# Surface Water Assessment

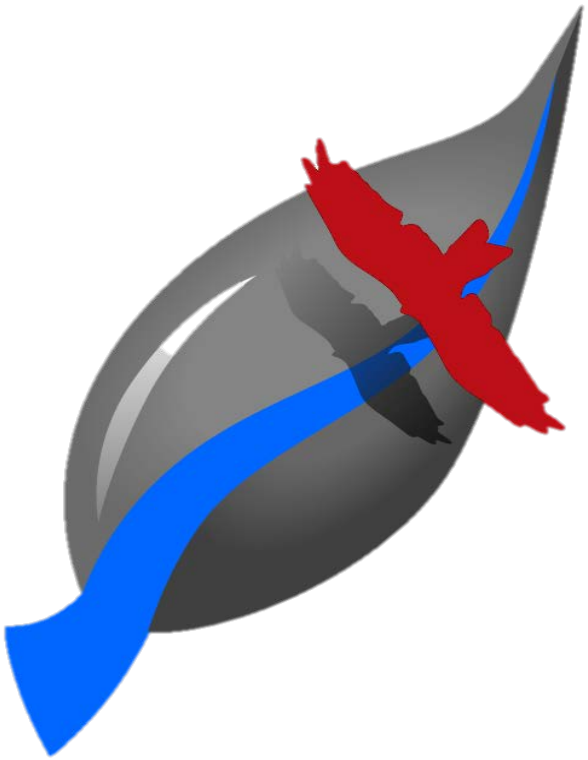
# For

# Bauba A Hlabirwa Mining Investments (Pty) Ltd

## Moeijelijk Chrome Mine

## On the Farm Moeijelijk 412 KS, Limpopo Province

## Date: February 2018



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# Executive Summary

Bauba A Hlabirwa Mining Investments (Pty) Ltd (Bauba) holds a mining right (LP10096MR) over the farm Moeijelijk 412 KS as well a Water Use License (Licence no. 01/B71B/ACGI/5052) for their current operations. Bauba is currently opencast mining the LG6 chromitite package on the farm Moeijelijk 412 KS. Additional chromitite layers are present on the same farm, near the surface. Thus, Moeijelyk Chrome Mine proposes to extend the existing opencast operations on the Mining Right area to access further ore deposits. The mine also proposes to establish a wash plant and associated facilities such as residue stockpiles. The residue material from the wash plant will be allowed to dry, after which it will be stockpiled, thus no tailings dam will be constructed for the project.

The following activities which necessitates the amendment of the Mining Right and Water use Licence are proposed:

- The extension of the existing opencast pit across various watercourses to access the remainder of the LG6 on the Mining Right area
- The development of a new opencast pit across various watercourses to access the LG2 and LG3 chromitite on the Mining Right area
- The extension of the ROM stockpile area
- The construction of a river crossing (culvert)
- Construction of wash plant
- Construction of residue drying and stockpiling facilities

Situated approximately 70 km north of the town of Steelpoort in the Limpopo Province, the mining area falls within the jurisdiction of the Fetakgomo Local Municipality and the Greater Sekhukhune District Municipality. As mentioned above water uses will take place on the Farm Moeijelijk 412 KS. The Moeijelijk Chrome Mine is situated within an area already characterised by numerous other mining activities including the Maandagshoek Platinum Mine (Anglo Platinum), the ASA Dilokong Mine, the Sefateng Chrome Mine and the newly proposed Twyfelaar Chrome Mine (near the R37 Route and approximately 51 km northwest of Burgersfort Town).

Surrounding land uses in the vicinity of the proposed site are rural residential areas. The main activities in the area are subsistence agriculture, with grazing taking place in the mountainous areas. Other activities include mining at the farms Groothoek, Maandagshoek, Winnaarshoek, Hackney, Twickenham, Mecklenburg, Waterkop, Paschaskraal and Moeijelijk itself. There are several non-perennial streams bordering the area of interest, however, this study only concentrated on the unnamed tributaries of the Moshashaneng River. Main disturbances within the non-perennial stream include erosion as well as head gully formations. Mining and subsistence agriculture are the only impactors on the aquatic environment, as there are no other activities higher in the catchment that can impact on the surface water.

The study area is situated within the upper reaches (head waters) of Quaternary Catchment B71B of the Olifants Water Management Area. The B71B Quaternary Catchment is characterised by a network of unnamed non-perennial tributaries of the Moshashaneng River, all flowing in a general northern direction to ultimately feed into the perennial Olifants River. It is evident that runoff from the Moeijelijk Chrome Mine feeds tributaries of the Moshashaneng River.

The study site has historically been impacted on by chrome mining and related water use activities. These existing infrastructures have already impacted the non-perennial drainage lines on site. The primary surface water impacts associated with the proposed expansion are the potential impacts on water quality degradation due to incidental waste discharges and storm water management at the project site, especially during the construction phase as well as the impact on surface water quantity due to the diversion of drainage lines. While the chemical and physical characteristics of the water itself are good (as determined using the DWS sampling points both located upstream), biological indices indicated that the system is already moderately impacted.

The impact on the surface water area could be seen as moderate to high without the implementation of mitigation measures. With the implementation of mitigation management measures the impact of the development on the surface water environment is ranked as a low significance.

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| | |
|---|---|
| **%** | Percentage |
| **˚C** | Degrees Celcius |
| **AMD** | Acid Mine Drainage |
| **CMA** | Catchment Management Agency |
| **DMR** | Department of Mineral Resources |
| **DWAF** | Department of Water Affairs and Forestry (previously) |
| **DWS** | Department of Water and Sanitation (currently |
| **EC** | Electrical Conductivity |
| **ECA** | Environment Conservation Act 1989, (Act No. 73 of 1989) |
| **EIA** | Environmental Impact Assessment |
| **EMP** | Environmental Management Plan |
| **EMPR** | Environmental Management Programme |
| **EWR** | Ecological Water Requirements |
| **fg/ℓ** | Femtogram per Litre |
| **FEPA** | Freshwater Ecosystem Priority Area |
| **GN** | Government Notice |
| **IEM** | Integrated Environmental Management |
| **ISP** | Interim Strategic Perspective |
| **IUA** | Integrated Unit of Analyses |
| **IWWMP** | Integrated Water and Waste Management Plan |
| **km** | Kilometres |
| **km²** | Square Kilometres |
| **ℓ** | Litres |
| **m** | Metres |
| **m³/a** | Cubic Metres per Annum |
| **MAP** | Mean Annual Precipitation |
| **MAR** | Mean Annual Runoff |
| **mcm** | Million Cubic Metres |
| **mg/ℓ** | Milligram per Litre |
| **mm** | Millimetres |
| **mS/m** | Millisiemens per Metre |
| **NEMA** | National Environmental Management Act, 1998 (Act No. 107 of 1998) |
| **NEMWA** | National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) |
| **NFEPA** | National Freshwater Ecosystem Priority Area |
| **NWA** | National Water Act, 1998 (Act No. 36 of 1998) |
| **NWRS** | National Water Resources Strategy |
| **PCD** | Pollution Control Dam |
| **RoD** | Record of Decision |
| **ROM** | Run-of-Mine |
| **RQO** | Resource Quality Objectives |
| **SANBI** | South African National Biodiversity Institute |
| **TDS** | Total Dissolved Solids |

| | |
|---|---|
| **TSS** | Total Suspended Solids |
| **TWQR** | Target Water Quality Range |
| **µg/ℓ** | Microgram per liter |
| **WCDM** | Water Conservation and Demand Management |
| **WM** | With Mitigation |
| **WMA** | Water Management Area |
| **WOM** | Without Mitigation |
| **WRC** | Water Research Commission |
| **WUA** | Water User Association |

# 1. INTRODUCTION

## 1.1. Locality and Background

Bauba A Hlabirwa Mining Investments (Pty) Ltd (Bauba) holds a mining right (LP10096MR) over the farm Moeijelijk 412 KS as well a Water Use License (Licence no. 01/B71B/ACGI/5052) for their current operations. Bauba is currently opencast mining the LG6 chromitite package on the farm Moeijelijk 412 KS. Additional chromitite layers are present on the same farm, near the surface. Thus, Moeijelyk Chrome Mine proposes to extend the existing opencast operations on the Mining Right area to access further ore deposits. The mine also proposes to establish a wash plant and associated facilities such as residue stockpiles. The residue material from the wash plant will be allowed to dry, after which it will be stockpiled, thus no tailings dam will be constructed for the project.

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Bauba A Hlabirwa Mining Investments (Pty) Ltd has appointed Red Kite Environmental Solutions (Pty) Ltd as independent specialists, to undertake the Surface Water Assessment for the proposed mining project. As the potential exists for the proposed project to impact on the surrounding water environment appropriate mitigation measures will need to be implemented to protect the environment.

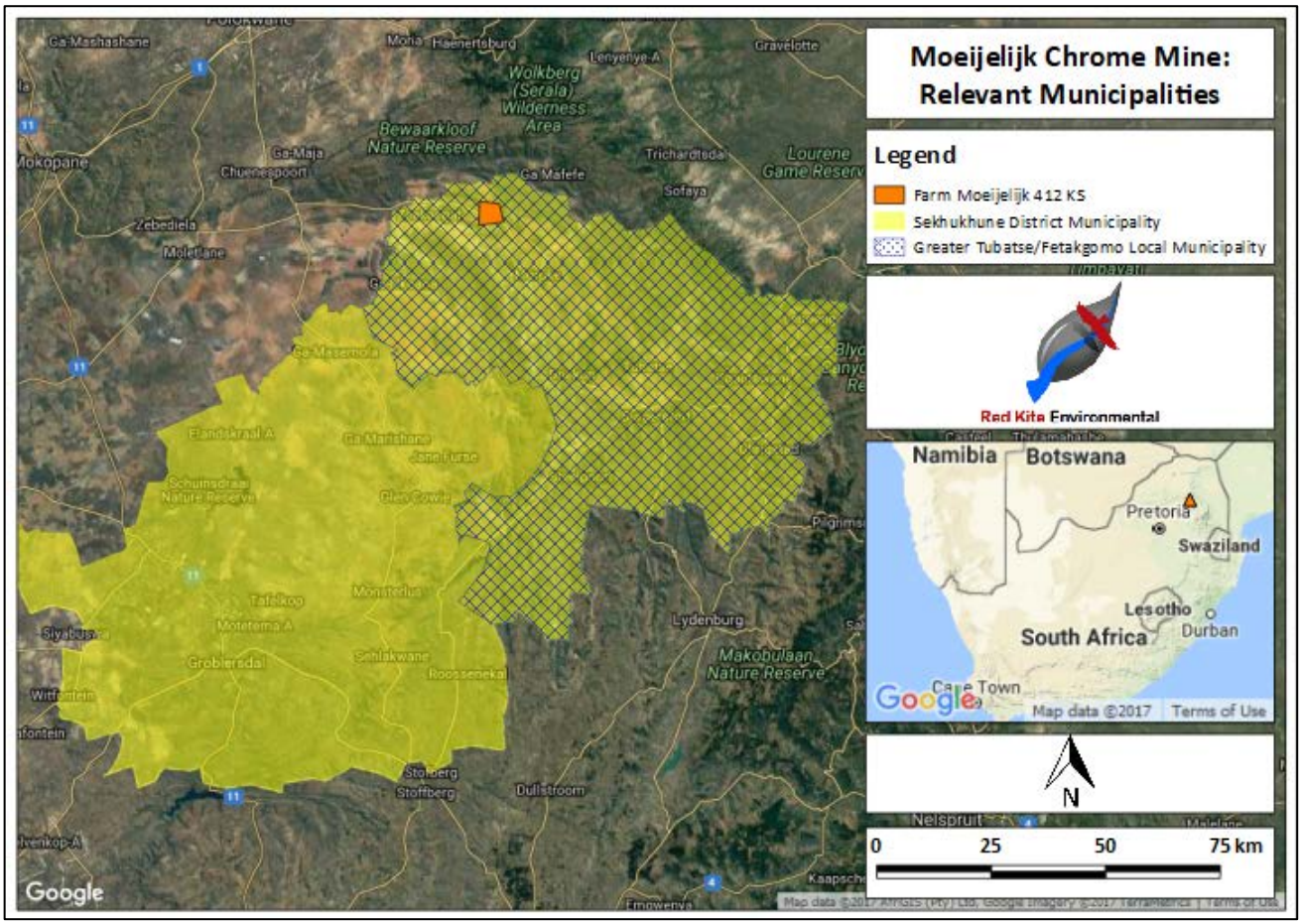


**Figure 1-1: Municipal Boundaries applicable to the study area**

## 1.2. Site Description

Surrounding land uses in the vicinity of the proposed site are rural residential areas. The main activities in the area are subsistence agriculture, with grazing taking place in the mountainous areas. Other activities include mining at the farms Groothoek, Maandagshoek, Winnaarshoek, Hackney, Twickenham, Mecklenburg, Waterkop, Paschaskraal and Moeijelijk itself. There are several non-perennial streams bordering the area of interest, however, this study only concentrated on the unnamed tributaries of the Moshashaneng River. Main disturbances within the non-perennial stream include erosion as well as head gully formations. Mining and subsistence agriculture are the only impactors on the aquatic environment, as there are no other activities higher in the catchment that can impact on the surface water.

## 1.3. Purpose of the Study

The purpose of the Surface Water Assessment is to define the water resources in its associated drainage area and to identify potential sources of contamination. The Surface Water Assessment also aims to characterise the existing surface water environment for it to be used as a benchmark against which future surface hydrological impacts could be measured. The Moeijelijk Chrome Mine needs to adhere to various environmental aspects in terms of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998). An application for Environmental Authorisation will therefore need

to be lodged with the Department of Mineral Resources (DMR). In addition, the Proponent needs to apply for the required Water Use Licenses in terms of the National Water Act (NWA), 1998 (Act No. 36 of 1998).

To meet all legal requirements needed to obtain environmental authorisation approvals the Surface Water Assessment and Impact Assessment for the proposed mining project will address the following aspects:

- Description of the affected drainage area;
- Identification of drainage lines and/or sensitive areas;
- Identification and quantification of potential impacts; and
- Formulation of mitigation measures.

## 1.4. Approach to the Study

Red Kite Environmental Solutions (Pty) Ltd, as independent specialist, undertook to facilitate the compilation of a Surface Water Assessment Report for the proposed mining project by piloting the following approach and methodology.

An extensive desktop study was conducted for the area by making use of the following main databases:

- The Water Resources (WR2012) database;
- The SANBI (South African National Biodiversity Institute) National Freshwater Ecosystem Priority Areas Atlas and online database (Nel, *et. al*., 2011);
- Google Earth™ Satellite Imagery.

Supplementary to the desktop study, a field investigation was conducted to determine the current situation of surface water resources transecting the property. The field investigation was conducted on the 29th September 2017. Furthermore, the Surface Water Assessment (MENCO, 2015) previously conducted for the site was also investigated and utilised where information was still relevant.

## 1.5. Limitations of the Study

While every care is taken to ensure that the data presented is qualitatively adequate, inevitably conditions are never of such a nature that the data is entirely satisfactory. Access to certain points along the section of the Aquatic System relevant to the study site was also limited. It should also be noted that the findings of this study were largely based on a single site visit within which to identify indicators. Visibility of indicators vary throughout seasons and it is therefore noted that, if in future, any further indicators are found on site, the author cannot be held liable for conclusions deducted in good faith based on the available resources and information provided at the time of the study. Furthermore, this study, only outlines the surface water environment directly related to the properties on which development will take place and does not include drainage lines outside of this scope. It is important that this report be viewed and acted upon with these limitations in mind.

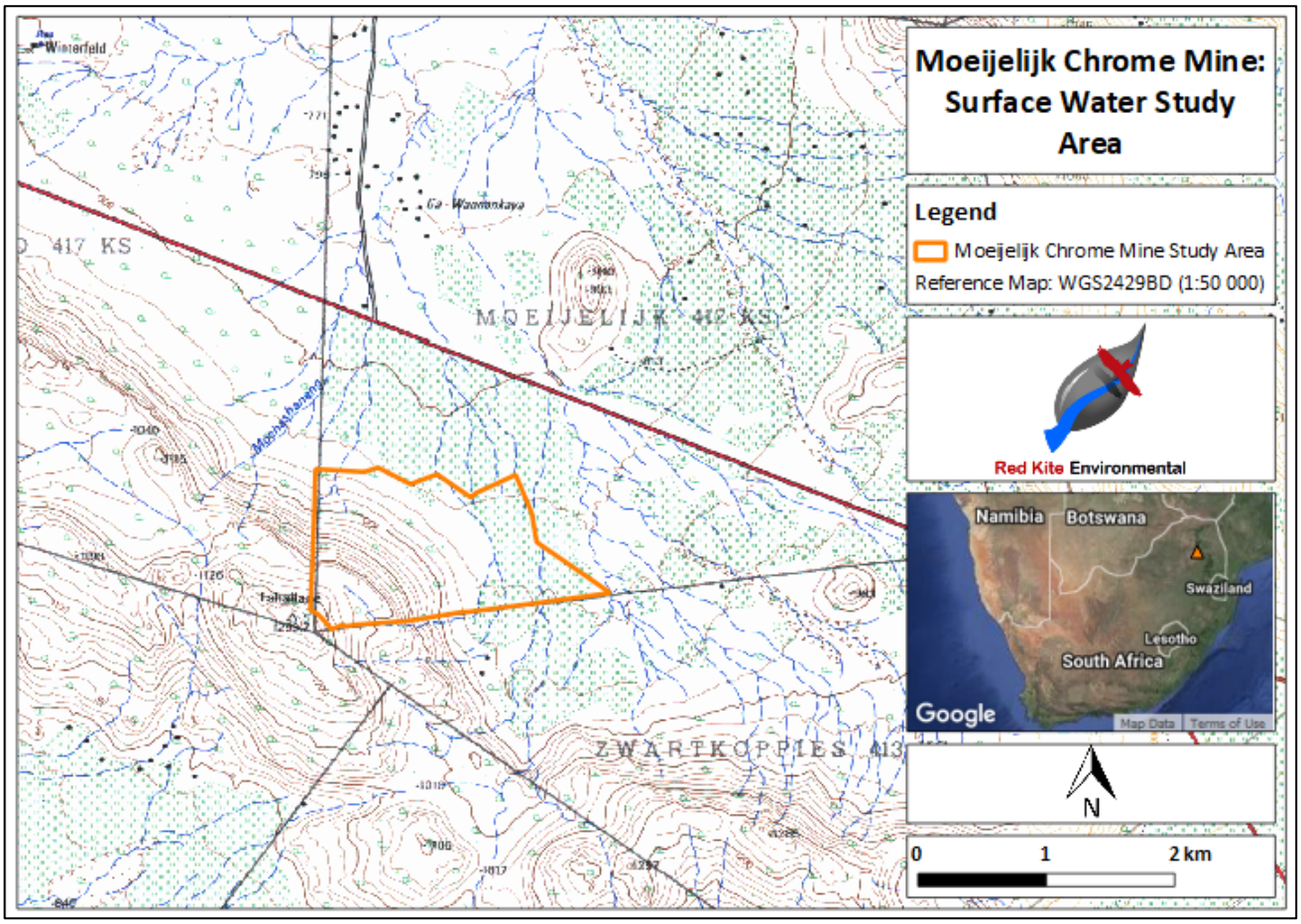


**Figure 1-2: Regional Locality of the surface water study area**

# 2. SURFACE WATER ENVIRONMENT

## 2.1. Affected Water Management Area

During 2012 the Department of Water and Sanitation (DWS) (previously the Department of Water Affairs) proposed to consolidate the original nineteen Water Management Areas (WMAs) into only nine based on the availability and allocation of funding, capacity, skills and expertise for the establishment of Catchment Management Agencies (CMAs). On 16 September 2016 the new nine WMAs were published under Government Notice No. 1056. The surface water study area falls within the boundaries of the Olifants Water Management Area (DWS, 2016a). The newly promulgated Olifants Water Management Area (WMA), as defined by the National Water Resources Strategy (NWRS) 2nd Edition (DWA, 2013a), comprises the original Olifants WMA, together with the Letaba River System (previously part of the Luvuvhu/Letaba WMA). A full description of the Olifants WMA boundaries are provided in GN No. 1056. Major rivers within the WMA include the Elands, Wilge, Steelpoort, Olifants and Letaba Rivers. As per the NWRS 2nd Edition, the Olifants WMA is a highly stressed WMA, fast growing in terms of population and need for improved services. There is very little opportunity for further water resource development and no realistiv opportunity to import significant volumes of additional water from elsewhere. **Figure 2-1** gives an indication of the relevant Catchment boundaries.

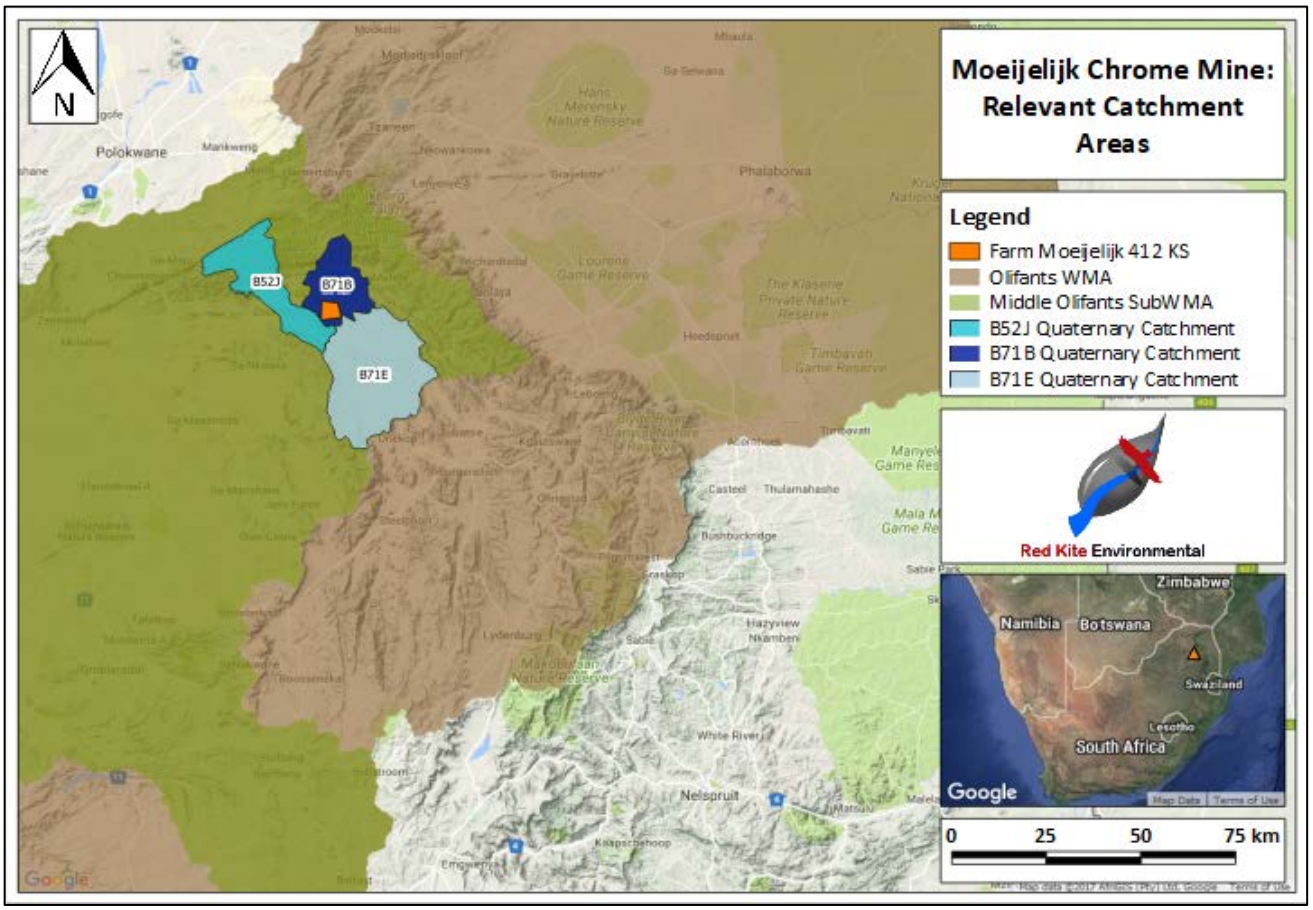


**Figure 2-1: Catchment Areas applicable to the Study Area**

## 2.2. Surface Water Features

As indicated in **Figure 2-1** the study area is situated within the upper reaches (head waters) of Quaternary Catchment B71B of the Olifants Water Management Area. The B71B Quaternary Catchment is characterised by a network of unnamed non-perennial tributaries of the Moshashaneng River, all flowing in a general northern direction to ultimately feed into the perennial Olifants River. As indicated in **Figure 2-2** it is evident that runoff from the Moeijelijk Chrome Mine feeds tributaries of the Moshashaneng River.

The unnamed tributaries from the adjacent farms (Zwartkoppies 413 KS) drains in a northerly direction and merge with unnamed tributaries on the farm Moeijelyk 412 KS flowing northerly still and merge with the Moshahaneng stream (originating on Wintersveld 417 KS) on the farm Jobskop 411 KS. After the merge, the Moshashaneng stream flows northerly to merge with the Olifants River on Jobskop 411 KS. The only other farm drained by unnamed tributaries of the Moshahaneng stream is Rostol 410 KS.

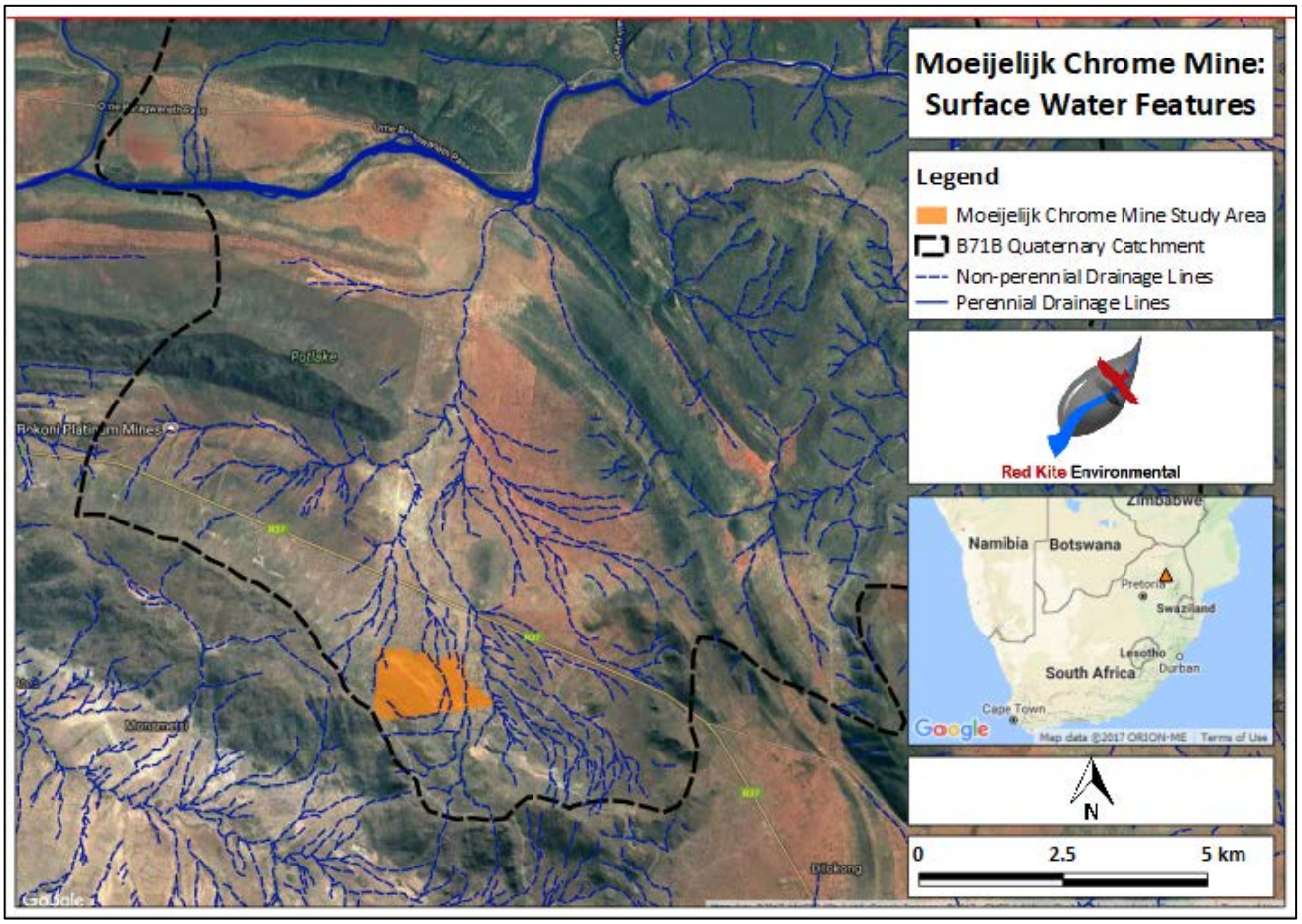


**Figure 2-2: Surface Water Features applicable to the study area**

## 2.3. Climate, Rainfall and Evaporation

A typical climatic description of the study area is hot summers and cold dry winters. The climate of the study area is, however influenced by the prevailing topography being the foothills of Sekhukune and Leolo mountain ranges that creates microclimatic effects in the form of a hotter and drier climate. The maximum temperature is recorded as 30.4ºC and the minimum is 3.9ºC.

The Mean Annual Precipitation (MAP) for the area is approximately 559 mm per annum, with the monthly rainfall varying between 4 mm and 102 mm. The rainy season is usually from November to March. The project area furthermore falls within the 1600-1700 mm per year evaporation isolines. The minimum evaporation is 102 mm per month and the maximum is 259 mm/month.

**Table 2-1: Rainfall and temperature data**

| Month | Rainfall | | | | Expected maximum in 24 hrs | | Temperature (°C) | |
|---|---|---|---|---|---|---|---|---|
| | Average | Days | Maximum | | | | | |
| | mm | ~1mm | 60 min | 24 h | 1:50 Y | 1:100 Y | Max | Min |
| January | 95 | 9.8 | 49 | 61 | 86 | 97 | 30.1 | 17.3 |
| February | 84 | 6.8 | 39 | 114 | 60 | 66 | 29.7 | 17.4 |
| March | 70 | 6.8 | 38 | 62 | 68 | 77 | 28.2 | 16.2 |
| April | 20 | 2.6 | 18 | 80 | 57 | 64 | 27.4 | 12.1 |
| May | 8 | 2.2 | 13 | 36 | 23 | 28 | 24.5 | 8.1 |
| June | 4 | 1.3 | 11 | 27 | 22 | 24 | 21.7 | 3.9 |
| July | 4 | 1.3 | 7 | 11 | 12 | 13 | 21.6 | 4.0 |
| August | 8 | 1.7 | 6 | 13 | 6 | 6 | 24.0 | 6.9 |
| September | 19 | 1.8 | 32 | 38 | 35 | 30 | 27.5 | 11.3 |
| October | 59 | 6.3 | 51 | 66 | 61 | 69 | 30.4 | 14.6 |
| November | 102 | 10.1 | 33 | 65 | 80 | 90 | 30.2 | 16.4 |
| December | 86 | 8.4 | 51 | 79 | 67 | 75 | 30.1 | 17.4 |
| Annual | 559 total | 59.1 | | | | 53.25 (mean) | 27.1 | 12.2 |

**Table 2-2: Evaporation data**

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Evaporation (mm) | 212 | 174 | 174 | 139 | 121 | 102 | 119 | 167 | 228 | 259 | 228 | 217 | 2140 |

## 2.4. Flood Volumes

To protect the drainage system at the Moeijelijk Chrome Mine, the drainage lines affected by the opencast mining activities were diverted prior to commencement with mining activities. These diversions were authorised by the current Water Use License (Licence no. 01/B71B/ACGI/5052) held by the Moeijelijk Chrome Mine. In the event that any new

drainage lines will be affected by the expansion of the opencast mine, these too will be diverted by means of clean storm water channels. A formal Storm Water Management Plan will be compiled as part of the expansion project.

## 2.5. Drainage Density

The drainage density (refer to **Table 2-3** below) for the Moeijelijk Chrome Mine area, inclusive of current and proposed activities, was determined by using the area indicated **Figure 2-3**.

**Table 2-3: Drainage density of the Moeijelijk Chrome Mining Area (current and proposed activities)**

| Component | Moeijelijk (Mining Area) |
|---|---|
| Total area (km$^2$) | 1.81 |
| Total drainage line length (km) | 3.93 |
| Drainage density (km/km$^2$) | 2.17 |

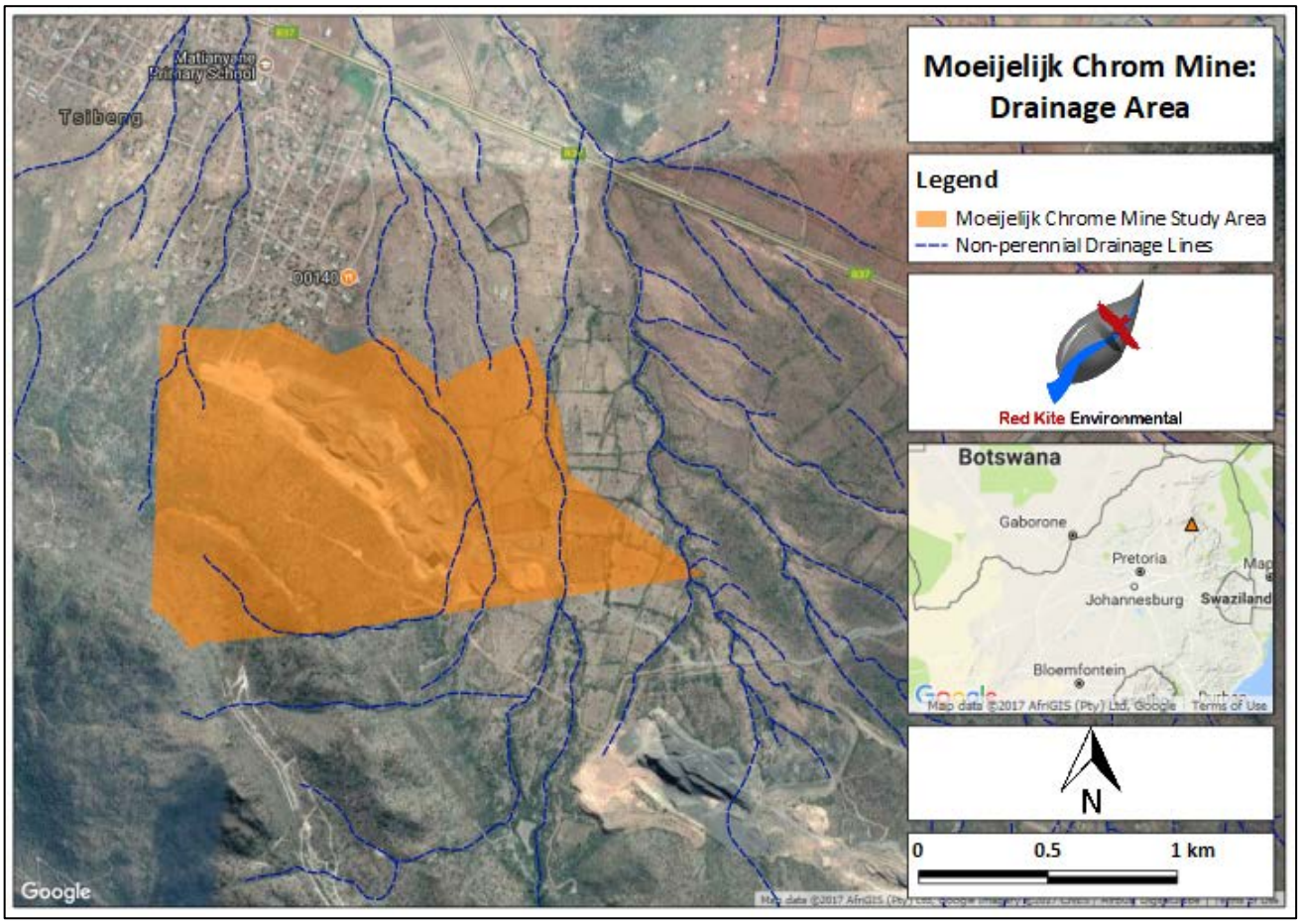


**Figure 2-3: Area used to determine the drainage density for the mining area**

## 2.6. Mean Annual Runoff (MAR)

Natural Mean Annual Runoff (MAR) for the Olifants WMA as per the National Water Resources Strategy (NWRS) 1st Edition (DWAF, 2004) equates to 2705 million $m^3/a$ of which 481 million $m^3/a$ occurs within the Middle Olifants Sub-WMA relevant to the study area. Mean Annual Runoff for the relevant Quaternary Catchment as acquired from WR2012 is indicated in **Table 2-4** below. The figures in the table below indicate a 5.3 % decrease in MAR for the Quaternary Catchment from 1920 to 2009. MAR for the delineated Moshshaneng River sub-catchment is estimated at 2.149 million $m^3/a$, using the MAR reported for the B71B sub-catchment (Midgley *et al*, 1994).

**Table 2-4: Quaternary Catchment Runoff Figures (WR2012)**

| Quaternary Catchment | Naturalised Flow MARs | | | |
|---|---|---|---|---|
| | 1920 -1989 MAR (WR90) Net (mcm) | 1920 - 2004 MAR (WR2005) Net (mcm) | 1920 – 2009 MAR (WR2012) Net (mcm) | Change in MAR (%) |
| B71B | 7.3 | 3.57 | 3.38 | -5.30 |

## 2.7. Surface Water Quality

The field investigation confirmed that the non-perennial drainage lines transecting the mining area contain no water for the majority of the year. No flowing water was observed during the field investigation conducted during the wet season. No surface water samples were therefore collected for analyses.

No water quality monitoring sites are maintained by the Department of Water and Sanitation (DWS) within the Mashashaneng River, neither within the B71B Quaternary Catchment. The Mashashaneng River has its origin from out the ridge area upstream from the Moeijelijk Chrome Mine and is not influenced by, nor influences, the Olifants River upstream from its confluence. The Mashashaneng River however, could have an impact on the Olifants River downstream from its confluence. A monitoring point, maintained by DWS, is available on the Olifants River downstream from the study area. Available background surface water quality data as obtained from the Directorate Resource Quality Services database for the above-mentioned monitoring point is presented in **Table 2-5**. All water quality data available for 2016 has been included as no data for 2017 is available.

**Table 2-5: DWS surface water quality monitoring point downstream from the study area**

| Station: WMS B71_192537 Olifants River D/S of Confluence with Motse River at the Pump Station | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Parameters (mg/ℓ unless specified otherwise) | | | | | | | | | | | |
| | Ca | Cl | EC mS/m | F | K | Mg | Na | $NH_4$ | N | pH units | $PO_4$ | $SO_4$ |
| 2016/01/20 | | | | | | | | | 0.213 | 8.6 | 0.010 | 85.836 |
| 2016/02/10 | | | | | | | | | 0.512 | 8.3 | 0.010 | 54.608 |
| 2016/03/16 | | | | | | | | | 0.430 | 8.3 | 0.010 | 36.116 |
| 2016/04/13 | | | | | | | | | 0.321 | 8.1 | 0.010 | 43.700 |

| Station: WMS B71_192537<br>Olifants River D/S of Confluence with Motse River at the Pump Station | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Parameters (mg/ℓ unless specified otherwise) | | | | | | | | | | | |
| | Ca | Cl | EC mS/m | F | K | Mg | Na | $NH_4$ | N | pH units | $PO_4$ | $SO_4$ |
| 2016/05/05 | | | | | | | | | 0.243 | 8.4 | 0.010 | 48.400 |
| 2016/06/08 | 36.3 | 49.5 | 61.7 | 0.668 | 3.1 | 28.8 | 51 | 0.05 | 0.427 | 8.4 | 0.092 | 66.000 |
| 2016/07/06 | | | | | | | | | 0.050 | 7.8 | 0.010 | 74.000 |
| 2016/08/03 | | | | | | | | | 0.371 | 8.5 | 0.081 | 49.700 |
| 2016/09/07 | | | | | | | | | 0.225 | 8.4 | 0.099 | 64.600 |

It should be noted that no surface water will be abstracted for use in piggery activities. The above results have been compared to the Target Water Quality Range (TWQR) for domestic use as set out in Volume 1 of the DWS Water Quality Guidelines (DWAF, 1996a). The reason being that rural communities are found throughout the region and are most likely using water from rivers found in the region. All parameters in **Table 2-5**, excluding Calcium and Phosphorus, falls within the TWQR for domestic use and thus pose no adverse health effects to consumers.

Although calcium levels above 32 mg/ℓ up to 80 mg/ℓ show no health effect, increased scaling of household heating appliances and the associated partial obstruction of pipes occur and lathering of soap becomes impaired.

The water quality guidelines for domestic use (Volume 1) do not specify TWQR for Phosphate ($PO_4$). However, the water quality guidelines for Aquatic Ecosystems, Volume 7, (DWAF, 1996b) shed light in this respect. Phosphorus can occur in numerous organic and inorganic forms, and may be present in waters as dissolved and particulate species. Elemental phosphorus does not occur in the natural environment. Orthophosphates, polyphosphates, metaphosphates, pyrophosphates and organically bound phosphates are found in natural waters. Phosphorus is an essential macronutrient, and is accumulated by a variety of living organisms. It has a major role in the building of nucleic acids and in the storage and use of energy in cells. In unimpacted waters it is readily utilized by plants and converted into cell structures by photosynthetic action. Phosphorus is considered to be the principle nutrient controlling the degree of eutrophication in aquatic ecosystems.

In South Africa, phosphorus is seldom present in high concentrations in unimpacted surface waters because it is actively taken up by plants. Concentrations between 10 and 50 fg/ℓ are commonly found, although concentrations as low as 1 fg/ℓ of soluble inorganic phosphorus may be found in "pristine" waters and as high as 200 mg/ℓ of total phosphorus in some enclosed saline waters. The most significant effect of elevated phosphorus concentrations is its stimulation of the growth of aquatic plants. Inorganic phosphorus concentrations of less than 5 fg/ℓ are considered to be sufficiently low to reduce the likelihood of algal and other plant growth.

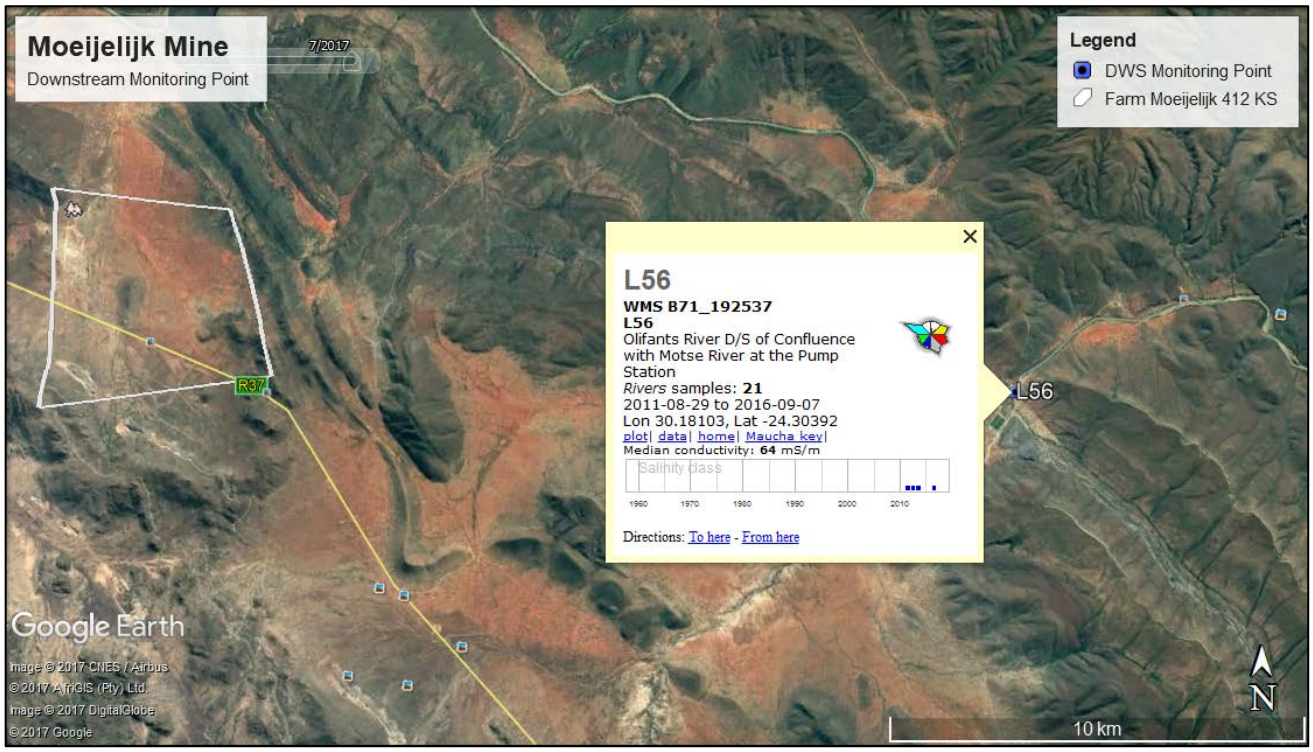


**Figure 2-4: DWS surface water monitoring point downstream from the study area**

## 2.8. Resource Class

On 22 April 2016, the Minister of Water and Sanitation, published the Classes and Resource Quality Objectives of water resources for catchments of the Olifants WMA, as Government Notice (GN) No. 466 in Government Gazette No. 39943. This notice provides a summary of the water resource classes and ecological categories for Integrated Units of Analyses (IUAs).

IUAs are classified in terms of their extent of permissible utilisation and protection as either Class I: indicating high environmental protection and minimal utilisation; or Class II: indicating moderate protection and moderate utilisation; and Class III: indicating sustainable minimal protection and high utilisation. **Table 2-6** below indicates the Resource Class set for the B71B Quaternary Catchment, within which the Moeijelijk Mine is situated, as well as its Ecological Category.

**Table 2-6: Water Resource Class and Ecological Category for the B71B Quaternary Catchment (DWS, 2016b)**

| IUA | Water Resource Class for IUA | Biophysical Node Name | Quaternary Catchment | River Name | Ecological Category to be maintained | Natural MAR (million $m^3/a$) | EWR as % of Natural MAR |
|---|---|---|---|---|---|---|---|
| 10 Lower Olifants | II | 92 EWR site 12 | B71B | Olifants | D | 813 | 4.3 |

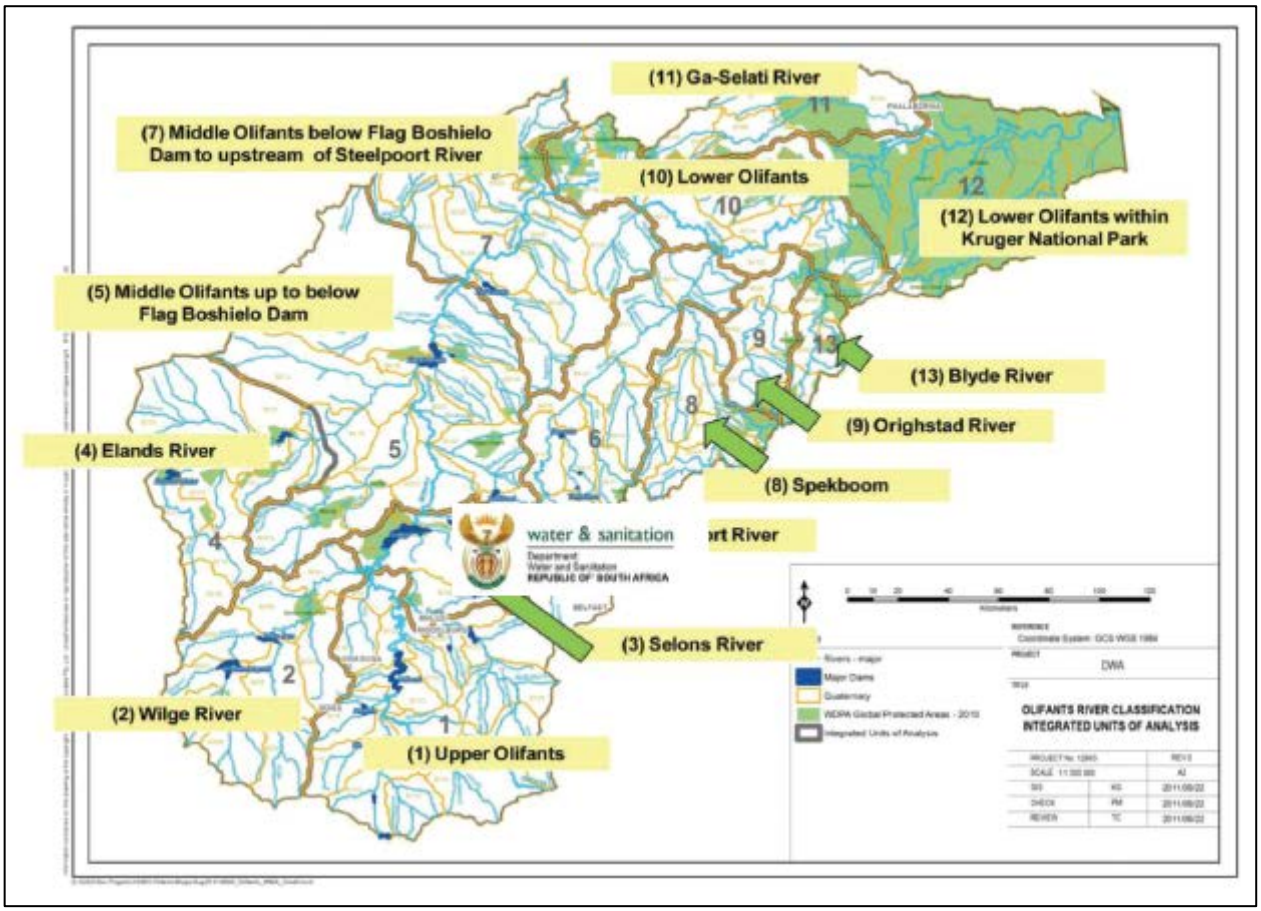


**Figure 2-5: Olifants WMA Integrated Units of Analyses (DWS, 2016b)**

## 2.9. Resource Water Quality Objectives

As per the NWRS, 2nd Ed., a management class and associated Reserve and Resource Quality Objectives (RQOs) have been set and approved for every significant water resource in the country. Resource Quality Objectives are regularly monitored for compliance, which informs enforcement and a strategic adaptive management cycle.

The key strategic objectives for water resource management, as per the NWRS, 2nd Ed., are to:

- Ensure sustainable management of the water resources through resource directed measures and source directed controls;
- Protect and maintain existing freshwater ecosystem priority areas in good condition and well-functioning water resource ecosystems by managing riparian and wetland buffers and critical groundwater recharge areas;
- Carry out rehabilitation of strategic water ecosystems;
- Ensure prevention of water resources from point source and non-point source pollution by managing at source;
- Create awareness among communities, business and decision makers about the value of water and ensure commitment to sustainable water use practices.

- Create an enabling environment for water resource protection through incentive based approach to water resource management; and
- Monitor the ecological health of our resources through an Integrated Information Management System.

As mentioned in **Section 2.8** of this report, Resource Water Quality Objectives (RQOs) have been set for each IUA within the Olifants WMA. The notice defines the RQOs for each prioritised resource unit (RU) for every IUA in terms of water quantity, quality, habitat and biota. Where specified, the ecological category or Recommended Ecological Category (REC) means the assigned ecological condition to a water resource in terms of deviation of its biophysical components from a predevelopment condition. Unfortunately, no RQOs specific to the B71B Quaternary Catchment (Biophysical Unit 92) have been set. However, RQOs have been set for other Biophysical Units within IUA 10. As such, for the purpose of this study, the RQOs specified for IUA 10 will be included in this report. **Table 2-7** indicates the RQOs specific to IUA 10.

**Table 2-7: RQOs relevant to the study area (DWS, 2016b)**

| IUA | Component | RQO |
|---|---|---|
| 10 | Quantity | • Low flows need to be improved to maintain the ecosystem.<br>• High flows need to be improved to maintain the ecosystem. |
| | Quality | • Water quality must be in a close to natural or better condition. |
| | Instream Habitat and Biota | • Instream habitat must be in a largely natural condition to support ecosystem processes.<br>• Instream biota should be in a close to natural condition. The requirements of ecologically important species must be provided for.<br>• Low and high flows must be suitable to maintain the river habitat and ecosystem condition. |
| | Riparian Zone Habitat | • The riparian zone must be in close to natural condition.<br>• Riparian vegetation must be in a close to natural condition<br>• Low and high flows must be in a better than a moderately modified condition. |

## 2.10. Surface Water Users

The surface water users are mainly agriculture (livestock watering) with domestic uses (further downstream) not impossible due to the scarcity of potable water in the area. The aquatic environment is included by default during the reserve determination stage as a surface water user.

## 2.11. Water Authority

The applicable Water Authority for the Bauba Moeijelijk Chrome Mine is the Department of Water and Sanitation by means of the Regional Office situated in Lydenburg Town. On 27 February 2015, the successful establishment of the Olifants Catchment Management Agency (CMA) was promulgated in Government Notice (GN) No. 168. As indicated within this notice, all initial, inherit and delegated fundtions will be performed in the Olifants CMA.

## 2.12. Sources of Water

The current mining activities on the farm Moeijelijk 412 KS obtain water from a borehole situated on the mining site and it is expected that the expansion activities will make use of groundwater as well. An additional source of water that could be utilized for mining purposes is the contaminated water contained in the various pollution control/storm water dams. However, the area is very dry with the evaporation rate three times greater than the MAP and minimal dewatering of the opencast area is expected and as such very little water will be available for reuse from the PCDs.

## 2.13. National Freshwater Ecosystem Priority Areas

As per the National Freshwater Ecosystem Priority Areas (NFEPA) Atlas (Nel, *et.al.*, 2011) the Farm Moeijelijk 412 KS is situated within an Upstream Management Area (see **Figure 2-6**). Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river Freshwater Priority Areas and Fish Support Areas.

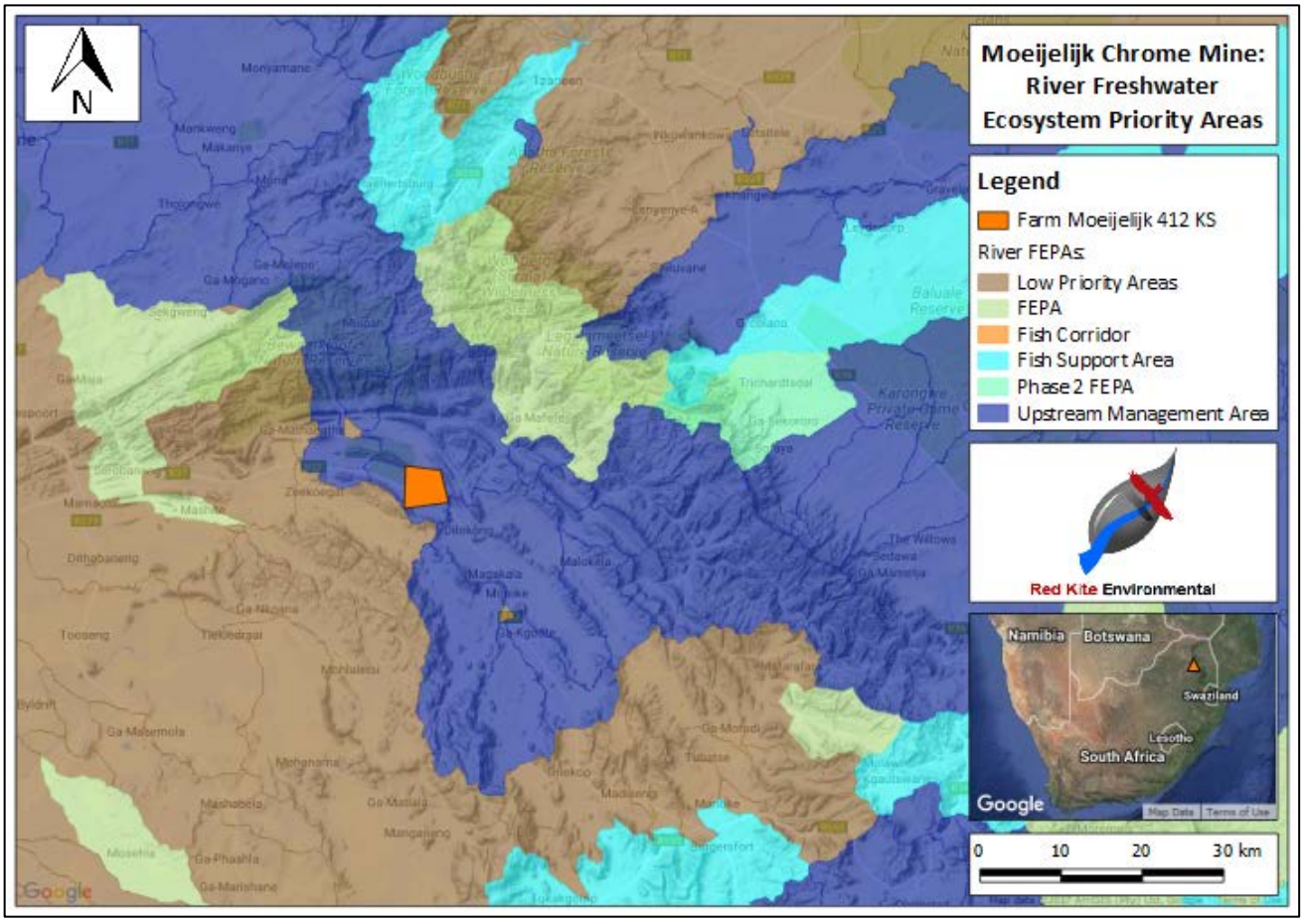


**Figure 2-6: River FEPAs applicable to the mining right area**

## 2.14. Reserve Determination

The Reserve is defined by DWS (DWA, 2013a) as that portion of the natural flow that has to be available in a river or stream in order to sustain the aquatic ecology, and also to provide for basic human needs. With regard to the ecological component of the reserve the notion is that only the portion of water in excess of the ecological reserve may be abstracted from the river as utilisable yield. For the Olifants Water Management Area (inclusive of the Letaba Catchment), the ecological reserve requirement is estimated to be 579 million $m^3/a$ (DWAF, 2004).

These figures are, however, estimates calculated at desktop level of accuracy for the NWRS and therefore do not incorporate a complete understanding of the functioning of ecosystems or habitat requirements. It is the responsibility of the Department of Water and Sanitation to provide a site-specific reserve determination for the area. The Reserve Determination of water resources for the Olifants and Letaba Catchments are underway. Comments on the proposed Reserve Determination have been invited as Government Notice No. 1038 of 22 September 2017 published in Government Gazette No. 41132.

## 2.15. Wetlands

There are no wetlands on the study area this was confirmed by the 1:50,000 ortho-maps. However, each stream, including the riparian zone (approximately 100 meters from the centre of the stream) must be considered as a sensitive aquatic environment as seepage and drainage areas in close proximity to these seasonal streams qualify as hydromorphic grasslands.

# 3. PROPOSED NEW ACTIVITIES

## 3.1. Surface Infrastructure

The expansion of existing opencast operations on the Moeijelijk Mining Right Area to access further ore deposits will require the establishment of additional surface infrastructure on site. The outline of the proposed expansion project is indicated in **Figure 3-1**. The Water Use License Application will include all relevant Engineer Design Drawings.

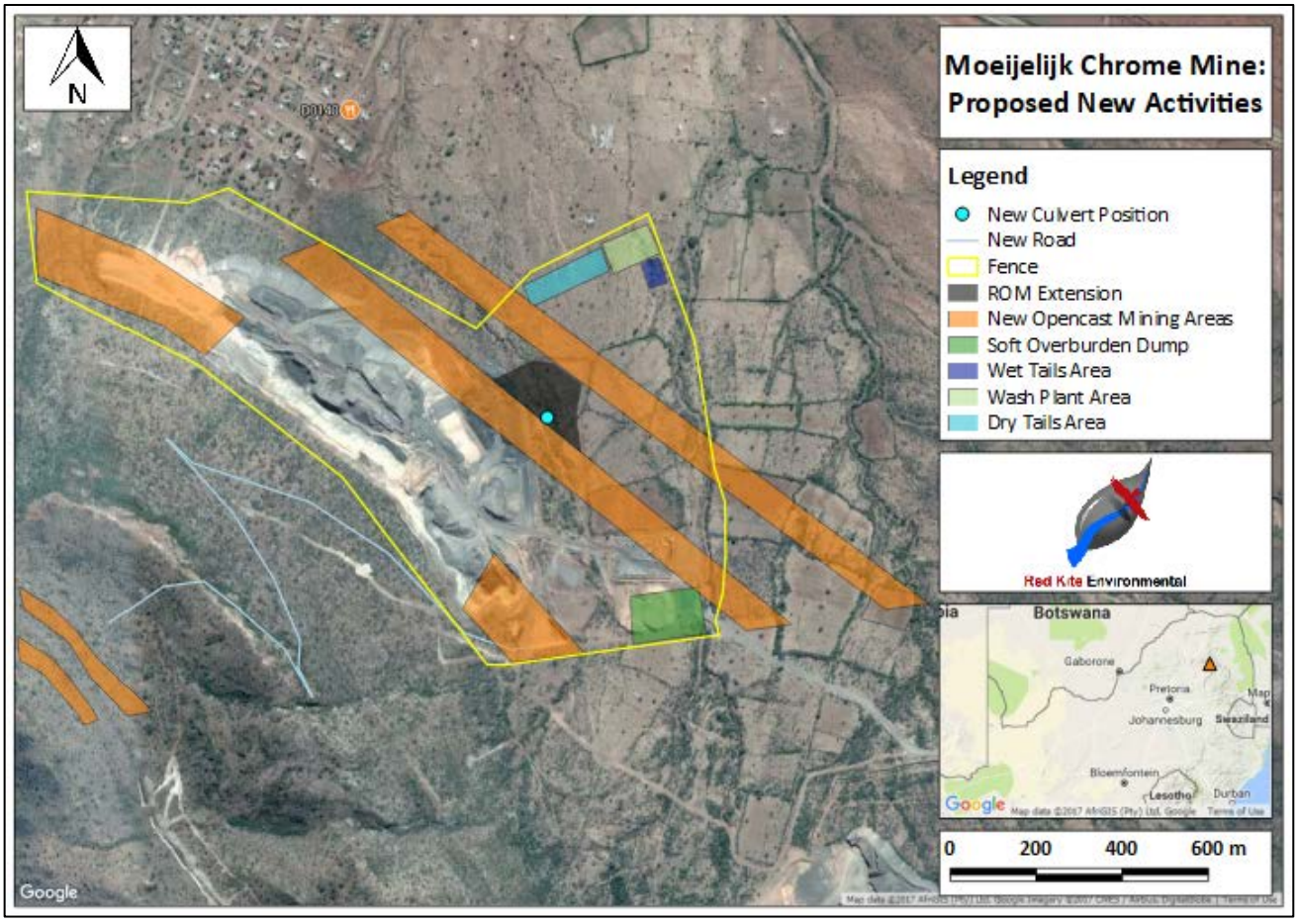


**Figure 3-1: Proposed expansion activities at the Moeijelijk Chrome Mine**

## 3.2. Storm Water Management

A formal Storm Water Management Plan will be compiled and implemented upon approval from the Department of Water and Sanitation. An accredited Engineering Institution, EcoElementum, has been appointed to design an appropriate Storm Water Management System as part of the expansion project. The main aim of such a system will be to separate clean runoff from dirty runoff which will be captured in appropriately designed containment facilities. The identified clean and dirty areas are indicated in **Table 3-1**.

**Table 3-1: Anticipated clean and dirty mining areas (current and proposed activities)**

| Classification | Description |
|---|---|
| Clean | Undisturbed land areas |
| Clean | Administrative offices |
| Clean | Surfaced roads |
| Clean | Culverts |
| Clean | Topsoil Stockpile |
| Dirty | Opencast pits |
| Dirty | Workshop and storage yards |
| Dirty | ROM |
| Dirty | Pollution control dams |
| Dirty | Overburden Dumps |
| Dirty | Wet and Dry Tails Areas |
| Dirty | Wash Plant |

## 3.1. Disturbance of Water Courses

Due to the numerous drainage lines on the study area it is not possible to place all mining infrastructure outside of the 1:50 year floodline or 100 m away from the drainage lines. As result of this, the Storm Water Design includes the diversion of clean water away from the mining area. As part of the Water Use Licensing process, the client will have to apply for exemption from the requirements of GN 704.

# 4. BUFFER DETERMINATION

## 4.1. Buffer Rationale and Methodology

Buffers are strips of land surrounding rivers or drainage lines in which activities are controlled or restricted, to reduce the impact of adjacent land uses on the riparian area. These areas are seen as part of the aquatic ecosystem and is rated the same sensitivity as the system. Buffer zones associated with water resources have been shown to perform a wide range of functions and have therefore been adopted as a standard measure to protect water resources and associated biodiversity.

Some of these key functions include:

- Maintaining basic aquatic processes.
- Reducing impacts on water resources from upstream activities and adjoining land uses.
- Providing habitat for aquatic and semi-aquatic species.
- Providing habitat for terrestrial species.
- A range of ancillary societal benefits.

Following discussions with the Department of Water and Sanitation, it was indicated that the best option for surface water management at the mining development area, would be to limit the diversion of drainage lines. It was therefore decided that the drainage line indicated in **Figure 4-1** should remain as is. The storm water diversion channel to be implemented as part of Storm Water Management should be redesigned to discharge clean surface water captured into this drainage line (receiving water body).

As the drainage line would not be affected by means of diversion it would therefore be required to apply an appropriate buffer zone to the drainage line for protection from mining activities. To scientifically determine an appropriate buffer area the methodology as indicated in the Buffer Zone Guidelines for Wetlands, Rivers and Estuaries by Macfarlane and Bredin (2017) was applied. This document provides detail on the assessment procedure and acts as the primary reference point for anyone wishing to determine an appropriate buffer zone around a river, wetland or estuary. It presents the concepts, background and technical aspects of the approach required for determining appropriate buffer zones.

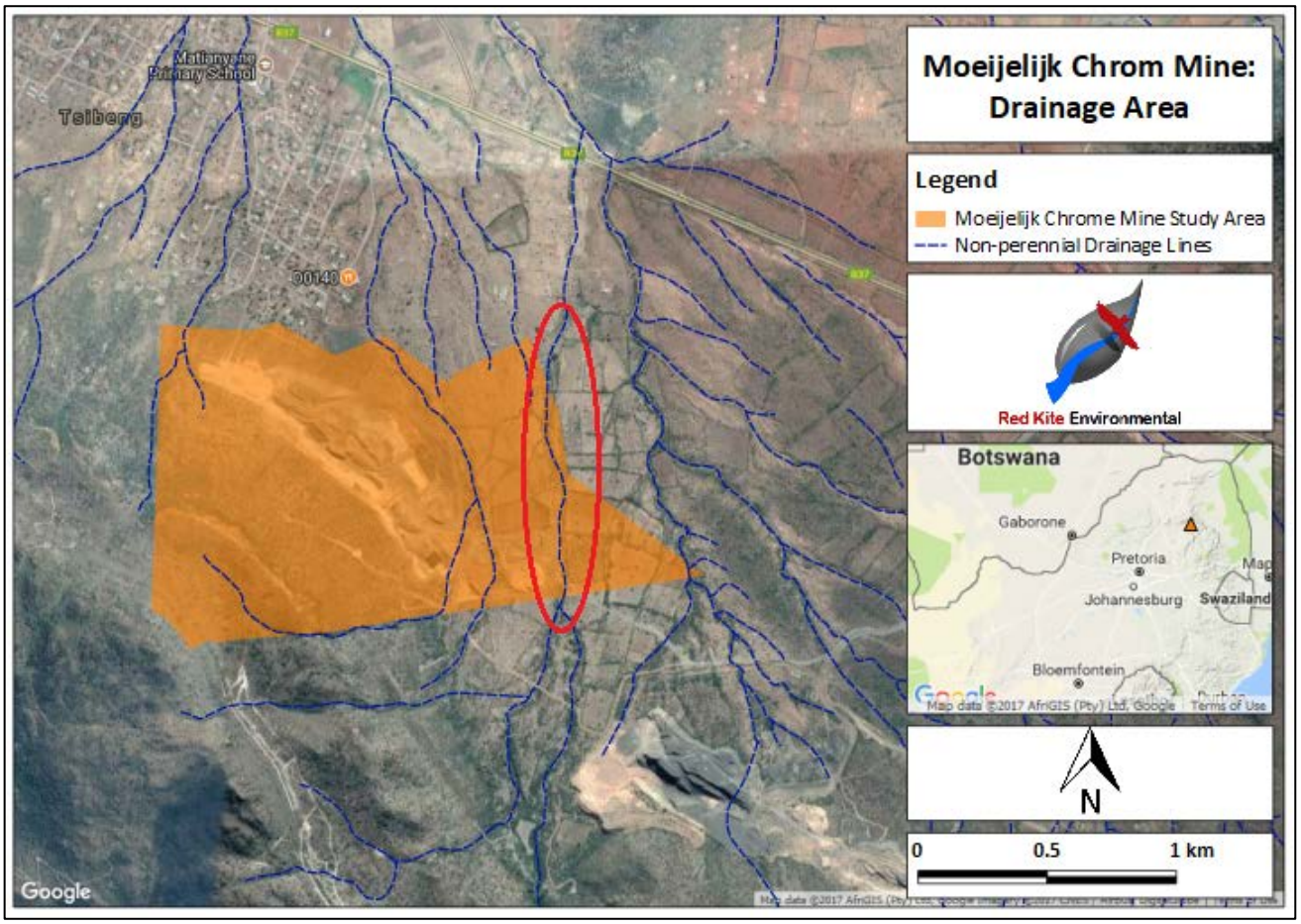


**Figure 4-1: Drainage line to remain as is (circled in red)**

## 4.2. Drainage Line Condition and Sector Selection

The baseline information was obtained from **Section 2** (Surface Water Environment) of this report. A Resource Class of "D" has been set for the B71B Quaternary Catchment within which the Moeijelijk Chrome Mine is situated. The Ecological Importance and Sensitivity for drainage lines within the study area are considered to be Low. This based on the fact that no clear indication of riparian vegetation exists, furthermore the drainage lines only contains water flow during storm events. To ensure a safe enough buffer zone area the sector selected was mining, at worst case (sub-Sector). Additional variables for the drainage line were obtained via the available Google Earth data and GIS layers (refer to **Table 4-3**).

## 4.3. Initial Threat Rating

Following determination of the drainage line condition, an initial and revised rating of threats poses by the proposed land use/activity was obtained for both the Construction and Operational Phases. This was then followed by assessing the sensitivity of important biodiversity elements to threats posed by lateral land-use impacts, if any.

### Table 4-1: Summary of drainage line condition

| | | |
|---|---|---|
| **Present Ecological State** | D | Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. |
| **Ecological importance & sensitivity** | Very Low | Features are not ecologically important and sensitive at any scale. The biodiversity of these areas is typically ubiquitous with low sensitivity to anthropogenic disturbances and play an insignificant role in providing ecological services. |
| **Management Objective** | Maintain | |

### Table 4-2: Sector Selection

| | | | |
|---|---|---|---|
| **Proposed development / activity** | **Sector** | Mining | This class comprises all mining-related activities including surface and sub-surface mining, quarrying and dredging for the extraction of minerals or materials, including sand and stone. |
| | **Sub-Sector** | Mining (worst case) | Worst-case scenario for the sector |

### Table 4-3: Variables set for the Drainage Line

| | | | | |
|---|---|---|---|---|
| **Stream order** | **Channel width** | **Perenniality** | **Average catchment slope** | **Inherent runoff potential of catchment soils** |
| 2nd order | 5 - 10m | Episodic systems | 9-11% | Moderate (B/C) |
| **Longitudinal river zonation** | **Inherent erosion potential (K factor) of catchment soils** | **Retention time** | **Inherent level of nutrients in the landscape: Is the river/stream and its catchment underlain by sandstone?** | **Inherent buffering capacity** |
| Mountain stream | 0.25 - 0.50 | Generally free-flowing (lotic) | No | Pure waters with poor pH buffering |
| **Underlying geographical formations** | **River depth to width ratio** | **Mean Annual Temperature** | **Level of domestic use** | Note: See the guideline document for further information on the rationale for indicator selection and how these attributes affect the sensitivity of Rivers to lateral inputs. |
| Primarily Palaeozoic and Mesozoic sedimentary rock formations | < 0.75 | Zone 5 (19.5 - 24.2 Deg C) | Low | |

## 4.4. Buffer Attributes and Condition

The area of the study site proposed to occupy the buffer is outlined in **Table 4-4** below.

**Table 4-4: Buffer Segment Description**

| Buffer attributes | Buffer Segment 1 |
|---|---|
| Slope of the buffer | Very Gentle (0 - 2%) |
| Vegetation characteristics (Construction phase) | Low: Sparse vegetation cover with large areas of bare soil |
| Vegetation characteristics (Operational phase) | Low: Sparse vegetation cover with large areas of bare soil |
| Soil permeability | High: Deep well-drained soils (e.g. sand and loamy sand). |
| Topography of the buffer zone | Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception. |

## 4.5. Revised Threat Rating

Following the initial Threat Rating, mitigation measures were proposed at activity attributes which were considered High threats, after which the threat was lowered to a Moderate rating. The Construction Phase of the proposed mining development is considered to pose a Low to Moderate threat, in general, without any additional mitigation measures required. Mitigation measures were specified for the Operational Phase which lowered the threat to Low to Moderate as well.

## 4.6. Final Aquatic Impact Buffer Requirements

By applying the methodology and scientific steps indicated in Macfarlane and Bredin (2017), a final buffer requirement was calculated. The Construction Phase buffer is set at 15 m, whereas the Operational Phase buffer is set at 16 m. The final aquatic buffer requirement is automatically taken as the largest of the two (refer to **Table 4-5**). It is suggested that this buffer zone be fenced off from mining activities to adequately demarcate it as no-go areas and to prevent accidental movement into the buffer zone.

**Table 4-5: Final Aquatic Buffer Calculation**

| | |
|---|---|
| Construction Phase | 16 |
| Operational Phase | 15 |
| Final aquatic impact buffer requirement | 16 |

# 5. LEGAL ASSESSMENT

## 5.1. Legislation and Guidelines to be Considered

### 5.1.1. National Environmental Management Act, 1998

The overarching principles of sound environmental responsibility are reflected in the National Environmental Management Act, Act 107 of 1998 (NEMA). The principles of the Act include:

- Environmental management must place people and their needs at the forefront of its concern[1].
- Development must be socially, environmentally and economically sustainable[2].
- That biological diversity is maintained, that pollution and degradation of the environment is avoided or minimised, that disturbance of landscapes and cultural heritage is avoided or minimised, that waste is avoided or minimised and recycled or disposed of in a responsible manner, that the use of non-renewable resources is responsible and equitable, that a risk averse and cautious approach is applied (i.e. the Precautionary Principle is used) and that negative impacts on the environment are anticipated and prevented or minimised and remedied where they cannot be avoided[3].
- Environmental management should be integrated and take into account the best practicable environmental option[4].
- Equitable access to resources, public participation, cradle to grave philosophies, transparency, application of global and international responsibilities, the Polluter Pays principle and the recognition of sensitive and stressed ecosystems[5].

The Environmental Impact Assessment (EIA) Regulations promulgated under the Environment Conservation Act (ECA) 1989, was replaced by the old EIA Regulations[6] which have been passed in terms of Chapter 5 of the National Environmental Management Act, 1998, as amended (NEMA). The repeal of the ECA EIA Regulations and its replacement with the 2010 NEMA EIA Regulations (effective from 18 June 2010) that was subsequently replaced by the 2014 EIA Regulations[7], which in turn were again replaced by the 2017 Amendments to the EIA Regulations[8]. NEMA states that before certain development activities can be undertaken, an environmental impact assessment must be followed. The environmental departments of the various provincial governments are responsible for evaluating applications that have

[1] Section 2(2) of the NEMA
[2] Section 2(3) of the NEMA
[3] Section 4(a) of the NEMA
[4] Section 4(b) of the NEMA
[5] Section 4(d)(e)(f)(k)(n)(p)(r) of the NEMA
[6] Government Gazette No. 33306 18 June 2010: R543/R544/R545/R546/R547
[7] Government Gazette No. 38282 4 December 2014: R982/R983/R984/R985
[8] Government Gazette No.40772 7 April 2017: 324/325/326/327

been submitted in terms of the EIA regulations. Based on the findings of the EIA process, a decision will be made by the Department of Mineral Resources on whether the development is authorised or refused.

The written decision previously called a Record of Decision (RoD) is now called an Environmental Authorisation. This is a legal document setting out the conditions of the authorisation and the actions required to protect human health and the environment. Any affected party may appeal against the decision contained in an environmental authorisation. Appeals must be lodged with the Minister who considers appeals in terms of the relevant provisions of NEMA and the environmental regulations.

A notable difference between the current EIA Regulations in terms of NEMA and previous EIA Regulations in terms of ECA is the stipulation of timeframes which must be adhered to.

Integrated Environmental Management (IEM) is a philosophy and procedure for ensuring that environmental considerations are fully integrated into all stages of the development process. This philosophy aims to achieve a desirable balance between conservation and development. The aim of the IEM guidelines is to ensure a pro-active approach to sourcing, collating and presenting information at a level that can be interpreted at all levels.

### 5.1.2. National Environmental Management Waste Act, 2008

The National Environmental Management Waste Act, Act 59 of 2008 (NEMWA) came into effect on 1 July 2009 and aims to:

- Reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.
- Provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government.
- Provide for specific waste management measures.
- Provide for the licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; and to
- Provide for compliance and enforcement; and to provide for matters connected therewith.

The regulations pertaining to the NEMWA activities were published on 29 November 2013 in Government Gazette 37083 under GN 921[9], as amended[10].

[9] Government Gazette No. 37083 29 November 2013: GN No. 921
[10] Government Gazette No.37604 2 May 2014: GN No.332

### 5.1.3. National Water Act, 1998

The National Water Act, Act 36 of 1998 aims to manage the national water resources to achieve sustainable use of water for the benefit of all water users. This requires that the quality of water resources is protected and also requires integration of the management of water resources with the delegation of powers to institutions at the regional or catchment level.

The purpose of the Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways, which take into account:

- Meeting the basic human needs of present and future generation
- Promoting equitable access to water
- Redressing the results of past racial discrimination
- Promoting the efficient, sustainable and beneficial use of water in the public interest
- Facilitating social and economic development
- Providing for the growing demand of water use
- Protecting aquatic and associated ecosystems and their biological diversity
- Reducing and preventing pollution and degradation of water resources
- Meeting international obligations
- Promoting dam safety; and
- Managing floods and droughts

Water uses are authorised under the following Sections of the National Water Act:

- Section 39: General Authorisation
- Section 40: License

There are 11 water uses described in Section 21 of the National Water Act:

(a) taking water from a water resource;
(b) storing water;
(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a stream-flow reduction activity contemplated in section 36;
(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
(f) discharging waste or water containing waste into a water resource through a pipe, canal, Sewer, sea outfall or other conduit;
(g) disposing of waste in a manner which may detrimentally impact on a water resource;
(h) disposing in any manner of water which contains waste from, or which has been heated in any industrial or power generation process;
(i) altering the bed, banks. course or characteristics of a watercourse;

(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

(k) using water for recreational purposes.

The above is regulated by the following:

- Government Gazette No. 40713 of 24 March 2017: No. R.267: Regulations regarding the Procedural Requirements for Water Use License Applications and Appeals.
- Government Gazette No. 40229 of 26 August 2016: No. 509: General authorisation in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i).
- Government Gazette No. 40243 of 2 September 2016: No.538: Revision of General Authorisation for the Taking and Storing of Water (Section 21(a) and Section 21(b)).
- Government Gazette No. 36820 of 6 September 2013: No. 665: Revision of General Authorisations in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998), (Sections 21(e)(f)(g)(h) and (j)).

Regulations specific to mining are the following:

- Government Gazette No. 32935 of 12 February 2010: No. R.77 which replaced Government Notice 704 (GN704) of 4 June 1999. However most Department officials still refer to GN704.

### 5.1.4. Other Legislation

In addition to the foregoing, the project must also comply with the provisions of other relevant international and national legislation and conventions, which includes the following:

- Constitution of South Africa, 1996 (Act 108 of 1996);
- Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965);
- Hazardous Substances Act and Regulations, 1983 (Act 85 of 1983);
- National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004);
- National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003):
- National Heritage Resources Act, 1999 (Act 25 of 1999);
- National Nuclear Energy Regulator Act, 1999 (Act 47 of 1999);
- National Parks Act, 1976 (Act 57 of 1976);
- National Spatial Biodiversity Assessment, 2011 (as available from South African National Biodiversity Institute (SANBI));
- Nuclear Energy Act, 1999 (Act 46 of 1999);
- Occupational Health and Safety Act, 1993 (Act 85 of 1993) and Major Hazard Installation Regulations;
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

## 5.2. Moeijelijk Chrome Mine Water Use Authorisation

Bauba A Hlabirwa Mining Investment (Pty) Ltd adheres to the requirements of the National Water Act (NWA), 1998 (Act No. 36 of 1998) in terms of their Water Use Authorisation. A Water Use License in terms of Section 40 of the NWA is applicable and has been granted. However, for their future planned activities, Bauba would once more, be required to apply for additional water uses which will be triggered by the expansion activities.

The following Section 21 water uses will need to be applied for in terms of the National Water Act (Act No. 36 of 1998):

- Section 21 (a) for the abstraction of groundwater
- Section 21(c) for impeding the flow in a water course;
- Section 21(g) for the disposing of waste in a manner that may detrimentally impact on a water resource;
- Section 21(i) for altering the bed, banks, course or natural characteristics of a watercourse;

## 5.3. GN 704

In addition to the above Moeijelijk Chrome Mine also needs to adhere to Government Notice 704 as published on 4 June 1999. Regulation 704 (Government Gazette 20118) was drawn up to address the issues in relation to mining activities. Most impacts must be managed according to Condition 4, which describes the locality of infrastructure and mining activities: Condition 6, which deals with the capacity requirements of clean and dirty water systems; and Condition 7, which describes the measures which must be taken to protect water resources. The Regulation requires containment to ensure that clean and dirty water systems cannot spill into each other more than once in 50 years. However, without detailed hydrographs it is not possible to apply this condition. To assist in planning and design, this condition has been interpreted as requiring containment of the 1:50 year storm event, over and above standard operating levels as detailed in DWAF's M6.1 Guideline.

In terms of the linkages of GN704 with other requirements of the National Water Act, it is stated in Operational Guideline No. M6 that should an exemption from any requirements of GN704 imply the necessity for a water use licence, the person in control of the mine or activity need only apply for a licence. The licence has higher authority than the GN704. The Moeijelijk Mining Area was evaluated using GN704 and the outcome is indicated in **Table 5-1**.

**Table 5-1: Compliance with the GN704 conditions**

| Section | Compliance | Exemption |
|---|---|---|
| **4. Restrictions on locality** | | |
| No person in control of a mine or activity may-<br>(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line 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 | NO | Must be applied for in WULA |

| Section | Compliance | Exemption |
|---|---|---|
| on ground likely to become water-logged, undermined, unstable or cracked;<br>(b) except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;<br>(c) 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<br>(d) 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. | NO<br>YES<br>NO | Must be applied for in WULA<br>Until final rehabilitation takes place<br>Must be applied for in WULA |
| **5. Restrictions on use of material** | | |
| No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource. | NO | Must be applied for in WULA/request exemption |
| **6. Capacity requirements of clean and dirty water systems** | | |
| Every person in control of a mine or activity must-<br>(a) confine any unpolluted water to a clean water system, away from any dirty area;<br>(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;<br>(c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;<br>(d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and<br>(e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level, unless otherwise specified in terms of Chapter 12 of the Act.<br>(f) design, construct and maintain all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of once in 50 years. | YES<br>YES<br>YES<br>YES<br>YES<br>YES | |
| **7. Protection of water resources** | | |
| Every person in control of a mine or activity must take reasonable measures to-<br>(a) prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water | YES | |

| Section | Compliance | Exemption |
|---|---|---|
| resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act; | | |
| (b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics; | YES | |
| (c) cause effective measures to be taken to minimize the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings; | YES | |
| (d) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, tailings, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof; | YES | |
| (e) prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources; | Yes | |
| (f) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time; | YES | |
| (g) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; and | YES | |
| cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act. | YES | |
| **8. Security and additional measures** | | |
| Every person in control of a mine or activity must- | | |
| (a) cause any impoundment or dam containing any poisonous, toxic or injurious substance to be effectively fenced-off so as to restrict access thereto, and must erect warning notice boards at prominent locations so as to warn persons of the hazardous contents thereof; | YES | |
| (b) ensure access control in any area used for the stockpiling or disposal of any residue or substance which causes, has caused or is likely to cause pollution of a water resource so as to protect any measures taken in terms of these regulations; | YES | |

| Section | Compliance | Exemption |
|---|---|---|
| (c) not allow the area contemplated in paragraph (a) and (b) to be used for any other purpose, if such use causes or is likely to cause pollution of a water resource; and | YES | |
| (d) protect any existing pollution control measures or replace any existing pollution control measures deleteriously affected, damaged or destroyed by the removing or reclaiming of materials from any residue deposit or stockpile, and establish additional measures for the prevention of pollution of a water resource which might occur, is occurring or has occurred as a result of such operations. | YES | |
| **9. Temporary or permanent cessation of mine or activity** | | |
| (1) Any person in control of a mine or activity must at either temporary or permanent cessation of operations ensure that all pollution control measures have been designed, modified, constructed and maintained so as to comply with these regulations. | YES | |
| (2) Any person in control of a mine or activity must ensure that the in-stream and riparian habitat of any water resource, which may have been affected or altered by a mine or activity, is remedied so as to comply with these regulations. | YES | |
| (3) On either temporary or permanent cessation of a mine or activity the Minister may request a copy of any surface or underground plans as required in terms of the Minerals Act, 1991. | YES | |
| **12. Technical investigation and monitoring** | | |
| (6) Subject to Chapter 4 of the Act, any person in control of a mine or activity must submit plans, specifications and design reports approved by a professional engineer to the Minister, not later than 60 days prior to commencement of activities relating to- | | |
| (a) the construction of any surface dam for the purpose of impounding waste, water containing waste or slurry, so as to prevent the pollution of a water resource; | YES | |
| (b) the implementation of any pollution control measures at any residue deposit or stockpile, so as to prevent the pollution of a water resource; and | YES | |
| (c) the implementation of any water control measures at any residue deposit or stockpile, so as to prevent the pollution of a water resource. | YES | |

# 6. POTENTIAL SURFACE WATER IMPACTS

## 6.1. Impact Assessment Methodology

All forms of development will have an immediate effect on the natural environment. It is therefore of utmost importance to provide information on the environmental consequences these activities will have and to inform the decision-makers thereof. The assessment of aspects which might potentially impact on the environment must adhere to the minimum requirements as recorded in the EIA Regulations, 2014, and should take applicable official guidelines into account. An explanation of the impact assessment criteria that will be applied during the Environmental Assessment is provided in the sections to follow.

### *6.1.1. Impact Assessment Criteria*

An impact significance rating and evaluation form part of the Impact Assessment. The majority of the identified and anticipated negative impacts listed below will only take effect once the construction of the proposed activity commences. The main period of positive impact occurrence is during the long term operational phase of the project when it is felt that the broader community will benefit from the project.

There are numerous assessment methodologies and approaches within the international sphere of assessing the potential impact of development activities on the environment. When a particular method for environmental impact analysis is selected or used certain general principles must be kept in mind. In general terms an environmental assessment evaluation comprises four main tasks which include:

1. Collection of data;
2. Analysis and interpretation of this data;
3. Identification of significant environmental impacts; and
4. Communication of the findings.

The selected impact evaluation method must enable these four tasks. Impact methodologies provide an organised approach for predicting and assessing the potential impacts. Any one methodology and approach will have opportunities and constraints, as well as resource and skill demands, and no one method is appropriate for all South African circumstances. The selected methodologies proposed by this document are appropriate for most South African situations, taking the above aspects into account.

The Impact assessment methodology should comply with the following set of criteria:

- *Be comprehensive:* The environment consists of intricate systems of biotic and abiotic factors, bound together by complex relationships. The methodology must consider the impact on these factors.

- *Be flexible:* Flexibility must be contained in the methodology, as projects of different size and scale result in different types of impacts.
- *Detect true impact:* The actual impact that institutes environmental change, as opposed to natural existing conditional changes. Long-term and short-term changes should be quantified.
- *Be objective:* The methodology must be objective and unbiased, without interference from external decision-making.
- *Ensure input of required expertise:* Sound, professional judgement must be assured by a methodology.
- *Utilize the state of the art:* Draw upon the best available analytical techniques.
- *Employ explicitly defined criteria:* Evaluation criteria used to assess the magnitude of environmental impacts should not be arbitrarily assigned. The methodology should provide explicitly defined criteria and explicitly stated procedures regarding the use of these criteria, including the documented rational.
- *Assess actual magnitude of impacts:* A method must be provided for an assessment based on specific levels of impact for each environmental concern.
- *Provide for overall assessment of total impact:* Aggregation of multiple individual impacts is necessary to provide an evaluation of overall total environmental impact.
- *Pinpoint critical impacts:* The methodology must identify and emphasize particularly hazardous impacts.

### 6.1.2. Impact Significance Rating

The evaluation of impact significance has been adapted from the Risk Assessment Key provided in the General Authorisation for Section 21(c) and (i) water uses (DWS, 2016c). The framework of the methodology used in the impact assessment is described below, and fully explains the rating procedure used and how the construction and operation values given in **Table 6-4** were derived.

The Significance of Environmental Impacts is the product of Consequence and Likelihood. To calculate Consequence it is required to rate the Severity, Spatial Scale and Duration of an impact. The rating scores of these aspects are then summed to provide a Consequence Score (see Equation 1 below). The rating scales for these three aspects are provided in **Table 6-1**.

Equation 1: Consequence = Severity + Spatial Scale + Duration

**Table 6-1: Risk Assessment Key for Consequence Calculation**

| Description/Meaning | Score |
|---|---|
| **SEVERITY** | |
| Insignificant/Non-harmful | 1 |
| Small/Potentially harmful | 2 |
| Significant/Slightly harmful | 3 |
| Great/harmful | 4 |

| | |
|---|---|
| Disastrous/Extremely harmful and/or wetlands involved | 5 |
| **SPACIAL SCALE** | |
| Area specific (at impact site) | 1 |
| Whole site (entire surface right) | 2 |
| Regional/Neighbouring areas (downstream within quaternary catchment) | 3 |
| National (impacting beyond secondary catchment or provinces) | 4 |
| Global (impacting beyond SA boundary) | 5 |
| **DURATION** | |
| One day to one month (PES, EIS and/or REC not impacted) | 1 |
| One month to one year (PES, EIS and/or REC impacted but no change in status | 2 |
| One year to 10 years (PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation | 3 |
| Life of the activity (PES, EIS and/or REC permanently lowered) | 4 |
| More than life of the organisation/facility (PES and EIS scores a E or F) | 5 |

To calculate Likelihood it is required to rate the Frequency of the Activity, Frequency of the Incident/Impact, Legal Issues and Detectability of the impact. The rating scores of these aspects are then summed to provide a Likelihood Score (see Equation 2 below). The rating scales for these four aspects are provided in **Table 6-2**.

Equation 2: Likelihood = Frequency of Activity + Frequency of Impact + Legal Issues + Detection

**Table 6-2: Risk Assessment Key for Likelihood Calculation**

| Description/Meaning | Score |
|---|---|
| **FREQUENCY OF THE ACTIVITY** | |
| Annually or less | 1 |
| 6 Monthly | 2 |
| Monthly | 3 |
| Weekly | 4 |
| Daily | 5 |
| **FREQUENCY OF THE INCIDENT/IMPACT** | |
| Almost never/almost impossible/>20% | 1 |
| Very seldom/ highly unlikely/>40% | 2 |
| Infrequent/Unlikely/Seldom/>60% | 3 |
| Often/Regularly/Likely/Possible/>80% | 4 |
| Daily/Highly likely/Definite/>100% | 5 |
| **LEGAL ISSUES** | |
| No Legislation | 1 |
| Fully covered by legislation (wetlands are legally governed) | 5 |
| **DETECTION** | |
| Immediately | 1 |
| Without much effort | 2 |
| Need some effort | 3 |
| Remote and difficult to observe | 4 |
| Covered | 5 |

Following the determination of Consequence and Likelihood, the Impact Significance/Risk can then be determined by multiplying the Consequence Score with the Likelihood Score (see Equation 3).

Equation 3: Significance/Risk = Consequence x Likelihood

The Significance Rating calculated without mitigation is then ranked according to its calculated score. **Table 6-3** below indicates the Significance Rating per score calculated.

**Table 6-3: Significance Rating of impact**

| RATING | CLASS | MANAGEMENT DESCRIPTION |
|---|---|---|
| 1-55 | Low Risk | Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded. |
| 56-169 | Moderate Risk | Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded. |
| 170-300 | High Risk | Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. |

### 6.1.3. Impact Mitigation

Following the assessment of impacts "without mitigation" appropriate mitigation measures must be applied to limit the potential impact. To gain a comprehensive understanding of the overall significance of the impact, after the implementation of the mitigation measures, it will be necessary to re-evaluate the impact.

## 6.2. Risk Assessment

This section of the report evaluates the potential impacts of the proposed expansion project and related infrastructure on the receiving surface water environment. The significance of the impacts was determined using the criteria given in **Section 6.1** above. The impact assessment will provide an evaluation of the significance of the Construction Phase, Operational Phase and Closure Phase of the project.

The study site has historically been impacted on by chrome mining and related water use activities. These existing infrastructures have already impacted the non-perennial drainage lines on site. A summary of all identified possible impacts of proposed new activities and infrastructure on the surface water environment together with mitigation measures is provided in **Table 6-4**. Refer to **APPENDIX 1** for the detailed Impact Assessment Register.

### 6.2.1. Construction Phase

A short construction phase will commence and will entail the following activities:

- Stripping of topsoil;
- Construction of the box cut/ opencast;
- Stockpiling of topsoil, subsoil and overburden;
- Construction of storm water drains;
- Construction of Wash Plant;
- Construction of wet and dry tails areas;
- Extension of the ROM;
- Construction of a new access road and a new culvert; and
- Erection of fencing.

### 6.2.2. Operational Phase

This phase entails the period during which mining operations are in progress. With the implementation of concurrent rehabilitation, the operational phase will overlap with the decommissioning phase. The following activities are related to the operational phase:

- Stockpiling of overburden, subsoil and topsoil;
- Stockpiling of ROM ore;
- Discharge of clean water diversions and road runoff;
- Silting of culverts and receiving water bodies;
- Extraction of chrome from opencast mining;
- Haulage of ROM product to the wash plant; and
- Wet and dry tails areas.

### 6.2.3. Closure Phase

This phase commences at the stage when all mining activities have ceased and entails the following activities:

- Sealing of boundary pillar;
- Filling of final voids;
- Removing of haul roads and 100 mm of underlying material;
- Clearing of stockpile areas and rehabilitation;
- Redesign of storm water management measures incorporating passive water treatment by means of artificial wetlands;
- Removal of stockpile (topsoil); and
- Initiating of monitoring programme.

**Table 6-4: Identification and quantification of potential impacts on the surface water environment**

| No | Phase | Impact | WOM | WM | Mitigation/Management Measures |
|---|---|---|---|---|---|
| 1 | Co, O, Cl | Alteration of drainage lines by impacting their natural course. Impact on catchment yield by capturing runoff and diverting the drainage systems. Degradation of stream channels through long-term reduced runoff and periodic discharge of high volumes. | Moderate | Low | Define the runoff/flood characteristics of the study site and design storm water management facilities accordingly. This will ensure appropriate separation of clean and dirty storm water and will maximise the return of clean water to the downstream drainage system. Keep the dirty area footprint as small as possible and capture all dirty storm water generated on site for potential re-use. Adherence to the Storm Water Management Plan as compiled by an accredited engineer is crucial. |
| 2 | Co | Pouring of concrete may result in concrete spills into the aquatic system. Disturbance and disruption of the natural flow regime as result of construction over surface water features. | Moderate | Low | The containment area for concrete pouring works should be expanded vertically to exceed pouring depth to facilitate overspill and horizontally with concrete absorbing materials (such as a Biddim blanket) to catch any overspills. Use concrete pump truck with telescopic arm to facilitate precision placement of concrete. Any concrete spills should immediately be cleaned and appropriately disposed of. |
| 3 | Co | Disturbance and disruption of the natural flow regime as result of construction over surface water features. | Moderate | Low | Installation of the required river crossings should be done in accordance with the Rehabilitation Plan. Topsoil must not be placed on exotic plants that can propagate when the topsoil is replaced. The infrastructure must be placed into the excavation as soon as possible to avoid the trench becoming a death trap to small animals. Soil must be replaced in the order it was removed. The top soil must be compacted to prevent erosion, but only to pre-construction levels. Once rehabilitation is complete the site must be monitored to detect any areas where soil stabilising or settling has taken place. Areas where settling takes place must be filled to pre-construction level. |
| 4 | Co, Cl | Exposed surfaces could result in increased erosion and associated runoff which in turn may result in increased siltation of surface streams. | Low | Low | Silt screens/sandbags could be employed on exposed areas. The construction contractor must monitor the formation of erosion channels and must repair these as required. All erosion channels which develop during construction should be backfilled and consolidated as required. Construction should take place during the dry season. Grass and vegetation removal should be limited to the footprint of the proposed project. |

| No | Phase | Impact | WOM | WM | Mitigation/Management Measures |
|---|---|---|---|---|---|
| 5 | Co, Cl | Exposed surfaces together with increased traffic on-site could result in increased siltation of surface water streams by excessive dust generation. | Low | Low | Watering and compacting of exposed surfaces where dust is generated must be conducted and strictly monitored. Vegetation removal should be limited to the footprint of the proposed project. A speed limit of 20 km/h must be imposed on construction vehicles. |
| 6 | Co, O, Cl | Inadequate maintenance of mobile sanitary facilities could result in spillage of sewage waste which could contaminate runoff to drainage lines. | Low | Low | Mobile sanitary facilities must be inspected regularly and adequately maintained by an approved contractor to prevent any spills/leaks from occurring. Mobile sanitary facilities must be located outside the applicable buffer zones. Ensure that an adequate number of mobile toilets are available for workers on site. |
| 7 | Co, O, Cl | An increase in traffic and the additional logistics may result in hydrocarbon spillages which could in turn result in contaminated runoff reaching drainage lines. | Moderate | Low | Spills resulting from vehicle maintenance or as result of the storage of hydrocarbon materials must immediately be cleaned and properly disposed of. Petroleum (and other hazardous materials) storage areas should be effectively bunded and applicable safety standards must be adhered to. Hazardous materials and chemicals must be stored on solid concrete surfaces. Storage containers must be inspected regularly for leaks and repaired as needed. Maintain parking areas and roads in good conditions for the duration of operations. No unauthorised washing of vehicles should be allowed on the premises. |
| 8 | O | Increased risk of surface water pollution as result of poor water quality within the opencast sections. Overflow could occur during storm events. Pipelines carrying contaminated water could burst, leak, or discharge during maintenance. | High | Low | Storm water runoff generated on the mining site should be directed to and contained within the lined Pollution Control Dams. Design waste water containing structures according to applicable standards. Immediate action must be taken to contain spillage. The dams must be inspected regularly for early detection of leaks. Ensure that pipelines are of a hard enough material to withstand damage. |
| 9 | Co, O | Solid waste could reach drainage lines if not correctly disposed of. | Low | Low | Uncontrolled disposal of waste near any construction site must be communicated to all contractors as unacceptable. All waste should be placed in a central collection point and removed from the site. Encourage and implement the separation and recycling of general waste. Place refuse bins on strategic places to encourage the disposal of litter to these bins. Erect |

| No | Phase | Impact | WOM | WM | Mitigation/Management Measures |
|---|---|---|---|---|---|
| | | | | | notices to inspire the staff to keep their environment clean and hazardous free. Inspect all on-site disposal sites regularly to ensure adherence to all legal requirements. Inspect all contractors and disposal agents, premises and sites regularly to ensure that all environmental and legal requirements are adhered to. |
| 10 | O | Seepage and runoff from stockpile areas are moderately contaminated and could impact on surface water quality. | Moderate | Low | Storm water runoff generated at stockpile areas should be directed to and contained within the lined Pollution Control Dams. Appropriate management measures should be implemented to drain any seepage to the lined PCDs. Dirty water should be re-used wherever practical. |
| 11 | Cl | Acidic leachate (AMD) could result in pollution of receiving water environment. | Moderate | Low | Low to Moderate risk of developing Acid Mine Drainage at the Moeijelijk Mine. Acidic leachate and decant to be contained in bunded areas and directed to a lined evaporation dam. Appropriate rehabilitation should be implemented in accordance with the Rehabilitation Plan. |

# 7. ENVIRONMENTAL MANAGEMENT

## 7.1. Key Objectives for Sustainable Development

Mining cannot be considered sustainable since it relies on the exploitation of non-renewable resources. However, if mining can contribute towards quality of life and has an overall positive impact with its interaction with the environment, mining can be regarded as a sustainable activity. The following objectives are listed to be achieved as part of sustainable development:

- Interaction with key stakeholders in terms of the project, design and planning in addressing community issues;
- Maintain ongoing and transparent communications with stakeholders;
- Demonstrate corporate and social responsibility; and
- Prevent and manage undue expectations of the project on the part of the regional stakeholders and local communities.

## 7.2. Integrated Water Resource Management

The Interim Strategic Perspective (ISP) for the Olifants River WMA endorses the concept of Integrated Water and Waste Management as the social, political and environmental criteria needs to be considered in water resource planning and management. The objective is to ensure that conformity exists between water resource management plans and programmes of water use authorities (CMA's or WUA's) and the plans and programmes of the water user as depicted in their EMP's or IWWMP's.

This integrated planning and management is to be achieved through co-operative governance and public participation to enable water managers to meet the needs of all people for water, employment, socio-economic upliftment and economic growth in a manner that is sustainable by means of allowing for protection, utilization and development of water resources.

## 7.3. Water Use and Management

The mine will follow a zero discharge policy and water management infrastructure will be designed in accordance with the requirements as contained in GN 704 Regulations. In this instance clean water separation will be induced allowing direct runoff towards natural watercourses. Surfaces within the dirty areas will be kept to a minimum to reduce the volume of dirty runoff generated by mining activities. This affected water will be collected in a settling pond from where the dirty water will be recycled for further use.

## 7.4. Surface Water Management

The following surface water management objectives will be applicable for the proposed expansion activities at the Moeijelijk Chrome Mine:

- Identify any potential risks from the project on the surface water resource;
- Protect and conserve the aquatic and surface water environment from any impacts;
- Prevent the aquatic and surface water environment from degrading due to the activities of the mine;
- Optimize water use on the mine;
- Strive for zero effluent discharge site;
- Preserve the water resources in line with the management objectives of the CMA/DWS for the management unit;
- Water use authorisation to be obtained from the relevant regulatory body; and
- To ensure compliance with GN 704.

## 7.5. Storm Water Management

Storm water management will be based on the objective of separating clean water from dirty water and therefore encompass the key principle of pollution prevention. The following objectives will apply:

- Keep clean water clean;
- Collect and contain dirty water;
- Ensure sustainable storm water management over mine life cycle; and
- Compliance with Regulations as contained in GN 704.

## 7.6. General Management Measures

- Quantitative and qualitative assessment of the water resources on the mining property to effectively conduct integrated Water Resource Management;
- Optimise water use by means of waste minimisation, reuse and recycling;
- Effective and efficient use of the existing available water resources in all water use sectors within the mine (WCDM);
- Responsible development in a water stressed area taking a sympathetic stance on the water needs of the local population;
- Minimisation and where possible prevention of water pollution stemming from mining activities by compliance with and adherence to management commitments as specified in the EMPR;
- Appropriate storm water management over the entire footprint of the project area to ensure reduction in silt load and erosion, especially from the extensive overgrazed areas; and
- Assessment of the cumulative impacts from adjacent mines with the implementation of appropriate management measures to ensure sensitive downstream water users are not detrimentally impacted.

The Bauba a Hlabirwa Moeijelijk Chrome Mine, as an opencast as well as an underground mining activity is committed to rehabilitating the mining area on the Farm Moeijerlik 412 KS in an environmentally responsible manner, with a balanced

approach by adequately and sufficiently managing negative environmental impacts on surface water to within acceptable limits. The remediation of negative impacts will as far as possible be based on the principle of Best Environmental Option (BEO) in conjunction with the specifications and requirements of the DWAF's Best Practice Guidelines for mining related activities. This would ultimately ensure the implementation of technically proven and acceptable remediation and rehabilitation measures. Proposed new techniques will be evaluated once they become available. These techniques will be implemented once proven effective, viable, feasible and sustainable.

# 8. SURFACE WATER MONITORING PROGRAMME

## 8.1. Natural Surface Water Features

It is noted that the drainage lines on site are completely dry for the majority of the year and does not contain water significant for sampling. Furthermore, the drainage lines show no form of riparian habitat. It is not anticipated that mining operations will have a significant impact on drainage lines. The drainage lines to be affected will be diverted in accordance with the civil design report. The only direct impact would be the installation of a new river crossing (culvert). Monitoring of the culvert construction should be conducted as per the Rehabilitation Plan.

As no flowing water has been available for sampling on site since issuance of the Mine's first Water Use License in 2015, it is suggested that, if and when a storm event occurs, a grab sample be taken for analyses. Due to the lack of surface water on site, a monthly/quarterly/annual monitoring plan is not feasible. In the event that a grab sample is possible, it should be analysed for the parameters indicated in **Table 8-1** below.

**Table 8-1: Surface water variables to be analysed**

| Variable | Unit | Frequency |
|---|---|---|
| pH | | When possible |
| Electrical Conductivity as EC | mS/m | When possible |
| Suspended solids as SS | mg/l | When possible |
| Total Dissolved Solids as TDS | mg/l | When possible |
| Sulphate as $SO_4$ | mg/l | When possible |
| Nitrate as $NO_3$ | mg/l | When possible |
| Sodium as Na | mg/l | When possible |
| Chloride as Cl | mg/l | When possible |
| Calcium as Ca | mg/l | When possible |
| Potassium as K | mg/l | When possible |
| Magnesium as Mg | mg/l | When possible |
| Total hardness as $CaCO_3$ | mg/l | When possible |
| Total alkalinity | mg/l | When possible |
| Fluoride as F | mg/l | When possible |
| Aluminum as Al | mg/l | When possible |
| Iron as Fe | mg/l | When possible |
| Manganese as Mn | mg/l | When possible |

There are many surface drainage channels on site, all of which are characterised as non-perennial. It is suggested that, if and when a storm event occurs, surface water quality monitoring take place at the points as indicated in **Table 8-2**.

**Table 8-2: Proposed surface water monitoring points**

| Sampling point | Coordinates |
|---|---|
| Upstream | S 24º 18' 25.20" E 29º 57' 29.47" |
| Downstream | S 24º 17' 45.43" E 29º 57' 29.47" |

## 8.2. Artificial Surface Water Features

In addition, monitoring of the water quality in the pollution control dams is and will continue to be conducted on a quarterly (October, January, April, July) basis and include the variables as specified in **Table 8-1**. The water quality is representative of:

- Seepage/run off from the mining areas.
- Seepage from waste rock dump.
- Dewatering of the open pit.
- Potential impacts from upstream mining.

Once the mine moves towards decommissioning and closure, the monitoring programme will have to be updated and upgraded to cover the monitoring needs related to the specific closure objectives. Due to the fact the mining area is located in the upper reaches/head waters of the unnamed tributary no upstream monitoring points are anticipated. It is proposed that the mine monitors the streams directly after a rainy event.

# 9. CONCLUSION

The primary surface water impacts associated with the proposed expansion are the potential impacts on water quality degradation due to incidental waste discharges and storm water management at the project site, especially during the construction phase as well as the impact on surface water quantity due to the diversion of drainage lines. While the chemical and physical characteristics of the water itself are good (as determined using the DWS sampling points both located upstream), biological indices indicated that the system is already moderately impacted.

In terms of findings related to the overall surface water environment relevant to the study site the following conclusions are made:

- The study area, inclusive of existing and proposed activities, is situated within Quaternary Catchment B71B of the Olifants Water Management Area.
- The B71B Quaternary Catchment is characterised by a network of unnamed non-perennial tributaries of the Moshashaneng River, all flowing in a general northern direction to ultimately feed into the perennial Olifants River.
- It is evident that runoff from the Moeijelijk Chrome Mine feeds tributaries of the Moshashaneng River.
- According to NFEPA the study area is situated within an upstream management area. Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river Freshwater Priority Areas and Fish Support Areas.
- The resource class set for the B71B Quaternary Catchment by DWS is Class D, largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
- The study site has historically been impacted on by chrome mining and related water use activities. These existing infrastructures have already impacted the non-perennial drainage lines on site.
- No wetlands occur within the study area.
- The Integrated Unit of Analyses (IUA) relevant to the study area is classified as Class II: indicating moderate protection and moderate utilisation.

The identified water users within this area are agriculture, with dry land farming (maize and soybeans), livestock and grazing (cattle) evident. Rural farming communities are also dependant on the water resources for their potable supply. Chrome and platinum mining as an industrial water user could be seen as the potential biggest impactor in the catchment.

The impact on the surface water area could be seen as moderate to high without the implementation of mitigation measures. With the implementation of mitigation management measures the impact of the development on the surface water environment is ranked as a low significance.

Considering that adequate hydrologic and geohydrological data had been gathered through specialist investigations coupled with the fact that ongoing data collection could fill the knowledge gaps, the mine would be in a position to implement an integrated water management plan with the main objective of reducing water resource and environmental degradation.

An Integrated Water and Waste Management Plan (IWWMP) needs to be compiled as a technical supporting document for the water use authorisation process. The Environmental Management Plan (EMP) for the proposed expansion should address good waste management practices, guidelines for the storage, handling, use and disposal of waste, etc. It is important that the project aim to limit impacts on the aquatic resources as far as possible in order to maintain its current basic ecosystem functions.

All mitigation measures that were provided within this report should be implemented and included in the relevant management plans. If all mitigation is adhered to, the combined impact could be rated as low.

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# APPENDIX 1:

# SURFACE WATER RISK ASSESSMENT MATRIX