentation and siltation of nearby watercourses			
Duration	5	The impact will likely occur during the establishment phase	72- Minor (negative)
Intensity	4	Serious to medium term environmental effects	
Spatial scale	3	Impact has the potential to extend across the site and to nearby water resources.	
Probability	6	Almost certain that the impact will occur	
Post-mitigation			
Duration	2	The impact will only likely occur in the short term given implementation of recommended mitigation measures	18- Negligible (negative)
Intensity	2	Minor effects on biological or physical environment are expected if silt traps and soil stabilisation procedures are followed	
Spatial scale	2	With proper management, the impact will be localized to the immediate downstream of the site	
Probability	3	There is a possibility that the impact will occur	

Dimension	Rating	Motivation	Significance
Impact: Surface water contamination leading to deterioration of water quality due to handling and storing general and hazardous waste			
Duration	5	The impact will likely occur for the life of the project	60- Minor (negative)
Intensity	4	This will moderately impact the water quality and the ecosystem functionality for downstream users	
Spatial scale	3	The impacts will be localized extending across the site and downstream	
Probability	5	The impact will likely occur	
Post-mitigation			
Duration	5	The impact will likely occur for the life of the project	18-Negligible (negative)
Intensity	2	With proper management of hydrocarbon and chemicals on site the impact will have low intensity	
Spatial scale	2	With proper management, the impact will be localized to sites where incidents occur	
Probability	2	The possibility of the impact occurring is very low as a result of implementation of adequate mitigation measures	

7.5.2. Operational Phase

Activities during the Operational Phase that may have potential impacts (Table 7-6) on the surface water resources are described and the appropriate management/mitigation measures are provided below.

Table 7-6: Interactions and Impacts of Activity

Interaction	Impact
Mining of sand resources including screening (if required), and transportation of mined sand.	The exposure of sand may result in sedimentation and siltation of adjacent watercourses.
Refuelling of machinery within the mining area including handling of general and hazardous waste.	The operational machinery, transportation and storage at the mine site are potential sources of hydrocarbon and chemical spills and leakages. When not properly managed, hydrocarbon and chemical spills and leakages will be washed away with the runoff generated on site and thereby contaminate surface water resources within and in proximity to the study area.

7.5.2.1. *Impact Description: Sedimentation and siltation of nearby watercourses*

Clearing or removal of vegetation leaves the soils prone to erosion during rainfall events, and as a result runoff from these areas will be high in suspended solids increasing turbidity in the natural water resources.

Also, dust generated during the establishment activities and caused by increased vehicle movements can also be deposited into the local water courses, thereby contributing to the accumulation of suspended solids in the water course, leading to the siltation of these water bodies.

7.5.2.2. *Impact Description: Surface water contamination from hydrocarbon and chemical spillages and leakages*

The operational machinery, transportation and storage at the mine site are potential sources of hydrocarbon and chemical spills and leakages. When not properly managed, hydrocarbon and chemical spills and leakages will be washed away with the runoff generated on site and thereby contaminate surface water resources within and in proximity to the study area.

7.5.2.3. *Management Objectives*

Management objectives during the operational phase are mainly to minimize the potential contamination of receiving waterbodies as a result of mine contaminated runoff, hydrocarbon spillages, and hazardous chemical leaks associated with the operational activities.

7.5.2.4. *Management Actions*

The following mitigation measures are recommended:

- Runoff from dirty areas should not be allowed to flow into the stream, unless DWS discharge authorisation and compliance with relevant discharge standards as stipulated in the NWA is obtained;

- The water quality monitoring program provided in this report should be adhered to for monitoring water resources within and in close proximity to the study area to allow detection of any contamination arising from operational activities;
- The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be collected by approved contractors for disposal to appropriate disposal sites;
- The overall housekeeping and storm water system management (including the maintenance of berms, conveyance channels and clean-up of leaks) must be maintained throughout the LOM;
- The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances;
- Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; and
- Vehicles must only be serviced within designated service bays.

7.5.2.5. *Impact Ratings*

The following tables rate the impacts for the operational phase:

Table 7-7: Impact Significance Rating for Operational Phase

Dimension	Rating	Motivation	Significance
Impact: Sedimentation and siltation of nearby watercourses			
Duration	5	The impact will likely occur during operational phase	72- Minor (negative)
Intensity	4	Serious to medium term environmental effects	
Spatial scale	3	Impact has the potential to extend across the site and to nearby water resources.	
Probability	6	Almost certain that the impact will occur	
Post-mitigation			
Duration	2	The impact will only likely occur in the short term given implementation of recommended mitigation measures	18- Negligible (negative)
Intensity	2	Minor effects on biological or physical environment are expected if silt traps and soil stabilisation procedures are followed	

Dimension	Rating	Motivation	Significance
Spatial scale	2	With proper management, the impact will be localized to the immediate downstream of the site	
Probability	3	There is a possibility that the impact will occur	

Dimension	Rating	Motivation	Significance
Impact: Surface water Contamination from hydrocarbon and chemical spillages and leakages			
Duration	5	The impact will likely occur for the duration of the operational phase	72- Minor (negative)
Intensity	4	Moderate impacts to water quality and ecosystem functionality are expected	
Spatial scale	3	The impact may extend across the site and to nearby settlements if contaminants are washed into proximal watercourses	
Probability	6	It is most likely that the impact will occur	
Post-mitigation			
Duration	5	The impact will likely occur for the life of the project	18-Negligible (negative)
Intensity	2	With proper management of hydrocarbon and chemicals on site the impact intensity will be low	
Spatial scale	2	With proper management, the impact will be localised to incident sites, where contaminants will quickly be cleaned up	
Probability	2	The possibility of the impact occurring is very low if mitigation measures re adequately implemented	

7.5.3. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts (Table 7-8) on the surface water resources are described and the appropriate management/mitigation measures are provided below.

Table 7-8: Interactions and Impacts of Activity

Interaction	Impact
Dismantling and removal of infrastructure	Sedimentation and siltation of nearby watercourses due to suspended solids that may be caused by the demolition and removal of infrastructure.
Backfilling of the mined excavations with topsoil and waste from the screening plants Rehabilitation (topsoil cover, ripping and vegetation establishment)	Restoration of pre-mining streamflow regime in nearby watercourses as much as practically possible to benefit the post mining land use. However, it should be noted that pre-mining hydrological flows are not likely to be achieved.

7.5.3.1. Impact Description: Sedimentation and siltation of nearby watercourses and deterioration of water quality

During the decommissioning phase demolition of infrastructure, will cause disturbance and subsequent erosion of soils into nearby watercourses. This will result in higher rates of sedimentation and siltation in nearby streams thereby reducing their flow/storage capacities and their ability to sustain aquatic ecosystems. The quantity and quality of water for downstream water users will thus be compromised.

7.5.3.2. Impact Description: Restoration of pre-mining streamflow regime in nearby watercourses

A positive impact is envisaged as water freely flows to downstream water users due to restoration of the natural streamflow regime close to pre-mining conditions without excess suspended solids reporting to nearby watercourses.

7.5.3.3. Management Objectives

The management objectives for the decommissioning and closure phase are to minimize potential contamination of receiving waterbodies as a result of the associated decommissioning activities. Furthermore, strategic removal of surface infrastructure should be implemented so that potentially contaminated runoff is diverted away from designated clean water areas.

7.5.3.4. Management Actions

The following mitigation measures are recommended:

- Restore the topography to pre-mining conditions as much as is practically possible by backfilling, removing stockpiles and restore the slope gradient and angle of the site;
- Clearing of vegetation should be limited to the decommissioning footprint area and immediate revegetation of cleared areas;
- Immediate revegetation of cleared areas;

- Movement of demolition machinery and vehicles should be restricted to designated access roads to minimise the extent of soil disturbance;
- Use of accredited contractors for removal or demolition of infrastructure during decommissioning is recommended; this will reduce the risk of waste generation and accidental spillages; and
- Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before decommissioning.

7.5.3.5. *Impact Ratings*

The following tables rate the impacts for the decommissioning and closure phases:

Table 7-9: Impact Significance Rating for Decommissioning Phase and Closure Phase

Dimension	Rating	Motivation	Significance
Impact: Sedimentation and siltation of nearby watercourses and deterioration of water quality			
Duration	2	The impact will be short term during the decommissioning phase	63-Minor (negative)
Intensity	4	Serious to medium term environmental effects	
Spatial scale	3	The impacts might extend across the site and to nearby streams	
Probability	7	Without appropriate mitigation, it is probable that this impact will occur	
Post-mitigation			
Duration	2	The impact will likely only occur during the decommissioning phase	12-Negligible (negative)
Intensity	2	The intensity will be low due to implementation of mitigation measures	
Spatial scale	2	The impacts will be localized to sites where demolition will be undertaken and contained by implementing temporary measures to trap silt on site, such as contouring	
Probability	2	The possibility of the impact occurring is very low due to implementation of adequate mitigation measures	

Dimension	Rating	Motivation	Significance
Impact: Restoration of pre-mining streamflow regime in nearby watercourses			
Duration	7	The impact will remain long after the life of the project	112-Major (positive)
Intensity	4	The impact leads to significant increase in the water quality of the receiving environment	
Spatial scale	5	The impact may extend across the project area and to nearby stream	
Probability	7	It is definite that this positive impact will occur (there is no mitigation for this impact)	

7.6. Cumulative Impacts

Due to the low risk of the project, no significant cumulative impacts are envisaged from downstream of the study area. Additionally, the quality of the water flowing from upstream of the study area shows minimal impact due to human activities, hence it is unlikely that there will be significant cumulative impacts as a result of the proposed project.

7.7. Unplanned and Low Risk Events

The potential risks or unplanned events involve accidental spillages of hazardous substances from waste storage facilities into adjacent surroundings during the operation phase. This may lead to impacts on water quality in the surrounding streams, should runoff from these contaminated areas enter the system.

A summary of the risks from unplanned events, together with the management measures are presented in Table 7-10.

Table 7-10: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
• Hazardous material spillage	• An emergency response plan and spill kits should be in place and accessible to the responsible monitoring team in case of pipeline bursts. The Material Safety Data Sheets (MSDS) should be kept on site for the Life of Mine for anytime reference in terms of best practice guidelines for handling, storage and disposal of materials.

8. Environmental Management Plan

This section provides a summary of the proposed project activities, environmental aspects and impacts on the receiving surface waterbodies. The frequency of mitigation, timing of implementation, the roles and responsibilities of persons implementing the EMP are summarized (Table 8-1).

Table 8-1: Environmental Management Plan

Activity/ies	Potential Impacts	Aspects Affected	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Site clearing; • Access and haul road construction; • Establishment of Infrastructure; • Topsoil stockpiling; and • Loading, transport, tipping and spreading of materials; • Use and repair of machinery and vehicles used for site clearance and construction	• Siltation of water resources due to increased turbidity from dust and soil erosion; and • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material	Surface Water Quality	Establishment	• Clearing of vegetation must be limited to the development footprint, and the use of any existing access roads must be prioritised to minimise creation of new ones; • Dust suppression with water on the haul roads and cleared areas must be undertaken to limit dust; • Hydrocarbon and hazardous waste storage facilities must be appropriately bunded to ensure that leakages can be contained. Spill kits should be in place and workers should be trained in the use of spill kits, to contain and immediately clean up any potential leakages or spills; • Vehicles should regularly be maintained as per the developed maintenance program. This should also be inspected daily before use to ensure there are no leakages underneath; • Drip trays must be used to capture any oil leakages. Servicing of vehicles and machinery should be undertaken at designated hard park areas. Any used oil should be disposed of by accredited contractors; and • Implementation of a stormwater management to separate clean and dirty water areas, if dirty water is generated.	Control through implementation of Storm water management:	During the establishment phase, preferably during the dry season

Activity/ies	Potential Impacts	Aspects Affected	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Sand Mining; • Stockpiling; • Diesel storage; • Movement of vehicles and mine machinery; and • Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste	• Siltation of water resources due to increased turbidity from dust and soil erosion; and • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material.	Surface Water Quality and Quantity	Operational	• The water quality monitoring program provided in this report should be adhered to for monitoring water resources within and in close proximity to the study area to allow detection of any contamination arising from operational activities; • The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be collected by approved contractors for disposal to appropriate disposal sites; • The overall housekeeping and storm water system management (including the maintenance of berms, conveyance channels and clean-up of leaks) must be maintained throughout the LOM; • The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances; • Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; and • Vehicles must only be serviced within designated service bays.	Implementation of the proposed stormwater management plan will control the impacts by mitigating the impacts; Control by confining movement to designated access and haul roads; Monitoring of water quality including	During the operational phase Monthly monitoring of water quality
• Demolition and removal of infrastructure; • Rehabilitation and closure.	• Siltation of water resources due to increased turbidity from soil erosion;	Water Quality and Water quantity	Decommissioning	• Restore the topography to pre-mining conditions as much as is practically possible by backfilling, removing stockpiles and restore the slope gradient and angle of the site; • Clearing of vegetation should be limited to the decommissioning footprint area and immediate revegetation of cleared areas; • Disturbance of soils during infrastructure demolition should be restricted to relevant footprint areas; • Movement of demolition machinery and vehicles should be restricted to designated access roads to minimise the extent of soil disturbance; and • Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before decommissioning.	Storm water management: Control contamination of receiving waterbodies by consideration of potential contamination sources and strategic decommissioning to minimize on potential environmental impacts; Water quality monitoring 3 years after decommissioning as required by legislation or until vegetation is established	During the decommissioning phase; Water quality monitoring 5 years post closure, or until vegetation establishment

9. Monitoring Programme

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented.

This report recommends or provides a surface water monitoring programme with clearly defined monitoring points to be implemented by the mine throughout the life of mine and post closure (Figure 7-5). The surface water monitoring plan is summarised as follows and shown in Table 9-1:

Table 9-1: Surface Water Monitoring Plan

Monitoring Element	Comment	Frequency	Responsibility
Water quality	Water quality monitoring should continue to sample points in the Vaal and Taaibosspruit Rivers (Figure 7-5). Parameters should include but not limited to; pH, Electrical Conductivity, Bicarbonates, Iron, Calcium, Magnesium, Potassium, Nitrates, Ammonia, Total dissolved solids, Suspended Solids; and Turbidity.	Quarterly monitoring during operation and decommissioning; (hydrocarbons can be done on a quarterly basis). Monitoring needs to carry on at least 3 years after the project has ceased, as is standard or best practice to detect residual impacts.	Environmental Officer

10. Stakeholder Engagement Comments Received

No comments received at this stage.

11. Recommendations

Ongoing surface water monitoring is imperative during all phases of the project life and post closure to allow for early detection of potential contaminants that may cause unforeseen negative impacts on the receiving environment.

12. Reasoned Opinion Whether Project Should Proceed or Not

Based on the findings of this surface water assessment, it is the opinion of the surface water specialist that the project should proceed as it is envisaged to cause minimal impacts on receiving waterbodies provided that the proposed mitigation measures are implemented.

13. Conclusion

The surface water assessment included a description of the hydrological setting of the study area within which the proposed study area is located. A baseline water quality assessment was undertaken, as well as a floodline delineation and an impact assessment.

The Mining Right Boundary of the Copper Sunset Operations stretches across three different quaternary catchments, namely C22F, C22G and C22K within the Vaal Water Management Area (WMA 5). The catchment area is drained by the Vaal River. The land use in the catchment includes agriculture, extensive gold and coal mining, power generation, industrial activities and urban developments.

Peak flows calculated for the 1:50-year and 1:100-year events are indicated to be 1427.75 m^3/s and 1922.45 m^3/s for the Vaal River, and 322.52 m^3/s and 451.83 m^3/s for the Taaibosspruit. These peak flows were used for hydraulic modelling as input flows within the HEC-RAS model. Modelled floodlines indicate that the existing and proposed Copper Sunset infrastructure including the additional expansion area are outside the floodwater way for both the 1:50-year and 1:100-year flood events. Placement of any future additional infrastructure should be outside the modelled 1:100-year floodlines from the edge of both the Vaal River and the Taaibosspruit to avoid impacting on water resources and to prevent infrastructure inundation.

The potential environmental risks associated with the proposed project pertain to sedimentation and siltation of nearby surface waterbodies due to eroded disturbed soils. Potential contamination from hydrocarbon and hazardous chemical spillages and leaks will likely impact on water resources. Although, some impacts are envisaged, the project will likely not result in significant impacts on the receiving Vaal and Taaibosspruit Rivers considering discussed mitigation measures.

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Appendix A: Impact Assessment Methodology

Impact Rating Methodology

The significance rating formula is as follows:

Significance = Consequence x Probability

Where

Consequence = Type of Impact x (Intensity + Spatial Scale + Duration)

And

Probability = Likelihood of an Impact Occurring

In addition, the formula for calculating consequence:

Type of Impact = ***+1*** *(Positive Impact) or* ***-1*** *(Negative Impact)*

The weighting assigned to the various parameters for positive and negative impacts is provided for in the formula and is presented in Table A-1. The probability consequence matrix for impacts is displayed in Table A-2, with the impact significance rating described in Table A-3.

Table A-1: Surface water Impact Assessment Parameter ratings

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts (Type of Impact = -1)	***Positive Impacts (Type of Impact = +1)***			
7	High significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem. Persistent severe damage. Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	Noticeable, on-going social and environmental benefits which have improved the livelihoods and living standards of the local community in general and the environmental features.	International The effect will occur across international borders.	Permanent: No Mitigation The impact will remain long after the life of the Project.	Certain/ Definite. There are sound scientific reasons to expect that the impact will definitely occur.
6	Significant impact on highly valued species, habitat or ecosystem. Irreparable damage to highly valued items of cultural significance or breakdown of social order.	Great improvement to livelihoods and living standards of a large percentage of population, as well as significant increase in the quality of the receiving environment.	National Will affect the entire country.	Beyond Project Life The impact will remain for some time after the life of a Project.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread positive benefits to local communities which improves livelihoods, as well as a positive improvement to the receiving environment.	Province/ Region Will affect the entire province or region.	Project Life The impact will cease after the operational life span of the Project.	Likely The impact may occur.
4	Serious medium-term environmental effects. Environmental damage can be reversed in less than a year. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense social benefits to some people. Average to intense environmental enhancements.	Municipal Area Will affect the whole municipal area.	Long term 6-15 years.	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some.	Local Extending across the site and to nearby settlements.	Medium term 1-5 years.	Unlikely Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by very few of population.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year.	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the Project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures.

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts (Type of Impact = -1)	*Positive Impacts (Type of Impact = +1)*			
1	Limited damage to minimal area of low significance that will have no impact on the environment. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level social and environmental benefits felt by very few of the population.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month.	Highly unlikely/None Expected never to happen.

Table A-2: Probability Consequence Matrix for Impacts

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	**-20**	**-19**	**-18**	**-17**	**-16**	**-15**	**-14**	**-13**	**-12**	**-11**	**-10**	**-9**	**-8**	**-7**	**-6**	**-5**	**-4**	**-3**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Consequence																																						

Table A-3: Significance Threshold Limits

Score	Description	Rating
109 to 147	A very beneficial impact which may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	**Major (positive)**
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive)
36 to 72	An important positive impact. The impact is insufficient by itself to justify the implementation of the Project. These impacts will usually result in positive medium to long-term effect on the social and/or natural environment.	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the social and/or natural environment.	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the social and/or natural environment.	Negligible (negative)
-36 to -72	An important negative impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the social and/or natural environment.	Minor (negative)
-73 to -108	A serious negative impact which may prevent the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe effects.	Moderate (negative)
-109 to -147	A very serious negative impact which may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects.	Major (negative)