FerroAtlántica Group

SiliconSmelters

Rand Carbide

INTEGRATED WATER AND WASTE MANAGEMENT PLAN (IWWMP) FOR SILICON SMELTERS (PTY) LTD - RAND CARBIDE

ON

PORTION 60 (REMAINING EXTENT) AND PORTION 101 OF THE FARM JOUBERTSRUST 310 JS

EMALAHLENI, MPUMALANGA PROVINCE.

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AEL	Atmospheric Emissions Licence
Al	Aluminium
AMD	Acid Mine Drainage
Ba	Barium
Baseflow	Part of stream flow derived from groundwater and shallow subsurface storage
BHN	Basic Human Need
Ca	Calcium
CARA	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
CBD	Central Business District
Chargold	now EMB
COD	Chemical Oxygen Demand
Cr(VI)	Hexavalent Chromium (Chrome 6)
Cu	Copper
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
E.C.A	Electrically Calcined Anthracite
EIS	Ecological Importance and Sensitivity
eMalahleni	previously known as Witbank
EMB	Enviroserve Mineral Beneficiation – previously Chargold
EWR	Ecological Water Reserve
FAPA	Ferro-alloys Producers Association
Fe	Iron
Fe-Si	Ferrosilicon
GDP	Gross Domestic Product
GGP	Gross Geographic Product
GNR	Government Notice Regulation
GPS	Global Positioning System
IFR	In-Stream Flow Requirements
ISO	International Organisation for Standardisation
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application
IWWMP	Integrated Waste and Water Management Plan
K	Potassium
kWh	Kilowatt hour
MAE	Mean Annual Evaporation
Mamsl	Metres above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
Mbgl	Metres below ground level
MDEDET	Mpumalanga Department of Economic Development, Environment and Tourism
Mg	Magnesium
Mn	Manganese
N	Nitrogen
Na	Sodium
NACA	National Association of Clean Air
NEM:AQA	National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NIOSH	National Institute for Occupational Safety and Health
NWA	National Water Act, 1998 (Act 36 of 1998)
O_2	Oxygen
OHSA	Occupational Health and Safety Act, 1993 (Act 85 of 1993)
OHSAS	Occupational Health and Safety Advisory Services
PCD	Pollution Control Dam
PES	Present Ecological Status
PM	Particulate Matter
Rand Carbide	Silicon Smelters (Pty) Ltd - Rand Carbide
REC	Recommended Ecological Category
Recharge	Water reaching the aquifer directly from precipitation and infiltration of surface water
Reserve	Sum of baseflow required by EWR and BHN reserve expressed as a percentage of recharge
RWQO	Receiving Water Quality Objectives
S	Sulphur
Si	Silicon
SG	Surveyor General
SHEQ	Safety, Health, Environmental and Quality Management
SO_4	Sulphate
SWCD	Storm Water Control Dam
SWMP	Storm Water Management Plan
TDS	Total Dissolved Solids
Ti	Titanium
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WMA	Water Management Area
WQO	Water Quality Objectives
XRD	X-ray diffraction
XRF	X-ray fluorescence
Zn	Zinc

1 INTRODUCTION

1.1 Background

1.1.1 History

Rand Carbide Limited, which came into being in 1918 in Germiston for the production of calcium carbide, moved to Witbank in 1926 to avail itself of cheaper power (electricity) and because it envisaged the use of the coal in Witbank area as a raw material. Since those early days, the production of carbide has been greatly expanded, and the company has diversified into the production of ferrosilicon (Fe-Si) and other products.

The site is almost 2 km from the eMalahleni (Witbank) Central Business District (CBD), but is now surrounded by residential areas surrounding the CBD.

Rand Carbide was acquired by Highveld Steel and Vanadium Limited in 1978 but was sold in February 2008 to Silicon Smelters (Pty) Ltd, a subsidiary of FerroAtlantica (Spain). The company is now referred to as Silicon Smelters (Pty) Ltd - Rand Carbide (hereafter referred to as Rand Carbide).

1.1.2 Operation

Rand Carbide produces ferrosilicon (Fe-Si) and other products such as silicon metal, electrically calcined anthracite (ECA), electrode paste and silica fume, both for its own use and for supply to other manufacturers employing electric furnaces. See Section 2 for process descriptions.

1.1.3 Water and waste management

Rand Carbide is currently supplied with municipal water from the eMalahleni municipality for both its domestic (worker) and industrial requirements. Sewage effluent feeds into the municipal sewage management system. Storm water discharges into the municipal storm water system and is also collected within an earth dam (Harry's dam) on site. Process water from cooling circuits is contained in a closed concrete tank (on site) for recycling.

Domestic type general waste is removed off site for disposal to the municipal landfill site. Hazardous waste is removed off site by EnviroServ and Darkmetals for disposal to Holfontein. All process waste is also removed off site for disposal to Holfontein. Rand Carbide however, has a historic waste dump which is currently being reprocessed by Chargold (now Enviroserve Mineral Beneficiation).

1.2 Contact details

1.2.1 Applicant

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1.3 Project location

Rand Carbide is situated on Portions 60 and 101 of the farm Joubertsrust 310 JS within the eMalahleni (Witbank) Municipal area of the Nkangala District, Mpumalanga Province (see Figure 1-1). The site can be accessed from Voortrekker Road, also known as the old Middelburg road or R555. Christiaan de Wet Street and Swartbos/O.R. Tambo Road also border the property. The site, which extends over 56.2810 ha, is situated approximately 2 km north east of the eMalahleni CBD. The site is used for industrial purposes and is surrounded by industrial/commercial and/or residential properties (see Figure 1-2). Rand Carbide operates 24-hour per day, 7 days a week. The site is in close proximity to residential properties and a primary school.

Province:	Mpumalanga	
District municipality:	Nkangala District	
Local municipality:	eMalahleni Municipality	
Farm:	Joubertsrust 310 JS	
Farm portions:	60 & 101	
Coordinates:	25° 51.738' South 29° 13.731' East	
Surrounding towns:	Witbank CBD	2 km south west
	eMalahleni residential	within 100 m south, east & north east

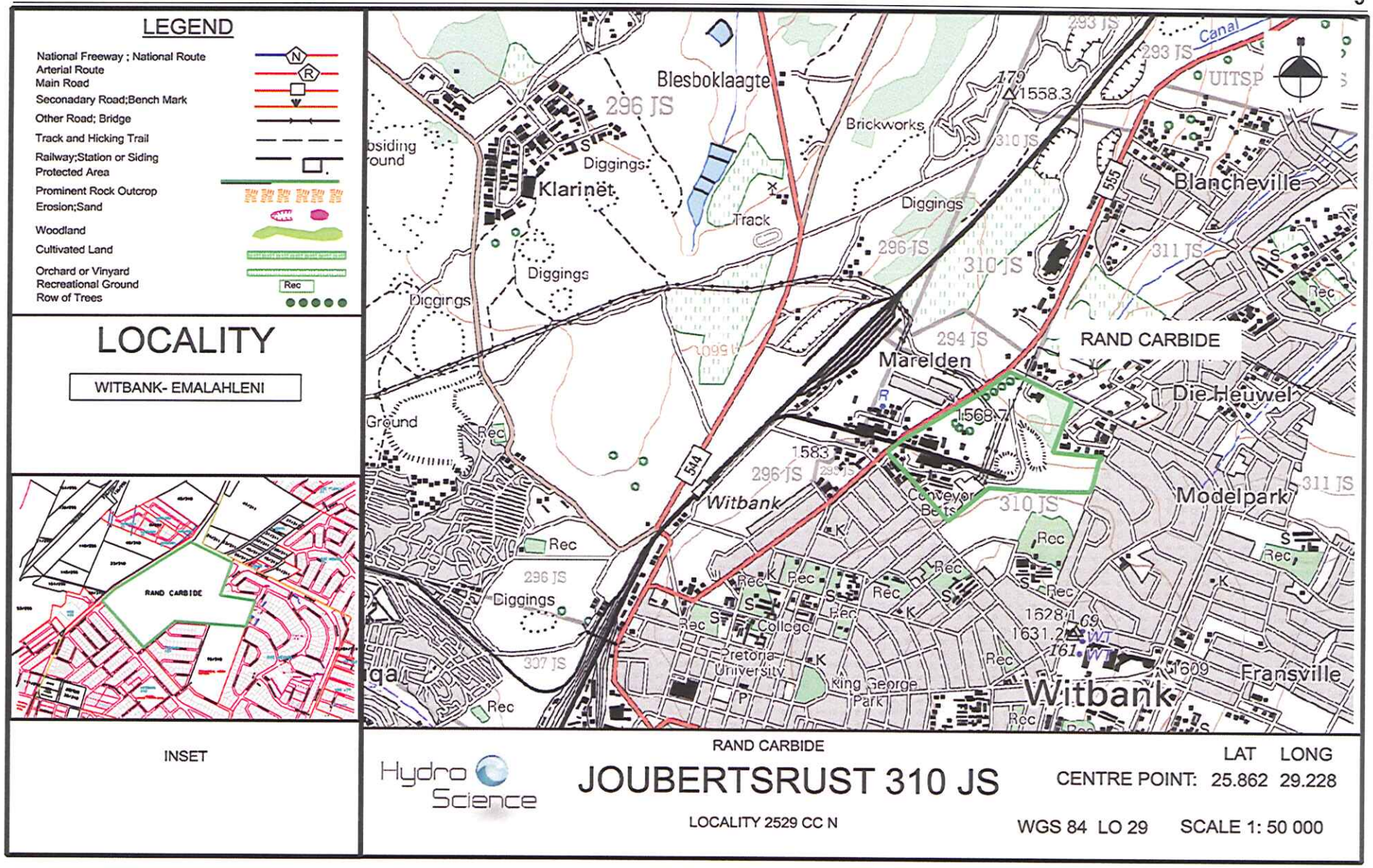

Figure 1-1: Regional locality map for Rand Carbide

Figure 1-2: Surrounding land uses

Roads: Voortrekker Road (old Middelburg road / R555) for access;
Christiaan de Wet Street on south western boundary;
O.R Tambo (previously Swartbos) - northern boundary; and
N4 - 3 km south

1.4 Property description

Farm: Joubertsrust 310 JS

1.4.1 Remaining extent of Portion 60

Surveyor General (SG) code: T0JS00000000031000060

Title Deed: T4136/2009 (Appendix A)

Registration date: 2009/05/18

Owner: Silicon Smelters (Pty) Ltd - Rand Carbide

Size: 27.4663 Ha

Land use: Industrial

Surrounding land use: Mixed

1.4.2 Portion 101

Surveyor General (SG) code: T0JS00000000031000101

Title Deed: T4137/1985 (Appendix A)

Registration date: 2009/05/18

Owner: Silicon Smelters (Pty) Ltd - Rand Carbide

Size: 28.8147 Ha

Land use: Industrial

Surrounding land use: Mixed

Please refer to Figure 1-3 for a general site layout.

1.4.3 Infrastructure

- Fe-Si furnaces: D & F furnaces
- Si metal furnace: E furnace
- Paste plant
- Calcine furnaces: 1 & 2 (1949 - 1971)
- Closed cooling towers for Furnaces
- Fe-Si crushing/screening plant (1926 with extensions in 1941 & 1991) – was carbide
- Dust plants: Plant F (1976), Plant D & E (1980)
- Laboratory for quality control (1964)
- Canteen & First aid (1980) building

- Change room and laundry building (1980)
- Training centre (1962)
- Electrical shop, Fitting & Boiler shop (1971), Carpenter shop (1980)
- Main substation building (1949 and extended 1964). Smaller substation/transformer facilities in different areas
- Brown Boveri Substation building (1962)
- Transformer storage (2003): storage of spare transformers for furnaces and dust plants
- Compressor house: Air compressors for dust plants and instrumentation
- Garage (1960s)
- Covered parking (1980) for vehicles
- Ablution blocks across the site
- Storage buildings across the site
- Workshops (electrical services, mechanical, carpentry, paste plant, instrumentation)
- General administration and office building (1960s)
- Gas burners
- Wash bay for vehicles
- Historic waste dump (being processed by Chargold / EMB since 2005)
- Engines (driving emergency circulating pumps)
- Raw material storage bunkers & conveyors
- Chargold plant (2005) – now Enviroserve Mineral Beneficiation (EMB)
- Underground storage tanks (UST): Petrol (14m^3; 1983); diesel (23m^3; 1979)

1.4.4 Additional business ventures operating on site

- EMB (Pty) Ltd (joint venture between Rand Carbide & EnviroServe; previously Chargold)
- Bakwena Ready Mix Concrete
- Afrox

1.4.5 Electricity supply

The Rand Carbide operations utilises electricity sourced from Eskom. 620 MegaWh/annum is used.

1.4.6 Water supply

Rand Carbide is supplied with municipal water from eMalahleni municipality for its domestic (worker) and industrial uses. Additionally, Rand Carbide also uses water abstracted from three (3) springs located on the property since 2011 (previously the water was just discharged). Cooling water is contained within a closed concrete tank which is situated on site for recycling purposes. Rand Carbide has installed three (3) booster pumps on the municipal water supply line to provide adequate water supply during emergency situations.

1.4.7 Sewage management

Sewage effluent feeds into the municipal sewage management system.

Figure 1-3: General site layout using Google Earth™ image

1.5 Legal assessment

South African legislation Rand Carbide will have to comply with includes, but is not limited to:

- Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) in terms of the right to an environment that is not harmful to people's health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures.
- Conservation of Agricultural Resources Act (CARA), 1983 (Act 43 of 1983), all alien invasive species on site must be eradicated or controlled as per Department of Agriculture, Forestry and Fisheries (DAFF) guidelines;
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010 in terms of activities requiring environmental authorisation from the provincial authority and duty of care (Section 28);
- National Environmental Management: Waste Act (NEM:WA), 2008 (Act 59 of 2008) in terms of waste management licences required for the historic waste dump and its processing by EMB;
- National Environmental Management: Air Quality Act (NEM:AQA), 2004 (Act 39 of 2004) in terms of the furnace activities which require an Atmospheric Emissions Licence (AEL);
- National Water Act (NWA), 1998 (Act 36 of 1998) in terms of water use licences required;
- Occupational Health and Safety Act (OHSA), 1993 (Act 85 of 1993);
- Municipal bylaws; and
- International treaties and conventions.

NEM:WA:
An application has been submitted to the Department of Environmental Affairs (DEA) in terms of NEM:WA (2008) for a waste management licence for the storage, recycling and/or recovery and treatment (through reprocessing) of waste material as per Government Notice Regulation (GNR) 718. This includes the historic waste dump and its reprocessing by EMB. A full Environmental Impact Assessment (EIA) process (consisting of a Scoping Report and Environmental Assessment Impact Report) are being compiled.

NEM:AQA:
Rand Carbide has an AEL in terms of NEM:AQA (2004). Licence number 17/4/AEL/MP312/11/02 issued by Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET) on 14 April 2011.

1.5.1 Existing lawful uses

Permit 282N (29 March 1989; ref B33/2/210/34) from the Department of Water Affairs (DWA) authorises Rand Carbide the use of municipal water for industrial purposes at the premises (see Appendix A). A quantity of 515 000m^3/annum (1 410 m^3/day) is authorised in terms of the repealed Water Act of 1956. Rand Carbide has used between 79 000 m^3/annum and 113 000 m^3/annum over the past five (5) years (2007 – 2011) which is well below the 515 000 m^3/annum authorised. No water use licence from DWA in terms of the NWA, 1998 is required for the use of water supplied by a water services provider such as a municipality. Rand Carbide has no agreement with the eMalahleni Municipality in terms of a guaranteed continued water supply, though it pays the municipality on a monthly basis for the water and has never experienced an interruption in its water supply (see municipal account attached - Appendix A).

Rand Carbide did submit NWA Section 21(g) water use registrations to DWA on 31 March 2011.

Rand Carbide did apply for a waste disposal site permit (16/2/7/B100/B34/Z1) in terms of section 20 of the Environmental Conservation Act, 1989 (Act 73 of 1989) but the permit was never issued by DWA due to insufficient information.

1.5.2 Summary of water uses

The following water uses form part of this application:

- **Section 21 (a): Taking water from a water resource:** Usage of the water from the three (3) springs for industrial purposes:
  - Spring underneath Furnace E water used for dust suppression
  - Spring underneath Furnace F water used for dust suppression
  - Spring underneath Conveyor Sump B9 water used for dust suppression
- **Section 21 (g): Disposing of waste in a manner which may detrimentally impact on a water resource:** Waste and wastewater disposal
  - Historic waste dump
  - Harry's dam
  - New storm water control dam
- **Section 21 (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:** Dewatering of three (3) springs in the plant area.
  - Spring underneath Furnace E
  - Spring underneath Furnace F
  - Spring underneath Conveyor Sump B9

1.5.3 Summary of relevant exemptions

None

1.5.4 Summary of general authorisations

None

1.6 Section 27 motivation

1.6.1 Redressing results of past racial and gender discrimination

Rand Carbide currently employs 292 permanent staff of which 229 is African, 3 is Coloured, 1 is Indian and 59 are White (of which one person is disabled and none are foreign nationals). This translates into 80% of the workforce being people of colour. Only 7% of the workforce is female. The workforce profile including various occupational levels is summarised in Table 1-1 below.

Table 1-1: Total number of employees at various occupational levels
A=Africans, C=Coloureds, I=Indians and W=Whites

Occupational Levels	Male				Female				Total
	A	C	I	W	A	C	I	W	
Senior management				1					1
Professionally qualified and experienced specialists and mid-management	6			12	1			2	21
Skilled technical and academically qualified workers, junior management, supervisors, foremen, and superintendents	53	1	1	33	9			5	102
Semi-skilled and discretionary decision making	157	2		6	3				168
Unskilled and defined decision making									
TOTAL PERMANENT	216	3	1	52	13			7	292
GRAND TOTAL	**216**	**3**	**1**	**52**	**13**			**7**	**292**

1.6.2 Efficient and beneficial use in the public interest

Water conservation: Rand Carbide implements a water reuse and reclamation strategy that results in less municipal water being used by its processes, ultimately aiding towards water conservation and consequently more sustainable use of water resources as well as more water available to domestic users within the municipal area. Only 10% of municipal water consumption by Rand Carbide is for process use.

Reduce evaporative losses: Rand Carbide minimises its industrial water use through measures such as closed circuits for cooling (furnaces and compressors) which minimises evaporative losses. This reduces evaporative losses and therefore top-up water required by approximately 75%.

Reuse/recycling: Rand Carbide further recycles all its water in the cooling circuits of the furnaces and compressors.

Dust suppression: Rand Carbide uses a large quantity of water for dust suppression due to its proximity to residential areas and in order to protect the health of the public. 40 - 50% of the municipal water used by Rand Carbide is applied for dust suppression. Rand Carbide has used a sweeper since 2011 to reduce municipal water consumption for dust suppression.

Charcoal: Rand Carbide has been using charcoal as a renewable energy source rather than coal as in previous years. The process of charcoal production is labour intensive and therefore creates thousands of jobs.

Informal work opportunities: Rand Carbide currently provides informal work opportunities for 500 people (collection, transportation etc).

Workers: Approximately 40% of the water used on the Rand Carbide site is for the workers.

Local employment: Rand Carbide currently employs 292 permanent staff and utilises more than 400 vendors (from air conditioning installations and maintenance to winch repairs). This implies financial support for at least 692 families.

1.6.3 Socio-economic-impact

Employment: Rand Carbide currently employs 292 permanent staff and utilises more than 400 vendors (from air conditioning installations and maintenance to winch repairs). This implies financial support for at least 692 families. SiS supplies Rand Carbide with charcoal which generates an additional 3 000 jobs related to only Rand Carbide charcoal needs.

Economic: Rand Carbide's turnover in 2010 was approximately R528 million. This translates into a significant contribution to the Gross Domestic Product (GDP). Furthermore, Rand Carbide's products (predominantly ferrosilicon, silicon metal and electrode paste) are purchased by almost twenty (20) major industries in South Africa (including Columbus Steel and Highveld Steel) which, in turn, generates additional employment opportunities and further growth potential in both local and national GDP. Columbus Steel is considered as one of South Africa's largest stainless steel producers. Rand Carbide further exports to Europe and America.

1.6.4 Catchment management strategy

There is no catchment management strategy compiled for this water management area. Details of the catchment are summarised below.

Water Management Area (WMA): Olifants (WMA 4); 54 550 km^2

Sub-catchment: Upper Olifants River (Loskop Dam); 12 285 km^2

Quaternary catchment: B11J (Please refer to Figure 1-4 & Figure 1-5)

Quaternary catchment area: 269 km^2; 2.19% of sub-catchment; 0.5% of WMA

Quaternary catchment irrigated: 9.3 km^2

Mean Annual Precipitation (MAP): 682 mm

Mean Annual Evaporation (MAE): 1 650 mm

Mean Annual Runoff (MAR): 49 million m^3

Groundwater recharge: 9.18 million m^3

Towns and land uses: The towns of Witbank and Middelburg (Highveld) are in the Upper Olifants River Catchment, an important coal mining area.

Water courses: The Upper Olifants River catchment comprises the drainage areas of the Olifants River, Klein Olifants River and Wilge River with tributaries down to the Loskop Dam. The headwaters of these rivers are located along the Highveld Ridge in the Secunda-Bethal area and the rivers then flow in a northerly direction towards Loskop Dam. The major tributaries are the Steenkoolspruit, Klein Olifants River, Wilge River and Elands River.

Urbanisation: It has large urban centres located in eMalahleni (Witbank), Steve Tswete (Middelburg) and also a number of smaller urban centres such as Bronkhorstspruit, Kriel,

Hendrina, Kinross and Trichardt. Satellite townships are also associated with most of the mining operations and power stations.

Dams: The natural rivers and streams have been extensively dammed with the result that the stream flow is now highly regulated. The major impoundments upstream of Loskop Dam include Witbank Dam, Middelburg Dam, Bronkhorstspruit Dam and Premiere Mine Dam. Many smaller farm dams and water supply structures associated with the mining operations have also been constructed in the catchment.

Mining: Extensive coal mining takes place in the catchment, most of which occurs in the Witbank Coalfields and Highveld Coalfields. The landscape in the southern and central part of the catchment is dominated by mining operations and mining-related infrastructure. Coal mining is mainly conducted by opencast techniques, high extraction underground operations and conventional board-and-pillar underground operations. The coal mines provide essential fuel to the local power stations as well as to the domestic and international markets. Numerous abandoned mining operations are located in the central part of the catchment, mainly towards the west and north-west of Witbank.

Power Stations: Several large coal-fired power stations are also located in the catchment including Arnot, Hendrina, Komati, Duvha, Matla, Kriel and Kendal. These stations are all supplied from local feeder mines in the catchment. Cooling water for the power stations has to be imported across several watersheds from other catchments where excess high quality water is available. Large ash disposal operations are associated with each power station.

Agriculture: Agriculture, both dryland and irrigated, is another important land use in the catchment with many areas in the southern and central portions producing high yields of maize. Irrigation farming of diverse crops takes place in various parts of the catchment the largest of which is the Loskop Dam Irrigation Scheme. Intensive farming in the form of piggeries and cattle feed lots are also scattered throughout the catchment.

The Upper Olifants River basin water resources are under constant pressure from both a supply/demand perspective as well as from a water quality perspective.

Major water uses in the Upper Olifants Catchment include:
- Irrigation;
- Urban and industrial uses;
- Rural uses; and
- Mining.

1.6.5 Effect of water use on water resources and other water users

The total water requirements for the Upper Olifants Catchment is approximately 410 million m^3/a. Approximately 20 million m^3/a (~5%) of the total is utilised by the mining and bulk industrial sectors. Rand Carbide obtains its water from the eMalahleni Local Municipality via the Witbank Dam. Rand Carbide utilises approximately 80 000 m^3 water per annum, which translates into Rand Carbide's water use per annum amounting to less than 0.2% of the water required in the catchment and 0.4% of the quantity used by mining and industrial sectors.

Rand Carbide is in the process of developing an Integrated Water and Waste Management Plan (IWWMP) that will result in not only the re-use and reclamation of water taken from the catchment (spring water, storm water & municipal water), but will also reduce the volumes of contaminated water entering the surrounding environment (capturing of contaminated storm water). In terms of this, the following should be noted:

- All water requiring dewatering (pumped from under the plant area) is reused for dust suppression. This water originates from three (3) springs in the plant area on the site and requires dewatering to allow the Rand Carbide plant to continue its operation as well as prevent risk to workers and plant infrastructure.
- The historic waste dump which is not lined is currently being reworked (EMB operation) and the area (footprint) will in the future (after reprocessing has been completed) be rehabilitated to prevent any potential groundwater contamination.
- No solid waste (process and other) is disposed on the site anymore. All current waste streams are removed for off-site disposal.
- The current storm water management system will be upgraded and a new storm water control dam will be built. The current dam (Harry's dam) is not lined but the new dam will be lined according to the latest legislation to contain contaminated water. This will reduce seepage, soil, groundwater and runoff contamination as well as capture all contaminated runoff from the site according to GNR704.

1.6.6 Class and resource quality objectives

Surface water:

The ecological water reserve (EWR) site for the B11J quaternary catchment is on the Olifants River, below Witbank Dam (25^0 45' 34.0" South; 29^0 18' 45.0" East). The present ecological status (PES) is E and the recommended ecological category (REC) is C. The Ecological Importance and Sensitivity (EIS) are moderate and the site is inundated due to the construction of a weir. A new site higher upstream is therefore considered (Department of Water Affairs, Classification of significant water resources in the Olifants Water Management Area (WMA4): WP 10383, Inception Report; Report RDM/WMA04/00/CON/CLA/0111; April 2011)

A summary of the present ecological status of surface water resources in the catchment is given in Table 1-2 below.

Table 1-2: Surface water present ecological status

Present Ecological Status (PES)			
Aspect:	**Rating: (0 – 5) 0 = no modification; 5 = large impact**	**Score (%)**	**Ecological category**
Bed modification	2	70	
Flow modification	1	85	
Introduced in-stream biota	0	95	
Inundation	2	70	
Riparian / Bank condition	2	70	
Water quality modification	4	30	
Desktop habitat integrity	-	*70*	C
Desktop invertebrate rating	5	10	
Desktop fish rating	5	10	
In-stream ecological condition	-	*30*	E
Desktop vegetation rating	3	50	
PES Ecostatus	-	**37**	**E**
Ecological Importance and Sensitivity (EIS)			
Diversity of types	2		
Importance of conservation & natural areas	0		
Intolerant (flow and flow related water quality)	1		
Migration route or corridor	0		
Rare and endangered	0		
Refugia	1		
Sensitivity to water quality changes	1		
Sensitivity to flow changes	2		
Species / Taxon richness	1		
Unique (endemic, isolated, etc)	0		
EIS		**Low / Marginal**	
Recommended Ecological Category (REC) Ecostatus		**D**	**Improvement required**

Confidence was rated as 4.4

Class: The table above (Table 1-2) provides the results from the Desktop Eco Classification assessment which has been done. The Recommended Ecological Category (REC) serves as the preliminary Class, albeit at a low confidence.

Ecological category C: Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

Ecological category D: Largely modified. The loss of natural habitat, biota and basic ecosystem functions has occurred.

Ecological category E: Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.

The closest EWR Site to Rand Carbide for the Comprehensive Reserve for the Olifants Catchment is EWR 2 on the Olifants River just before Loskop Dam.

DWA is currently using the Receiving Water Quality Objectives (RWQO) for the Olifants in terms of what the water quality should be. This will serve as an interim until such time that the DWA:Resource Directed Measures (RDM) obtains funding to add water quality sites (and review the previous sites) for Comprehensive Reserve determinations.

DWA prepared an interim water quality management plan for the Klipspruit sub-catchment in 1992/93 (IWQS Report No: N/B100/RMQ0996) and identified water quality requirements for a number of different water uses (potable use, irrigation, livestock watering and the natural aquatic environment). Guidelines were set for a number of water quality variables at two levels:

- Interim water quality guidelines were set to be achieved after implementation of Phase II of the water quality management plan, involving the collection and neutralisation of acid mine drainage.
- Acceptable water quality guidelines were set to be achieved after implementation of Phase III of the water quality management plan, involving remining and rehabilitation of the old mine workings.

The different water quality guidelines stipulated in the Klipspruit management plan are summarised below in Table 1-3.

Table 1-3: Interim Resource Water Quality Objective (RWQO) for Management Unit 9

Water Quality Variable	Units	MU 9
Physical		
Conductivity	mS/m	70
pH		6.5-9.0
Dissolved Oxygen	% Saturation	70
Suspended Solids	mg/L	-
Turbidity	NTU	-
Chemical, Inorganic		
Alkalinity ($CaCO_3$)	mg/L	120
Boron	mg/L	0.5
Calcium	mg/L	150
Chloride	mg/L	25
Fluoride	mg/L	1
Magnesium	mg/L	70
Potassium	mg/L	50
Sodium	mg/L	70
Sulphate	mg/L	200
Total Dissolved Solids	mg/L	450
Sodium Adsorption Ratio	$Meql^{0.5}$	1.5
Chemical, Organic		
Dissolved Organic Carbon	mg/L	10
Metals (Dissolved)		
Iron	mg/L	1
Manganese	mg/L	0.4
Aluminium	mg/L	0.02
Chromium	mg/L	0.05
Plant Nutrients		
Ammonia	mgN/L	0.007
Nitrate	mgN/L	6
Phosphate	mgP/L	0.05

Water Quality Variable	Units	MU 9
Total Phosphorus	mgP/L	0.25
Total Inorganic Nitrogen	mgN/L	1.25
Microbiological		
Faecal Coliform	# per 100 ml	130
Chlorophyll a	mg/L	0.02

Historical water quality: High concentrations of sulphate, TDS and dissolved metals together with very low pH values were noted in the historical data due to continuous seepage of acid mine drainage (AMD) from mainly old, defunct and abandoned mines in the catchment.

Constituents of concern: pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), sulphate (SO_4), aluminium (Al) and manganese (Mn).

Pollution loads: Sulphate loads at Zaaihoek (B1H004 on Klipspruit) are significant within the context of the Loskop Dam Catchment. The catchment is therefore considered severely polluted and makes a large contribution to the total sulphate load entering Loskop Dam. Loads show little seasonality, typical of a situation dominated by AMD from mine workings. The unit sulphate loads for Klipspruit were high and therefore it is considered to carry a high level of pollution.

Groundwater:

Geology: The B11J quaternary catchment is characterised by rocks of the Vryheid Formation of the Ecca group comprising arenite, shale and coal.

Groundwater is extensively used for domestic water supply and stock watering in the agricultural areas. Rehabilitated open cast pits tend to encourage recharge and local recharge well above average can be anticipated over small areas. Groundwater monitoring programmes have been implemented at numerous mines.

The aquifer represents an important source for stream base flow in the headwaters of the Olifants and its tributaries. Protection of the aquifers from mining impacts is crucial.

Area: 269 km^2

Mean Annual Precipitation (MAP): 682 mm

Groundwater recharge: 9.18 million m^3/annum (5% of MAP)

Baseflow: 5.17 million m^3/annum

Reserve: 1.66 million m^3/annum (18.08% of recharge)

Ecological Water Reserve (EWR): 1.09 million m^3/annum (11.87% of recharge)

Basic Human Need (BHN) reserve: 0.57 million m^3/annum (6.21% of recharge)

Present Ecological Status (PES): Category D

Table 1-4: Groundwater quality objectives (WQO) - preliminary

Parameter	Units	Class 0	Class I	Class II	Class III
pH		6 – 9	5 – 6 9 – 9.5	4 – 5 9.5 - 10	< 4 > 10
Electrical Conductivity (EC)	mS/m	0 – 70	70 – 150	150 – 370	> 370
Total Dissolved Solids (TDS)	mg/ℓ	0 – 450	450 - 1000	1000 – 2450	> 2 450
Calcium (Ca)	mg/ℓ	0 – 80	80 – 150	150 – 300	> 300
Magnesium (Mg)	mg/ℓ	0 – 70	70 – 100	100 – 200	> 200
Sodium (Na)	mg/ℓ	0 – 100	100 – 200	200 – 400	> 400
Chloride (Cl)	mg/ℓ	0 – 100	100 – 200	200 – 600	> 600
Sulphate (SO_4)	mg/ℓ	0 – 200	200 – 400	400 – 600	> 600
Nitrate (NO_3-N)	mg/ℓ	0 – 6	6 – 10	10 – 20	> 20
Fluoride (F)	mg/ℓ	0 – 1	1 – 1.5	1.5 – 3.5	> 3.5
Faecal coliforms	Counts/ 100 mℓ	0	0 - 1	1 - 10	> 10

Class I for where groundwater is used for domestic purposes (not applicable to Rand Carbide as it is situated in an urban area with water supply from the municipality)
Class II for disposal activities

Monitoring required: Groundwater levels quantity impact
Quality for quality impacts

1.6.7 Investments and financial provisions

2010 investment to reduce environmental impacts: > R1.6 million
Annual environmental monitoring: R124 612

1.6.8 Strategic importance

Please refer to "Socio economic impact" as set out in Section 1.6.3.

1.6.9 Probable duration

The duration of current activities at Rand Carbide is indefinite. A water use licence should therefore be issued for twenty (20) years.

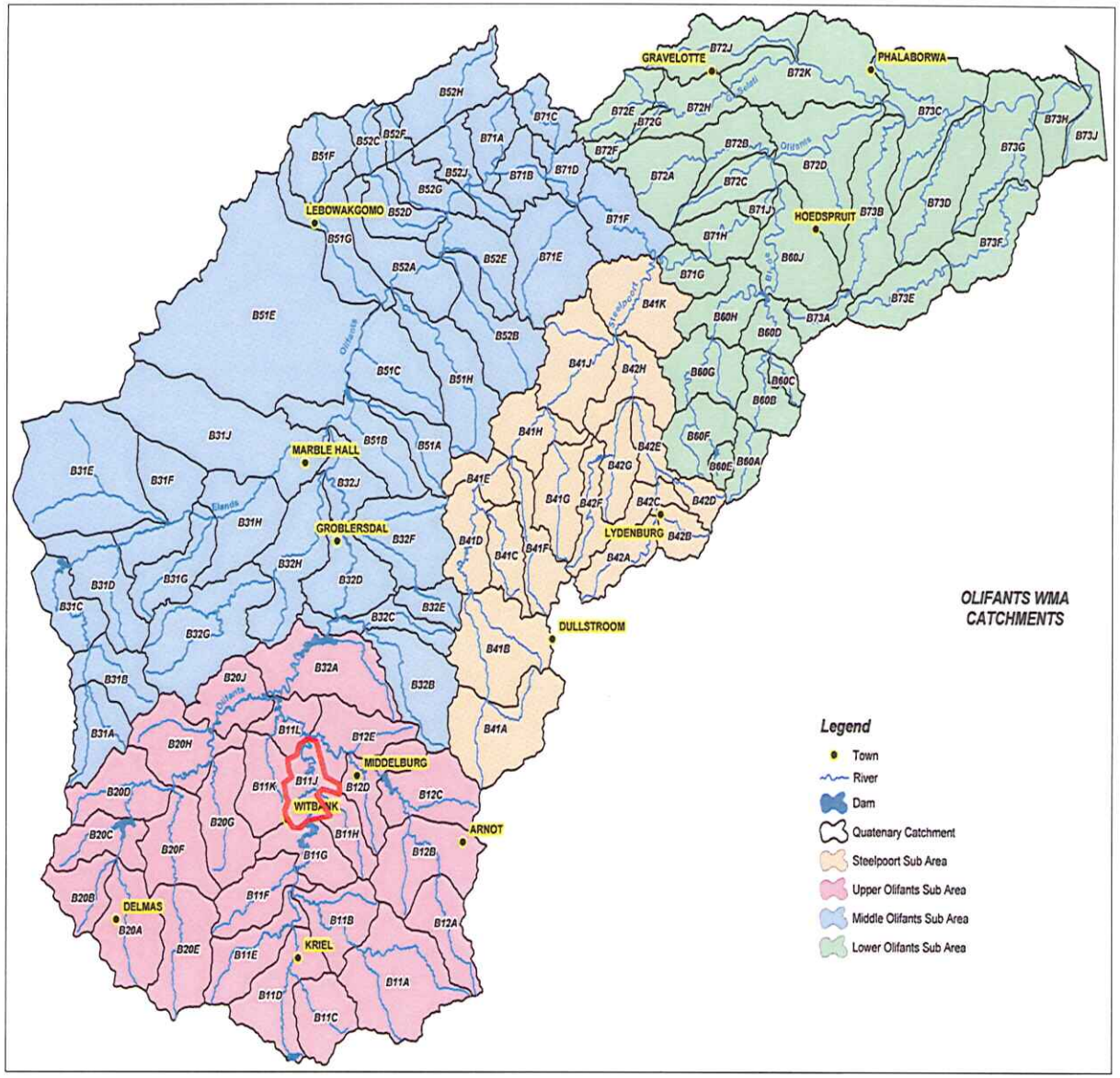

Figure 1-4: Map indicating the various catchments (including B11J) of the Olifants WMA

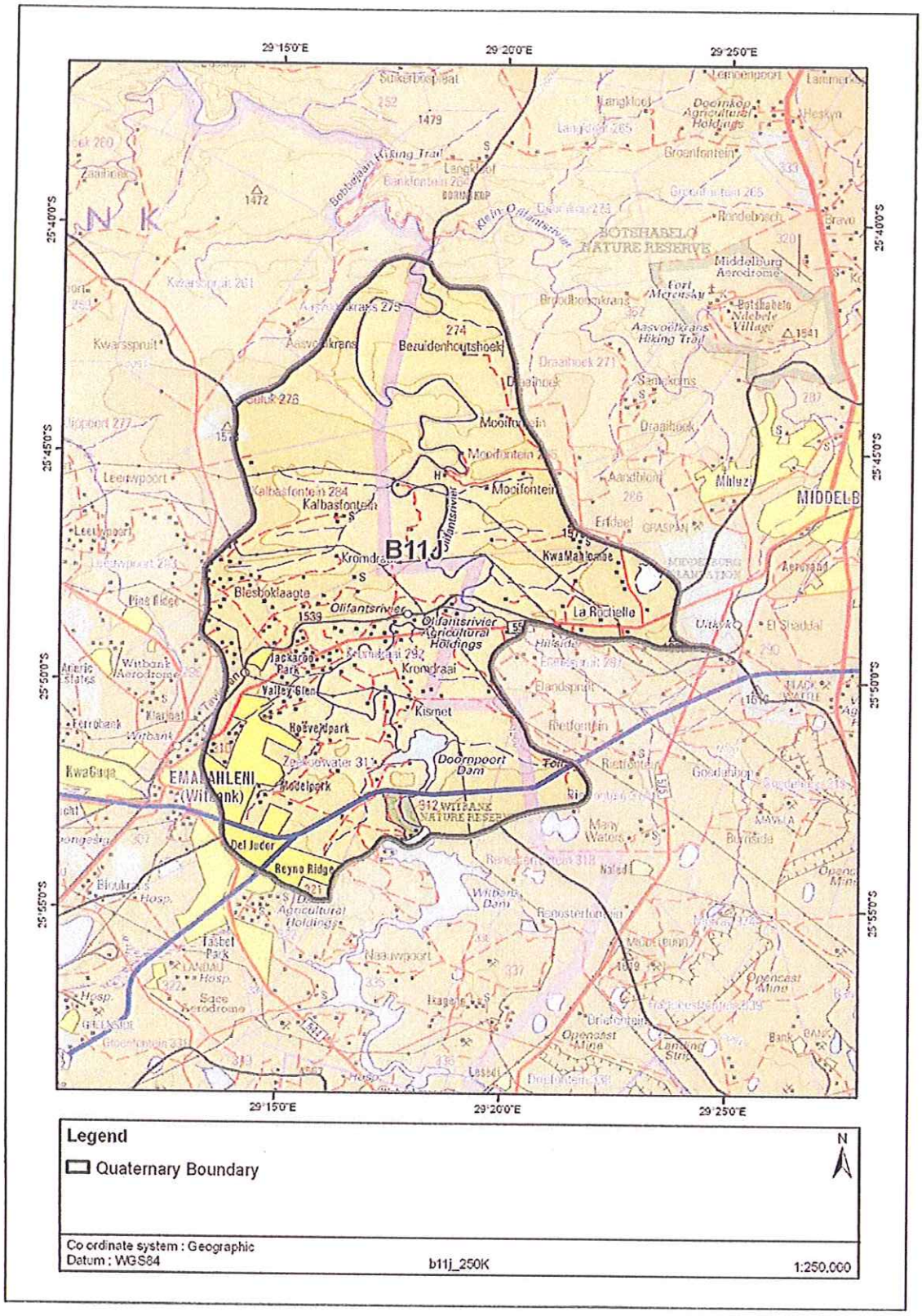

Figure 1-5: Map of quaternary catchment B11J of the Olifants WMA