Surface Water Scoping Report for the Proposed Pure Source Sand Mining Project

Project Number:

PSM001

Prepared for:

The Biodiversity Company

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November 2018

DOCUMENT CONTROL

Project Name	Pure Source Sand Mining Right Application
Report Type	Surface Water Scoping Report
Client	The Biodiversity Company
Project Number	PSM001
Report Number	01
Report Status	Draft
Submission Date	30 November 2018
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Author Signature	

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1 INTRODUCTION

Hydrospatial (Pty) Ltd (hereafter Hydrospatial) was appointed by Pure Source Minerals Mining Contracting (Pty) Ltd (hereafter the client) to conduct a surface water study for the Pure Source Mining Right Application (MRA) (hereafter the Project). This report provides the surface water input required for the Environmental Impact Assessment (EIA) scoping report.

1.1 Project Location

The Project is located near Vaal Oewer on the southern bank of the Vaal River within Free State Province of South Africa. The Project is located on portions 3, the remaining extent of portion 1, and the remaining extent of the farm Woodlands 407. The location of the Project is indicated on Figure 1-1.

1.2 Project Description

The Project will involve the development of an open pit mine, processing plant and associated infrastructure. Sand, gravel and diamondiferous gravel are proposed to be mined. Three alternative infrastructure layout plans will be considered. These are indicated on Figure 1-2, Figure 1-3 and Figure 1-4.

1.3 Legislative Requirements and Guidelines

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

- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice No. 704 (GN704) of the NWA – Regulations on the Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources;
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated Environmental Impact Assessment (EIA) 2014 Regulations;
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- Department of Water and Sanitations (DWS) Best Practice Guideline documents.

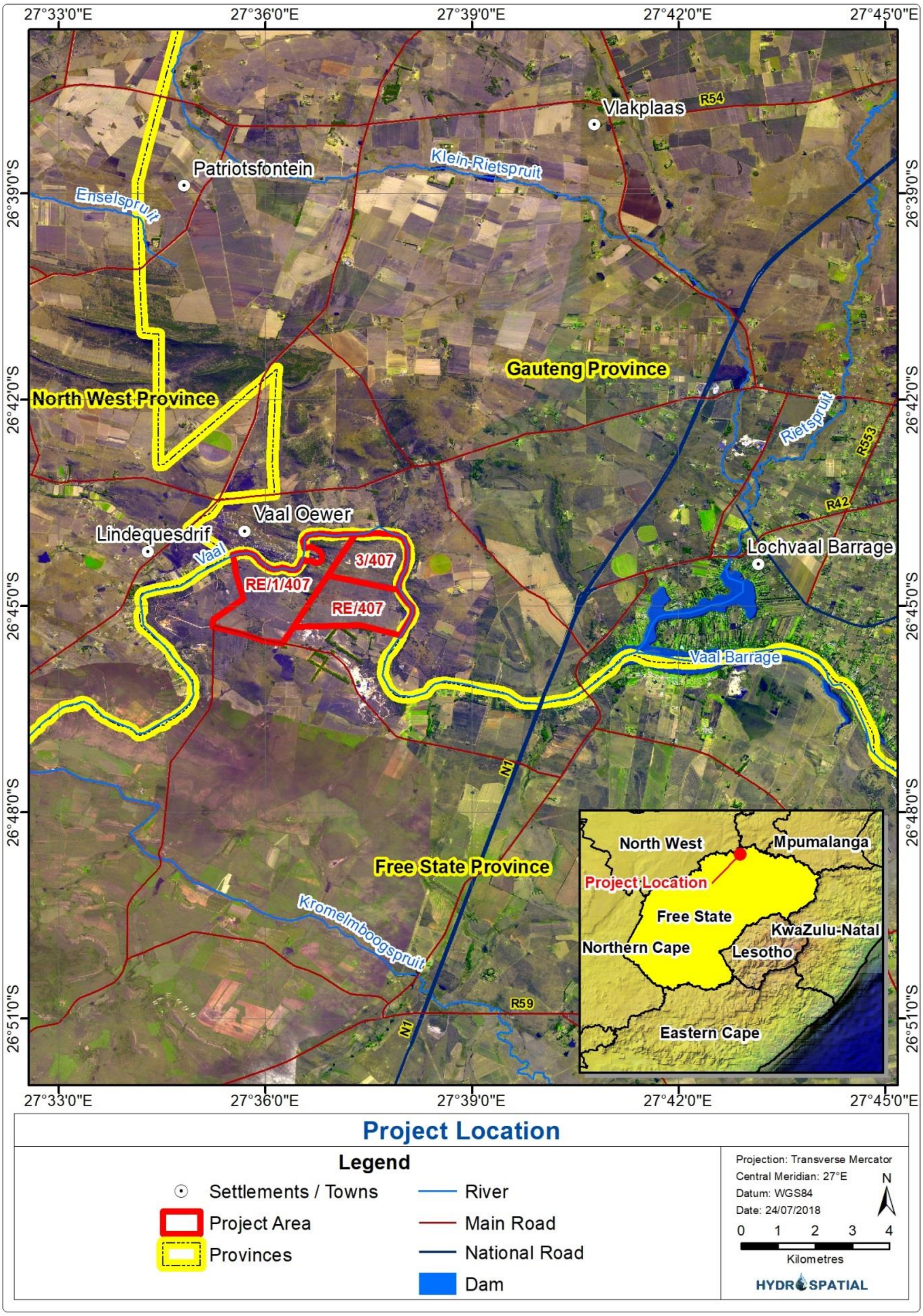

Figure 1-1: Project location

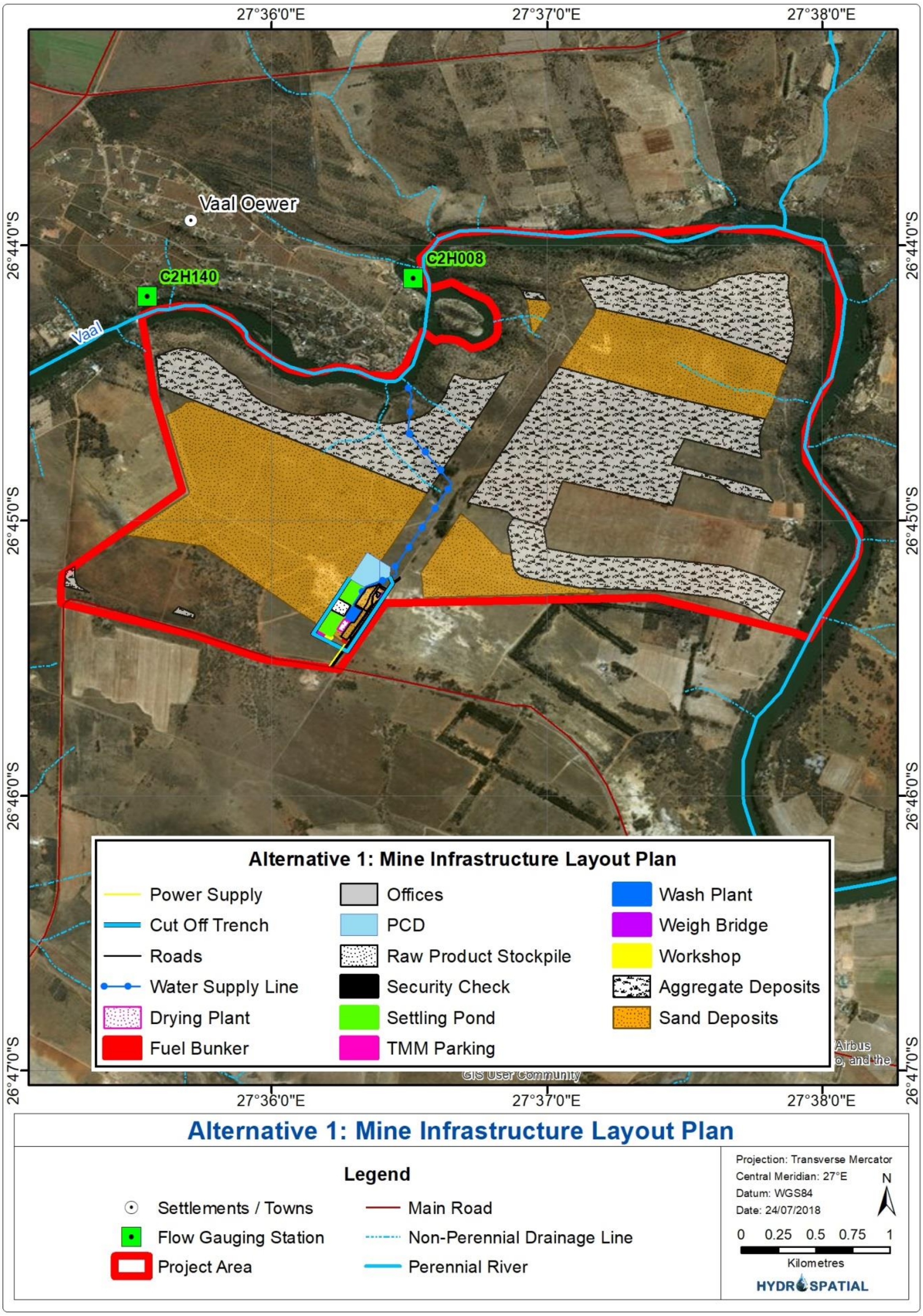

Figure 1-2: Alternative 1: mine infrastructure layout plan

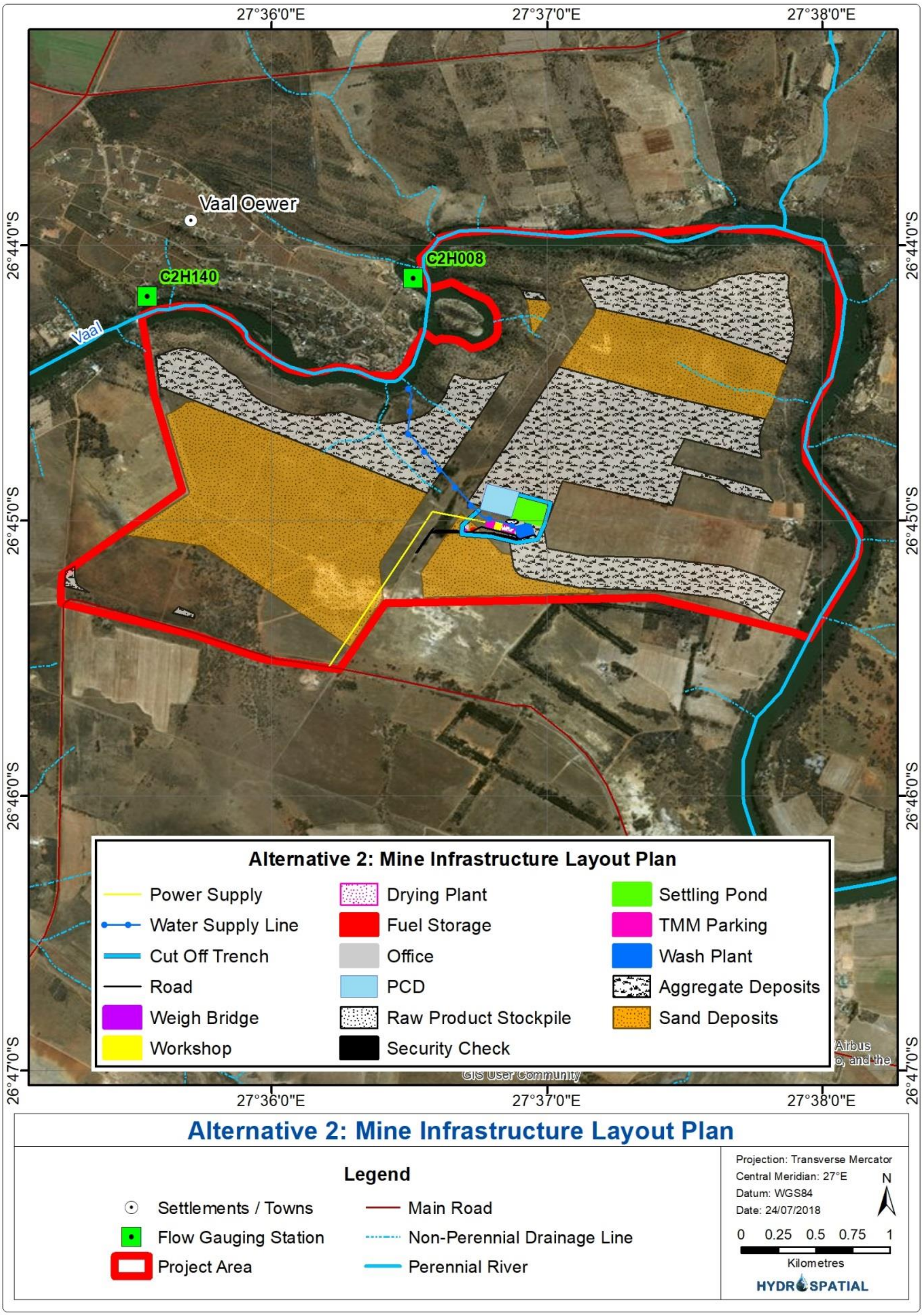

Figure 1-3: Alternative 2: mine infrastructure layout plan

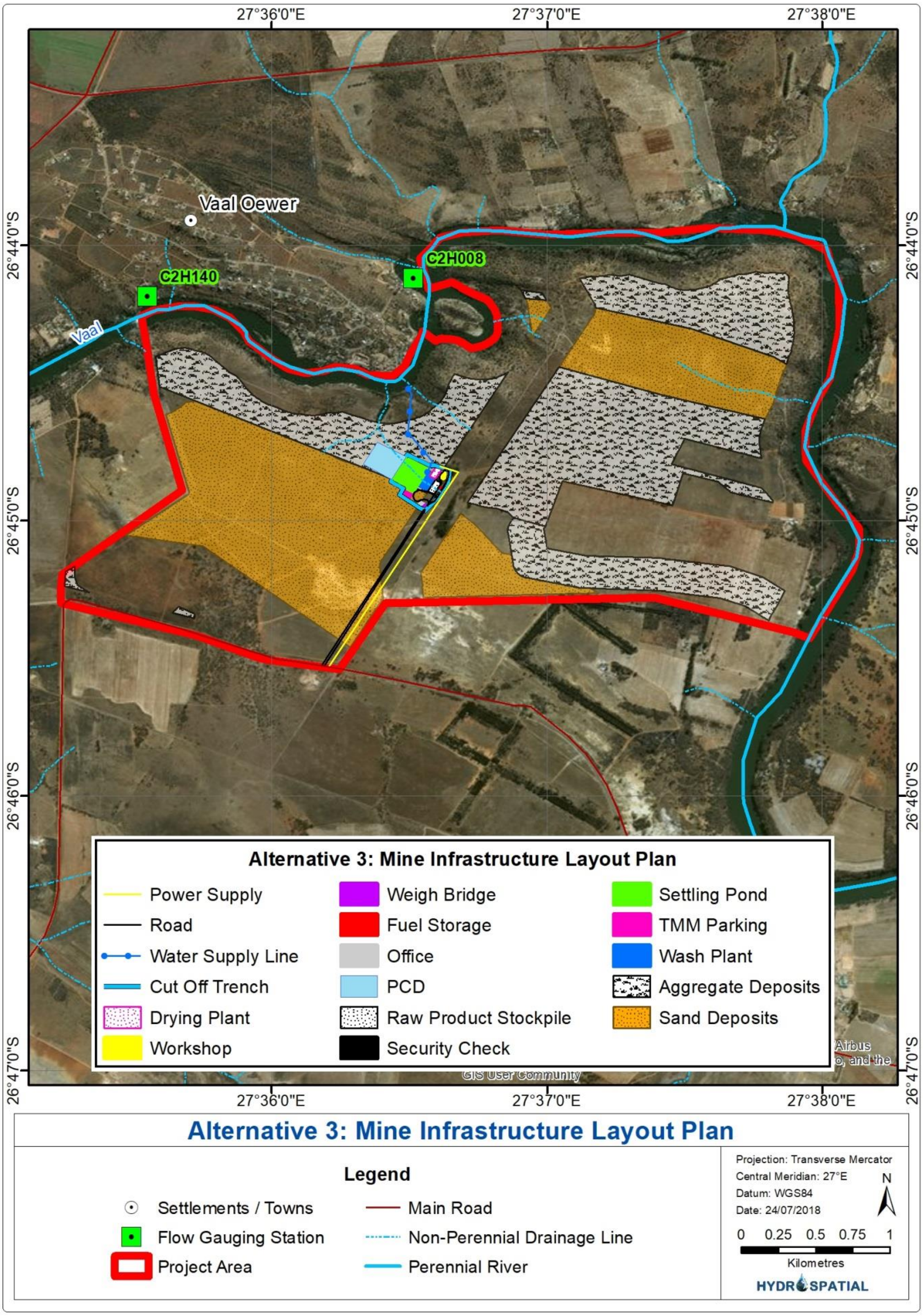

Figure 1-4: Alternative 3: mine infrastructure layout plan

2 SCOPE OF WORK

The scope of work for the surface water scoping input included the following:

- Provide a baseline (pre-construction and mining) description of the surface water environment;
- Provide the preliminary anticipated surface water impacts for the Project; and
- Provide the terms of reference for the surface water study for the EIA phase.

3 BASELINE HYDROLOGY

The primary purpose of this section is to provide the baseline (pre-mining) surface water description for the Project. It will also be used to inform the floodline determination, conceptual stormwater management plan and water balance.

3.1 Climate

The following sources of climatic data were investigated for use:

- South African Weather Service (SAWS) weather station data;
- Department of Water and Sanitation (DWS) weather station data;
- Lynch (2003) rainfall database;
- Design Rainfall and Flood Estimation in South Africa (Smithers and Schulze, 2002);
- Water Resources of South Africa, 2012 Study (WR2012); and
- The Food and Agriculture Organisation (FAO) New LocClim Local Climate Estimator software programme.

3.1.1 Rainfall

Daily rainfall depths were extracted from the Lynch (2003) database for the South African Weather Service (SAWS) station: Barrage (RWB) (0438315 W). The Daily Rainfall Extraction Utility software programme was used to extract the rainfall depths for the period 1920/1/1 to 2000/8/31 (79 years and 8 months of rainfall data). Although the Woodlands weather station (0438225 W) is the closest weather station to the site, the Barrage (RWB) weather station, which is located 7.2 kilometres (km) south-east of the site, had a longer rainfall record (82 years compared to 39 years), and a higher reliability in terms of observed rainfall. Rainfall from the Barrage (RWB) weather station was therefore adopted for this study.

The site has a Mean Annual Precipitation (MAP) of 680 mm. The total average monthly rainfall is indicated in Figure 3-1. The wettest months occur from October through to March, with the driest months occurring over the period of June to August. Rainfall is mostly in the form of convective thunderstorms, which are often brief, but regularly high in intensity. Tropical and frontal rainfall systems also occur in the region, but are not as common.

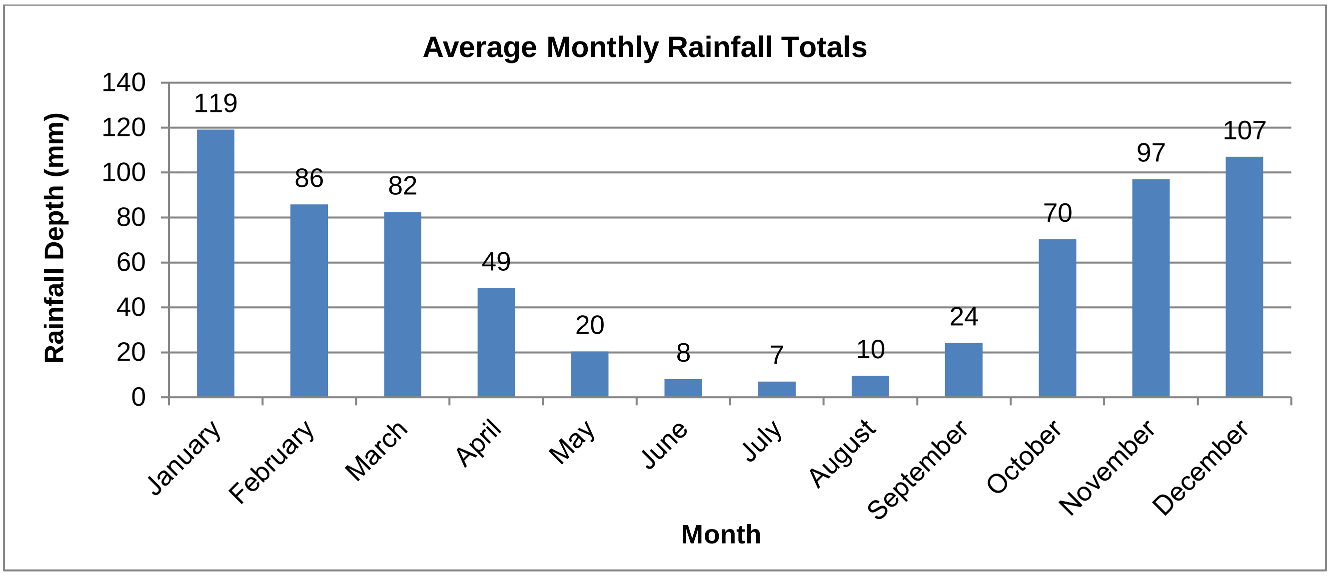

Figure 3-1: Average monthly rainfall totals for the Project

3.1.1.1 Storm Rainfall Depths

The storm rainfall depths for the centre position of the Project area were extracted from the Design Rainfall Estimation in South Africa software programme (Smithers and Schulze, 2002). The programme uses the six closest rainfall stations to a user specified coordinate, to calculate the storm rainfall depths for that area. The six closest rainfall stations to the Project area are indicated in Table 3-1.

Table 3-1: Six closest rainfall stations to the Project

Station Name	Station No.	Distance from Site (km)	Record (Years)	Latitude	Longitude	MAP (mm)	Altitude (mamsl)
WOODLANDS	0438225 W	1	39	26°45'S	27°37'E	633	1415
LINDEQUESDRIFT	0438134 W	5.7	32	26°44'S	27°34'E	619	1440
BARRAGE (RWB)	0438315 W	7.2	82	26°45'S	27°41'E	657	1420
WOOLDRIGDE	0438047 W	9.7	55	26°47'S	27°32'E	634	1470
ZANDFONTEIN	0438404 W	12.7	31	26°44'S	27°44'E	612	1418
GROENVLEI	0438323 W	14.5	46	26°52'S	27°41'E	561	1440

The extracted storm rainfall depths for the Project are indicated in Table 3-2.

Table 3-2: Storm rainfall depths for the Project

Storm Duration	Return Period / Storm Rainfall Depth (mm)						
min / hr / day	1:2 yr	1:5 yr	1:10 yr	1:20 yr	1:50 yr	1:100 yr	1:200 yr
5 min	8.6	11.5	13.4	15.3	17.8	19.6	21.5
10 min	12.6	16.7	19.6	22.3	25.9	28.6	31.3
15 min	15.6	20.9	24.3	27.7	32.2	35.6	38.9
30 min	19.9	26.5	31	35.3	41	45.3	49.6
45 min	22.9	30.6	35.7	40.7	47.2	52.1	57.1
1 hr	25.3	33.8	39.5	45	52.2	57.6	63.1
1.5 hr	29.2	38.9	45.4	51.8	60.1	66.3	72.7
2 hr	32.3	43	50.2	57.2	66.4	73.3	80.3
4 hr	38	50.7	59.2	67.5	78.3	86.4	94.7
6 hr	41.9	55.8	65.2	74.3	86.2	95.2	104.2
8 hr	44.8	59.7	69.8	79.5	92.2	101.9	111.6
10 hr	47.2	63	73.6	83.8	97.2	107.4	117.6
12 hr	49.3	65.8	76.8	87.5	101.5	112.2	122.8
16 hr	52.8	70.4	82.2	93.7	108.7	120.1	131.5
20 hr	55.7	74.2	86.7	98.8	114.6	126.6	138.6
24 hr	58.1	77.5	90.5	103.1	119.7	132.2	144.8
1 day	50.4	67.2	78.4	89.4	103.7	114.5	125.4
2 day	61.9	82.6	96.4	109.9	127.5	140.8	154.2
3 day	69.9	93.1	108.8	123.9	143.8	158.8	173.9
4 day	75.7	100.9	117.8	134.2	155.7	172	188.4
5 day	80.5	107.3	125.3	142.8	165.7	183	200.4
6 day	84.6	112.9	131.8	150.2	174.2	192.5	210.8
7 day	88.3	117.8	137.5	156.7	181.8	200.9	219.9

3.1.2 Evaporation

Monthly Symon's Pan evaporation was downloaded from the Department of Water and Sanitations (DWS) Hydrological Services website, for the Vaalplaats weather station (C2E001), located 7.3 km south-east of the Project. Symon's Pan evaporation measurements are not a true reflection of open water evaporation, as water temperatures in the Symonds Pan are higher than that of a natural open water body, resulting in higher evaporation rates. In order to convert Symon's Pan measurements to open water evaporation, a monthly open water evaporation conversion factor was used, which was obtained from the WR2012 study. The adopted monthly evaporation for the Project is indicated in Table 3-3.

Table 3-3: Symon's Pan and open water evaporation for the Project

Month	Symon's Pan Evaporation (mm)	Open Water Evaporation Factor	Open Water Evaporation (mm)
January	179	0.84	150
February	147	0.88	129
March	136	0.88	119
April	102	0.88	90
May	78	0.87	68
June	59	0.85	50
July	65	0.83	54
August	93	0.81	75
September	129	0.81	105
October	161	0.81	131
November	169	0.82	138
December	180	0.83	149
Total	**1498**	**N/A**	**1259**

3.1.3 Temperature

The average monthly temperatures for the Project were extracted using the nearest neighbour method from weather stations in the region, using the LocClim Local Climate Estimator software programme (FAO, 2005). Figure 3-2 indicates the minimum, average and maximum temperatures for the Project. The warmest months occur from October through to March. The coolest months occur over the period of May to August.

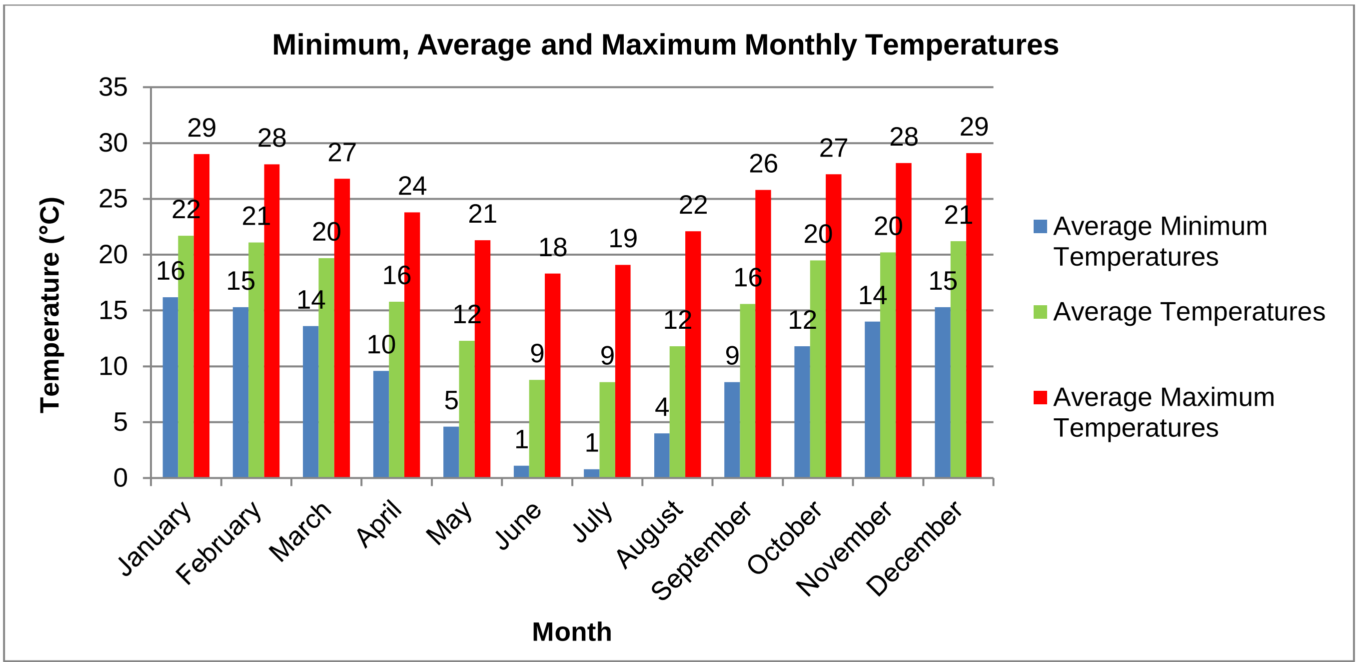

Figure 3-2: Minimum, average and maximum monthly temperatures for the Project

3.2 Hydrological Setting

The hydrological setting of the Project is described in this section.

3.2.1 Regional Catchments

The DWS and the Surface Water Resources of South Africa studies (WR90, WR2005 and WR2012) have divided South Africa into primary, secondary, tertiary and quaternary catchments. Primary catchments are the largest defined catchments for South Africa, of which there are 22, and are assigned a letter ranging from A – X (excluding O). Secondary catchments are subdivisions of the primary catchments, and are the second largest catchments in South Africa, and are assigned the primary catchment letter within which they are located, and a number e.g. A5 (secondary catchment 5 located within primary catchment A). Similarly, tertiary catchments are subdivisions of secondary catchments, and are represented for example by A53 (tertiary catchment 3 located within secondary catchment A5). Lastly, quaternary catchments are the smallest defined catchments and are assigned the tertiary catchment number, along with a quaternary catchment letter e.g. A53D (quaternary catchment D located within tertiary catchment A53).

Further to the above, the DWS have divided South Africa into 9 Water Management Areas (WMAs), which are managed by separate Catchment Management Agencies (CMA). The 9 WMAs include the Limpopo, Olifants, Inkomati-Usuthu, Pongola-Mtamvuna, Vaal, Orange, Mzimvubu-Tsitsikamma, Breede-Gouritz and Berg-Olifants.

The Project is located in the Vaal WMA, within quaternary catchment C23B (Figure 3-3).

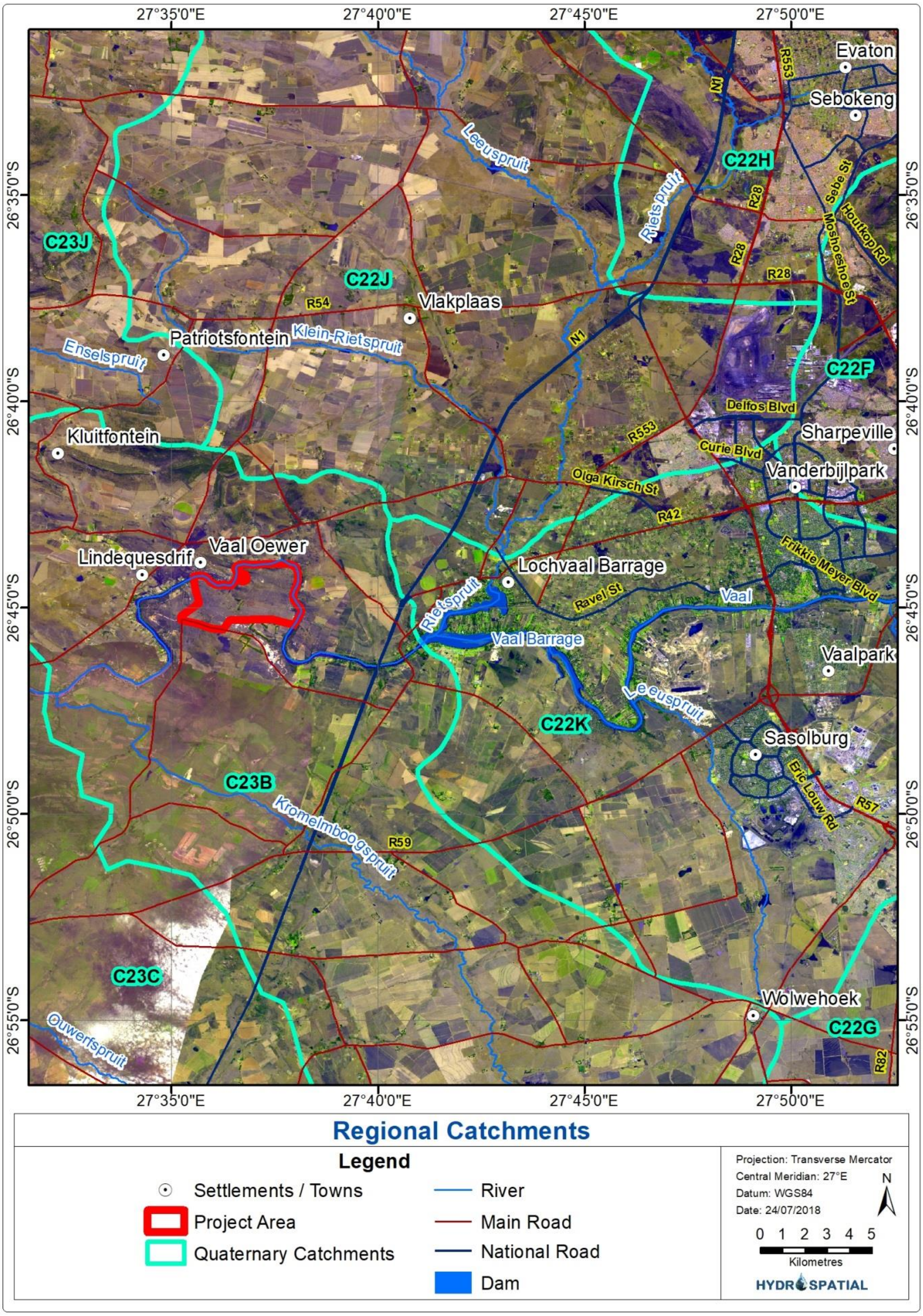

Figure 3-3: Regional catchments

3.2.2 Topography

Elevation within the Project area varies from 1 471 metres above mean sea level (mamsl), along an elevated ridge which runs in a north-west to south-east direction through the site, to 1 406 mamsl along the banks of the Vaal River. A smaller ridge that is approximately 5 m in height, is located directly north and runs in the same direction as the above mentioned ridge.

3.2.3 Soils

A soil delineation was undertaken by The Biodiversity Company (TBC). The northern section of the Project area consists mostly of Glenrosa and Clovelly soil types, with the middle to southern section's consisting of Oakleaf, Hutton, Clovelly and Westleigh soil types.

3.2.4 Land Cover/Use

According to the 2013 – 2014 South African National Land Cover Dataset (Geoterraimage, 2015), the Project area consists mostly of grassland, with agricultural fields occurring towards the south. Thicker vegetation occurs along the banks of the Vaal River. Beyond the Project area, the dominant land use is agriculture.

3.2.5 Surface Water Use

Surface water within the area is mostly used for crop irrigation, livestock watering and recreational purposes such as water sports and fishing.

3.3 Surface Water Runoff

Two flow gauging stations are located within close proximity to the Project on the Vaal River. This includes flow gauging station C2H140, located at the north-western tip of the Project area, as well as flow gauging station C2H008, located directly north (Figure 1-2). Flow data for Station C2H140 was adopted to represent the runoff volumes for the Vaal River, as it located at the most downstream point of the Project, and has more recent data (October 1996 – February 2018), albeit having a shorter record than station C2H008 (September 1952 – October 1996). It is likely that station C2H008 was decommissioned, and that C2H140 was commissioned, as they are in close proximity to each other.

Monthly runoff volumes for station C2H140 was downloaded from the DWS Hydrological Services website. The gauging station has a catchment area of 47 222 km^2. Missing data, particularly for months occurring within the years 2002 to 2004 was noted. The average monthly runoff volumes are indicated in Figure 3-4. Discharge is highest over the period of December to March, with the lowest discharge months occurring from July to September. Flow within this section of the Vaal River is highly regulated by the upstream Vaal Barrage and Vaal Dam.

The non-perennial drainage lines that occur within the Project area are seasonal, and are only likely to flow in response to high rainfall during the summer months.

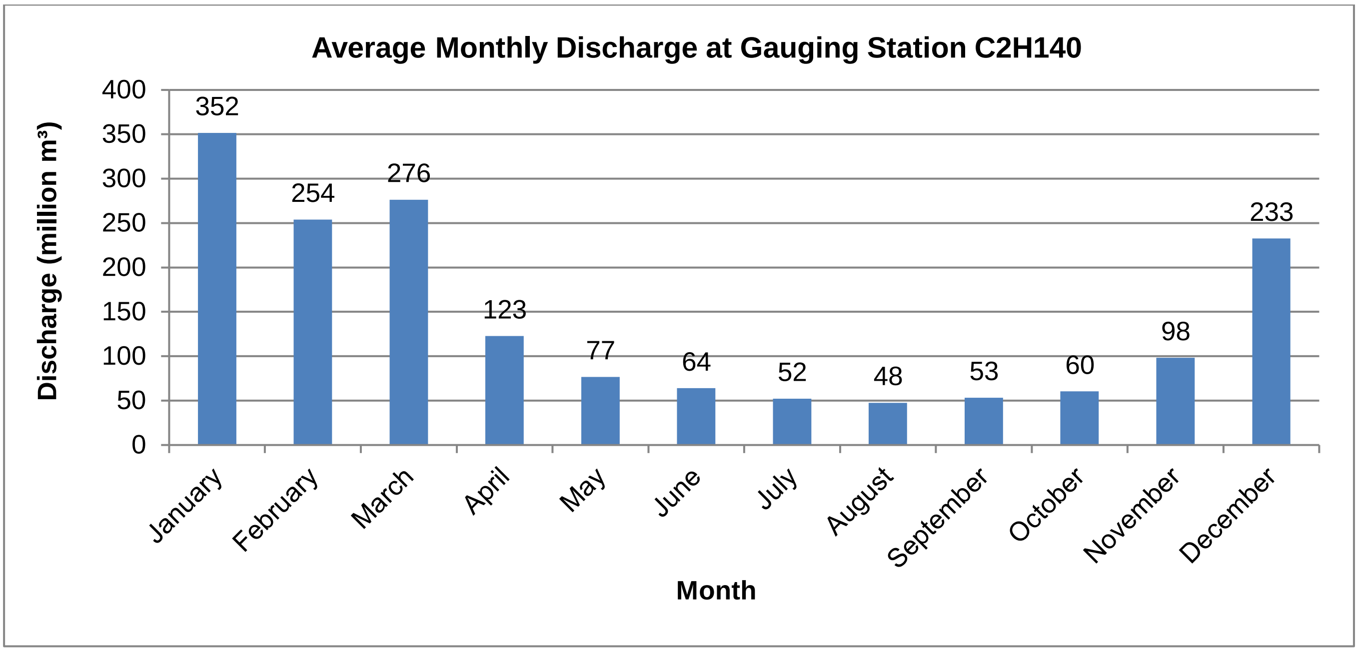

Figure 3-4: Average monthly runoff volumes for gauging station C2H140

3.4 Surface Water Quality

Surface water quality samples will be taken during the EIA phase of the Project, and will be assessed and discussed in greater detail in the surface water report prepared for that phase.

4 POTENTIAL SURFACE WATER IMPACTS

The preliminary anticipated surface water impacts for the construction and operational phases of the Project are indicated in Table 4-1. These impacts will be investigated in further detail during the EIA phase of the Project.

Table 4-1: Anticipated surface water impacts

Activity	Impact Description	Significance Pre- Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Construction Phase				
Removal of vegetation and exposure of soils	Erosion and consequent increase in Total Suspended Solids (TSS) in surrounding watercourses	Medium	• Temporary erosion control measures that reduce flow velocity (e.g. runoff berms) should be implemented around construction areas; • Clearance of vegetation must be limited as far as possible to only necessary areas; and • Water quality sampling must be implemented upstream and downstream of the construction area.	Low
Laydown of impermeable surfaces such as concrete	Increased velocity in surface water runoff leading to erosion and consequent increase in TSS of surface water resources	Medium	• Measures (energy dissipaters, detention dams, swales, etc.) that reduce flow velocity from impermeable areas should be implemented. The goal of all stormwater management should be that the post-development runoff is the same or does not exceed the pre-development runoff; • Impermeable areas must not be constructed unnecessarily; and • Water quality sampling must be implemented upstream and downstream of construction areas. Specific parameters that should be monitored include TSS and turbidity. They should be kept within the baseline water quality range.	Low

Activity	Impact Description	Significance Pre- Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Alteration to the natural topography (e.g. pit excavations, dumps, infrastructure, etc.)	Alteration in surface water drainage patterns leading to erosion and consequent increase in TSS in surrounding watercourses.	Medium	• Stormwater management measures around the dumps, plant area, etc. are proposed; and • Water quality sampling must be implemented upstream and downstream of construction areas. Specific parameters that should be monitored include TSS and turbidity. They should be kept within the baseline water quality range.	Low
Operational Phase				
Open pit mining	Open pit mining will result in a loss of contributing catchment area to the Vaal River. Runoff will be captured in the pits that would have otherwise reported to the Vaal River.	Medium	Should the open pits not be rehabilitated to a pre-mining topography post mine operation, then this impact will remain indefinitely. Due to the small mining area, it is unlikely that this impact will have a substantial decrease on the flow volumes in the Vaal River.	Medium

Activity	Impact Description	Significance Pre- Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Operation of the plant area and stockpiles	Runoff from the plant area and stockpiles is likely to contain high levels of TSS and potentially high dissolved solids that could runoff into the environment.	Medium	A stormwater management plan must be designed and implemented that captures and contains dirty water runoff from the site, in accordance with the requirements stipulated in the GN704 Regulations. Dirty water captured, should be recycled and used at the plant, and should not be allowed to report to the environment.	Low
Open pit mining through drainage lines	Some of the proposed mining deposits occur within drainage lines. The function of these drainage lines is to drain the area during and post rainfall. Mining through drainage lines may result in flooding of pits and other infrastructure, as well as a loss of runoff reporting to the Vaal River.	Medium	According to Regulation 4 (a) and (b) of GN704, no mining should take place within a 100 m buffer of watercourses, or within the 1:50 and 1:100 year floodlines, unless exemption is obtained. Should mining be permitted within the drainage lines, then upstream runoff should be diverted around the open pits, to prevent any unnecessary flooding.	Medium

Activity	Impact Description	Significance Pre- Mitigation	Mitigation Measures / Recommendations	Significance Post-Mitigation
Groundwater seepage into the open pits	It is highly likely that groundwater will seep into the open pits, resulting in dirty water. The pits may also become flooded due to high seepage rates.	Medium	Dirty water from the pits should be dewatered for use at the plant. This should ensure that water levels within the pits are maintained at suitable levels. Dirty water should be kept in a closed system, to ensure that it does not report to the environment.	Low
Abstraction of water from the Vaal River	Loss of water volumes and a reduction of flows in the Vaal River	Medium	The plant is likely to have the highest water demands for the Project. Unnecessary pumping of water from the Vaal River must be avoided. This can be done through the recycling of water from groundwater seepage and runoff into the pits, for use at the plant.	Low

5 TERMS OF REFERENCE FOR THE EIA PHASE

The following will be undertaken during the EIA phase of the project for the surface water study:

- Surface water quality sampling and assessment;
- Development of a conceptual Stormwater Management Plan (SWMP) in accordance with the DWS Best Practice Guideline G1: Storm Water Management and GN704 Regulations. The primary purpose of the SWMP is to ensure that clean (non-impacted water) and dirty water (mine impacted water) are clearly separated in accordance with the above mentioned Guideline and Regulations;
- Determination of the 1:50 and 1:100 year floodlines;
- Development of a water balance according to the DWS Best Practice Guideline G2: Water and Salt Balances. The water balance will provide the sources and water volumes required for the mine;
- An assessment of the potential surface water impacts and possible mitigation measures; and
- Development of monitoring plans that can be used to monitor potential impacts resulting from the proposed mine.

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