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mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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From: Directorate: Mineral Regulation: Northern Cape **Date:** 25 October 2010
Enquiries: Mr. N.V. Muila **E-mail:** vincent.Muila@dmr.gov.za
Ref No.: NC 30/5/1/2/3/2/1/061EM

SA HERITAGE RESOURCES AGENCY
RECEIVED
10 NOV 2010

The Director
South African Heritage Resources Agency
PO Box 4637
CAPE TOWN
8000

Attention: Mrs Nonofho Ndobochani

CONSULTATION IN TERMS OF SECTION 40 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT 2002, (ACT 28 OF 2002) FOR THE APPROVAL OF AN AMENDED ENVIRONMENTAL MANAGEMENT PROGRAMME FOR MINING RIGHT ON THE FARM EENZAAMHEID NO. 626, SITUATED IN THE MAGISTERIAL DISTRICT OF GORDONIA: NORTHERN CAPE REGION.

APPLICANT: SAAMWERK SOUTWERKE CC

Attached herewith, please find a copy of an amended EMPR received from the above-mentioned applicant, for your comments.

It would be appreciated if you could forward any comments or requirements your Department may have to this office and to the applicant **23 December 2010** as required by the Act.

Consultation in this regard has also been initiated with other relevant State Departments. In an attempt to expedite the consultation process please contact **Mr Vincent Muila** of this office to make arrangements for a site inspection or for any other enquiries with regard to this application.

Your co-operation will be appreciated.

....

REGIONAL MANAGER: MINERAL REGULATION
NORTHERN CAPE REGION

Appendix 2:

Environmental Management Program Report
Amendment 1 - August 2010

(contemplated in regulation 51 of the Mineral and Petroleum Resources Development Act, 2002) (Act No. 28 of 2002)

Portion of the Farm Eenzaamheid No. 626
Saamwerk Soutwerke BK

Reg. No. 2003/042729/23

Reference NC 30/5/1/2/2/061 MR

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Aim of Report

This report serves first and foremost as the Environmental Management Programme Report to minimize environmental impacts and secondly to enable management to make day to day and longer term planning decisions within a reported and transparent framework. During the assessment of the continued appropriateness and adequacy of the environmental management program it was clear that the approved document is a standard environmental management plan intended for use with prospecting and mining permits in terms of regulation 52 and needed to be amended to be in line with regulation 51.

Background

Since ancient times, salt has been used to flavour and preserve food. Early trade routes and many of the first roads were established for transporting salt. Many ancient civilizations levied taxes on salt. Salt was considered so precious that it was traded ounce for ounce for gold. In ancient China, coins were made of salt. In the Mediterranean regions, salt cakes were used as money. Ancient cities such as Genoa, Pisa, and Venice became salt market centres. By the fifteenth century, salt was obtained by boiling brine from salt springs, and many towns and cities in Europe located near such sources. During the eighteenth century, the efficiency of the boiling brine process was improved by using coal instead of wood as fuel. Because of its coal supply, England became the leading salt producer in the world. Early colonies in America were dependent on England for most of their salt. After the Revolutionary war, the United States developed salt works along the Atlantic coast for boiling sea water. After salt springs were discovered in New York, near where the city of Syracuse is today, the Erie Canal was constructed. By the early nineteenth century, equipment and technology was developed for the deep-drilling of wells, a process that improved the quality and increased the quantity of salt springs used for salt production. In the mid-1800s, underground mining of salt deposits began.

In recent times Salt, or sodium chloride, is a readily available inexpensive bulk mineral that can be produced by a variety of methods:

- Solar brine – seawater evaporation in shallow coastal basins or artificial ponds. Lake brine is also used as feed in conventional solar ponds.
- Underground deposits of halite or rock salt, mined by room and pillar, or solution mining which forms a large underground cavity.
- Vacuum evaporation – brine dehydration to crystallise salt in a series of multiple-effect evaporators operated under vacuum to reduce process temperatures.

Over a 100 countries produce a significant amount of salt with many others on a small scale. The USA is the biggest producer of salt in the world, accounting for approximately 21%, with China providing about 15% and Europe just over 20%, of which Germany and France are the biggest contributors. Other major producers are India, Australia, Mexico and Canada.

The main uses of salt irrespective of production method are:

- Chemical production;
- Cooking and food processing;
- De-icing of roads in winter;
- Agriculture;
- Other industrial uses such as oil and gas exploration, textile dyeing, aluminum refining, glazing, soap making and leather tanning.

The biggest consumer of salt is the chemical industry. The chlor-alki sector is a major consumer using salt to manufacture chlorine and sodium hydroxide. Salt is a popular raw material in the industry as it is the cheapest and most common source of soda and chlorine. About 1.75 tons of salt are required to make 1 ton of chlorine and 1.1 ton of caustic soda co-product.

In South Africa the production of salt from 1996 – 2006, exhibited average growth of 2.8 percent per annum. Production has been on the increase from 2004 and reached 465 tons in 2006. The top six companies contributed 82 percent to local production but because local production cannot supply all of South Africa's salt, imports are necessary. Imported salt is sourced mainly from Botswana and Namibia.

The chemical industry utilises imported high grade, coarse marine salt. NCP Chlorchem and Sasol are the two biggest users. NCP manufactures downstream chlorine products whilst Sasol uses chlorine as an intermediate in the manufacture of polymers, the major being polyvinylchloride (PVC). NCP Chlorchem is a captive producer (i.e. produces its own salt) and sources its salt requirement from Walvis Bay Salt Holdings in Namibia and Sasol Polymers, imports from Botash in Botswana and Walvis Bay.

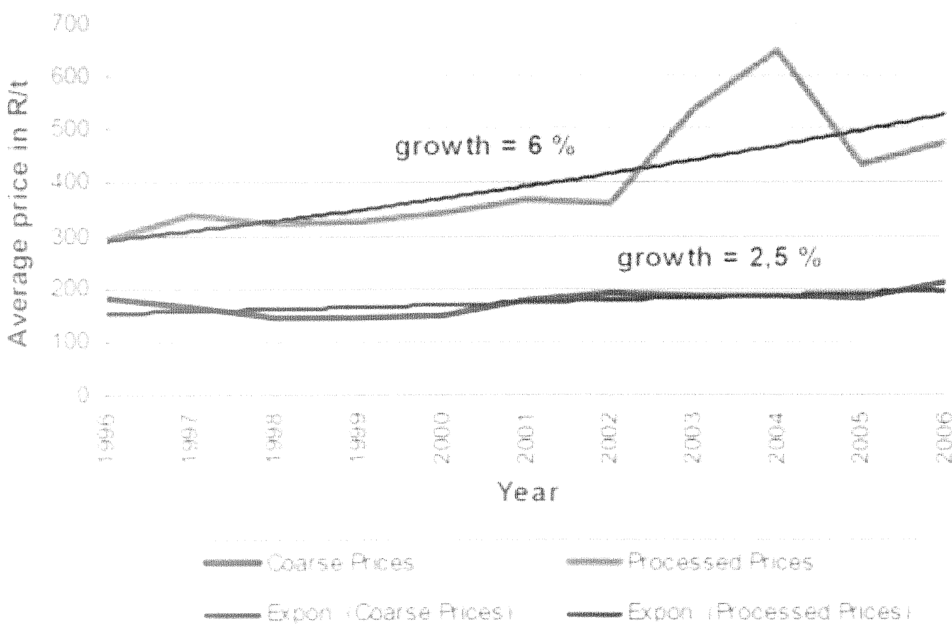
The challenge facing the chlor-alki industry is that of a "chlorine sink", i.e. South Africa produces excess chlorine and storing and transporting chlorine is an environmental hazard. Export of chlorine is problematic, as no port in the world will allow more than 30 tons on a ship.

Sales of salt grew at an average rate of 2.2% per annum and reached a record high of R90 million in 2006, which represented 0.05% of total revenue generated from mining.

The local market is quite competitive. Cerebos controls the 'top-end' of the food market i.e. it sells branded salt to the major retailers. Swartkops Sea Salt supplies the wholesale market, particularly the Free State, Eastern Cape and KZN regions. The Western Cape market is supplied by United Salt. Salt Refiners and Packers supplies the KZN and Gauteng markets, but in addition does contract packaging for other producers.

Various types of salt have unique production, processing and packaging factors that determine their selling price. Salt sold in bulk is naturally less expensive than salt that has been packaged, palletised or pressed into blocks. Vacuum pan salt is the most expensive because of the higher energy cost involved in processing and purifying the product. The average local price of coarse salt has shown an average growth of 2.5% per annum and processed salt and average growth of 6% per annum (refer to Figure 1 below).

Figure 1: Average local prices of salt, 1996 – 2006 (nominal terms) - (Source: Directorate Mineral Economics)



There are several restraining factors on growth of the market including:

- Salt pans are located in remote areas of the country, and transportation is a major cost. Pumping brine is an economic means of transportation but cannot be used for dry salt. Large bulk shipments of dry salt by ocean freight are low cost but are restricted in points of origin and consumption. As salt is a bulk, low value commodity, available wagons on the rail network are diverted to commodities which have better yields.
- As salt is packaged, handled and shaped in small units, the accompanying cost increases that are not always reflected in higher sales prices.
- A serious handicap to the salt industry is the relatively poor quality of salt produced at a number of the inland pans. This is due mainly to wide daily fluctuations in temperature and the composition of the brine at the time of crystallisation, often aggravated by faulty layouts of many of the works as well as a lack of adequate technical control during crystallisation. The most common impurities in pan salt, apart from dust, are the sulphates of sodium and calcium.
- Desertification or drying up of underground resources has put pressure on salt pans, particularly in the Brandvlei area.

On the opposite side there are also some driving factors on growth of the market including:

- Small scale mining and Black Economic Empowerment
- Current state of the economy (i.e. its performance and capacity to create jobs)
- Growing demand for the products in the chemical industry

The usage of salt in the chemical industry is expected to grow, on the back of the strong performance of the economy. Demand in the agricultural industry is seasonal i.e. during cycles of above average rainfall and when animal grazing is abundant; demand for salt is low compared to drought periods when demand increases. Salt demand in this sector would be based on forecast data for rainfall and herd sizes.

Ubiquitous salt reserves in the country, as well as growing demand, consistent with unprecedented levels of economic growth, create further opportunities for increased supply needs for salt particularly as South Africa imports more than 50 percent of salt to meet its demand levels.

Major Environmental Findings

Salt mining is very different from other mining operations in that no rock is broken and no mining waste is generated. Therefore the impact on the topography is insignificant and no waste dumps are created above surface. Production essentially entails the pumping of brine onto hardened surfaces where crystal growth occurs by solar evaporation.

1. PART 1: BIOGRAPHIC DETAILS

1.1. Name and address of Mine, Mine Owner and Manager/responsible person

Full name of company:	Saamwerk Soutwerke
CC registration number;	2005/023969/07
Postal address:	P.O. Box 1228, Upington, 8800
Physical address:	52 Karakoel Street, Upindust, Upington 8800
Contact Person:	Elizabeth G. du Toit (Elda)
Tel: 054 3311408	Fax: 086 6289820
Cell: 082 5503707	E-mail: eldadt@lantic.net

1.2. Name of Owner of Land and Title Deed Description

Portion of the Remainder of the Farm Eenzaamheid No. 626 in extend 11307.0097 Ha situated in the Siyanda District Municipality local authority of the Gordonia administrative district of the Northern Cape. The property is registered in the name of Sans Cuici Agri (Pty) Ltd (Reg. No. 1997/021173/07) by virtue of title deed T2340/1998. LPI code C02800000000626000010

1.3. Regional Setting

The Eenzaamheid mine is situated about 113 km north-northwest of Upington in the Kalahari region of Cordonia district, Northern Cape Province. The mine is situated within jurisdiction of the local authority of the Siyanda District Municipality with an approximate centre Latitude S27.66592° and Longitude E20.83965° (refer to Figure 2 below for major roads and towns).

1.4. Land Tenure and use of immediately adjacent land

The area is zoned as agricultural land use mainly for small stock and game farming. The productivity of the area is relatively low at a carrying capacity of 10 Ha/SSU. The productivity of the Pan floor is however zero. No other land uses have an impact on the environment except for similar small scale salt mining activities on the northern edge of the pan.

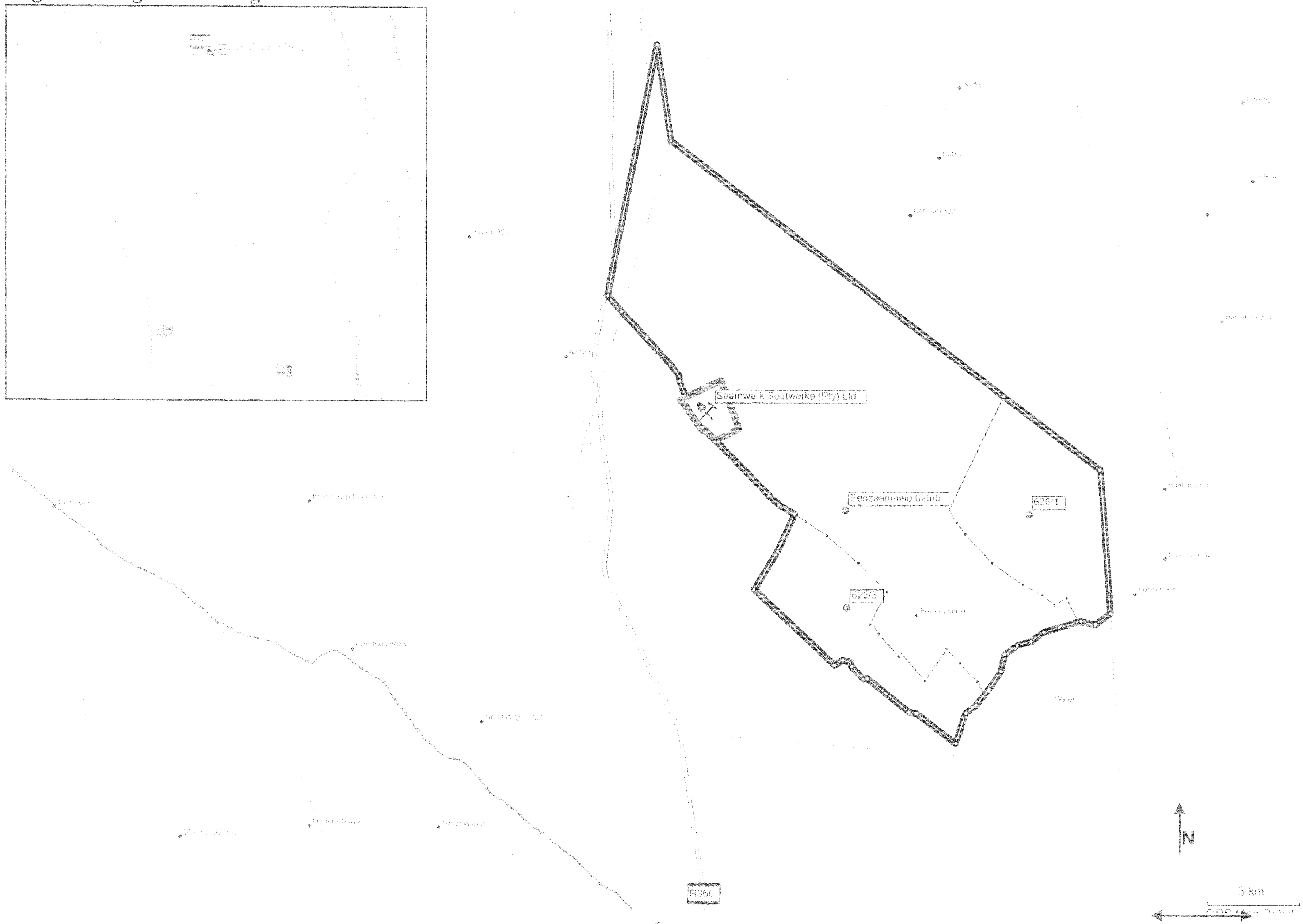
1.5. Water catchments

The Eenzaamheid Pan is located along ancient drainage systems one of a considerable number of large saltpans found in the Kalahari region to the north of Upington (refer figure 7).

1.6. Surface Infrastructure

A well maintained tarred road the R360 gives access to the mine (refer to Figure 2 above). Telecommunication is by means of cellular and potable water is carted in from the pipeline of the local authority. No power supply is available and generator sets are used.

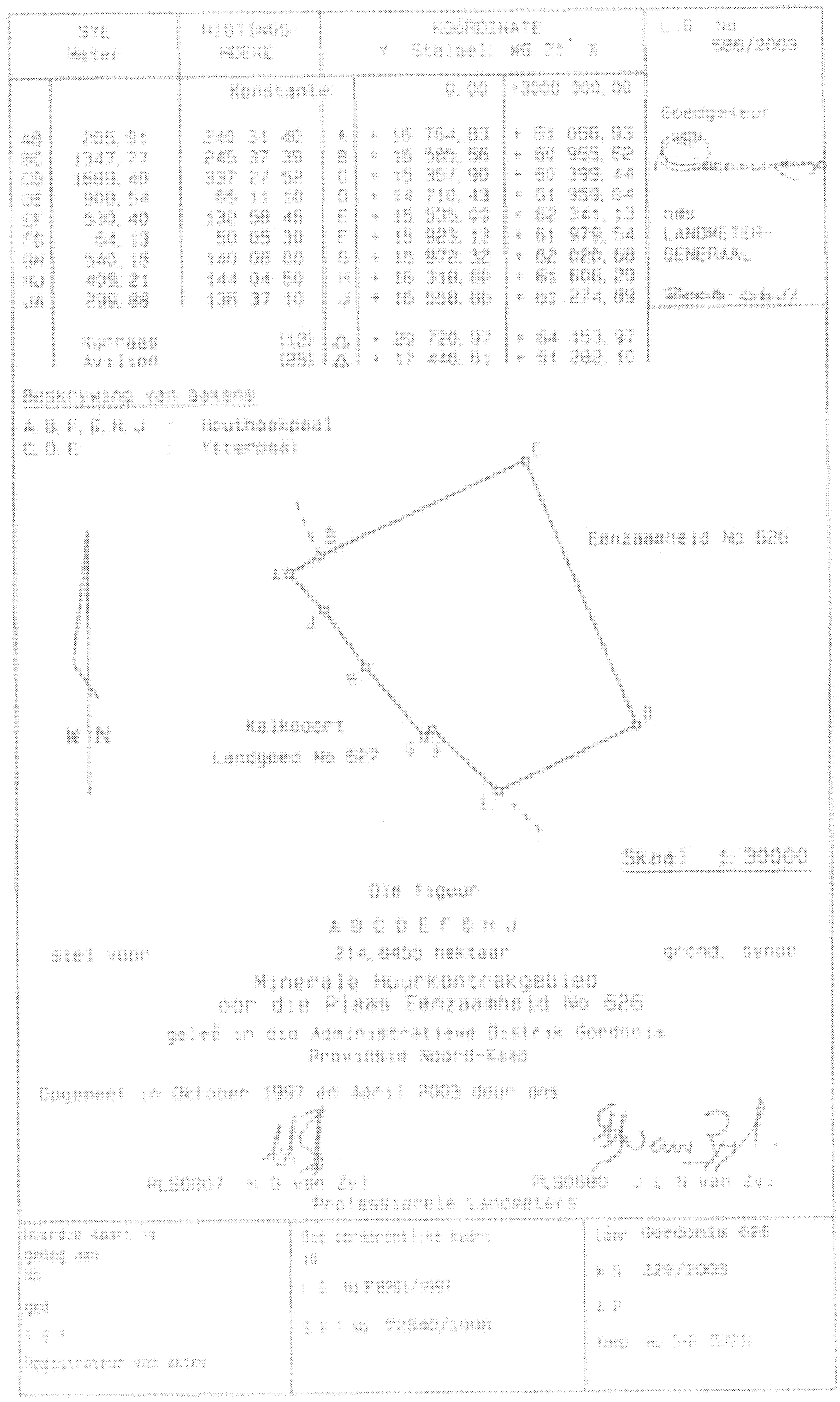
Figure 2: Regional setting



1.7. Presence of servitudes

No servitudes are registered over the property except for this mineral lease (refer figure 3).

Figure 3: Mineral lease



1.8. Minerals to be mined

Mineral deposit

The mineral to be mined is salt, a clear, brittle mineral that contains the elements of sodium and chlorine. Its chemical formula is NaCl; its mineral name is halite. Salt forms clear, cube-shaped crystals. Impurities can cause salt to appear white, gray, yellow, or red. All salt deposits began as salty water; brine from seas, oceans, and salt lakes. Even underground salt deposits were formed by the evaporation of sea water, eons ago.

South Africa's salt resources are confined to underground brines associated with inland saltpans, coastal saltpans and seawater. There are no known economical rock salt deposits in the country. The majority of inland pans lie on rocks of the Karoo Sequence, in a curved belt between 50 and 60 km wide, extending from near Vryburg in the North-West Province to Hopetown on the eastern border of the Northern Cape, continuing westwards past Brandvlei.

Most of the pans have formed on shales of the Dwyka and Ecca Groups, which, in that area, were deposited under marine conditions.

The salt deposit on the Farm Eenzaamheid is an underground deposit of halite or rock salt, mined by solution mining. The Eenzaamheid Pan is located along ancient drainage systems one of a considerable number of large saltpans found in the Kalahari region to the north of Upington that also lies on shale's of the Dwyka Group. The salt obtained from the pans underlain by the Dwyka Group rocks has a relatively high sodium sulphate content, this probably results from the oxidation of iron sulphate to sulphate.

The results from the water analysis show the NO;-N and NH4-N are slightly higher than were expected; however no nitrate values were picked up in the salt analysis. The nitrate values are unrelated to rainfall and cultivation, and according to a study done in Texas (Williams and Hastings, 1951) the values were found to increase in shallow wells (less than 70m deep) situated in late Tertiary and Quaternary Formations. The equivalent in South Africa will be the Kalahari Group sediments and younger sediments.

Estimated reserve

In 1974, the salt resources of South Africa's inland saltpans were conservatively estimated at 53 million tons. This figure represented salt contained in the top 3m of pan soil, which is only recoverable after the salt has been leached into the underground brine. South Africa's production of salt from 1974 – 2006 is estimated at 17 Mt, including production from coastal pans and Walvis Bay. Salt resources still appear to be large, but drier weather conditions experienced in the Northern Cape have put some pans under pressure, e.g. Brandvlei. World reserves of salt are simply classified as "large"; the oceans comprise an inexhaustible supply.

This potential source of salt at Eenzaamheid is unlimited, and leaching of salt will continue as long as water move through the sediments. The composition of groundwater is influenced by the rate of flow through the Dwyka, which in this flat area, are relatively slow. For the production of salt by means of solar evaporation, the annual evaporation must exceed the rainfall for effective salt production. These criteria are easily met as a result of high temperatures and long hours of sunlight. A life of mine calculation based on the above criteria can be estimated at more than 30 years.

Production rate

Salt mining only involve the pumping of brine from boreholes for the production of salt by means of solar evaporation. A top-up of 16 m^3 water is obtained from 2 boreholes on the mining area. The boreholes are currently pumped far beneath their potential yield (58% and 40% respectively).

Salt is harvested when crystals are about 50 mm thick producing about 350 tons per month on a 1 Ha crystallisation pan.

In the summer (September to April) months production rates are at the optimum level and during the winter (May to August) the salt pans go into a resting period where no salt is being produced. Due to this rest period and the productive yield of the bore holes the life of the mine is indefinite and can only be influenced by climate change.

The current average production is 15 000 tons salt per year. Production can however be increased with the availability of more water. At present Eenzaamheid is operating only 2 pumps with a total yield of 16-24 cubic meters per hour.

At this stage, Eenzaamheid does not directly beneficiate its own production further than the sorting, valuation and sales preparation. This means that the salt produced at Eenzaamheid is sold as FoT product to a salt refinery in Upington where the various types of salt have unique production, processing and packaging factors that determine their selling price.

2. PART 2 DESCRIPTION OF THE PRE-MINING ENVIRONMENT

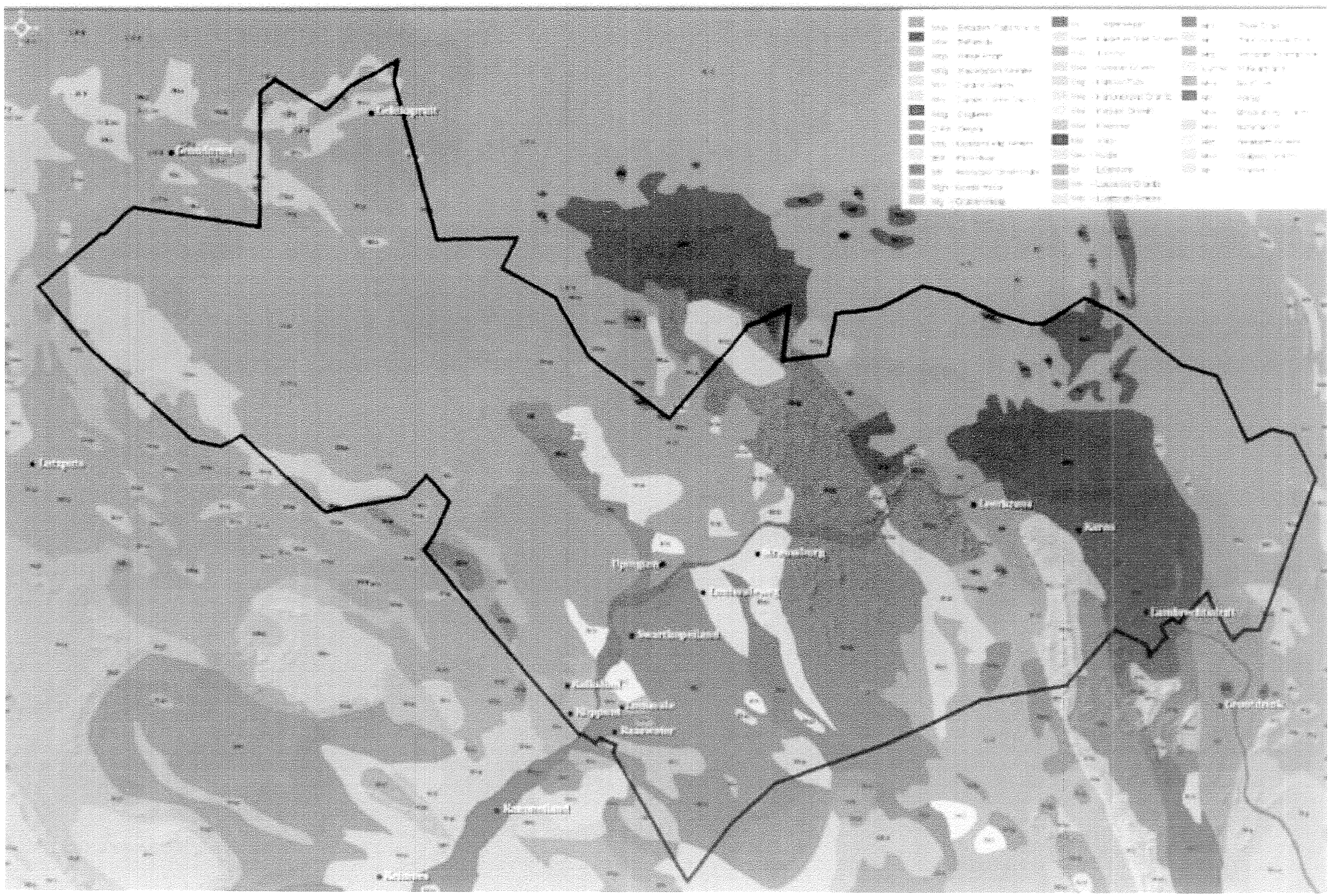
2.1 Geology

The regional geology of the area is characterised by the metamorphosed sediments and volcanic activity intruded by granites and is known as the Namaqualand Metamorphic Province (refer to Table 1 and Figure 4 below).

Table 1: Geological units (lithostrat) represented in the region

LITHOSTRAT	REF CODE	DESCRIPTION
Betadam Gabbronorite	Mbd	Dark grey gabbronorite forming irregular vein-like intrusions as well as plutons
Bethesda	Mbe	Biotite-rich and pelitic gneisses, muscovite-biotite schist, subordinate amphibolite and calc-silicate rocks
Biesje Poort	Mbp	Quartzite, quartz-feldspar gneiss, calc-silicate rocks, kinzigite, subordinate marble, amphibolite and aluminous gneiss
Blauwbosch Granite	Mbg	Medium-grained, porphyritic, unfoliated syeno-granite occurring as several small stocks
Colston Granite	Mcs	Weakly foliated, coarse-grained, grey biotite granite
Curries Camp Gneiss	Mcc	Coarse-grained to megacrystic quartz-feldspar gneiss (intrusive)
Dagbreek	Mdg	Quartz-muscovite schist, quartzite, subordinate gneiss and amphibolite
Dwyka	C-Pd	Diamictite (polymictic clasts, set in a poorly sorted, fine-grained matrix) with varved shale, mudstone with dropstones and fluvioglacial gravel common in the north
Dyasons Klip Gneiss	Mdy	Brown-weathering porphyroblastic to megacrystic gneiss (intrusive)
Fish River	(E)f	Red sandstone/quartzite, interbedded red siltstone and shale
Friersdale Charnockite	Mfr	Dark-weathering, fine- to medium-grained, inequigranular (locally porphyritic) charnockitic adamellite
Goede Hoop	Mgh	Quartzite, quartz-muscovite schist, conglomerate lenses
Groblershoop	Mg	Schist, subordinate quartzite and metalava (greenstone)
Jannelsepan	Mj	Amphibolite, amphibole gneiss, subordinate biotite, quartz-feldspar and politic gneisses, calc-silicate rocks and mica schist.
Kakamas Suid Gneiss	Mkm	Grey augen gneiss (intrusive)
Kalahari	K-Q	Superficial deposits comprising gravels, clays, sandstone, silcrete, calcrete and Aeolian sand
Kalkwerf Gneiss	Mkw	Red-brown, coarse-grained granite gneiss
Kameel Puts	Mkp	Quartz-feldspar and biotite gneiss, amphibolite, lenses of conglomerate, calc-silicate rocks, marble and quartzite
Kanoneiland Granite	Mke	Medium- to coarse-grained, moderately foliated, mesocratic granite with scattered phenocrysts
Keboes Granite	Mke	Medium-grained, moderately foliated, porphyritic granite
Kleinbegin	Mkd	Medium- to coarse-grained, weakly foliated granites
Koras	Mkr	Basic and acid lava, volcaniclastic rocks, sandstone, conglomerate
Kuibis	Nku	Quartzite
Leerkrans	Ml	Basic and acid volcanic rocks, schist
Lousivale Granite	Mlv	Light grey, moderately to well foliated biotite granite
Luptzputs Gneiss	Mlp	Sillimanite- and garnet-bearing granitic gneiss
Ratel Draai	Mrd	Kinzigite
Riemvasmaak Gneiss	Mrv	Pink-weathering granular or augen quartz-feldspar gneiss
Rooiputs Granophyre	Mrg	Grey, medium-grained, unfoliated granophyre
Sout River	Mso	Fine- to medium-grained biotite gneiss, muscovite gneiss, sillimanite-bearing gneisses
Sprigg	Msr	Quartz-feldspar-biotite-muscovite schist, subordinate garnet-sillimanite-biotite gneiss, quartzite and conglomerate
Straussburg Granite	Msb	Grey, coarse-grained, inequigranular, moderately foliated biotite granite with numerous xenoliths
Sultanaoord	Msu	Massive quartzite, subordinate phyllite
Swanartz Gneiss	Msz	Porphyroblastic biotite gneiss
Vaalputs Granite	Mvp	Grey, well-foliated, medium-grained, locally porphyritic adamellitic granite with abundant xenoliths
Zonderhuis	Mz	Quartzite, phyllite, schist, dolomite, conglomerate

Figure 4: Dominant geological characteristics of the region - (Source: EnviroNomics et al, 2007).



The local geology surrounding the mining area are however not complex, and comprise essentially rocks from Dwyka- and Kalahari Groups. Some tillite scree is encountered on the deflation surface of the pans. Red-coloured sand dunes of the Gordonia Formation of the Kalahari Group are found along the edges of these pans. It appears as if the paleo-drainage system in which these pans occur is divided by dune formation along the channel.

A study of the younger lithologies of the Karoo Super group and Kalahari Group within the mining area was completed and is attached as part of the supporting documentation (para. 10.1).

The study has shown that the sedimentation of the Karoo Super group was initiated by the Permo-Carboniferous glaciations known as the Dwyka Formation. The compositions of some of the sediments show that much of the material was deposited from melt-water streams issuing from the fronts of glaciers. Pebble drop mudstone indicates that the shore of the Dwyka Sea was located nearby. The movement of the Dwyka ice sheets has been interpreted as representing a series of lobes moving broadly southwards. The Karoo episode closes in the Jurassic with the Drakensberg volcanic event of which only the hypabyssal event i.e. the intrusion of dolerite dykes are present in the study area.

This volcanic event is related directly to the break-up of Gondwanaland and the separation of Africa from the southern continents.

The formation of the escarpment and interior basin was a direct result of the rifting which accompanied the break-up of Gondwanaland as a consequence of sea-floor spreading and plate tectonics. By Early Cretaceous, Africa emerged as a separate plate and the Kalahari Basin, of which we see the southern fringe, was created as a shallow depository. By this time the Southern African landmass was one of erosion related to new base levels. The Kalahari Basin has been in existence for the whole Cenozoic with rivers draining into this region, dumping gravel clay and calcareous sand. Initially the climate was wet and large valleys were cut into the African Surface. This fairly wet cycle was followed by a generally dry cycle which gave rise to the Gordonia Formation.

2.2 Climate

Upington is located 836 m above sea level in a semi-desert. The climate of the area is typical of a semi-desert and an arid savannah area. It is characterised by fluctuating temperatures, low and unpredictable rainfall and high evaporation rates.

Upington is generally accepted as the hottest town in South Africa, with average summer temperature varies between 18°C and 36°C with extremes of up to 43°C. Winter temperatures are mild and vary between 3°C and 23°C. The night temperatures, although averaging between 4°C and 10°C can drop to 0°C or below. Rain usually occurs in spring and then again between February and April. The region has an average rainfall of 184 mm per year (refer to Table 2 below). Most rainfall received in the area is of convective origin and occurs in summer. Storms are relatively brief and peak intensities over 5, 10 and 15 minutes occur.

The prevailing winds are northerly and westerly. Winds during the period October to January originate from a north-north-western direction. Although these winds are not strong, they are of a long lasting nature. During winter months, strong south-west and south-south western winds are experienced although they are not of a long lasting nature. Frost occurs periodically and mean humidity is the lowest in South Africa.

Table 2: **Summary of the climate in Upington (1961-1990)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Total
Highest recorded temperature (°C)	42	42	41	38	34	29	29	33	39	40	41	43	43
Average daily maximum temperature	36	34	32	28	24	21	21	23	27	30	33	35	29
Average daily minimum temperature	20	20	18	13	8	5	4	6	9	13	16	19	13
Lowest recorded temperature	10	9	5	2	-2	-5	-6	-7	-2	2	5	6	-7
Average monthly precipitation (mm)	24	35	37	26	4	2	4	4	4	9	17	17	189
Average number of rain days	4	6	6	5	2	2	1	1	2	3	3	4	37
Highest 24 hour precipitation	33	59	46	52	26	13	7	40	19	22	51	42	59

(Source: South African Weather Service)

2.3 Topography

The mining area is located in a relatively flat terrain characterised by shallow valleys and dry drainage lines. It forms part of the 'Great African Plateau' which was uplifted during the great Mesozoic and Tertiary earth movements. This plateau forms the largest part of the ancient continent of Gondwanaland which formally included Eastern Brazil, Southern India, Western Australia and Antarctica. In each of these fragments the general foundation is the same with an ancient surface of old rocks which together form the 'fundamental complex' of the ancient land-mass. Over time this surface was covered by sedimentary beds in a freshwater inland lake and by means of wind blown sand (Siyanda EMF, 2007). The regional topography surrounding the mining area is generally flat laying sandy plains with low dunes and numerous salt pans (refer to Figure 5 below).

2.4 Soil

The soils in a regional context are reddish, moderately shallow, sandy, and often overlay layers of calcrete of varying depths and thickness. The soils are typically weakly structured with low organic content. These soils drain freely which results in a soil surface susceptible to erosion, especially wind erosion when the vegetation cover is sparse and gulley erosion in areas where storm-water is allowed to concentrate (Bohlweki, 2006).

The soils of the flat lowlands areas can be described as red, eutrophic (high base status) and excessively drained sandy soils. The soils often overlay thick layers of calcrete, which is known for its hardness. The average clay content of the topsoil is less that 10-15% and the soil depth varies between 400 and 750 mm (refer to Table 3 below).

Figure 5: Topography and landscape

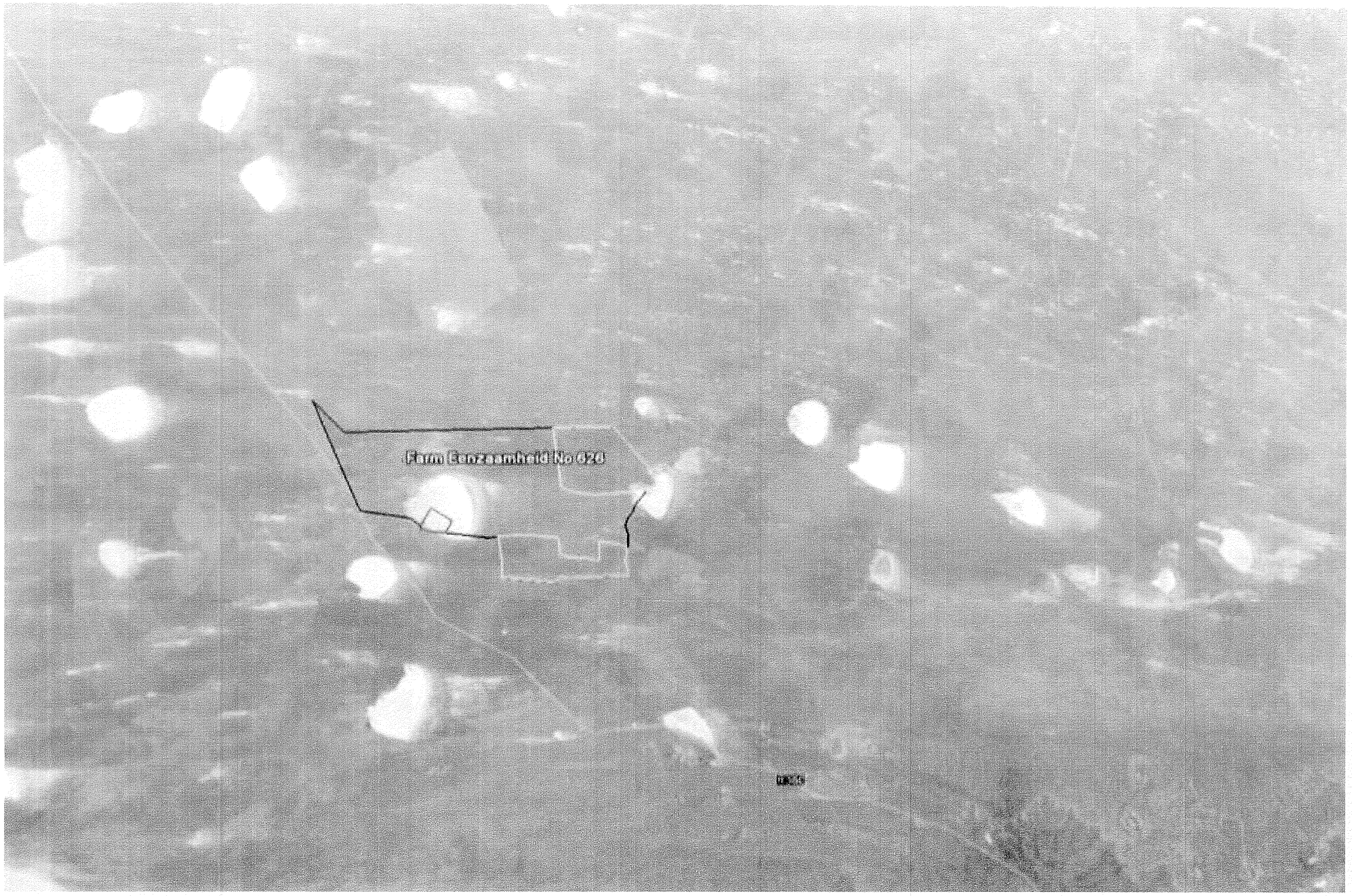


Table 3: Soils of the region

Soil Description	
a)	Red, yellow and greyish excessively drained sandy soils (Arenosols). These soils are also very prone to wind erosion.
b)	Red massive or weak-structured soils with high base status (association of well-drained Lixisols, Cambisols, Luvisols).
c)	Soils with minimal development, usually shallow or hard or weathering rock with or without intermittent diverse soils; lime generally present in part of most of the landscape. (Association of Leptosols, Regosols, Calsisols and Durisols). In addition, one or more of Cambisols and Luvisols may be present.
d)	Soils with negligible to weak profile development usually occurring on recent flood plains (association of Fluvisols, Cambisols, Luvisols and Gleysols).

The soils of the pans within the mining area are characterized by a wide range of soil types, with a gradient of both chemical and physical properties from the centre of the pan outwards towards the rim. Owing to the shape of the pan and a higher concentration of silt and clay content on the lower banks, finer soil particles, organic matter and soil minerals are carried inward towards the centre of the basin during inundation. This result in an increasing concentration of minerals and clay particles in the soil, from the higher to the lower-lying parts of the pan. Red Kalahari sand (Hutton) overlies the surrounding area outside the pan floor. The upper 100 mm sandy soil contains a little humus and grass seed. This is underlain by sand of similar type, and is on average a further 400 mm thick. Given the high sand content of this material as well as the lack of vegetation cover, it is very susceptible to erosion (particularly wind erosion) and gulley erosion in areas where storm-water is allowed to concentrate.

2.5 Pre-mining land capability

The soils in the area are generally not suitable for dry land crop production and the only area where intensive crop cultivation is feasible is along the Orange River where irrigation is possible therefore the pre-mining land capacity is categorized as Class III grazing land. The productivity of the area is very low at 8Ha/SSU.

The mining area has been classified into the following classes of land capability:

Arable land:	0 ha.
Grazing land:	0 ha.
Wetland:	214.8455 ha.
Wilderness land:	0 ha.
TOTAL:	**214.8455 ha**

Of this total area only about 25% is disturbed by mining activities and all of it is within the class wetland. Although termed wetland the salt pan is devoid of any wetland vegetation or other wetland features and can rather be termed waste land.

2.6 Land use

Historic salt mining operations has left the site with some historic disturbances. Grazing with cattle is the primary agricultural activity in the rest of the area. Apart from these mining related impacts, no other evidence of misuse exists. The only permanent structures are farm buildings.

2.7 Natural vegetation / plant life

The study area falls within the Savannah Biome. The Savannah Biome is the largest biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. It is well developed over the low veldt and Kalahari region of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe.

It is characterised by a grassy ground layer and a distinct upper layer of woody plants. Where this upper layer is relatively low, this vegetation type is often referred to as Shrub veldt. Dense areas are often referred to as Woodland, and the intermediate stages are known as Bush veldt. A major factor that determines the distribution of this biome is low rainfall which prevents the upper layer from dominating. The grass layer prospers where the growing season is hot and moist. Most of the savannah vegetation types are suitable for grazing (refer to Table 4 below).

Table 4: Vegetation types represented in the region

VEGETATION TYPES	
Bushmanland Arid Grassland	Occurs in some of the most arid parts of South Africa where the topography is generally flat and most of the region lies at about 900m. Soils are quaternary sands and Karoo Sequence shales which give rise to weak and structureless clay and sandy soils. Structurally Bushmanland Nama Karoo is dominated by annuals and non-succulent shrubs. In the more sandy parts of this region the vegetation is dominated by Cauliflower Ganna (*Salsola tuberculata)* and after good summer rains by Small Bushman Grass *(Stipagrostis obtuse)* and Tall Bushman Grass *(S. ciliate)*. In the more rocky areas, Thorny Kapokbush *(Eriocephalus spinescens)*, Thorn Vygie *(Eberlanzia spinescens)*, and especially Three Thorn are important species. Annuals, such as *Pentzia annua* and Brakspekbos *(Zygophyllum simplex)*, are common and together with geophytes comprise nearly 50% of the total number of species in the region. This type is very poorly conserved, with no major conservation areas occurring. Riverine areas are invaded by Mesquite and Three Thorn mainly where heavy grazing occurs.
Gordonia Duneveld	This type consists of loose to partially stabilised sand dunes with very sparse vegetation that occurs primarily at the footslopes of such dunes. There are no known endemics in this vegetation and at national scale this vegetation type has not been transformed. Although none of this vegetation is conserved, it is not considered to be a threatened vegetation type. It contains protected tree species such as Camel Thorn *(Acacia erioloba)* and Sheppard's Tree *(Boscia albitrunca)*.
Kalahari Karroid Shrubland	This type is found in the drainage basin of the Gariep River Calcrete crops, where alluvial deposits as well as soils derived form the ancient basement garnites and geniesses of the Namaqua Mobile Velt occur on extensive plains. On the pediments the shrub layer is poorly to well developed and individuals of Black Thorn *(Acacia mellifera)*, Three Thorn *(Rhigozum trichotomum)*, Karee-thorn *(Lycium boscifolium)*, Sheperd's Tree *(Boscia albitrunca)* and Stink Sheperd's Tree *(Boscia foetida)* can be found. On the banks of the Gariep River and its tributaries, shrubs and trees such as Buffalo Thorn *(Ziziphus mucronata)*, Wild Tamarisk *(Tamarix usneoides)* and Ebony *(Euclea pseuoebenus)* occur. The grass layer is generally poorly developed and depends on the amount of rainfall during the growing season. Lehman's Love grass *(Eragrotis lehmanniana)*, Sour Bushman *(Schmidtia kalahariensis)*, Silky Bushman grass *(Stipagrotis ciliate)* and *Stipagrotis obtuse* can dominate large areas (Bohlweki Environmental, 2006).
Lower Gariep Alluvial Vegetation	This vegetation occurs on flat alluvial terraces and riverine islands. The vegetation consists of a complex of riparian thickets dominated by *Ziziphus mucronata, Euclea pseudebenus* and *Tamariz usneoides*, reed beds with *Phragmites australis* and flooded grasslands and herblands along sand banks and terraces within and along the river. There are no known endemics in this vegetation type. Little of this vegetation is conserved and its highly transformed by cultivation (approximately 50%). It is considered to be a threatened vegetation type classified on a national scale as Endangered with only about 6% conserved. A significant proportion of the vegetation has been transformed by especially agriculture in the Gariep River floodplain.

Table 4: Continued

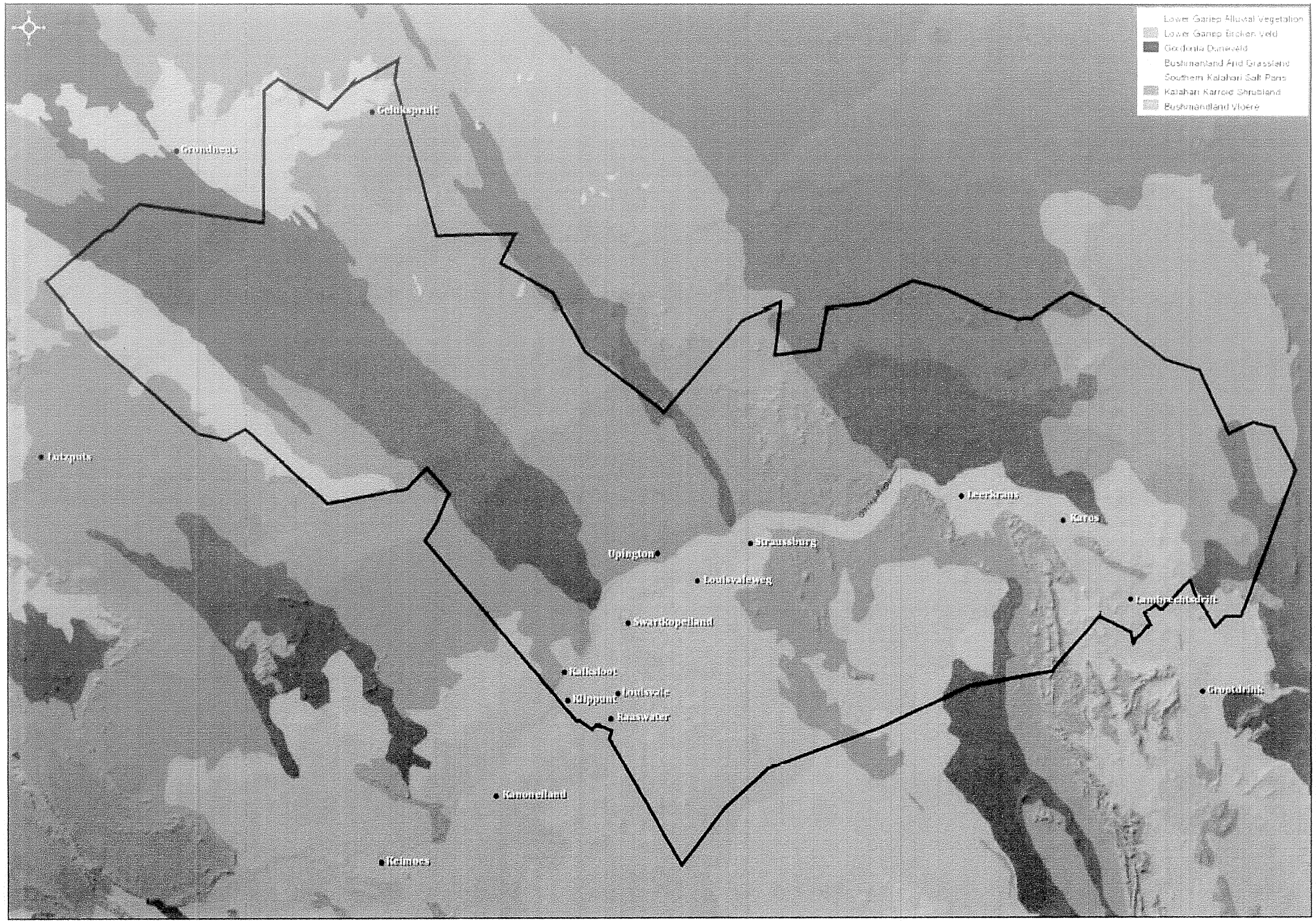
Lower Gariep Broken Veld	This type is found on rocky terrain. Its name refers to the scattered individuals of tall shrubs and small trees (2m to 3m in height) that 'break' the uniformity of the low shrub layer, which is rich succulents. The most characteristic plant is the giant aloe called quiver tree (kokerboom) *(Aloe dicholoma)*. The quiver tree is adapted to the dry desert and semi-desert areas on the rocky hills, the extreme temperatures, and the infertile soil. The Camel Thorn is also a dominant species in the region and the Sweet Thorn Tree occurs mainly along rivers and drainage lines. The Shepherd's tree or 'Witgat' also occure here. Other plants which are easily spotted in the vicinity are Desert broom *(Sisyndite spartea)*, Namaqua porkbush *(Cereria namaquensis)* and Bushman grass *(Stipagrotis hochstetterina)*.
Southern Kalahari Salt Pans	This type occurs as low grasslands on pan bottoms (these are often devoid of vegetation) often dominated by *Sporobolus* species, with a mixture if dwarf shrubs. The low shrubland dominated by *Lycium* and/or *Rhigozum* usually forms part of the outer belt in the salt-pan zonation systems.
Bushmanland Vloere	This vegetation occurs in patches throughout the flat areas in pans and the broad bottoms of seasonal rivers. Often the centre of the pan or the river drainage channel itself is devoid of vegetation. It is loosely patterned scrub dominated by *Rhigozum trichotomum* and various species of *Salsola* and *Lycium*, in combination with a mixture of non-succulent dwarf shrubs of Nama Karoo origin. Thickets of *Parkinsonia africana*, *Lebeckia linearifolia* and *Acacia karoo* occur in places.

The Vegetation map of South Africa by Mucina, Rutherford & Powrie 2005 groups the salt pans of this area north of Upington into their own Vegetation Unit namely Southern Kalahari Salt Pans (refer to Figure 6 below). The surface of salt pans is normally so brack that no vegetation can grow there (Leistner 1967). The vegetation only occurs in some instances on the marginal zone of the pan and is characterized by a higher number of plants, mainly mesembs and a few grasses.

A botanical assessment of two of the salt pans in close proximity to the mining area compiled by A. van Heerden & T.A. Anderson of the McGregor Museum form part of the supporting documentation (para. 10.2). During this study the following plant species were found on the marginal zones:

Eragrostis lehmanniana. - Poaceae
Galenia sarcophylla - Aizoaceae
Hypertelis salsoloides - Molluginaceae
Lycium sp. – Solanaceae
Mesembryanthemum sp. - Mesembryanthemaceae
Mesembryanthemum cf. inachabense - Mesembryanthemaceae
Opophytum aquosum - Mesembryanthemaceae
Pteronia sp.
Salsola sp. - Chenopodiaceae
Zygophyllum simplex – Zygophyllaceae

Figure 5: Vegetation types of the region - Mucina, Rutherford & Powrie 2005



2.8 Animal Life

Approximately 200 years ago, Johan Jakob Wikar trekked around the present Upington and described the presence of numerous groups of lion, elephant and hippopotami along the Gariep River. These were however all hunted to extinction and today remnants of animal populations are found on farms and in the municipal Spitskop Nature Reserve. Species that occur include Gemsbok (*Oryx gazelle*), Zebra (*Equus zebra*), Springbok (*Antidorcas maruspialis*), Eland (*Tragelaphus oryx*), Red Hartebeest (*Alcelaphus buselaphus*), etc. Small mammals such as Cape Grey mongoose (Galerella pulverulenta), Cape porcupine (Hystix africaeaustralis), Bushveld gerbil (Tatera leucogaster), Springhare (Pedets capensis), etc. are also found in the region (Siyanda EMF, 2007).

Avifauna found in the Municipality include, inter alia, Ostrich (*Struthio camelus*), Rock Kestrel, Pygmy Falcon, Cape Turtle Dove, Rock Pigeon, Barn Owl, Little Swift, Greater Striped Swallow, Laughing Dove, Namaqua Dove, Ashy Tit, Spike-heeled Lark, etc. The Black Harrier occurs in open grassland, scrub, semi-desert and mountain areas and is endemic to southern Africa, mostly in South Africa. It is reliant on private farmland and is vulnerable to changing land use. The Ludwig's Bustard occurs in open plains of the semi-arid Karoo. They are highly susceptible to collisions with overhead power lines and telephone wires, the single most important threat to this species (Bohlweki Environmental, 2006).

The role played by mammals in the formation of pans is emphasized by Parris (1984). In the Kalahari, where annual rainfall is low, seasonal waterholes formed during thundershowers are particularly important to game. Excessive grazing and trampling of vegetation around the edges of pans by large mammals inhibit the growth of vegetation and expose pans to destructive wind action. In addition, soil from the pan substratum adheres to the grazing and drinking animals and is carried away from the pans. The removal of soil deepens the pans and helps to maintain their basins. The extensive digging and burrowing activities of smaller mammals result in a continuous agitation of the soil surface in and around pans and expose soil to other natural soil-forming elements. Small mammals can be an important faunal component of many pans and their role in affecting the ecology has been studied in the Kalahari (Smihers 1971, Parris 1984). No faunal study has been conducted on the study area but larger herbivore species are absent due to the competitive land use as with the rest of the region. Springbok was however introduced and are observed on the pan floor from time to time. No rare species were reported and given the extent of similar land types in the area, any rare or endangered species will migrate to the surrounding habitat.

2.9 Drainage region

The study area falls within the Lower Orange Water Management Area (LOWMA). The Water Authority for this area is that of the Lower Orange managed by the Department of Environment and Water Affairs, Private Bag X5192, Upington, 8800.

The LOWMA's natural environment is generally characterised by an arid climate with minimal rainfall and drought conditions, with occasional severe flooding. The evaporation (including evapotranspiration) is as high as 3 000 mm per annum, which is generally more than the Mean Annual Rainfall. As a result, little usable surface runoff is generated over most of the area as a result of the extremely low and infrequent rainfall.

With the exception of the Gariep River, all the rivers in the region are non-perennial rivers. The Gariep River was created by volcanic eruptions two hundred million years ago in Southern Africa. These massive lava flows created the Drakensberg Mountains. The runoff of these mountains created the Gariep River flowing in a westerly direction towards the Atlantic Ocean. At almost one million km^2 the Gariep River basin is the largest basin south of the Zambezi River (refer to Figure 6 below).

It is the most developed trans-boundary river basin in Southern Africa and feeds numerous water transfer schemes which supply water to municipalities, industries and farms in and outside of the catchment of the river (Earle et al, 2005) (refer to Figure 7 below).

Rain in the highlands of Lesotho (average of 2 000 mm per year) and snowfalls feed the river. The flow reaches its peak in the summer months, while in winter the river is often reduced to little more than a series of deep pools linked by a trickle of water. The Gariep River basin stretches over a number of countries, namely South Africa, Lesotho, Botswana and Namibia and forms the border between South Africa and Namibia (refer to Figure 7 below). These countries cover a range of ecological zones – the high rainfall mountainous areas of the Lesotho Highlands, through the savannah grasslands of the central plateau to the desert conditions in the western part of the basin.

2.10 Surface Water

<u>Regional context</u>

The only perennial water source in the region is the Gariep River to the south. With the increase in farming activities the need for water increased dramatically and the Gariep River has become a natural resource of growing importance. The LOWMA Report (2003) recorded irrigation as the dominant water use in the LOWMA sector representing a total of 94%, which is a total of 977 million m^3 of water per annum of the total 1 028 million m^3 of water used per annum in the year 2000 (refer to Figure 8 below).

The flow of the Gariep River varies between 50 and 1800 m^3 per second, depending on the season. The flow of the river is controlled mainly by discharges from upstream dams such as the Bloemhof, Gariep and Van der Kloof dams. The Khara Hais Municipality is presently the holder of a permit authorising the withdrawal of 25 million m^3 of water per year from the Gariep River for urban use.

The current maximum withdrawal in the peak season amounts to 28 000 m^3 per day. The quality of the water in the Gariep River is deteriorating. Reasons for this are the increasing agricultural and industrial activities upstream from Upington, as well as the lower inflow of low quality water from Lesotho.

The quality of the water varies with the seasons and also depends upon which river the main supply comes from. From the Gariep River, the turbidity, sand and sludge contents are usually high whilst the water from Vaal River generally has large amounts of nutrients that result in the growth of algae.

Figure 7: The Gariep River Basin – source WRP as cited in Earl *et al* 2005

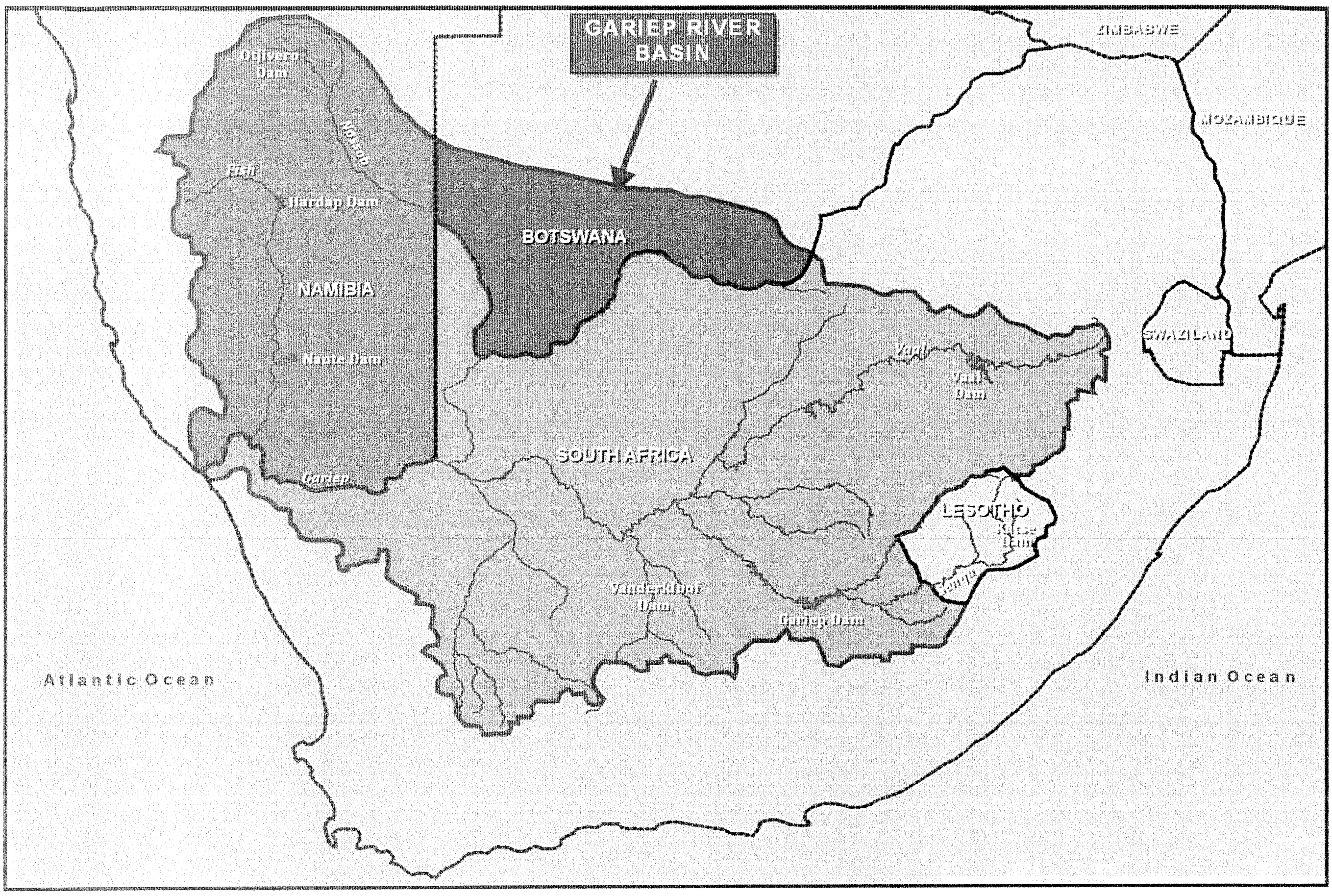


Figure 8: Areas under irrigation and water supply schemes in the SA part of the Lower Gariep River Basin – source DWAF as cited in Earl *et al* 2005