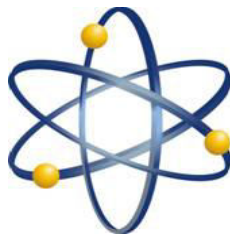




**PUBLIC ACCESS  
REPORT**

Compiled for  
**REPTILE URANIUM NAMIBIA (PTY) LTD**  
and its majority owned subsidiary  
**SHIYELA IRON (PTY) LTD**  
and minority Joint Venture Owner  
**OPONONA INVESTMENTS (PTY) LTD**



**ENVIRONMENTAL IMPACT ASSESSMENT REPORT**  
and  
**DRAFT ENVIRONMENTAL MANAGEMENT PLAN**  
**FOR THE SHIYELA IRON PROJECT**

Report No SHIEIAREP/2011/01  
5 October 2011



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- water and waste management
- environmental management
- environmental assessments
- air pollution assessments
- dedicated software

## ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR THE SHIELA IRON PROJECT

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## EXECUTIVE SUMMARY

Reptile Uranium Namibia (Pty) Ltd intends to submit an application for a mining licence on EPL 3496 in the Namib-Naukluft Park to the competent Namibian authorities for the extraction of iron and associated minerals from its Shiyela Iron project. However, before any mining licence can be granted, an environmental impact assessment (EIA) process must be undertaken by the relevant applicant and authorised by the Ministry of Environment and Tourism.

A scoping report in terms of Sections 19 and 26 of the draft environmental assessment (EA) regulations was completed in October 2010 for the Omahola project that consisted of the Shiyela Iron and INCA and Tubas uranium deposits. Subsequent work on these deposits and discussions with representatives of the Ministry of Environment and Tourism on 15 March 2011 resulted in the original Omahola project being subdivided into singular standalone projects, namely the Shiyela Iron, INCA uranium and Tubas uranium projects. This report represents the environmental impact assessment conducted for the Shiyela Iron project, originally part of the overall Omahola project, in accordance to the requirements stipulated in Section 27 of the draft EA regulations.

This proposed activity envisaged the design, construction and operation of an iron ore facility in EPL 3496. Key findings from the EIA include, *inter alia*, the following:

- extensive drilling on the Shiyela Iron project area indicate wide high-grade concentrations of magnetite that could sustain a large open-pit mining operation if continuity along strike is persistent;
- Namibia presently is a net importer of raw iron ore and supplying the requirements of Rössing and that of any other consumers of imported iron will save on foreign exchange;
- creation of new job opportunities;
- the full operation of the proposed mine will have a significant economic impact on both regional and national levels, with recent estimates indicating that, when fully operational, direct and indirect taxes to the Namibian government will be in the order of N\$ 370 million per year;
- although most of the direct employment effects will take place in the mining industry, the multiplier effect will result in job creation effects in areas such as transport, equipment manufacturing and personal services; and
- albeit that various negative impacts on the environment were identified through extensive specialist studies, none of them represented fatal flaws.

The above positive and negative implications of the proposed activity were assessed against various alternatives, inclusive of the no-go alternative, which is the option of not undertaking the proposed activity or any of its alternatives. With all the categorised alternatives, the location (site) alternative normally plays the biggest role in assessment of an activity and its related impacts. However, in the case of mining operations the location is seldom available for alternative selection as the proposed mineral for extraction is by its very nature exactly at a particular selected site. Alternative options were thus evaluated and assessed as part of the overall design of the proposed mining operation, inclusive of alternative extraction methods, relevant processing operations and scheduling and input alternatives.

In summary, the activity of mining will always result in some form of negative impact on the environment, whether impacts are mitigated or not. The ideal is to match the environment, social and economic issues to such an extent that the overall outcome of an activity will not result in a combined lesser value for the three issues. The economic benefit and potential social upliftment of the proposed Shiyela Iron project should outweigh the environmental impacts addressed in this report, through the implementation of mitigation measures, to result in an overall positive value for the combined environmental, social and economic issues identified.

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## 1. INTRODUCTION

Deep Yellow Limited (DYL), through its 100% owned subsidiary Reptile Uranium Namibia (Pty) Ltd (RUN), proposes to mine iron for export from the Shiyela Iron deposit situated on exclusive prospecting licence (EPL) 3496 and intends to submit a mining licence application to the competent Namibian authorities. However, before any mining licence can be granted, an environmental impact assessment (EIA) process must be undertaken by the relevant applicant and authorised by the Ministry of Environment and Tourism (MET, 2009). In terms of Section 8 of the draft environmental assessment (EA) regulations (MET, 2009), RUN appointed Softchem as its environmental assessment practitioner (EAP) for this environmental impact assessment process.

A scoping report in terms of Sections 19 and 26 of the draft EA regulations was completed in October 2010 (Friend *et al.*, 2010) for the Omahola project that consisted of the Shiyela Iron and INCA and Tubas uranium deposits. Subsequent work on these deposits and discussions with representatives of the Ministry of Environment and Tourism on 15 March 2011 resulted in the original Omahola project being subdivided into singular standalone projects, namely the Shiyela Iron, INCA uranium and Tubas uranium projects. This report represents the environmental impact assessment conducted for the Shiyela Iron project, originally part of the overall Omahola project.

In accordance to Section 26 of the draft EA regulations, the scoping report included terms of reference (plan of study) that set out the proposed approach to the relevant environmental impact assessment. For the Shiyela Iron project (as part of the Omahola project) the terms of reference included, *inter alia*, a description of tasks to be undertaken for the environmental impact assessment process, an indication of the stages for competent authority consultation, a description of the assessment methodology to be used and particulars of the public participation process to be followed. Finally, the terms of reference also proposed the relevant investigations to be completed for this EIA. The various aspects that were to be addressed to make an objective assessment of the proposed activity and any related alternatives, including the no-go option, were as follows (Friend *et al.*, 2010):

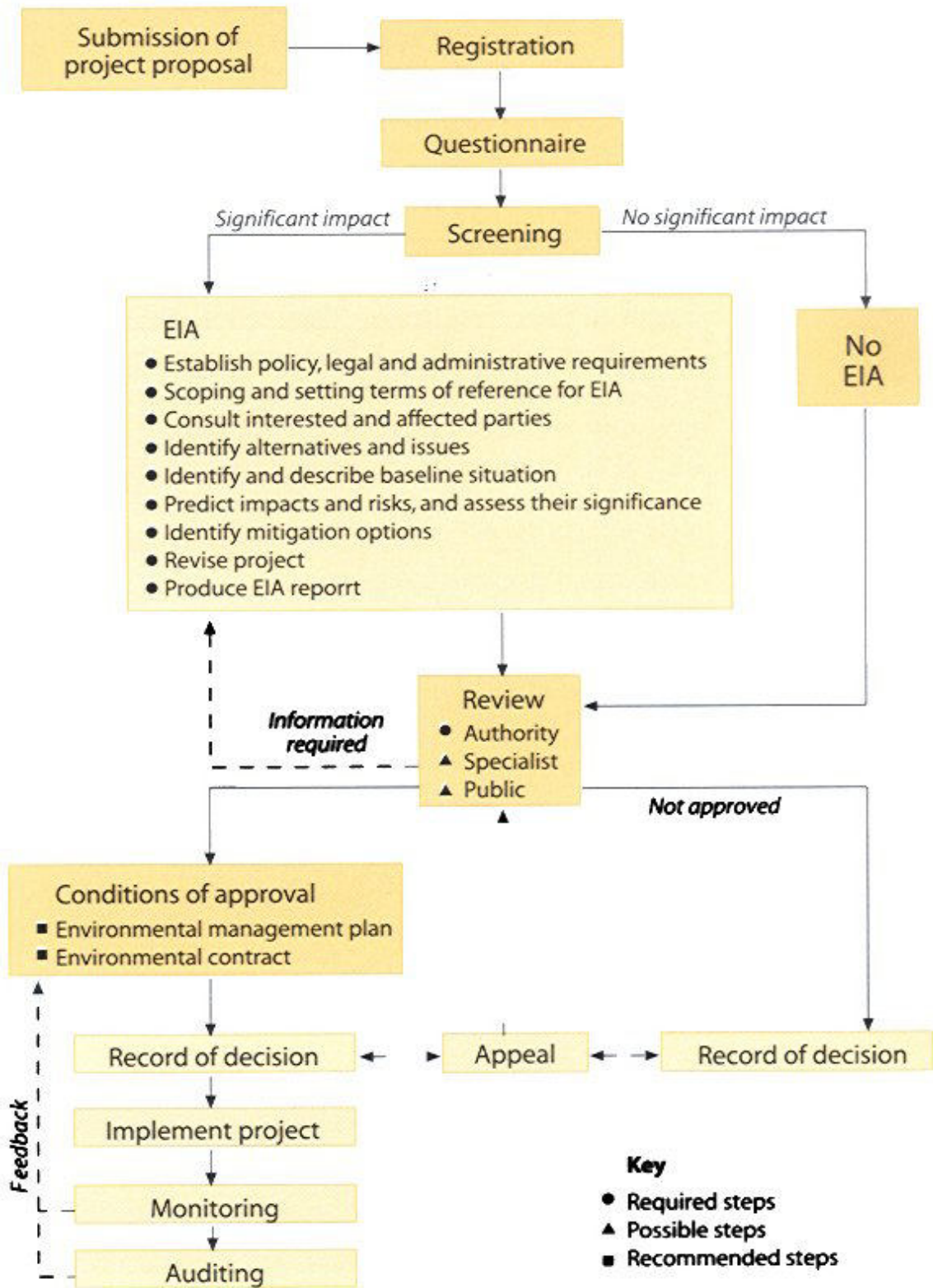
- climate,
- geology,
- topography,
- soils,
- land use capabilities,
- hydrology,
- air quality,
- natural vegetation,
- animal life,
- archaeological, heritage and cultural aspects,
- sensitive landscapes and visual aspects,
- noise,
- social and economic environment, and
- occupational health and safety.



The above terms of reference were accepted by the Ministry of Environment and Tourism in their letter dated 30 March 2011 and is presented in Appendix A.

The EIA process followed for the Shiyela Iron project, based on the Namibian Environmental Assessment Policy of 1995 and the draft EA regulations of 2009, is illustrated in Figure 1.1 (Tarr and Figueira, 1999; SAIEA, 2003; MET, 2009; SAIEA, 2010). In terms of Section 27 of the draft EA regulations the components of this environmental impact assessment report are set out below, with references to the relevant sections within this report (MET, 2009):

- details and expertise of the EAP who prepared this report (Section 11);
- description of the proposed activity (Section 3);
- description of the property on which the activity is to be undertaken and the activity's location on the property (Section 2);
- description of the environment that may be affected by the activity (Section 5 and Appendices B to H) and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity (Sections 5 and 8 and Appendices B to H);
- details of the public participation process (Section 9 and Appendices I to M);
- description of the need and desirability of the proposed activity (Section 4);
- identified potential alternatives, inclusive of associated advantages and disadvantages (Section 6);
- indication of the methodology used in determining significance of potential environmental impacts (Section 7);
- description and comparative assessment of alternatives (Section 6);
- summary of findings and recommendations of specialists (Sections 5 and 8);
- environmental issues identified during the EIA process, assessments of significance and mitigation measures (Section 8 and Appendices B to H);
- assessment of identified potentially significant impacts (Section 8);
- description of assumptions, uncertainties and gaps in knowledge (Section 13);
- reasoned opinion of whether activity should be authorised and any prescriptive conditions (Section 13);
- an environmental impact statement (Section 13);
- draft environmental management plan (Section 12 and Appendix N);
- irrevocable financial grantee (Section 13);
- copies of specialist's reports (Appendices B to H);
- any specific information required by the competent authority (Section 13); and
- in addition, health and safety issues (Section 10).

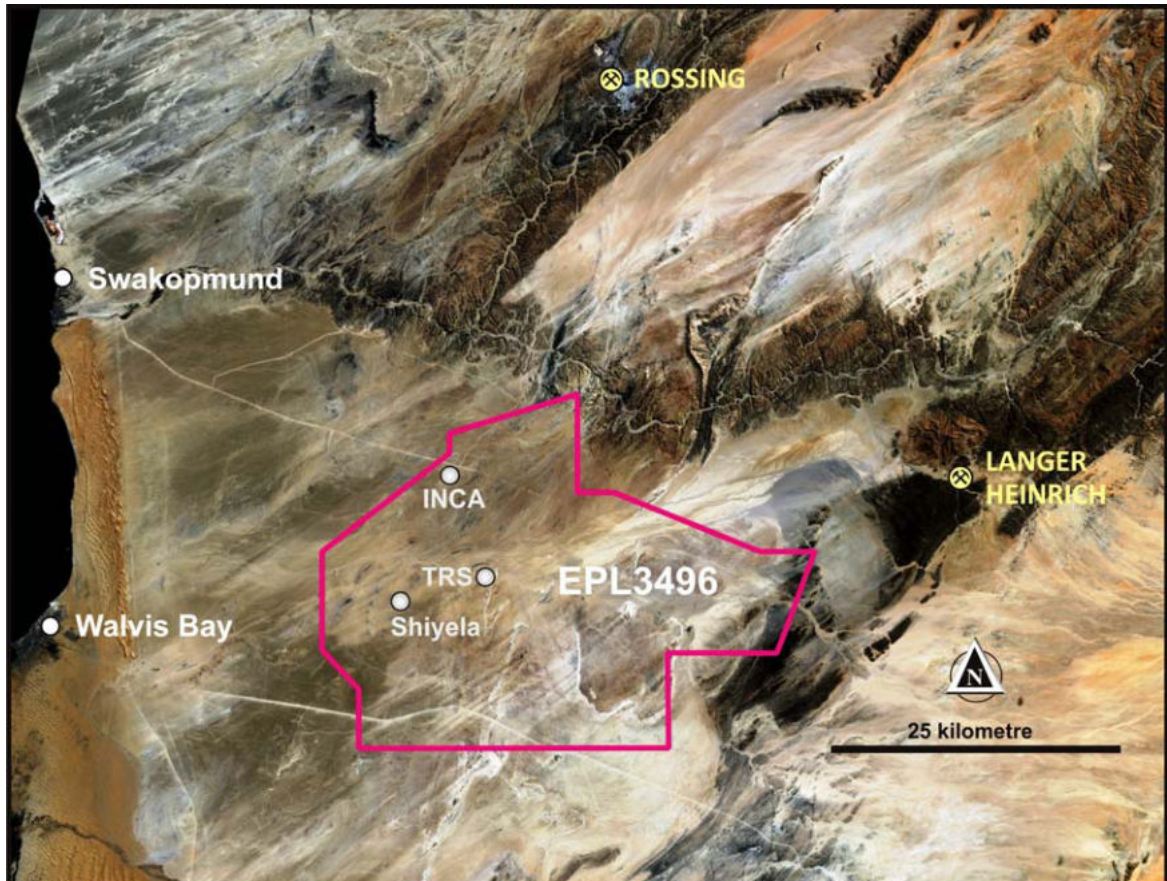


**Figure 1.1** The environmental assessment process for projects in Namibia.

## 2. PROPERTY DESCRIPTION

### 2.1 Regional setting

RUN's Shiyela Iron project is located in the west of central Namibia, Southern Africa; situated approximately 40 km east of the major deepwater seaport at Walvis Bay and east-southeast of the coastal town of Swakopmund. The location of the project in relation to the mentioned towns, as well as mining operations in the area, is shown in Figure 2.1. The regional setting in terms of climate, land cover and other regional characteristics is described in Section 5.



**Figure 2.1** Location of the Shiyela Iron deposit on EPL 3496.

### 2.2 Proposed mining area

The proposed mining licence area is illustrated in Figure 2.2 and the coordinates of this area given in Table 2.1.

**Table 2.1** Coordinates of the Shiyela Iron mineral deposit area.

ID point	Easting UTM	Northing UTM
1	484000	7470000
2	487250	7470000
3	487250	7459500
4	481250	7459500
5	481250	7468500
6	484000	7468500



### 2.3 Land use

The proposed Shiyela Iron project is contained within the Namib Naukluft Park, which is used primarily for tourism. However, mineral exploration, drilling campaigns and mining operations have previously been undertaken either on or near the proposed project site intermittently during earlier ownerships (see Figures 2.3 and 2.4). According to SAIEA (2010), by the end of December 2009 four mining licences had been granted in the central Namib - two mines were operational, a third was undertaking trial mining, and the fourth was beginning construction.

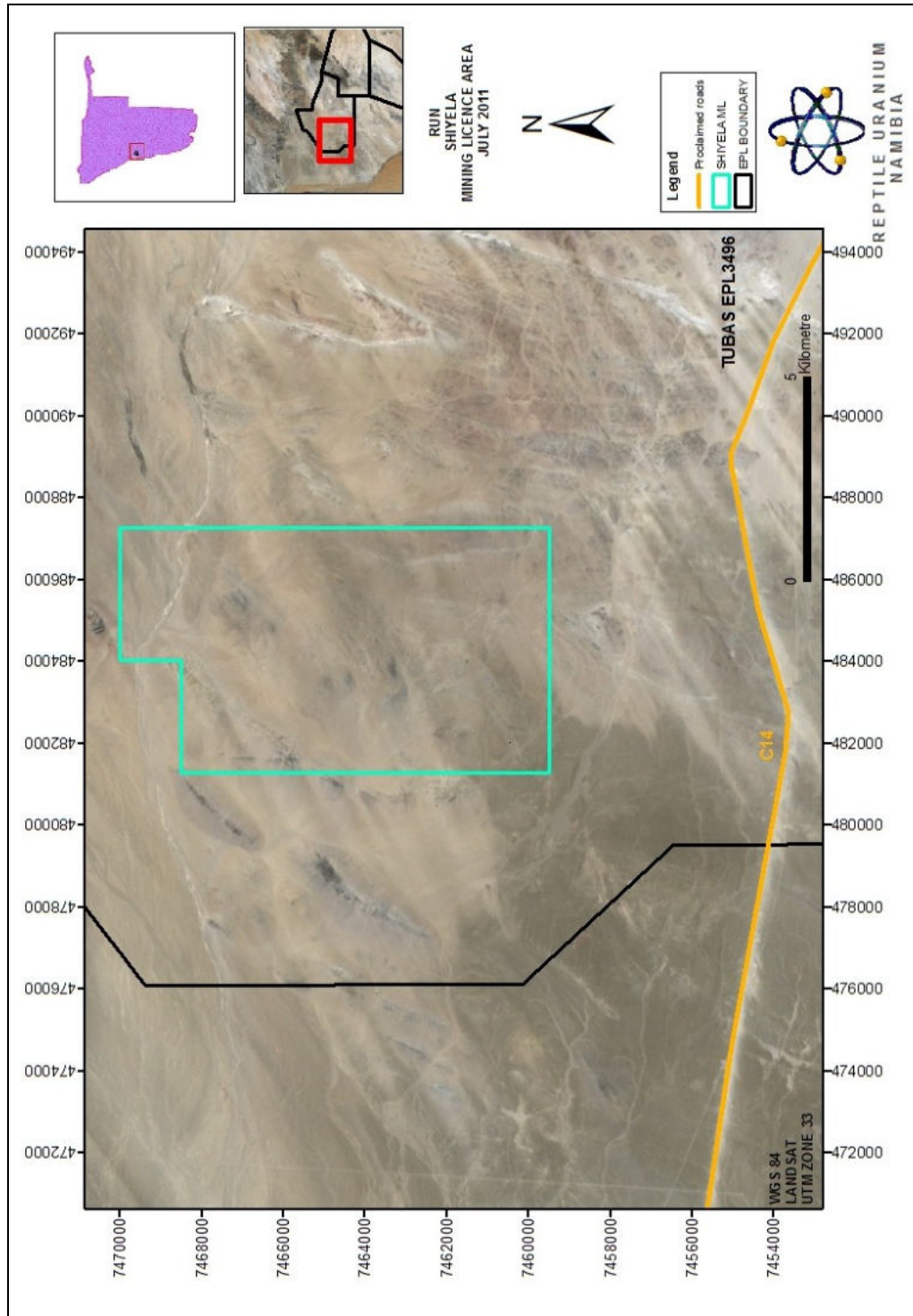


Figure 2.2 Location of the Shiyela Iron project area on EPL 3496.



**Figure 2.3** Previous magnetite mining on EPL 3496.



**Figure 2.4** Active gypsum mining on EPL 3496.

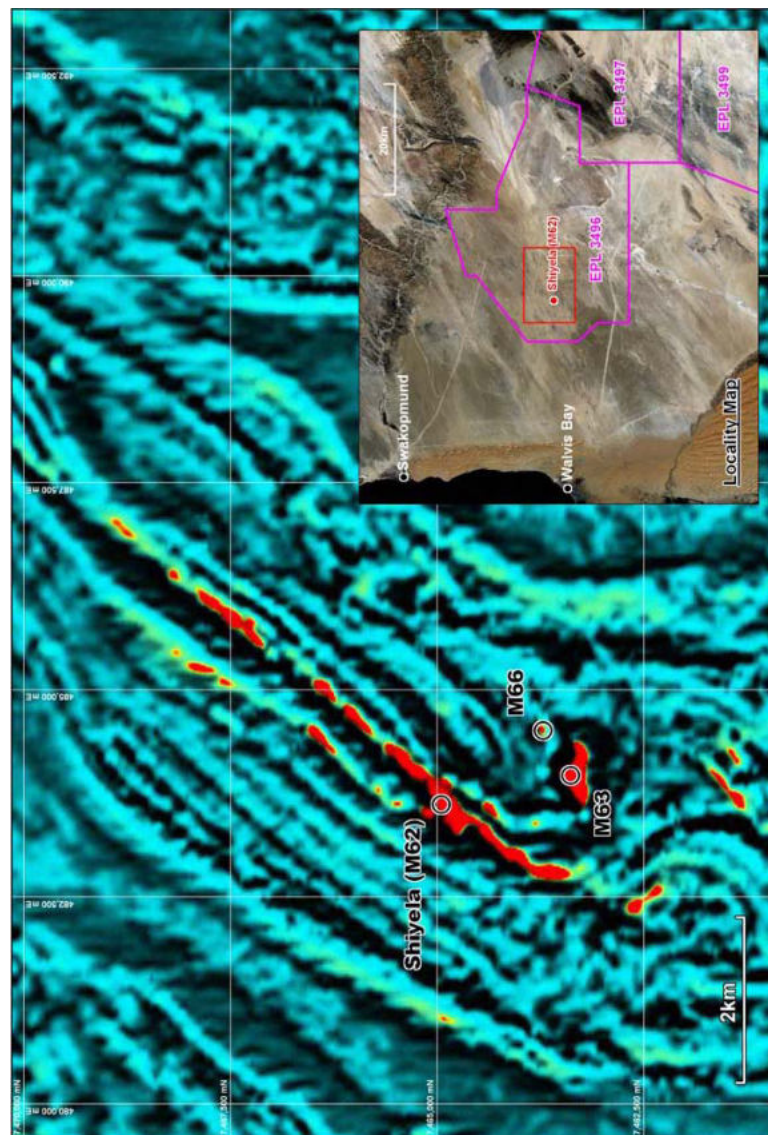


### 3. DESCRIPTION OF THE PROPOSED ACTIVITY

The activities for the proposed Shiyela Iron project include, *inter alia*, construction of mining infrastructure, open cast mining, loading and hauling, processing of ore, tailings storage facility, the transport of iron product, the disposal of waste rock, continuous rehabilitation and ultimately mine closure and final rehabilitation.

#### 3.1 Resource Shiyela Iron deposit

Follow-on drilling began during late June 2010 in the vicinity of the M62 magnetic anomaly (Figure 3.1) where core samples from a RUN diamond drill hole completed in 2008 and renamed SHID1 were re-evaluated and found to produce a high-grade, low-impurity magnetite concentrate product. A series of lines of 60 degree angle reverse circulation (RC) drill holes spaced at 50 m were drilled across strike in close proximity to the original diamond drill hole SHID1. Results on a section of Line 1 is illustrated in Figure 3.2 showing a plot of down hole magnetic susceptibility together with a visual estimate of magnetite content for each hole, indicating wide high-grade concentrations of magnetite that could sustain a large open-pit mining operation if continuity along strike is persistent. (DYL, 2010b)



**Figure 3.1** Total magnetite intensity image showing local extent of interpreted "high magnetite terrain" in red at Shiyela Iron project.

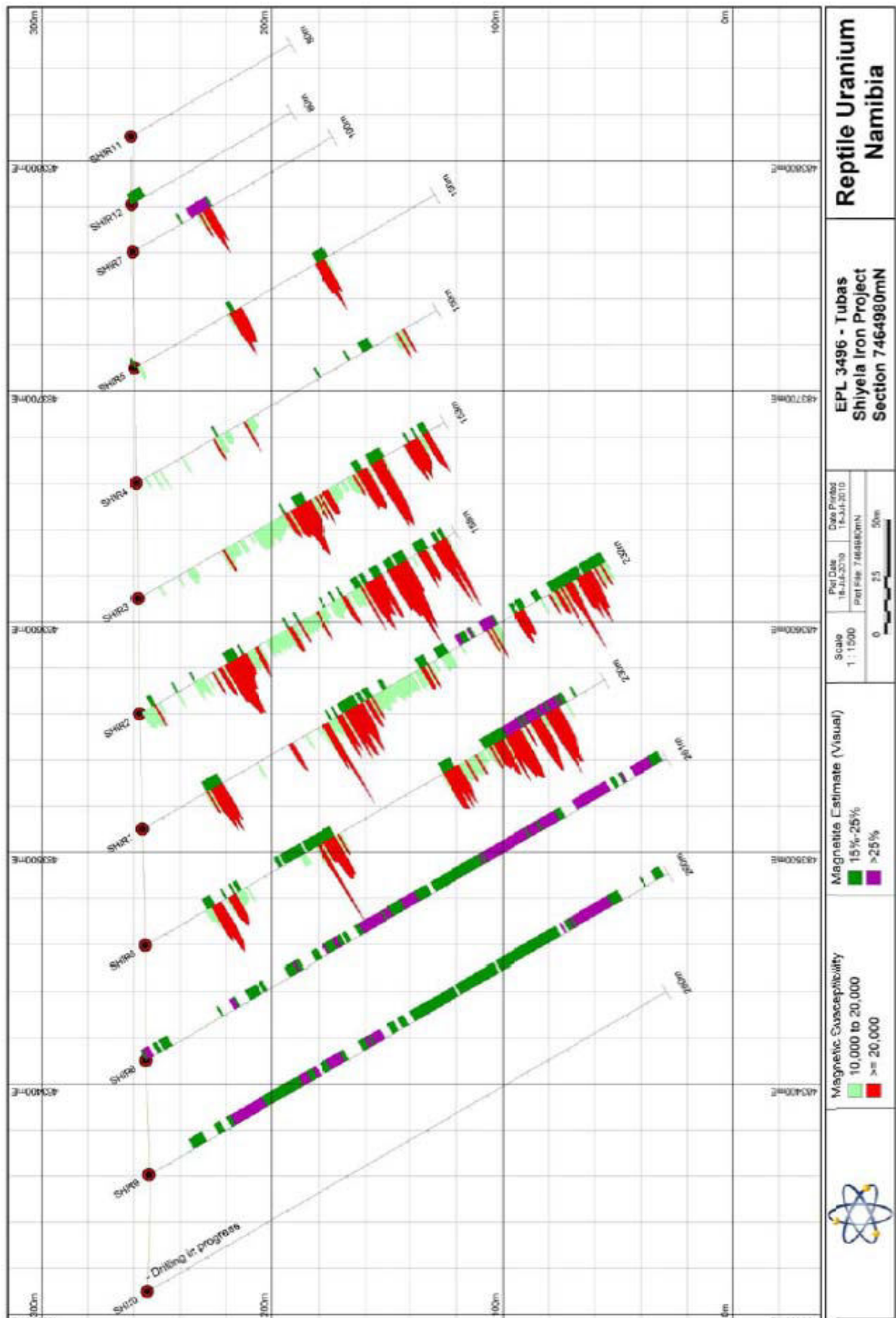


Figure 3.2 West to east section on Line 1 looking north with histograms of magnetic susceptibility and visual estimate of magnetite content.



The magnetite mineralisation is hosted by steeply dipping, fine-grained magnetite-rich metasediments; granite containing coarse magnetite; and, semi-massive to massive magnetite within a predominately granite and gneissic metasedimentary sequence. Photographs of these lithologies are shown in Figure 3.3. (DYL, 2010b)

### 3.2 Shiyela Iron process description

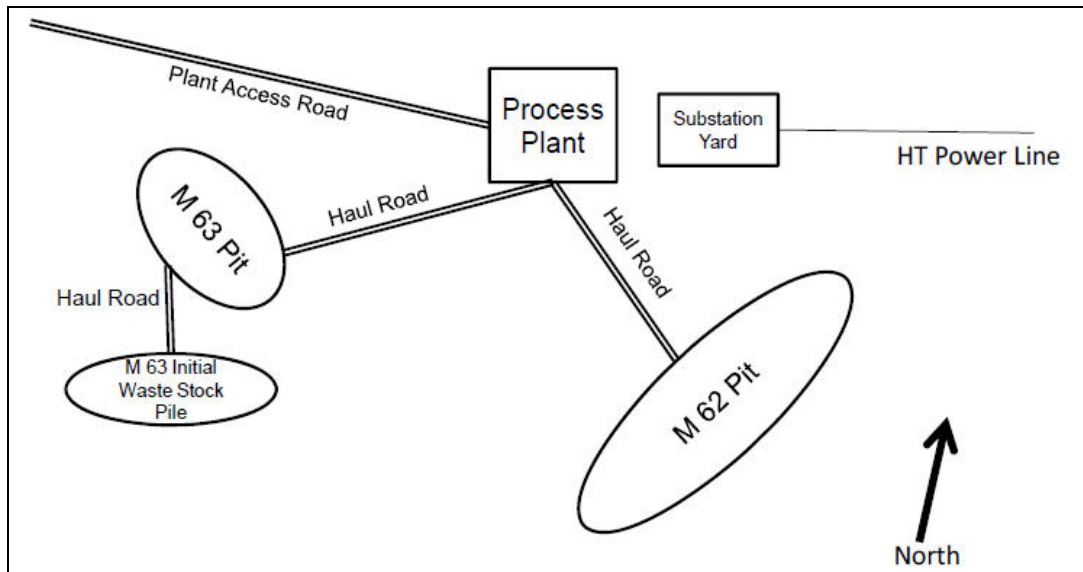
The proposed site layout for the Shiyela Iron project is presented in Figure 3.4, the proposed process flow diagram given in Figure 3.5, the crushing and screening plant model shown in Figure 3.6 and the model for the grinding circuit for fine product shown in Figure 3.7. A brief description of the proposed process is given below.



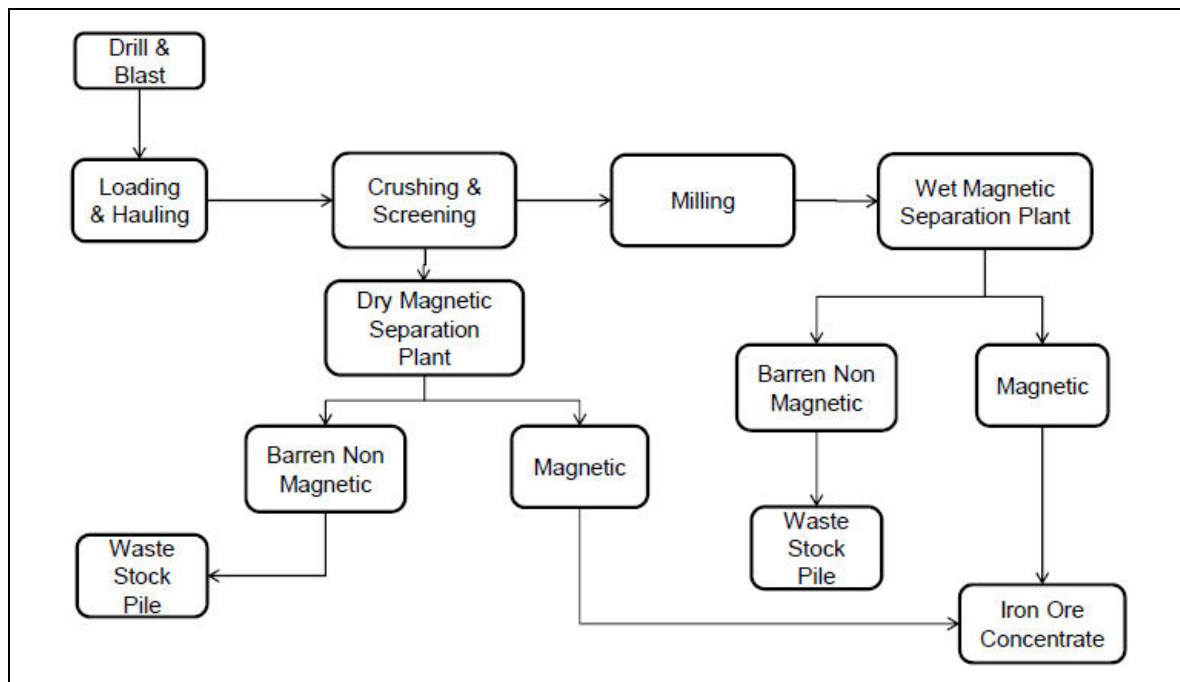
**Figure 3.3** Reverse circulation drill chips from hole SHIR3 showing zones of massive magnetite.



Iron (magnetite and hematite) ore will be mined from one or more open pits with an ore to waste ratio of about 1:1. During the first stage of mining the waste rock will be stockpiled on waste stockpiles and as a second open pit is developed, backfilling of waste rock into the first pit may commence. From present drilling results it is proposed to develop M63 first, followed by M62. Once final rehabilitation is completed, there will be minimal visual impact on the environment as any remaining waste rock stockpiles will be shaped and contoured to blend into the surrounding environment. Barren ore from the processing plant will also be stockpiled on the waste stockpiles. Total run-of-mine (ROM) feed will be 13.3 million tonne per annum (Mtpa) at a recovery rate of 15% based on the available present Walvis Bay bulk loading capacity of 2 Mtpa, which will be increased once the port's container terminal expansion is complete in 2015/2016, potentially freeing up more bulk capacity to allow a ROM rate of 50 Mtpa.



**Figure 3.4** Proposed site layout for the Shiyela Iron project.



**Figure 3.5** Shiyela Iron project's proposed process flow diagram.

Ore from the open pit will be stockpiled on dedicated stockpiles to allow control of ore blend for the total ROM feed. Ore reclaimed from the respective stockpiles using a single front end loader will be directly dumped on to a heavy duty ROM grizzly feeder. Grizzly oversize will be broken with a hydraulic impact hammer by the mining contractor and loaded back into the system. Ore that passes through the grizzly will drop into a ROM dump hopper, which discharges onto a ROM apron feeder. This apron feeder will feed 8,680 tonne per hour (t/h) to an inclined, static ROM crusher grizzly. Oversize rocks from the static grizzly will feed a ROM crusher. Product from this single toggle jaw crusher will be combined with the undersize from the static grizzly onto a conveyor belt that will feed a vibrating screen.

Oversize material from the vibrating screens will gravitate to a secondary crushing and screening circuit and combined with the undersize from the vibrating screen to produce a final product at <19 mm. This material will be transported via a conveyor belt to a dry magnetic separation (DMS) circuit. The beneficiated ore from the DMS circuit will be transported to the port storage facility by road. Reject (non-magnetic) product from this circuit will be stockpiled and further processing will take place to prepare it for the domestic aggregate demand and sold as a by-product to the Namibian building, mining and road industries as aggregate in different size fractions.

Dust suppression sprays using local palaeochannel brine water will be strategically located around the feed preparation circuit to minimise dust generation during the tipping, crushing and dry DMS operations. Spillage generated in the feed preparation circuit will gravitate to a conventional spillage pump arrangement, comprising of a feed preparation area spillage pump and sump screen, and pumped to the process water thickener.

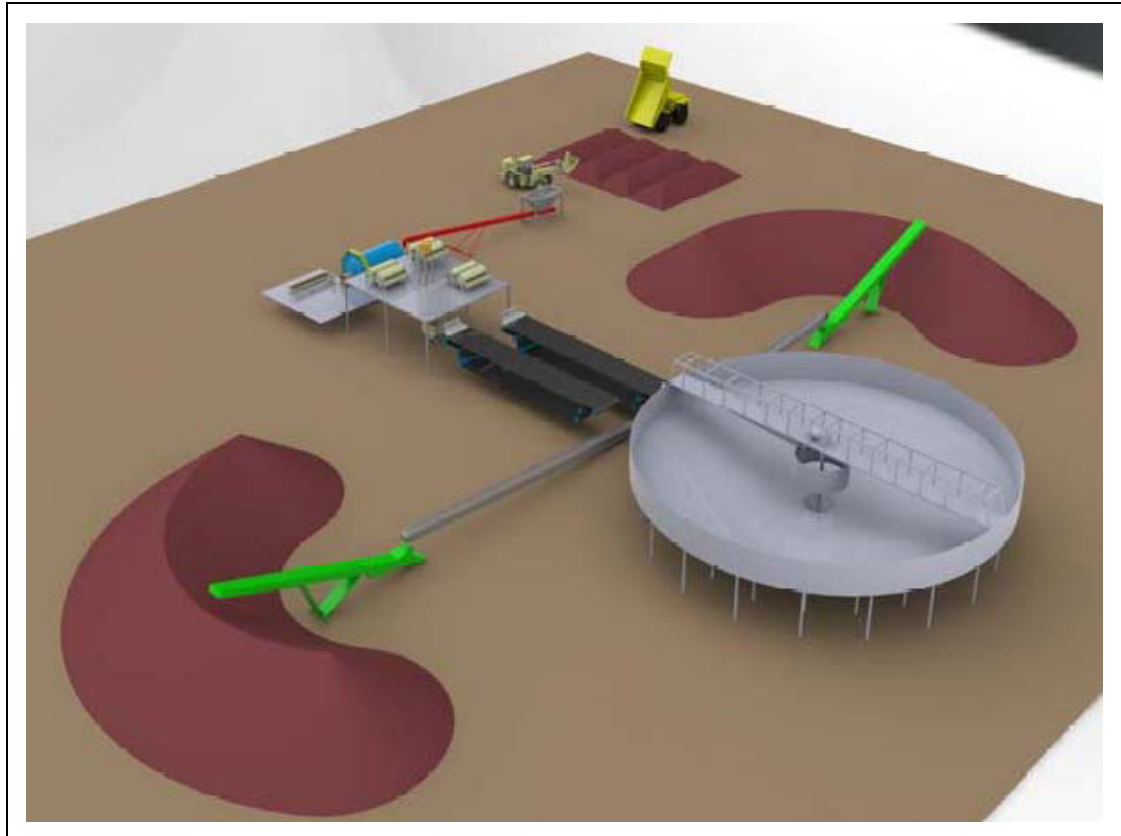


**Figure 3.6** Shiyela Iron project's crushing and screening plant model.

Identified ore with a high hematite content and reject from the DMS circuit with a high hematite content will be transferred via a removable mill feed chute to a single stage ball grinding mill, in closed circuit with a hydrocyclone classification arrangement. Desalinated local or seawater will be added to the mill inlet to achieve a milling solids concentration of  $\pm 60\%$ . Water will be added to the mill discharge to dilute it to  $\pm 40\%$  solids by mass, as feed to the cyclone cluster arrangement. Slurry from the ball mill will discharge into a ball mill discharge sump via a ball mill trommel screen. Oversize from the ball mill trommel screen will be collected and returned to the ball mill via the crushed ore load-in feeder.

The mill discharge will be pumped to the cyclones clusters using the ball mill discharge pumps with one operating and one on stand-by. Both pumps will be driven by variable speed motors. Cyclone underflow will be returned back to the mill for further grinding, while the overflow will be gravity fed to a trash screen for removal of vegetation, rubber, plastic, etc. The screened cyclone overflow at  $<1$  mm fraction will gravitate to a low intensity magnetic separation (LIMS) process and the  $<75 \mu\text{m}$  fraction from the cyclone cluster gravitated to a wet high intensity magnetic system (WHIMS). Spillage generated in the milling circuit will gravitate to a conventional spillage pump arrangement. The concentrated product from both circuits (LIMS and WHIMS) will be pumped to the header of a vacuum belt filter for dewatering. The dewatered concentrate will then be stockpiled and transported to the port for shipment.

Once the port expansion is completed in 2015/2016, the concentrated ore production is expected to be increased to 7.5 Mtpa and therefore the ore from the fine grinding circuit ( $<75 \mu\text{m}$ ) will be repulped with desalinated local or seawater and pumped as slurry to the port where it will be dewatered and stored prior to final shipment. The water discharged from the belt filters at the port will be pumped back to the process plant for reuse. The slurry pumping circuit will consist of a closed loop water circuit, and water losses will be made up utilising seawater and the returned mixed water desalinated on site.



**Figure 3.7** Shiyela Iron project's grinding circuit for fine product model.

Process water, belt filter discharge water and the slurry from the magnetic separation circuits will be pumped to the feed well of a tailings thickener. Diluted flocculant will be added in the feed launder and/or feed well of the thickener to assist in the flocculation, settlement and compaction of the solids. The underflow from the thickener will be pumped to the header of a belt filter for dewatering. The clean overflow from the thickener will be reused in the process circuit. The water circuit will be a closed loop circuit (water is only lost via the dewatered final product, dewatered tailings and evaporation), therefore minimal makeup water will be required. Tailings ex-belt filters will be conveyed at an approximate rate of 6,945 t/h from the process plant to the tailings storage facility (TSF), where movable conveyors and a stacker at the facility will be used to systematically deposit the tailings within the TSF area. Dilution and spray water will be drawn off from the process water header.

It is estimated that the initial plant feed will be about 1,250 t/h to produce 2 Mtpa final product.

### **3.3 Water reticulation and requirements**

Various qualities of water will be used for human consumption and ablutions, in the processing plant, for dust suppression in the open pit and haul roads. RUN received licences to complete a well-field testing programme in the palaeochannel and is in the process of applying for abstraction permits, although the water is extremely saline and will require partial or full desalination to make it useable. Water will need to be put through a desalination plant or used as is for dust suppression. This water will be sourced from the extensive palaeochannel underground water system that is in close proximity to the physical beneficiation plant.

The chloride content of this raw water is significantly higher than sea water and will require reduction prior to use. This water source has been classified as unfit for human consumption and was classified as an unallocated water resource by the Ministry of Water Affairs and Forestry. However, palaeochannel and pit de-watering water can possibly be used in untreated or partially desalinated form as process water. Potable and product washing water will require complete desalination treatment in a reverse osmosis plant on site and pilot plant tests have indicated 70% recoveries and low pressures.

The raw water will be pumped from the surrounding well-fields in the palaeochannel to a raw water reservoir. Water from the raw water reservoir will feed both the process water tank and a reverse osmosis (RO) water treatment plant. The process water tank will feed the process water distribution network. The purified water from the RO plant will be used as gland seal, product cleaning and potable water. The concentrated waste brine stream of the RO plant will be re-used as dust suppression water and offered to the Roads Authority for use on the C28, C14 and other secondary roads in close proximity. One sewage treatment plant will be installed to handle all sewage generated from the gatehouse, offices and washdown from the plant workshops.

Application has been made to NamWater for a total of three million cubic metres of fresh water a year and RUN is part of the desalination task force. Given the diminishing volumes of water available from the Omdel and Kuiseb aquifer systems it is highly likely that only desalinated water will be available from NamWater.

Water required for fire fighting duties will be extracted from the raw water reservoir. The reservoir will be designed to meet the legal requirements in terms of fire water storage volume. This implies that the suction for the fire fighting pumps will be lower than the suction for all other raw water pumping systems by an amount that accommodates the legal storage volume. Fire water will be supplied to the required areas using an electric pump, augmented by a diesel driven fire water pump in the event of a power outage. A dedicated diesel tank will be provided for the diesel driven fire water pump.

The amount of water for the system will meet any fire response requirements based on a two hour residence for the maximum flow rate and will be fed via a pressurised ring main. The fire detection systems will consist of the following:

- fire alarm sensors in all buildings, activated by smoke detection, as well as manual “break-glass” units as appropriate;
- local fire alarm annunciator panel per building or group of detectors;
- potential free-contactors to allow feedback to the programmable logic controller (PLC);
- manual call point per annunciator panel; and
- siren/strobe per annunciator panel.

Estimated water volumes are given in Table 3.1. Detailed water balances will be available after engineering studies have been completed for the mining licence application.

**Table 3.1** Estimated water volumes for Shiyela Iron project.

Sources/use	m <sup>3</sup> /h
Well field water	450
NamWater make-up	to be confirmed
Potable water	1
Process water (processing 4,500 t/h)	378
Fire water	0,2
Gland seal water	5
Reverse osmosis brine	56
Evaporation	3

### 3.4 Barrens storage facility

As no reagents or chemicals are used in the ore beneficiary process except for possible biodegradable flocculants or flotation media, the barrens slurry will be metallurgically and chemically similar to the rocks of the surrounding area. Therefore no lining is required, and all supernatant water can be recycled in the process plant. The topography of the plant location and the proposed barrens storage facility (BSF) is very flat and there are virtually no local features that would significantly influence their location. The disposal of the virtually dry barrens from the belt filter will provide increased flexibility in the construction of the barrens storage facility; where height, location and dust suppression will be taken into consideration.

Barrens from the belt filters will be transported via a conveyor belt from the process plant to the storage facility. Movable conveyors and a stacker at the barrens storage facility will be used to deposit the barrens systematically within the BSF area. Rain and supernatant water will be pumped back to the process water tank. A storm water diversion trench will be required to divert run-off away from the BSF site.

### 3.5 Electricity supply

The mining site is in the vicinity of the Kuiseb substation. Currently this substation must be upgraded to satisfy the increasing demand by the development of new uranium mines in the area, as well as the increasing demand from both the Swakopmund and Walvis Bay municipalities. All outgoing feeders from the substation are currently rated at 66 kV, but have to be upgraded to 132 kV. The substation is connected to Ruacana and Windhoek by 220 kV transmission lines. The electricity supplier, NamPower, has spare capacity that will be allotted to new mine developments on a first come, first served basis.



The initial design requires about 15 MW but will increase to about 35 MW once further development of the project, to fully utilise port capacity, has taken place. An official application to NamPower has been lodged and approval is pending on the granting of a mining licence, which will be applied for late 2011. It is envisaged that two 20 MVA 132/11 kV transformers will be installed and intake battery limit will be the landing gantry on the 11 kV bus bars. Plant reticulation to the motor control centres will be 11 kV. Plant process reticulation will be 550 V and motors in excess of 350 kW are to be supplied at 3,300 V. Small power and lighting will be at 400 V and emergency power will be produced by three 1,000 kVA diesel units. However, this is modular and can be adapted to process requirements. During the construction and commissioning of the NamPower transmission line electricity for the process plant will be supplied by a temporary semi-mobile diesel generating set.

### **3.6 Access road**

The most acceptable access road to the mine site would be the existing approved park road (track) leading off the C14 road that is also currently used to conduct exploration activities (see Figure 3.8). Although a service road for the Kuiseb substation electricity transmission line to Langer Heinrich is in close proximity, it is not safe to have heavy truck traffic use the easement as it would impose a risk to the integrity of the transmission line.

### **3.7 Other site infrastructure/requirements**

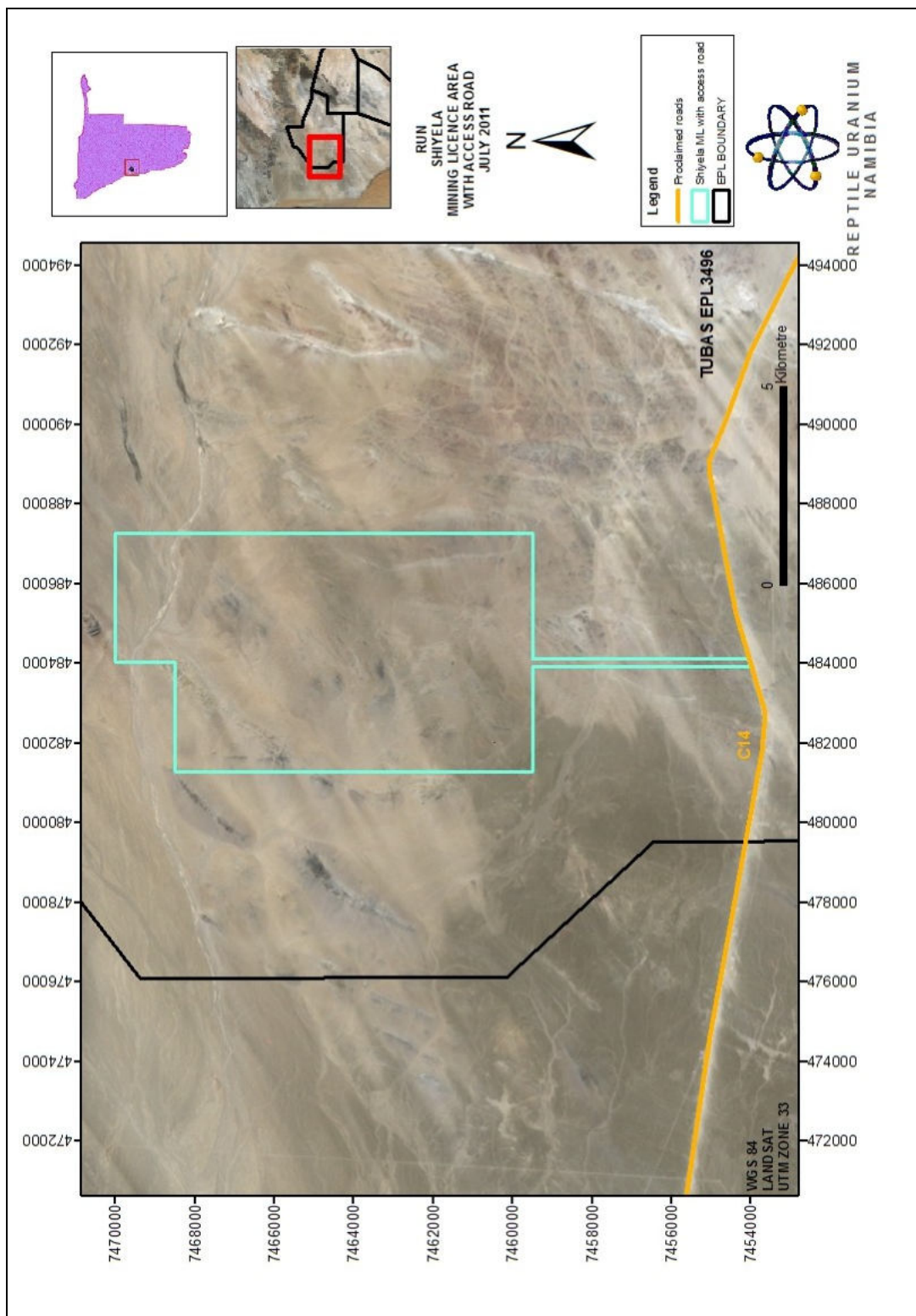
Compressed air will be required at the process plant (plant air) and for instrument operation (instrumentation air). Two air compressors, one operating and one on stand-by will provide the compressed air requirements for the process plant. Each compressor will have an internal air drier and air filter. Two air receivers will be installed to supply the plant air reticulation and one instrument air receiver will supply the instrumentation air reticulation.

In the proposed site layout allowance has been made for the following buildings and facilities within the plant area:

- gate house,
- administration building,
- change house,
- laboratory,
- medical building,
- electrical substations and motor control centres,
- central control room, and
- workshop.

All buildings will be “modular” type structures placed on an engineered terrace with a concrete floor slab, with adequate sanitary facilities and air conditioning as required. Steel structures will include the general workshop and stores building, pipe and cable racking and miscellaneous access platforms and walkways.

No need for onsite housing is foreseen for either the construction or production phase of the project. Housing would be located in either Walvis Bay or Swakopmund. However, during the plant start-up and commissioning phase an emergency dormitory will be available on site with a limited number of beds and ablution facilities.



**Figure 3.8** Location of the Shiyela Iron project area with existing access road.

General waste will be deemed to consist of domestic waste (comprising primarily of food wastes from the cafeteria and office waste) and industrial waste consisting of construction waste (concrete, wood, metal, and other scraps), empty non-hazardous reagent containers, tyres, and other waste products from the construction and operations stages. General provision will be made for disposal of all waste material at offsite licenced refuse/disposal sites as the site is located within a national park.

It is envisaged that the onsite communications and information management systems will consist of the following:

- telecommunication system,
- two-way radio system,
- security and closed circuit television (CCTV),
- access control,
- office local area network (LAN),
- supervisory control and data acquisition (SCADA), and
- central electronic control room.

The mine organigram has been developed from first principles based on ProMet Engineers (mining and process plant designing engineers) experience of existing similar operations. A total complement of 150 personnel (including mining, process plant and concentrate transport) is projected for the mine operation.

Working hours for the mine site and processing plant would be 24 hours per day, seven days a week. The transportation of the iron ore concentrate by road would take place during the same time roster. Alternative routes for the product shipment between the mine site and port are either a conveyor belt transporting the ore from the mine site to silos at the C14 road where the trucks would be loaded; or by truck to the nearest rail head and a rail-cart unloading facility at the port. The slurry pumping planned for the future, as well as the alternative options, would be operated 24 hours per day, seven days a week, similar to the working hours at the port.

### **3.8 NamPort facility**

The final ore would be shipped via the Walvis Bay port. Suitable vacant land is presently available to accommodate the initial final product at 2 Mtpa or 400,000 m<sup>3</sup> at a specific gravity (SG) of 5. Grindrod, a bulk materials handling company with long-term management rights for handling bulk materials at the port will be responsible for the receiving, storage and ship loading. Export shipment volumes will initially be 2 Mtpa and once the planned port expansion is completed in 2015/2016, mine production will increase to 7.5 Mtpa.

Minus 1 mm iron ore will be transported by trucks to the port, while material at <75 µm will later be pumped as slurry to the port, dewatered and stockpiled prior to ship loading. Alternative ore transport options (see also Section 3.6) will be considered and the most economically viable one presented to the local authorities.



## 4. NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

### 4.1 Demand for iron

Iron is the world's most commonly used metal. It is used primarily in structural engineering applications and in maritime purposes, automobiles, and machinery, with the main consumers being China, Japan, Korea, the United States and the European Union. Magnetite and haematite (both iron oxides) are the two main commercial ores of iron, with iron also recovered from pyrites ( $\text{FeS}_2$ ). Iron ore is mined, processed and smelted chiefly to produce steel in integrated steel plants. (Bloomberg, 2011)

Growth in emerging economies, commensurate with economic recovery across the Organisation for Economic Co-operation and Development (OECD) countries, has continued to foster the expansion of global steel demand. This has led to the resurgence in iron ore prices and operating margins of iron ore producers. The fundamental precept of iron ore demand is its intimate association with steel production and its correlation to gross domestic product (GDP) expansion. (Mark and Healy, 2011)

This correlation can be illustrated by the steel intensity (SI) curve that relates the evolution of steel intensity, represented by the ratio of apparent steel use (ASU) to GDP, to the level of economic development of a country as measured by GDP per capita. There are five stages in the development of steel intensity, namely a very low level before economic take-off, a rapid rise, a leveling off stage, a decline and finally stabilisation – as illustrated in Figure 4.1. (Ecorys, 2008)

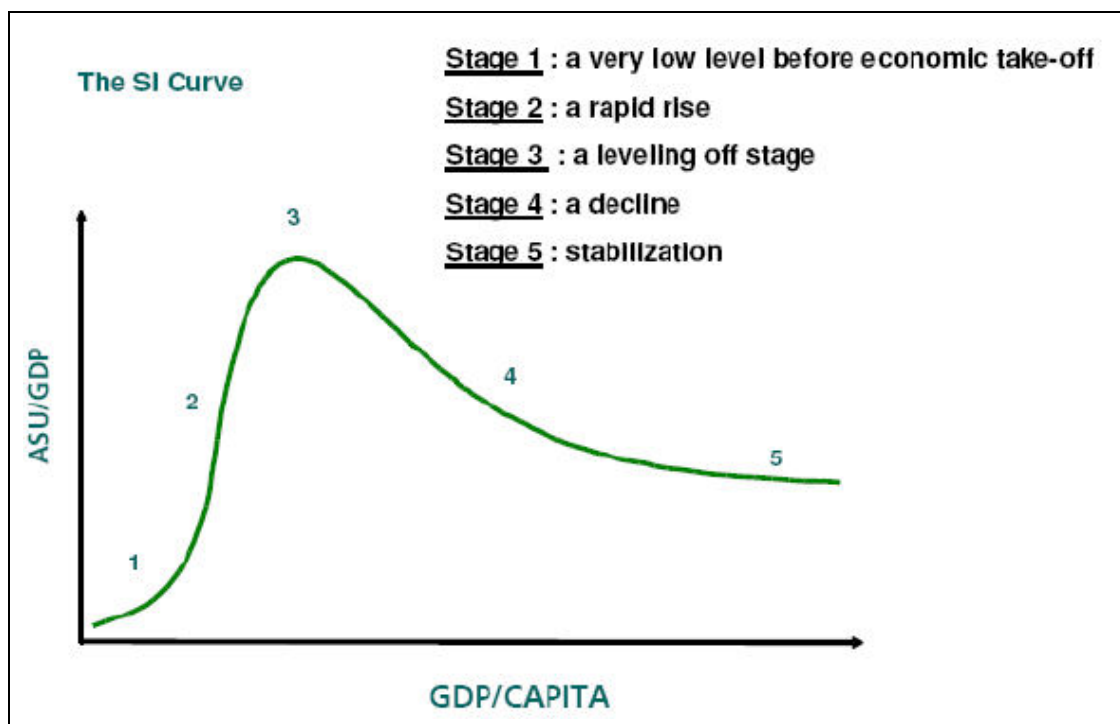


Figure 4.1 The steel intensity curve.

Global steel production has increased steadily over the last decade, but this growth has been supported by the 'new consumer' economies in the Asian region, whereby the advanced economies (for example, USA, Japan, and Germany) have witnessed minimal growth that has reduced collective market share. (Mark and Healy, 2011)

Despite the unprecedented economic downturn suffered across 2008 and 2009, steel production in the “new consumer” economies returned to record, or near-record levels in 2010, whereas the developed economies are slowly approaching pre-2008 output levels as utilisation rates continue to trend upwards. This asymmetric growth profile provides both an opportunity to supply raw materials to the faster growing nations, and the expansion of seaborne trade of this bulk commodity as projected GDP growth expectations for China and India remain well above the OECD average. It is expected that iron ore demand in the near term will be dominated by growth in Asia. This will also be aided by support from advanced economies as they collectively return to higher utilisation rates. (Mark and Healy, 2011)

#### 4.2 Supply of iron ore

Global production is dominated by the three largest diversified mining houses, Vale, RioTinto and BHPBilliton that largely export product from Australia and Brazil to across the world (Mark and Healy, 2011). World mine production for 2010 and reserve estimates for various countries are given in Table 4.1 (Jorgenson, 2011). The mine production for China is based on crude ore (the ore as it leaves the mine in an unconcentrated form), rather than usable ore (a steel industry term for high-grade iron ore, concentrates, or agglomerates that can be used in blast furnaces or other processing plants), which is reported for the other countries (Jorgenson, 2011).

The underlying feature of this bulk commodity is that the concentrated nature of supply, and the distal and disparate nature of steel producers, means that transport costs comprise a significant proportion of the ultimate cost of the delivered product (Mark and Healy, 2011). This feature is particularly highlighted by the low cost mining-processing operations in Australia and Brazil, and also becomes evident in elevated commodity price environments where traditional local trading partners (North American iron ore producers and steel manufacturers) look further afield in the search to increase margins (Mark and Healy, 2011). The top ten global iron ore producers are given in Table 4.2 (Storm, 2011).

**Table 4.1** World iron ore mine production (2010) and reserves.

Country	Mine production 2010 (Mt)	Reserves crude ore (Mt)
Australia	420	24,000
Brazil	370	29,000
Canada	35	6,300
China	900	23,000
India	260	7,000
Iran	33	2,500
Kazakhstan	22	8,300
Mauritania	11	1,100
Mexico	12	700
Russia	100	25,000
South Africa	55	1,000
Sweden	25	3,500
Ukraine	72	30,0900
United States	49	6,900
Venezuela	16	4,000
Other countries	50	11,000
World total (rounded)	2,400	180,000

**Table 4.2** The ten main iron ore mining companies in 2009.

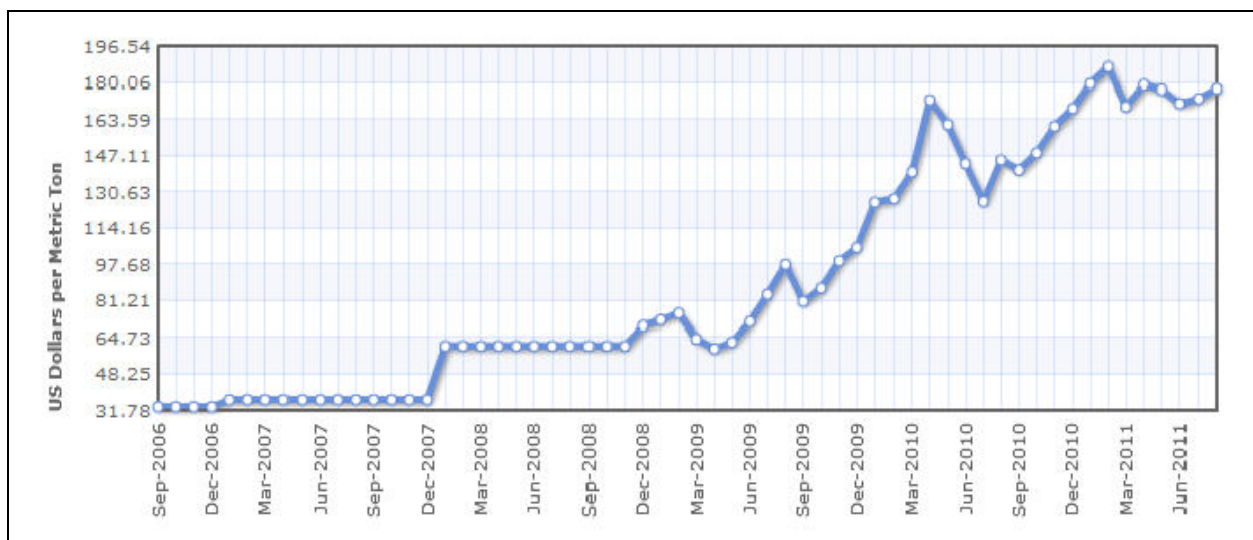
Company	Country	Production (Mt)
Vale	Brazil	255.0
Rio Tinto	United Kingdom	172.0
BHPBilliton	Australia	137.0
SAIL/NMDC	India	55.0
Anglo American	United Kingdom	43.8
Arcelor Mittal	Luxemburg	37.7
Metalloinvest	Russia	35.5
Fortescue Metal Group	Australia	34.9
System Capital Management	Ukraine	27.0
Cliffs Natural Resources	United States	24.9

### 4.3 Iron ore price

Iron ore prices fluctuate like most commodities, dependent on supply and demand trends. Iron ore prices are traditionally set annually when the world's largest iron ore consumers agree on contract costs with suppliers (Ecorys, 2008). Since 2004 iron ore prices have increased substantially due to bottlenecks in supply chain resulting in difficulties to meet high demand (Ecorys, 2008). The same trend followed in spot prices and as of August 2011 the average spot price for iron ore is US\$ 177.45 per metric tonne (IM, 2011). The price fluctuations for iron ore over the last five years are illustrated in Figure 3.1 (IM, 2011). Financial modelling for the proposed Shiyela Iron project indicates that the project is capable of producing satisfactory returns.

### 4.4 Relevance of economic viability

Uncertainties or substantial fluctuations in production levels, or the actual failure of resource projects, potentially create adverse social and environmental impacts. This is particularly so in the case of large scale projects involving major supporting physical and social infrastructure. Therefore the analysis of the broad economic viability of a project forms a relevant important component of an environmental impact assessment.



**Figure 4.1** Price fluctuations for iron ore between September 2006 and August 2011.

In the case of the proposed Shiyela Iron project, assessing economic viability involves consideration of the forecast demand for mined iron ore, and its anticipated price relative to the proposed investment in its production. However, for this project fluctuations in the rate of production will have only a minor impact on the socio-economic structure of the region, compared with larger resource projects that involve the establishment of townships and the provisions of a wide range of support services. The proposed project places minimal demands on government services and the interaction with the local community will be relative modest and predominantly beneficial.

#### **4.5 Economic and non-economic benefits and costs**

Social and economic impacts of the proposed Shiyela Iron project forms part of the environmental impact assessment undertaken for the project. Naturally new job opportunities will be created at the proposed mine, coupled with economic benefits to the Namibian government and the Swakopmund/Walvis Bay regional community through direct and indirect taxes, and purchases and acquired services in the Swakopmund/Walvis Bay regional area.

Economic costs to the regional community will be minimal, particularly with regard to infrastructure, as dedicated power infrastructure will be developed as part of the proposed project in conjunction with the relevant authorities, water infrastructure for the project will be developed on site, and additional transportation infrastructure costs beyond the Namibian regional road system will be borne by Reptile Uranium Limited.

Significant non-economic benefits can be expected to emanate from increased employment opportunities in skilled and semi-skilled jobs, including the associated training and experience, in the Swakopmund/Walvis Bay regional community, including social upliftment programmes and through an employment multiplier of about two hundred percent.

## 5. DESCRIPTION OF THE ENVIRONMENT

In this part of the report a description of the environment that may be affected by the activity is provided in accordance to Section 27(d) of the draft environmental assessment regulations (MET, 2009). Based on the terms of reference developed for this proposed activity in the scoping report (Friend *et al.*, 2010), various specialist investigations were completed as part of the impact assessment process. Information and findings collated from these investigations are given in the proceeding sections, with the complete specialist reports provided in referenced appendices to this report in terms of Section 27(q) of the draft environmental assessment regulations (MET, 2009).

### 5.1 Climate

#### 5.1.1 Rainfall

The average annual rainfall ranges from about 15 mm at the coast to about 35 mm further inland and can best be described as extremely variable, patchy and unreliable. A given location can go for years without any rain. However, the project area receives significant amounts of moisture from fog or dew, particularly near the coast. This fog is sufficient to support at least two species of lichens and many other plants in the project area. (Christian, 2006)

#### 5.1.2 Temperature

The Namib Desert near the coast has a temperature range that is moderated by proximity to the sea. As distance increases from the coast the temperature range rapidly becomes more extreme. The hottest month is February, when maximum air temperatures can reach 40°C but the average maximum is 25°C - 30°C. The coldest month is August, when the average minimum temperatures are between 8°C and 12°C depending on distance from the coast. (Christian, 2006)

Monthly-diurnal-hourly-arithmetic-mean temperatures (measured at 10 m) are presented in Figure 5.1 (Khumalo and Liebenberg-Enslin, 2010). Monthly temperature trends are discussed in more detail in the specialist report in Appendix B.

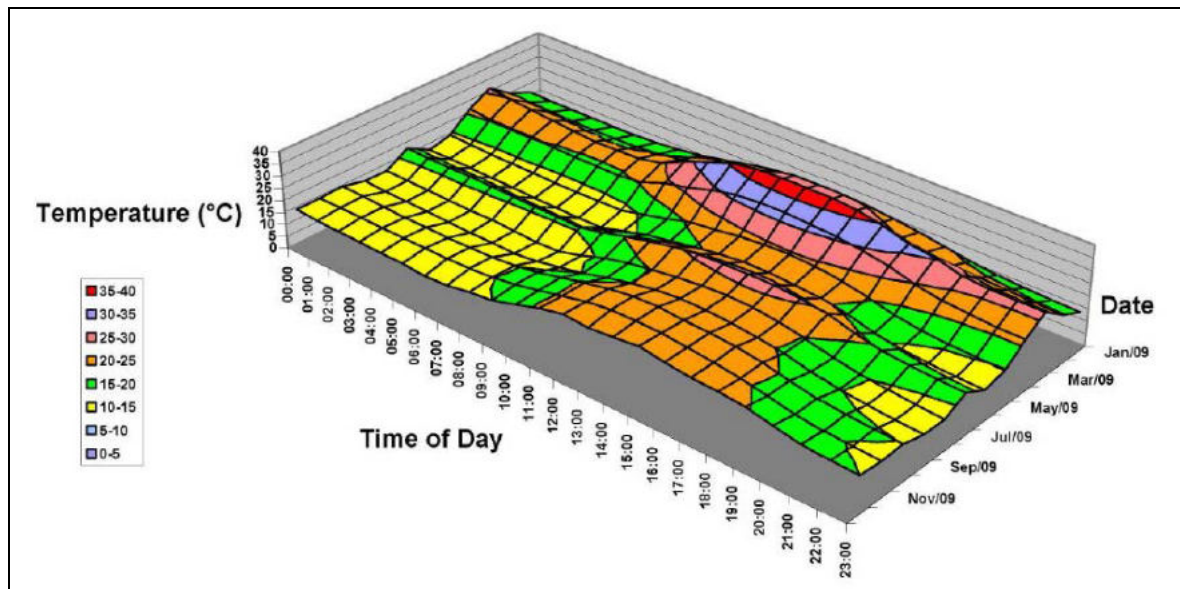


Figure 5.1 Air temperature trends for the region.

### 5.1.3 Humidity

The average humidity for the region is illustrated in Figure 5.2 and shows a marked winter minima (Friend *et al.*, 2005).

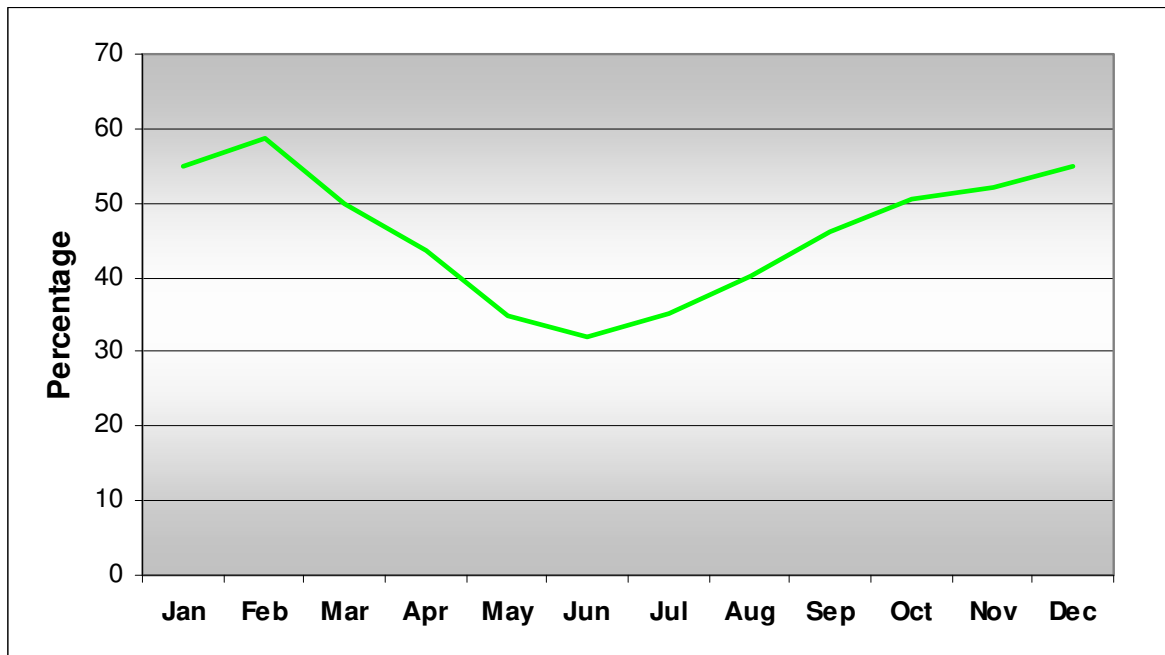


Figure 5.2 Average humidity for the region.

### 5.1.4 Wind

Near the coast strong southerly winds prevail, but westerly to south westerly winds are also frequent. With increasing distance from the coast the wind speed generally decreases and its direction becomes more variable. Warm easterly winds from the interior blow for typically between 7 and 14 days per year. These “berg winds” are hot dry winds caused by air descending from the interior. As the air descends it is compressed, causing a rapid increase in temperature. These winds can cause serious sandstorms, particularly in winter and spring. (Christian, 2006)

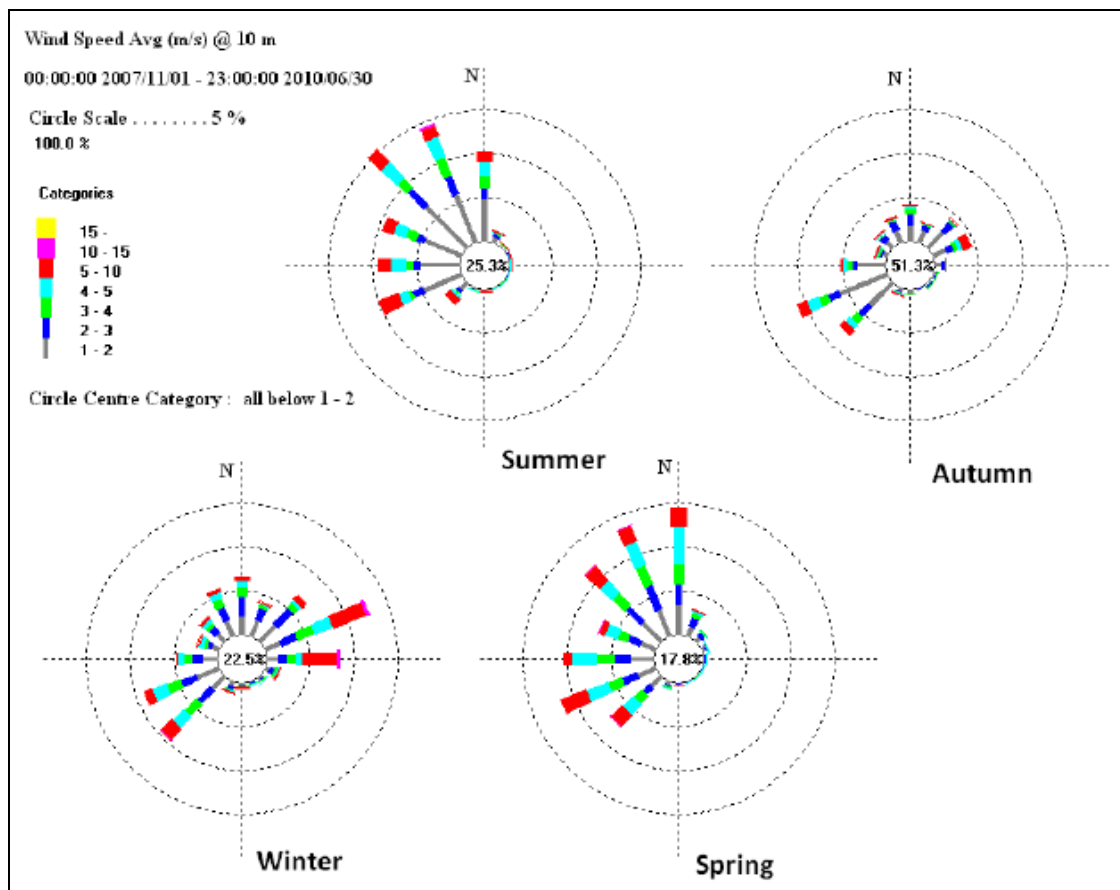
Seasonal wind roses for the region are shown in Figure 5.3 (Khumalo and Liebenberg-Enslin, 2010). Prevailing wind direction (predominantly from the north- and southwest) and other wind parameters are discussed in more detail in the specialist report in Appendix B.

## 5.2 Geology

### 5.2.1 Regional geology

The Shiyela Iron project is situated in the Central Zone of the Damara Orogen. The regional geology encompasses rocks of Achaean to Phanerozoic age. Most of Namibia’s surface is either bedrock exposure or young surficial deposits of the Kalahari Deserts. The coastal and intra-continental arms of the late Proterozoic Damara Orogen (800 to 500 million years) underlie large parts of northwestern and central Namibia, with stable platform carbonates in the north and a variety of metasedimentary rocks pointing to more variable depositional conditions further south. Along the southwestern coast, the volcano sedimentary Gariep Belt is interpreted as the southern extension of the Damara Orogen. (Fietze and Mohutsiwa, 2011)





**Figure 5.3** Seasonal wind roses for the region.

### 5.2.2 Local geology

The Shiyela Iron project includes two main deposits, namely M62 and M63, with the M62 area further divided into the Central, North and South sections. The red anomalies in Figure 5.4 indicate high magnetism, which is an indication that there could be conductive metal-bearing rocks, typically magnetite. Minor amounts of pyrite and chalcopyrite are the only sulphide minerals recognised in some of the Shiyela Iron project's drill holes (Fietze and Mohutsiwa, 2011). The main iron ore minerals are magnetite and hematite.

The main mineralised zone at both deposits consists of a mixture of coarse grained magnetite-quartz rock and fine grained quartz-magnetite-hematite gneiss with lesser lower grade mineralised zones of fine grained magnetic granitised gneiss. Whole HQ diamond core was used for physical characteristic test work to determine, *inter alia*, crushing and grinding indices. Quarter-coned reverse circulation (RC) and quarter cut and pulverised RC from completed HQ diamond drilling from each deposit have been sampled and assayed to supply continuous sample data throughout each deposit and for additional test work, including Davis Tube recovery (DTR) and product analyses. (DYL, 2010a)

### 5.2.3 Drilling information

The drill pattern on the Shiyela Iron project's area is shown in Figure 5.5, with the drill plans at M62 and M63 illustrated in Figures 5.6 and 5.7 respectively. Altogether 355 holes were drilled over a distance of 40,270 metres. The following geological, structural interpretations and descriptions are based on the extensive RC drilling, limited diamond drilling and on the scant outcrop:

- the magnetite/hematite iron mineralisation is interpreted to be of syn-sedimentary origin, that is, not introduced (PA, 2011);

- massive magnetite (magnetite-quartz rock) is spatially related to remobilisation by contact metamorphism close to granite/pegmatic intrusives (DYL, 2011); and
- fine-grained magnetite in migmatic quartz-biotite-magnetite gneiss probably represents original bedded sedimentary deposits that have been subjected to lower grade metamorphism (DYL, 2010a).

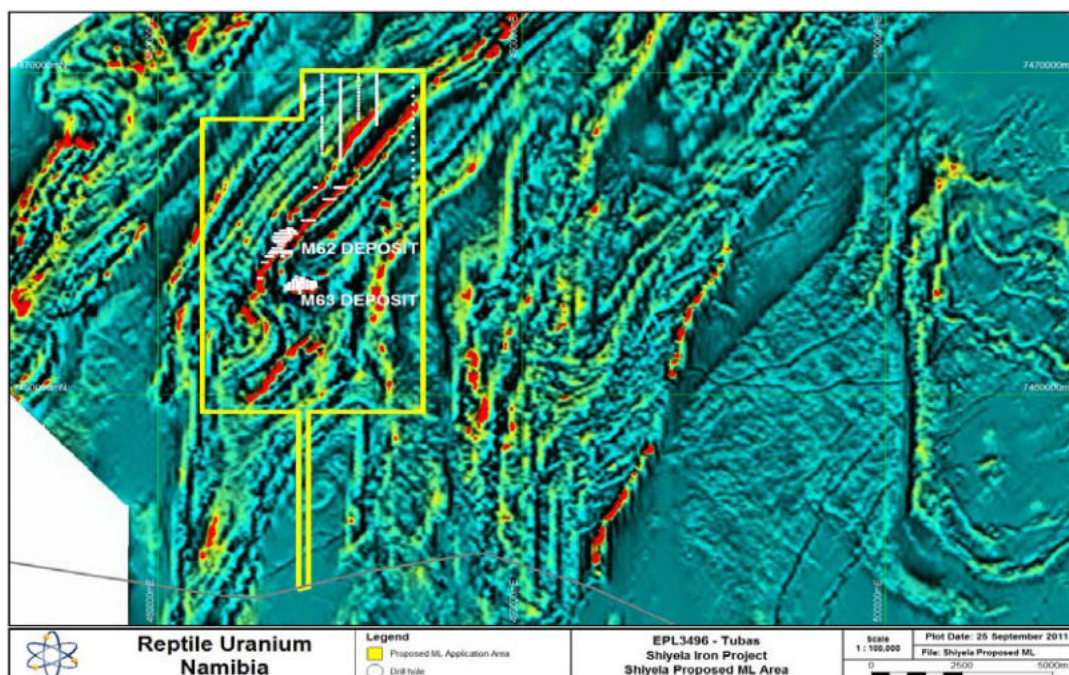
In addition, three types of magnetite ore have been identified:

- Sporadic shallow oxidisation is observed in some drill holes that has resulted in hematization of both the fine and coarse grained low to medium grade magnetite mineralisation. This alteration rarely occurs below 25 metres vertical depth. (DYL, 2011)
- Fine grained quartz-biotite-magnetite gneiss containing low to medium grade mineralisation.
- Coarse grained massive magnetite-quartz rock containing high grade mineralisation.

Mineralisation resides in tectonic layering – steeply dipping and regionally (and locally) intense folding is present (see Figures 5.8 and 5.9). At M62 layering dips at about 45 degrees to the west and strikes approximately 030 degrees. At M63 layering is sub-vertical and strikes approximately east-west, although modified by steeply plunging folds in part.

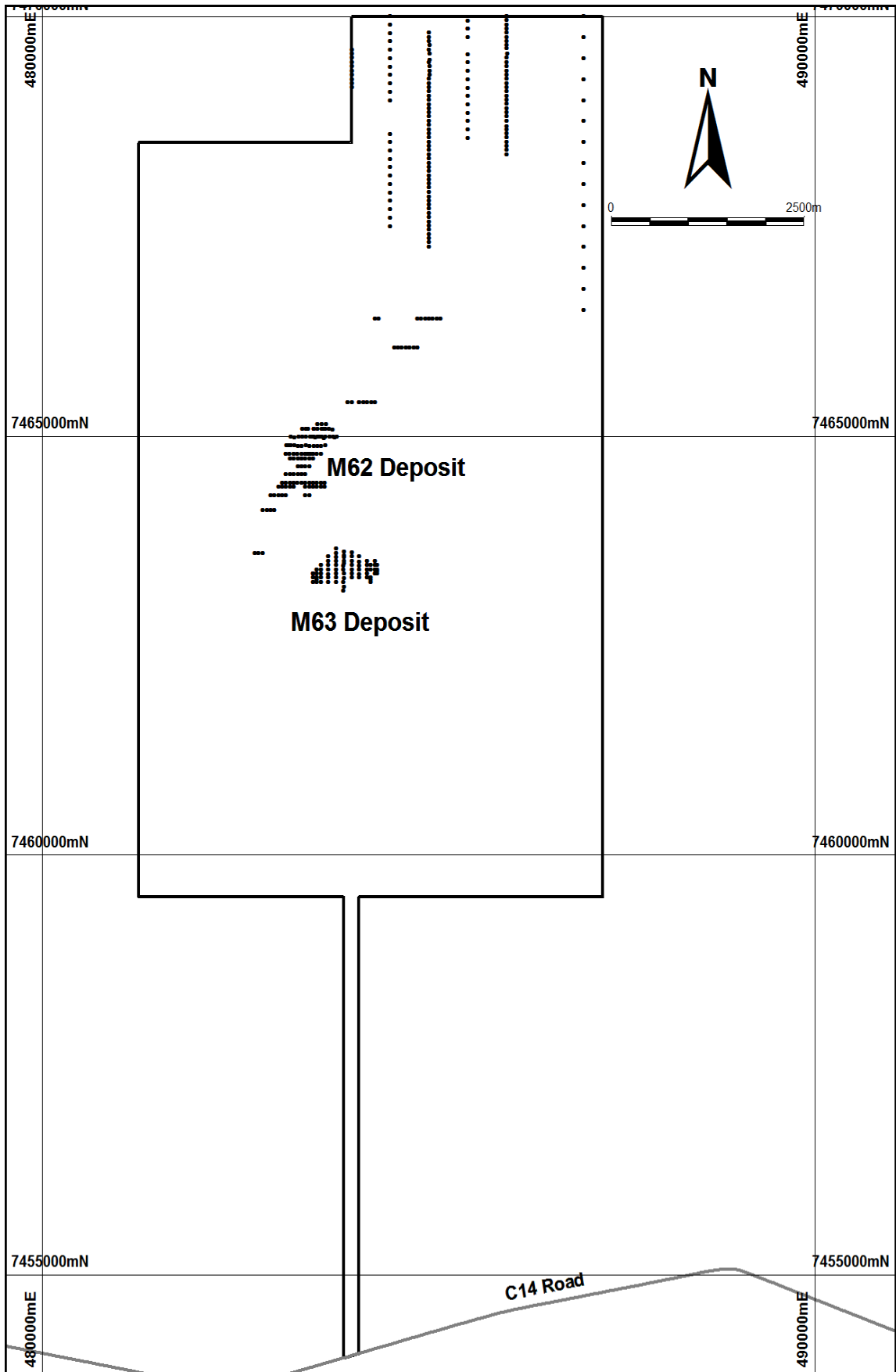
#### 5.2.4 Geophysics

An aeromagnetic map showing a total magnetic intensity (TMI) image for the Shiyela Iron project's area is shown in Figure 5.10, with red showing the highest intensity of magnetism (such as from magnetite) and blue the lowest intensity (DYL, 2010a). The preliminary geological evaluation of the area around M62 outlined a broad zone, approximately 100 m wide, characterised by narrow lenses of SW-oriented massive magnetite. However, RC drilling has shown the magnetite zone to be at least 400 m wide and is open to depth and along strike in both directions (DYL, 2010b).



**Figure 5.4** Red anomalies indicative of high magnetism in the Shiyela Iron project area.





**Figure 5.5** Drill pattern at Shiyela Iron project for the M62 and M63 deposits.

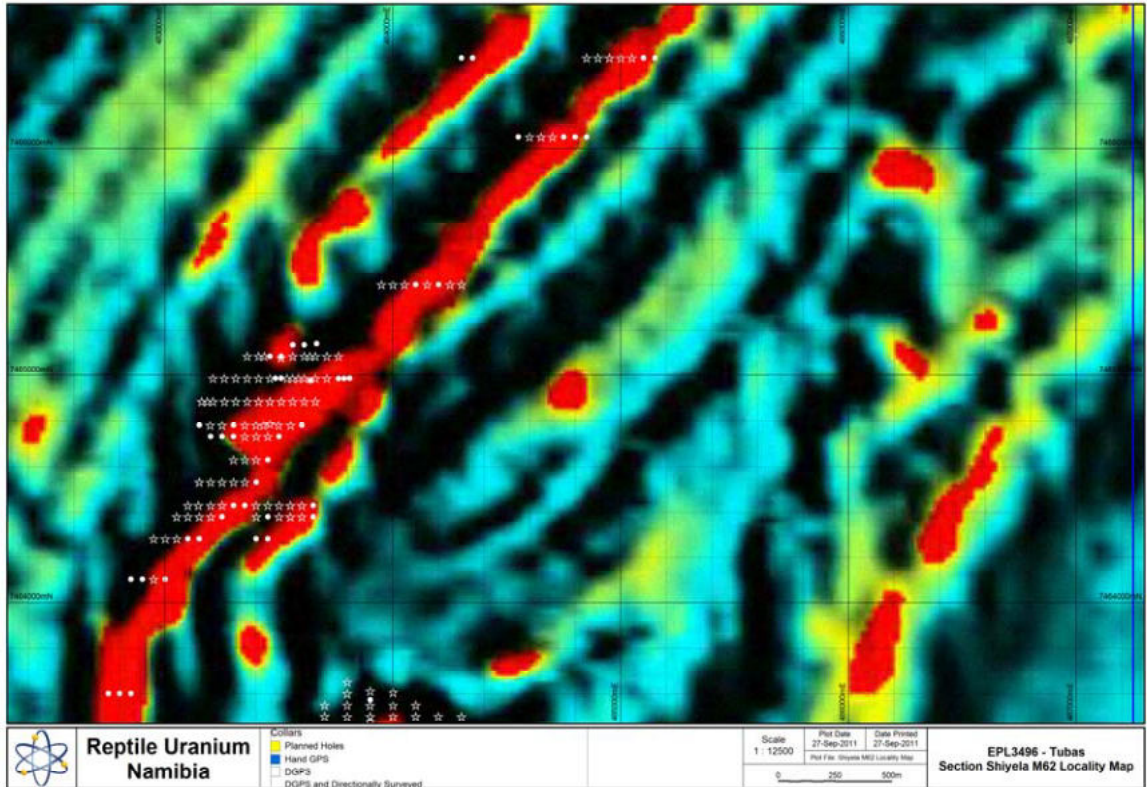


Figure 5.6 Drill plan at M62 deposit.

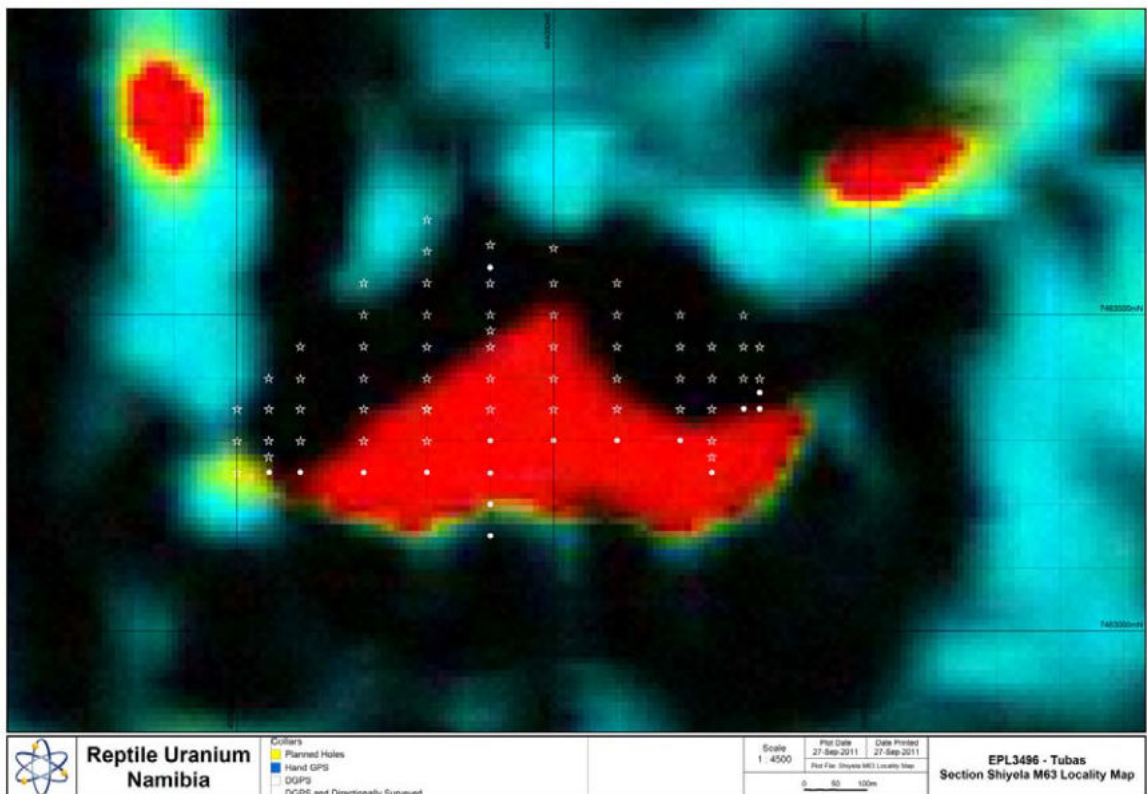


Figure 5.7 Drill plan at M63 deposit.





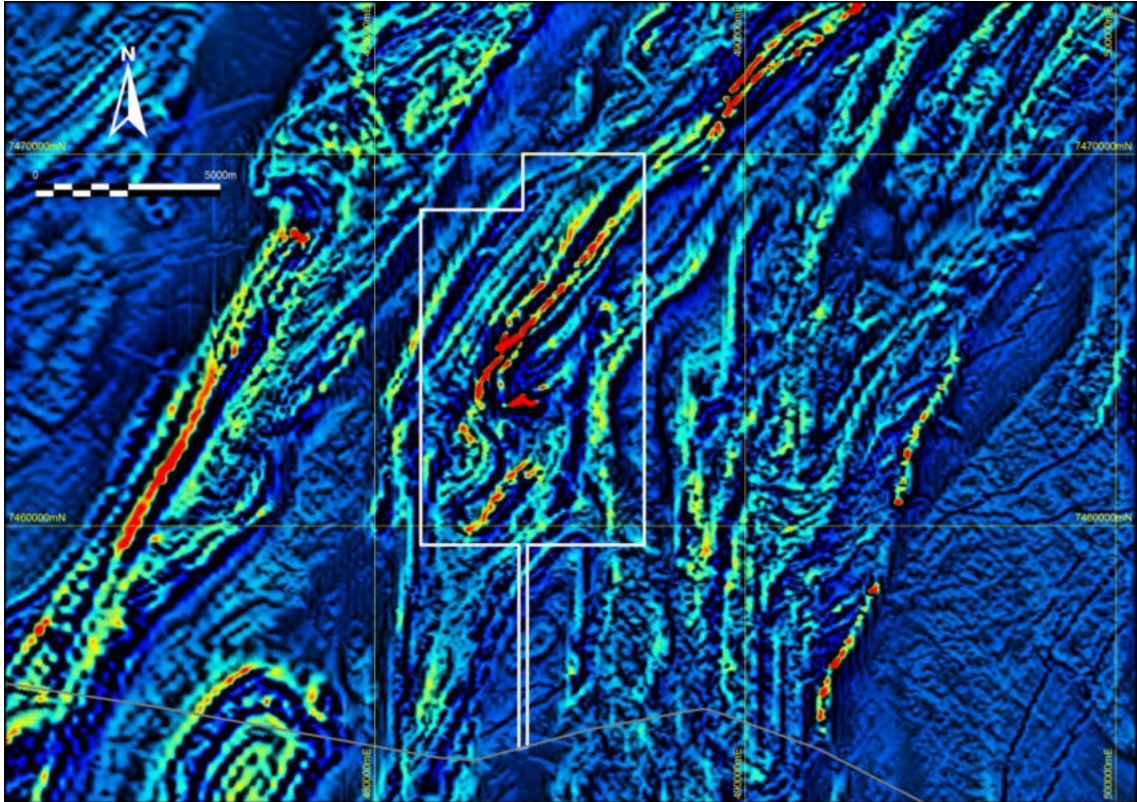
**Figure 5.8** Medium to coarse grained dark grey magnetite bands at 23 m depth (M63).



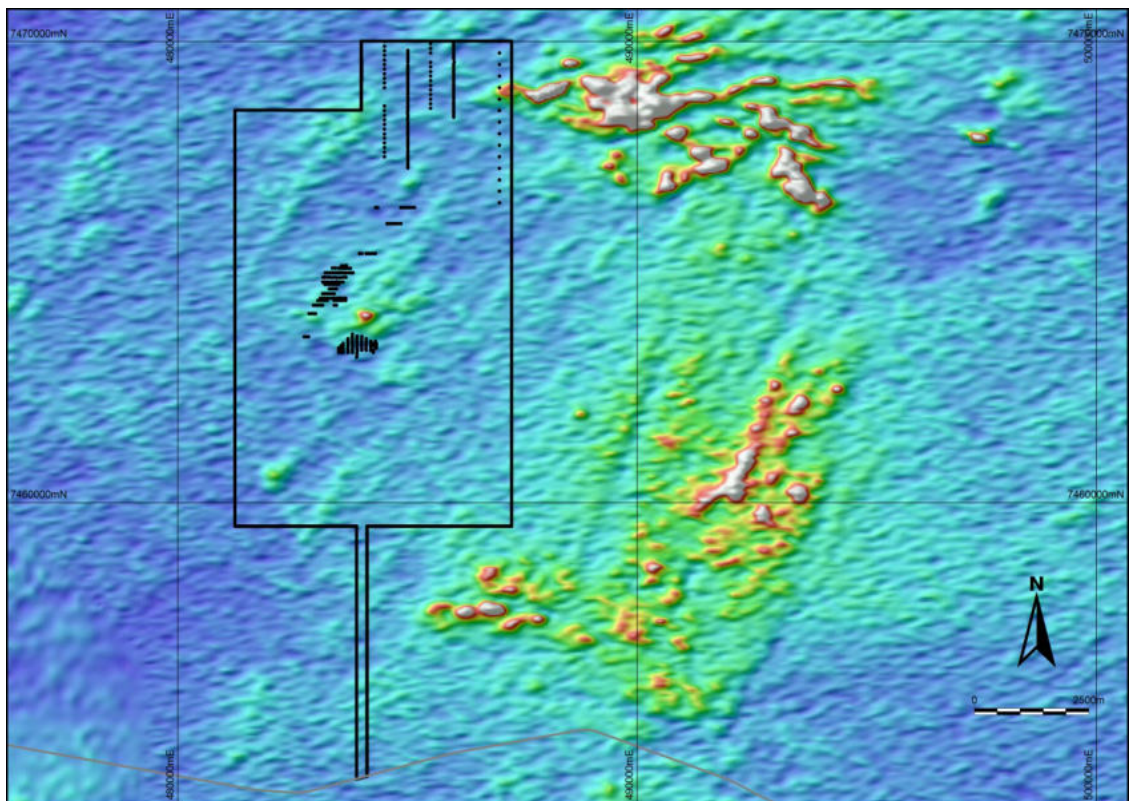
**Figure 5.9** Fine medium grained dark grey magnetite bands in folded gneiss at 235 m depth (M63).



A radiometric image showing predominantly low radioactivity count in the Shiyela Iron project's area is given in Figure 5.11. The uranium content is less than 10 ppm  $U_3O_8$ , as tested in a diamond drill core. (DYL, 2010a)



**Figure 5.10** Total magnetic intensity image over Shiyela Iron project's area.



**Figure 5.11** Radiometric image showing predominantly low radioactivity (white is high).



### 5.3 Topography

The proposed project area (see Figure 5.12) consists of a wide variety of granitic rocks that occur in the mountainous areas to the east and low-lying gravel plains that are generally fairly flat, except where they have been incised by rivers (erosion cycles, leading to shifts in the horizontal and vertical alignments of watercourses, resulted in the formation of old river terraces that now stand at elevations of several metres higher than the present watercourses). (Christian, 2006)

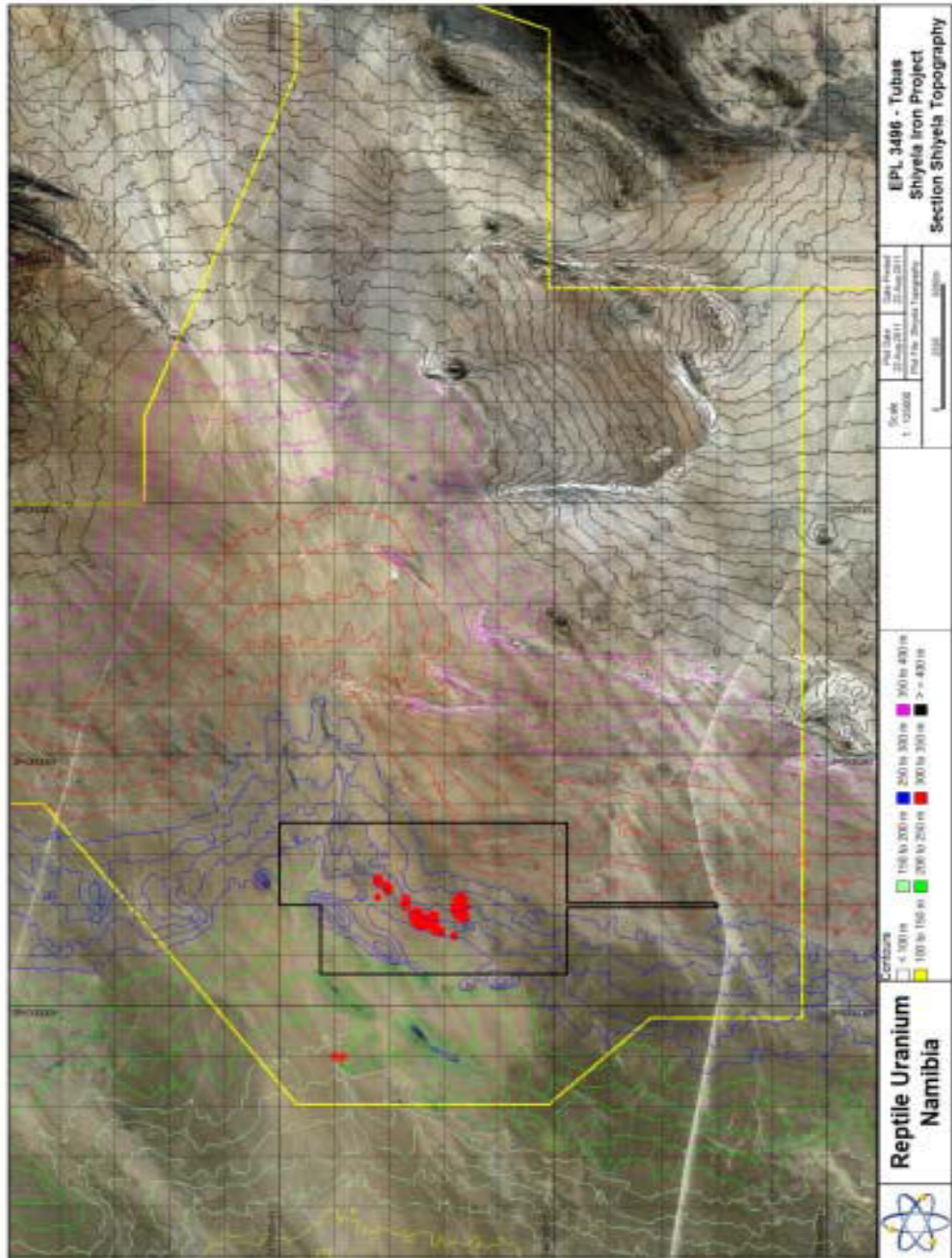


Figure 5.12 Topographical map of the Shiyela Iron project area.

#### 5.4 Soils

The soils of the Namib Desert are formed by various processes, both mechanical and chemical. Near the coast fog, which contains salt and hydrogen sulphides, intensifies chemical processes and soil genesis (Smuts, 1988). Soil formation is a slow and weak process on the plains of the Namib. The soil usually forms a crust that provides a stabilising effect, but is also very sensitive to any form of disturbance (Seely and Pallet, 2008). However this terrain is also fairly easily restored (Burke, 2005).

The surface soils of most of the western and central parts of the project area can be classified as coastal gravel plains. Coastal gravel plains consist of thin soil crusts approximately 4 mm thick or more. They are generally either gypsum crusts (gypcrete) or calcium carbonate crusts (calcrete) that develop from deposits due to fog precipitation. (Walsdorff *et al.*, 2009)

The coastal gravel plains of the Central Namib are very fragile systems and are extremely sensitive to destruction by development activities (NACOMA, 2009). The movement of vehicles over this type of terrain causes long-term damage, both to the soil type and to the ecology that it supports. Gravel plains are usually difficult to restore (Burke, 2005).

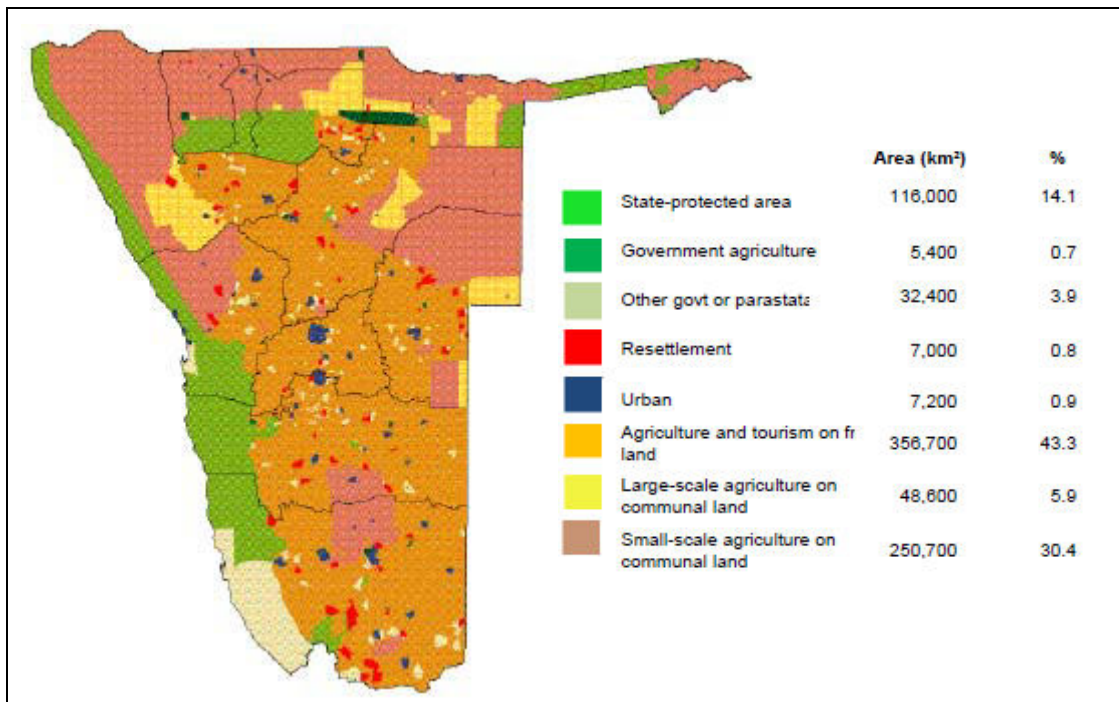
The gypsum plains occur only in the first 60 km strip from the coast. They have a very porous structure that is easily disturbed, reducing the value of the soil to the ecology that it supports (Seely and Pallet, 2008). The crust is usually very thin but can be up to 4 m thick close to the coast.

The calcrete plains are located further inland than the gypsum plains and may have a limited occurrence in the proposed mining licence area (Seely and Pallet 2008). This soil formation usually supports annual grasses that require at least 20 mm of rain to start germination.

Several smaller river washes cross the proposed mining licence area in the longitudinal direction that mostly contains washed sandy soils. The larger watercourses are usually comprised of coarse sand, sometimes mixed with some gravel in certain areas. In some places the sand is well packed and hard. Elsewhere only the surface is hard due to the formation of a crust, nominally 8 – 10 cm thick. These hard surfaces are often underlain by soft sand and powdery silt (Smuts, 1988). In a few of the smaller tributaries of the Tumas drainage system, shallow pans are found. These are comprised of finer material, namely silt and clays mixed with carbonates and salts. These pans would become very soft after rain. The surfaces of such pans, in places where water has stood for some time, are devoid of vegetation (Smuts, 1988).

#### 5.5 Land use capabilities

Major land uses in Namibia are illustrated in Figure 5.13 (Mendelsohn *et al.*, 2002). Large parts of the Erongo Region are desert and retained by the state as protected areas under conservation management, including the Namib Naukluft Park (Mendelsohn *et al.*, 2002). The arid nature of the landscape means that very little of the area has agricultural potential and is thus used primarily for tourism. However, mineral exploration, drilling campaigns and mining operations have previously been undertaken in the area, with illustrative examples of mining and other activities within the Namib Naukluft Park given in Figures 5.14 and 5.15.



**Figure 5.13** Major land uses in Namibia.



**Figure 5.14** Example of a mining operation within the Namib Naukluft Park.





**Figure 5.15** Example of a stone quarry within the Namib Naukluft Park.

## 5.6 Hydrology

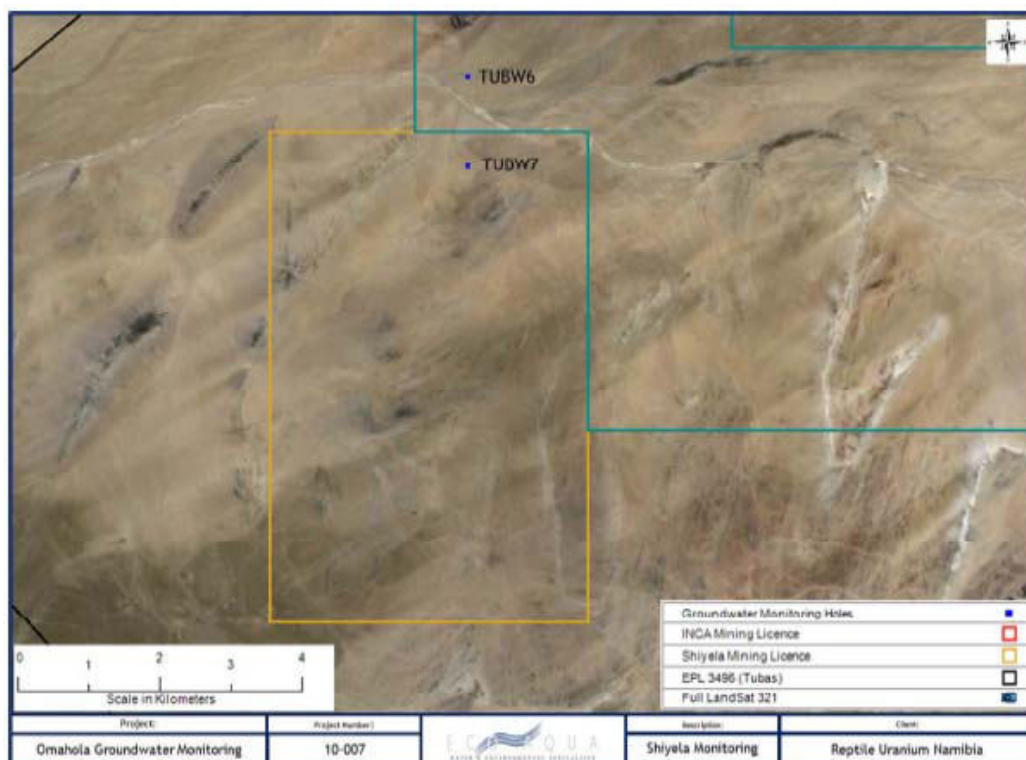
The development of the Omahola project, comprising the Shiyela Iron and two uranium projects INCA and Tubas, initiated a groundwater monitoring campaign to provide baseline data for relevant studies and assessments, as well as long term monitoring data for environmental compliance (Stanton, 2010). The groundwater monitoring campaign, conducted by Namibian company Eco Aqua, is presented in more detail in the specialist report in Appendix C.

The locality map for the Shiyela Iron monitoring holes is shown in Figure 5.16. Albeit that TUBW7 did not source water, the results from drilling at TUBW6 provides upstream data values. In order to assess the quality of groundwater in the region of the proposed Shiyela Iron project, it is necessary to distinguish between the various water classifications applicable to water within Namibia. Water is classified into four groups according to certain parameters (determinants), namely (Stanton, 2010):

- Group A – water with an excellent quality,
- Group B – water with an acceptable quality,
- Group C – water with low health risk, and
- Group D – water with a high health risk, not suitable for human consumption.

The overall quality group into which a water is classified is determined by the parameter (determinant) that complies least with the guidelines for the quality of drinking water. The results from monitoring at TUBW6 are given in Table 5.1, with reference to Group A and Group D Namibian water quality guidelines (Stanton, 2010). The groundwater is characterised by high salinities and is unsuitable for human consumption (Stanton, 2010).





**Figure 5.16** Locality map of monitoring holes for the Shiyela Iron project.

**Table 5.1** TUBW6 monitoring results.

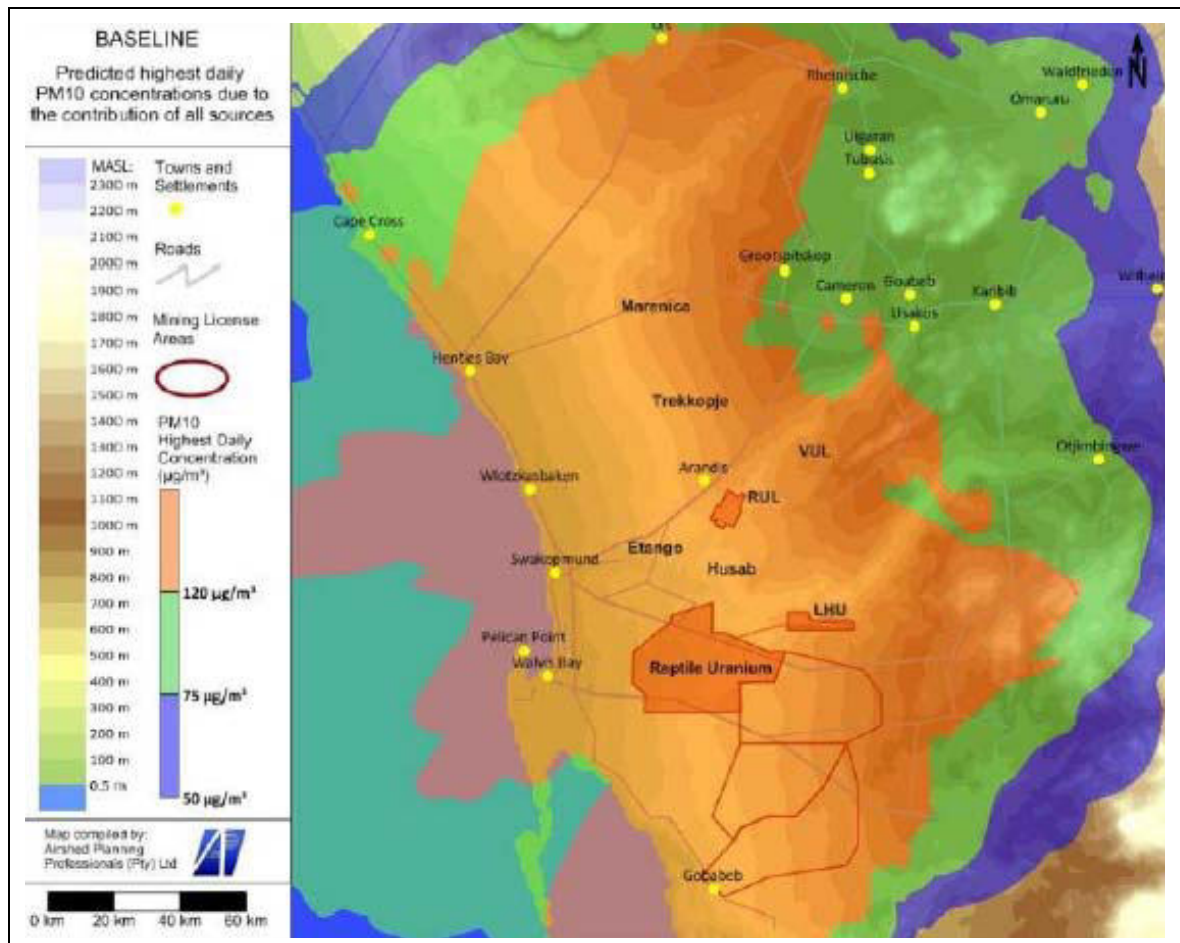
Parameter	TUBW6	Group A	Group D
pH (at 21°C)	7.7		
Conductivity (mS/m at 25°C)	3,888	150	400
Total dissolved solids	31,800	500	500
Calcium (Ca)	980	150	400
Magnesium (Mg)	246	70	200
Sodium (Na)	6,383	100	800
Potassium (K)	163	200	800
Total alkalinity (as CaCO <sub>3</sub> )	67	-	-
Bicarbonate (HCO <sub>3</sub> )	82	-	-
Carbonate (CO <sub>3</sub> )	0	-	-
Chloride (Cl)	10,250	250	1,200
Sulphate (SO <sub>4</sub> )	1,824	200	1,200
Nitrate (NO <sub>3</sub> )	121	-	-
Nitrogen (N)	27.3	10	40
Fluoride (F)	2.5	1.5	3
Total suspended solids	167	25	25
Sum of cations (meq/l)	350.96	-	-
Sum of anions (meq/l)	330.45	-	-
Arsenic (AS)	0.02	0.1	0.1
Aluminium (Al)	<0.009	0.15	0.15
Manganese (Mn)	<0.001	0.05	2
Iron (Fe)	0.56	0.05	2
Silicon (Si)	9.7	-	-
Uranium (U)	<0.004	1	8

## 5.7 Air quality

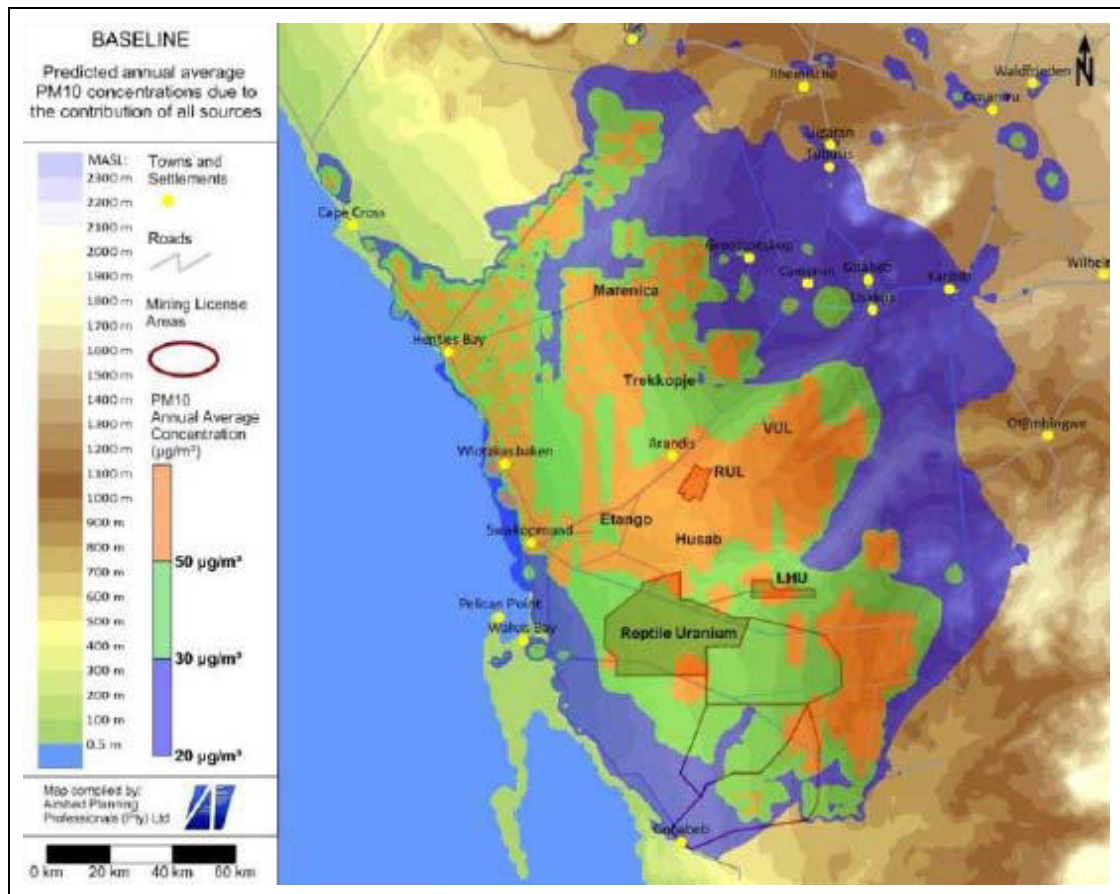
A baseline air quality characterisation and air quality impact study for the Omahola project was concluded by Airshed Planning Professionals, who also conducted similar studies for the strategic environmental assessment (SEA) for the Erongo region, and is presented in detail in Appendix B. The predicted baseline highest daily average PM<sub>10</sub> concentration for the Erongo region is shown in Figure 5.17, with annual average PM<sub>10</sub> concentrations illustrated in Figure 5.18 (Khumalo and Liebenberg-Enslin, 2010)

Anthropogenic sources of emission in the vicinity of the proposed Omahola project site mostly include mining activities. Current operating mines in the Erongo Region include Rössing Uranium Mine, located approximately 40 km to the north northeast of the Omahola Project site, and Langer Heinrich Uranium Mine, situated about 44 km to the east. Valencia Uranium and Trekkopje mines are approved proposed uranium mines in the region and will also utilise opencast mining methods. (Khumalo and Liebenberg-Enslin, 2010)

Predicted background concentrations and measured dust deposition rates were obtained from the SEA study recently undertaken for the Erongo Region. Background concentrations predicted around the proposed Omahola project site are in the region of 180 µg/m<sup>3</sup> (highest daily) and with an annual average of 40 µg/m<sup>3</sup>. (Khumalo and Liebenberg-Enslin, 2010)



**Figure 5.17** Predicted baseline highest daily average PM<sub>10</sub> concentration for the Erongo region.



**Figure 5.18** Predicted baseline annual average PM<sub>10</sub> concentration for the Erongo region.

### 5.8 Natural vegetation

A vegetation survey consisting of a systematic recording of all identifiable woody species, grasses, forbs and alien (exotic) plants within each of the stratified units on site was completed by Ekotrust and is presented in detail in Appendix D. The survey had the following objectives (Van Rooyen, 2010):

- to distinguish the different plant communities of the area
- to search the area for rare and/or threatened plant species, and
- to determine the impacts that the proposed mining venture will have on the vegetation and flora of the area.

A plant community is defined as a vegetation unit described by a specific plant species composition, having a uniform physiognomy and being restricted to a specific habitat (Van Rooyen, 2010). The plant communities (or associations) described do not exist as completely separated, clearly defined units in the area (Van Rooyen, 2010). Because of the relatively homogenous character of the habitat, these communities are in many instances related and form a continuum from one community to the next community within the larger ecosystem (Van Rooyen, 2010). The following plant communities were distinguished for the three Omahola project sites, namely (Van Rooyen, 2010):

1. *searsia marlothii-sarcostemma viminalis* sparse shrubveld of granite inselbergs;
2. *aloe asperifolia-hoodia cf currorii* sparse shrubveld of rocky outcrops and schist ridges;
3. *zygophyllum stapffii-brownanthus sp.* sparse shrubveld of rocky ridges and "hardeveld" along drainage lines;
4. *acanthosicyos horridus-pechuel-loeschea leubnitziae* riverbeds and washes;

5. *arthraerua leubnitziae-zygophyllum stapffii* dwarf shrubland of the gravel plains and washes;
  - 5.1 *arthraerua leubnitziae-salsola tuberculata-gomphocarpus filiformis* dwarf shrubland of the gravel plains and sheetwashes;
  - 5.2 *arthraerua leubnitziae-salsola tuberculata-stipagrostis obtusa* sparse shrubveld of the gravel plains;
  - 5.3 *arthraerua leubnitziae-citrullus ecirrhosus* sparse shrubland of gravel plains and sheetwashes;
6. *arthraerua leubnitziae-welwitschia mirabilis* sparse dwarf shrubland of the northern gravel plains and sheetwashes;
7. *zygophyllum stapffii-arthraerua leubnitziae* dwarf shrubland of the gravel plains;
8. *salsola tuberculata* shrubland of river terraces and undulating plains and footslopes;
9. *arthraerua leubnitziae* rocky ridges and dolerite dykes; and
10. barren gravel plains

Descriptions of these communities are provided in further detail by Van Rooyen (2010) in Appendix D. Using these communities a vegetation map for the Shiyela Iron project area is presented in Figure 5.19, with examples of relevant plant communities provided in Figures 5.20 to 5.25 (Van Rooyen, 2010).

## 5.9 Animal life

### 5.9.1 Introduction

Two comprehensive studies on animal life within the project area were completed, namely a vertebrate fauna study (mammals, reptiles, amphibians and birds) by Environment and Wildlife Consulting Namibia (complete report in Appendix E; Cunningham, 2010) and an invertebrate fauna study by Biodata and Scarab (complete report in Appendix F; Irish and Scholtz, 2011). For the vertebrate study a field survey was conducted between 25 and 29 June 2010, which was preceded by a comprehensive literature desktop study that took place during June 2010. The baseline study for invertebrate fauna entailed a desktop literature review as well as an extensive field survey that spanned a period of three months. After the first significant summer rains in the project area, preservative pitfall traps were deployed in twelve vegetational habitats. Once-off manual invertebrate collection in each habitat was also undertaken as part of the field survey.

### 5.9.2 Mammals

Detailed descriptions of mammals occurring in the area are presented in Appendix E. Of the twelve species observed and/or confirmed from the area during the fieldwork the round-eared elephant shrew (*macroscelides proboscideus flavicaudatus*), bat-eared fox (*otocyon megalotis*) are viewed as the most important with conservation and legal status of endemic (vulnerable) and vulnerable/peripheral, respectively. Another important species is the brown hyena *parahyaena (hyaena) brunnea* that is classified as “insufficiently known” and probably “vulnerable” in Namibia, but occurs widespread throughout the coastal areas. (Cunningham, 2010)

Other important species expected to occur in the general area, although not confirmed during the fieldwork, are the Namibian wing-gland bat (*cistugo seabrai*), Namib long-eared bat (*laephotis namibensis*) and Littledale’s whistling rat (*protomys littledalei namibensis*). *protomys littledalei namibensis* is known from the better vegetated areas in the Swakop and Kuiseb River mouth areas and probably only occurs in the Tumas drainage lines under exceptionally wet periods. However, very little is known of this subspecies. (Cunningham, 2010)



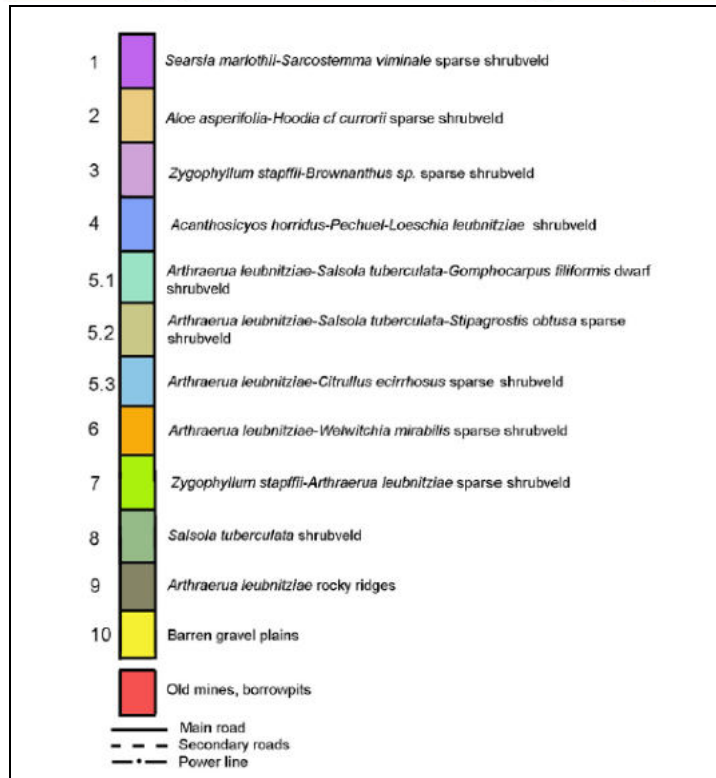
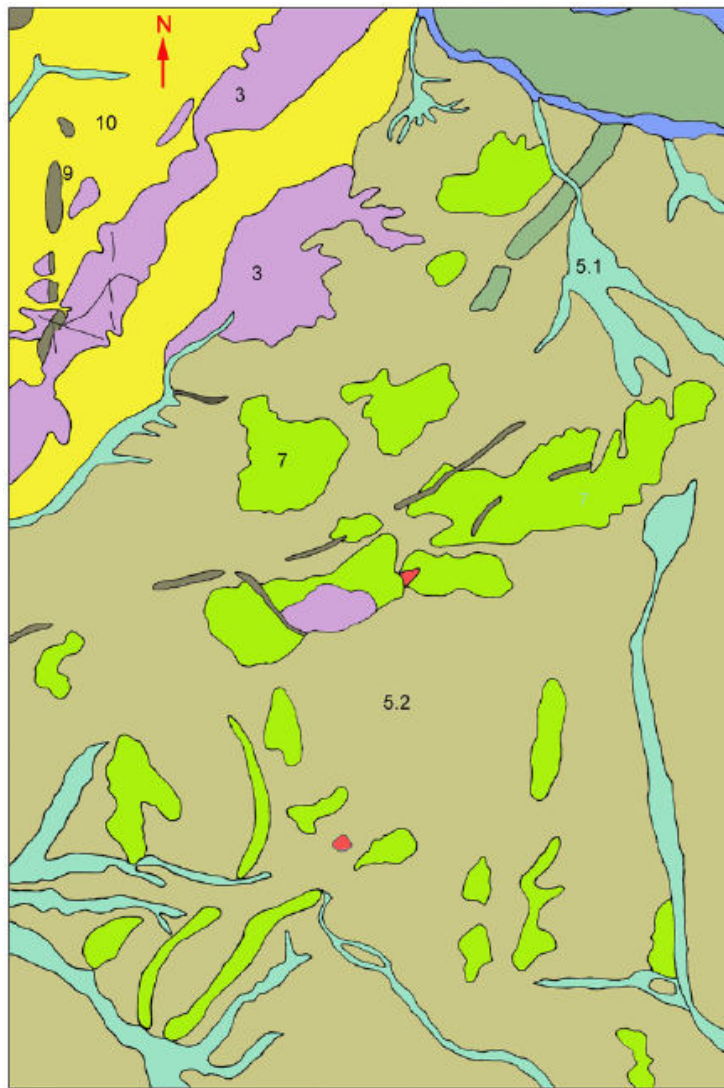


Figure 5.19 Vegetation map of the Shiyela Iron project area.



**Figure 5.20** Community 3: bare rocky ridges with species such as *orthanthera albida* and *hexacyrtis dickiana* in the gullies.



**Figure 5.21** Community 5.1 in wash in foreground with community 3 on terraces in the background.





**Figure 5.22** Community 5.2: sparsely vegetated plains with *arthraerua leubnitziae* and *salsola tuberculata* the dominant species.



**Figure 5.23** Community 7: undulating terrain with scattered individuals of *arthraerua leubnitziae*.



**Figure 5.24** Community 9: flat rocky ridges almost devoid of any plants.



**Figure 5.25** Community 10: Barren plains with 'foam or spongy' soils covered with small quartz pebbles.



### 5.9.3 Reptiles

Detailed descriptions of reptiles occurring in the area are presented in Appendix E. Of the 56 species of reptiles expected to occur in the general Swakopmund area, of which a high percentage are viewed as endemic (55.4%), only 14 species were observed and/or confirmed during the fieldwork conducted between 25 and 29 June 2010. All 14 species observed and/or confirmed from the area, are viewed as “secure”, including the nine endemic species. *Ptenopus carpi* (Carp’s barking gecko) is viewed as the most important species observed during the fieldwork, as their range is limited in Namibia (Kuisseb River to Rocky Point on barren gravel plains) and they are nowhere common (see Figure 5.26). Other reptile species of concern and expected to occur in the general area, are the endemic *afroedura africana* (African flat gecko), *pedioplanis husabensis* (Husab sand lizard), *leptotyphlops occidentalis* (Western thread snake) and *lycophidion namibianum* (Namibian wolf snake). Although the endemic *pedioplanis husabensis* potentially occurs in the area, none were observed. (Cunningham, 2010)



Figure 5.26 *Ptenopus carpi* observed in study area.

### 5.9.4 Amphibians

Amphibians are not viewed as important throughout the project area although the ephemeral Tumas drainage lines might occasionally serve as temporary habitat. *Poyntonophrynus (Bufo) hoeschi* and *phrynomantis annectens* are viewed as the most important but they are not exclusively associated with the proposed mining areas. (Cunningham, 2010)

### 5.9.5 Birds

Detailed descriptions of birds occurring in the area are presented in Appendix E. Although seven of the fourteen endemics to Namibia are expected to occur in the general area, very few birds were observed during the fieldwork conducted between 25 and 29 June 2010. Naturally more birds are expected to occur in the area during favourable environmental conditions (for example, rains and associated vegetative growth spurts); however, the extremely marginal environment limits the numbers and diversity. The most important species confirmed and/or expected to occur in the general area are *ammomanopsis grayi* (Gray’s lark), *namibornis herero* (Herero chat) and *eupodotis rueppellii* (Rüppell’s korhaan). *Ammomanopsis grayi* is viewed as the most important species from the area although not threatened and well represented in protected areas throughout coastal Namibia. No *namibornis herero* were observed during the fieldwork and they are known to favour the rocky areas towards the northeast, for example, Spitskoppe, etc. *Eupodotis rueppellii* occurs widespread throughout the western regions of Namibia. (Cunningham, 2010)

### **5.9.6 Invertebrates**

The complete invertebrate study report is presented in Appendix F. A total of at least 319 distinct invertebrate species were recorded in the total project area (comprising the Shiyela Iron, INCA and Tubas projects) and 21,021 individual invertebrates were recovered from pitfall traps. During the fourth trapping period the diversity and abundance of recorded invertebrates increased significantly. The sensitivity of the different habitats was assessed by evaluating it according to the diversity and potential diversity of invertebrate trophic guilds, the habitat restoration potential and the uniqueness of the habitat. The Salsola river terraces and plains habitat were identified as the most sensitive habitat within the total project area, with the marble ridge habitat, northern gravel plains, lower Tumas drainages, western and southern gravel plains and granite hill categorised as “highly sensitive habitats”. (Irish and Scholtz, 2011)

### **5.10 Archaeological, heritage and cultural aspects**

An archaeological survey of EPL 3496 was conducted during 2010 and the complete survey report presented in Appendix G (Kinahan, 2010). Archaeological assessment in Namibia follows the conventional three phase process of evaluation, assessment and mitigation, as shown in Figure 5.27. The archaeological survey, focussed on the Tubas River valley and environs, has located thirty nine archaeological sites ranging in age from the late Pleistocene to recent (see Figure 5.28). Eight of these were recorded on the Shiyela Iron project area. The area is of generally low archaeological significance. (Kinahan, 2010)

### **5.11 Sensitive landscapes and visual aspects**

The Shiyela Iron project falls within the boundaries of the Namib Naukluft Park, which constitutes a sensitive landscape. The legal establishment of the present Namib Naukluft Park started at the beginning of the twentieth century when, in 1907 under German colonial rule, it was proclaimed as a game reserve. This area encompassed mainly the northern part of the current park that falls within the Erongo Region. (Friend *et al.*, 2005)

The park is administered by the Ministry of Environment and Tourism (MET) in Namibia, maintaining all facilities associated with the park, for example, camp sites and roads. Visitors and non-MET residents of the Gobabeb Centre (located at the Kuiseb River) require permits for entry that outline their activities within the park. These permits normally allow visitors access to the park and to overnight at lookouts and camp sites. (Friend *et al.*, 2005)

One of the major attractions to tourists visiting the Namib Naukluft Park is the scenic beauty of the park itself (Figure 5.29). This is based primarily on the lack of human activity and structures in the park, coupled to a sense of remoteness (Figure 5.30). Albeit that a large number of mining operations have started in certain parts of the park, coupled with increased tourism operations, the park remains virtually void of any human interaction.

The sense of remoteness of the Namib Naukluft Park is directly related to the *sense of place* concept identified in Barnard *et al.* (2006). Sense of place is an environmental concern that can be impacted upon by development and should be considered accordingly. Impacts from the development of mines and industries can destroy the sense of place of an area and thus the spiritual, aesthetic and therapeutic qualities of an area will also be eliminated (Barnard *et al.*, 2006).

Two essential requirements for an appreciation of sense of place are that it must be a *person* experiencing the sensation and it must be a *place* that is experienced. Sense of place therefore cannot exist in isolation, but requires an interaction between the affected individual and the place where it happens. The importance of the sense of place is thus determined not only by the place itself, but by the value that the individual gives it. (Barnard *et al.*, 2003)

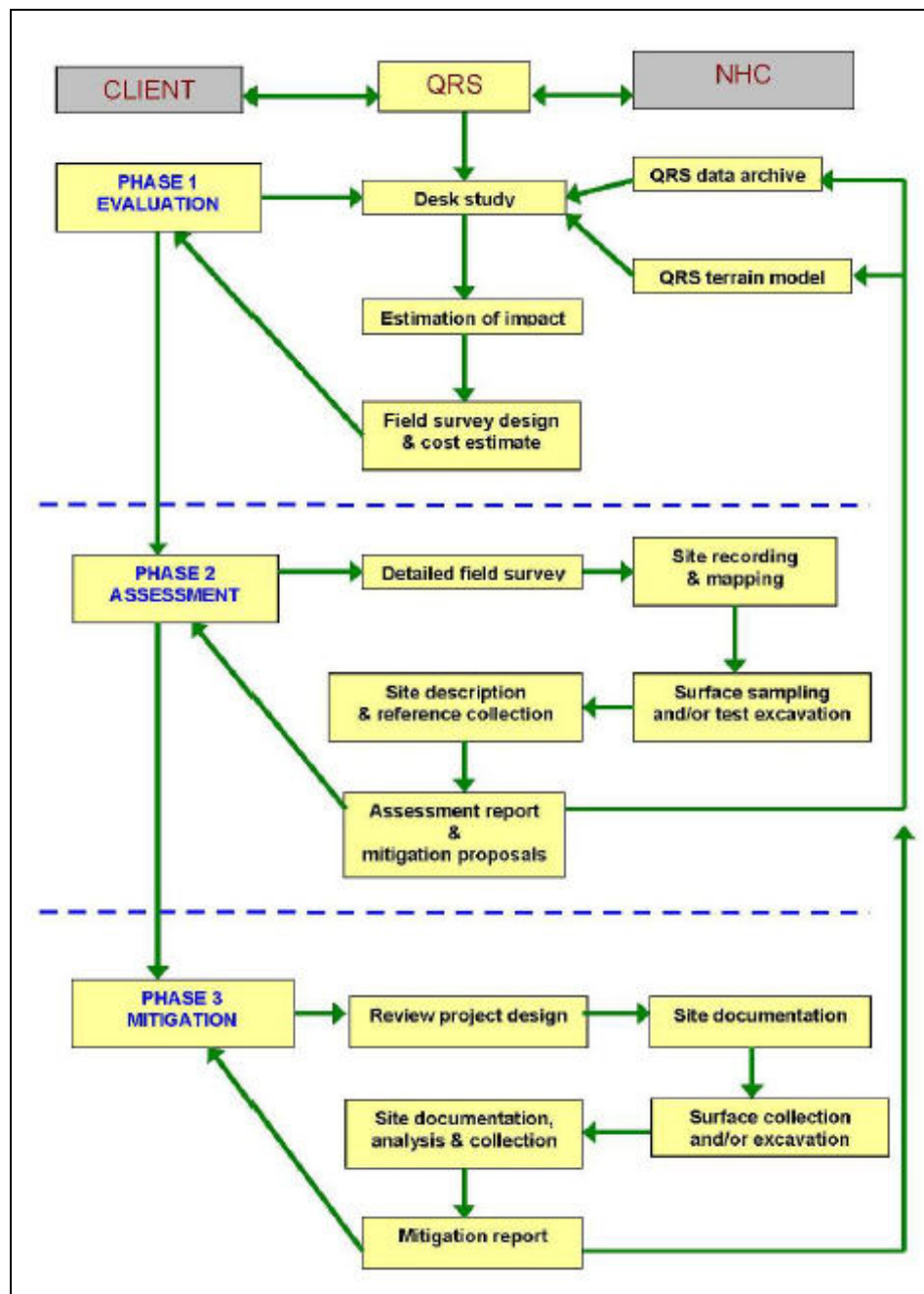
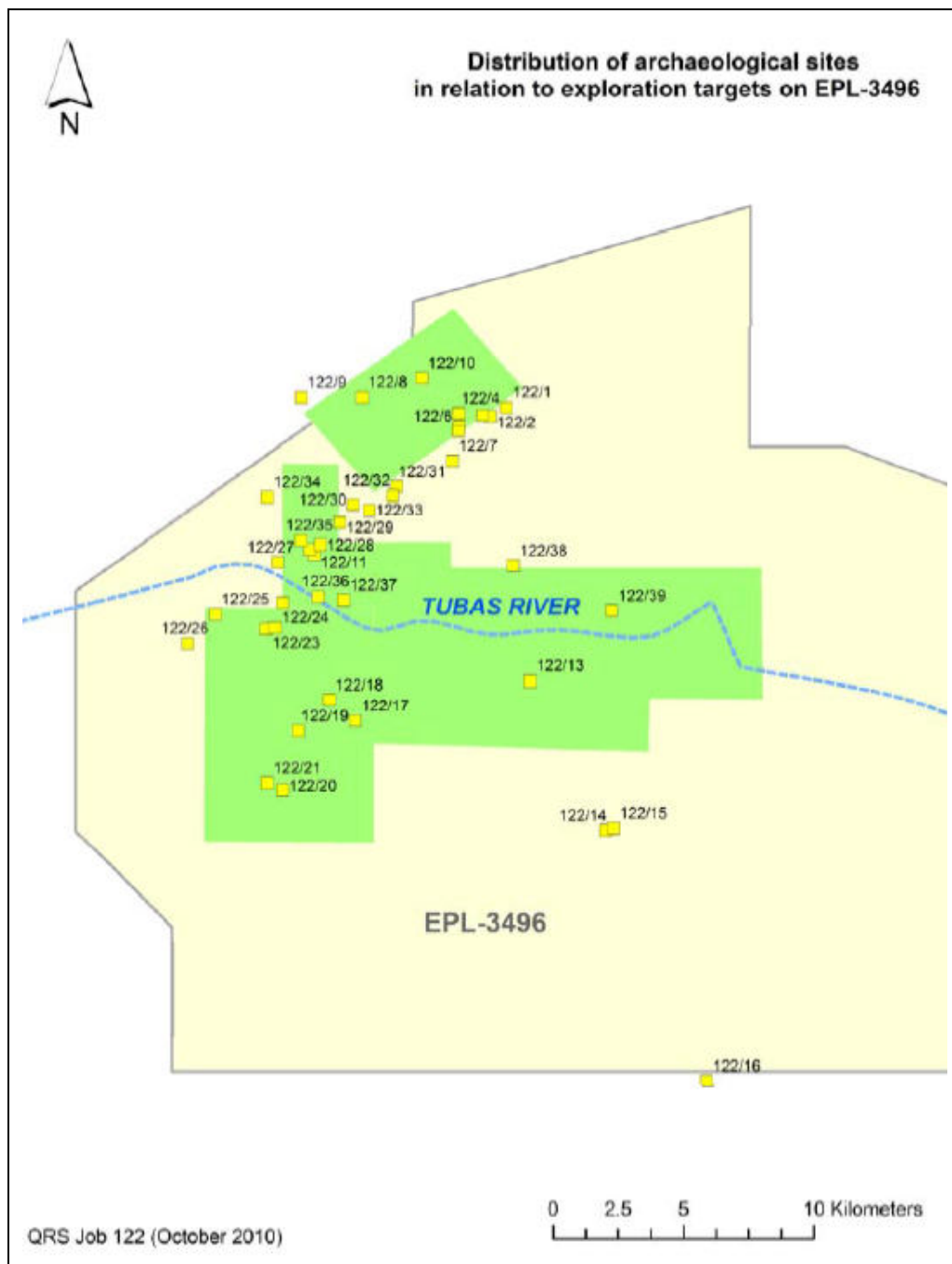


Figure 5.27 The QRS assessment process.

### 5.12 Noise

A baseline noise survey was completed for the proposed project area and the complete report presented in Appendix H (Cornelissen, 2010). A-weighted sound pressure levels were recorded over the period of an hour during different time periods and spread over a five day period. One of the measurements was also taken on a Sunday at the respective measurement points. The median values of the measurements recorded during the five days for the proposed development varied between 31.6 dB(A) and 65.6 dB(A). Weekend time measurements varied between 32.7 dB(A) and 37.3 dB(A) for the various points. Both day and weekend measurements were substantially below the World Bank guideline values of 45 dB(A) and 55 dB(A), respectively. According to SANS 10103:2004 a change of 10 dB(A) is equivalent to an apparent doubling or halving of sound levels; putting into perspective the difference between the measured sound levels and the World Bank guideline. (Cornelissen, 2010)





**Figure 5.28** The distribution of archaeological sites (numbered yellow squares) on EPL 3496.

## 5.13 Social environment

### 5.13.1 Introduction

The proposed Shiyela Iron project lies in the Erongo region, situated approximately 40 km to the east of Walvis Bay and east-southeast of Swakopmund. The area falls within the Namib Naukluft Park and no permanent settlements have been recorded. The socio-economic structure of the Erongo region, and Namibia as a whole, has important implications for proposed mining projects in terms of skills availability and labour pool. Mining and tourism are sectors in which prospects for growth are the best. The high unemployment and poverty levels in Namibia means that any new development is perceived as being economically beneficial to the area. (Friend *et al.*, 2005)



**Figure 5.29** Scenic beauty of the Namib Naukluft Park.



**Figure 5.30** Sense of unique remoteness within the Namib Naukluft Park.

### 5.13.2 Demographic characteristics

The population of the Erongo region is relatively small and densities are low. Most of the population is to be found in urban areas with 63% living in the towns of Walvis Bay, Swakopmund, Omaruru, Karibib, Arandis, Usakos, Uis and Henties Bay (IDC, 1995). Important for the study area is that the dependency ratio is low due to migration to the coastal cities (Walvis Bay and Swakopmund) for employment. Generally, the human development in the Erongo region is somewhat better than in the rest of the country (NPC, 2000a).

### 5.13.3 Population size and density of the Erongo region

The closest towns to the proposed Shiyela Iron project are Walvis Bay and Swakopmund. An overview of the population characteristics of both towns are given in Table 5.2 (CBS, 2002). The total population of the Erongo region is 107,629, which is approximately 6.7% of the total population of Namibia (CBS, 2002). Walvis Bay is divided into urban and rural areas; however, most people live in the urban part. At 3.8 the average household size in Walvis Bay (urban) is slightly higher than that of Swakopmund, whereas the average household size in the Erongo region lies at 4.5 persons per household, a figure lower than the national average of 5.7 persons per household (NPC, 2000b).

**Table 5.2** Population distribution of Walvis Bay and Swakopmund.

Town	No of households	Population			Average household size
		Male	Female	Total	
Walvis Bay (urban)	10,719	22,053	18,796	40,849	3.8
Walvis Bay (rural)	189	363	260	623	3.3
Swakopmund	7,560	13,175	12,267	25,442	3.4

### 5.13.4 Migration

The primary route of migration in the Erongo Region is in-migration from the northern regions of the country by young male labourers seeking employment, primarily in Walvis Bay. However, a number of migrant labourers go to mining towns (for example, Arandis) and commercial farms within the Erongo Region (NPC, 2000b).

Out-migration occurs primarily from rural areas to socially more attractive areas, such as towns within the region and also to larger urban centres such as Windhoek. Only one-third of Erongo residents were born where they live, the rest have come to their place of residence from elsewhere (NPC, 2000b). Compared with all 13 regions of Namibia, no other region has such a high rate of people living in an area away from where they were born (NPC, 2000b).

### 5.13.5 Households and economic conditions

The main source of income (76% in 2000) in the Erongo region is wages (Mendelsohn *et al.*, 2002 and NPC, 2000b). The number of households financed through pensions and cash remittances makes up 21% (NPC, 2000b) and the remaining 3% have no income at all. Approximately 40% of the households have one income, 20% have two incomes and below 5% of the households have three incomes (Mendelsohn *et al.*, 2002). The statistics for the Erongo region reflects the general situation of Namibia. Looking at the Gini coefficient (a measure of inequality) the Erongo region has one of the highest levels of inequality within Namibia, reflecting the large differences in wealth between people within the region (Mendelsohn *et al.*, 2002).



### **5.13.6 Human development**

The World Bank (2001) classifies Namibia as one of the 48 developing nations in sub-Saharan Africa and groups the country within the Lower-middle-income Group (\$ 756 - \$ 2,995) based on its Gross National Income (GNI) per capita. However, the inadequacy of using income as the sole indicator of development was discussed by Friend (2003) by using an example from May *et al.* (2000); whereby South Africa was compared with Poland, Thailand, Venezuela, Botswana and Brazil. All of these countries have lower per capita income than South Africa, yet generally they perform better on indicators such as life expectancy, infant mortality and adult literacy (May *et al.*, 2000).

The shortcomings of income as an indicator of development led the United Nations Development Programme (UNDP) to construct a composite index termed the Human Development Index (May *et al.*, 2000). The index is a composite of three factors, namely (Harris and Codur, 1998 and May *et al.*, 2000):

- longevity (as measured by life expectancy at birth),
- educational attainment (as measured by a combination of adult literacy and enrolment rates), and
- standard of living (as measured by real gross domestic product per capita).

Based on these factors the Human Development Index (HDI) indicates the relevant position of a country on an HDI scale between 0 and 1. Countries with an HDI below 0.5 are considered to have a low level of human development, those with an HDI between 0.5 and 0.8 a medium level, and those of 0.8 and above a high level of human development. (May *et al.*, 2000)

The national HDI for Namibia in 2010 was 0.606 and the country was ranked 105 in the latest HDI rankings published (UNDP, 2010). The Erongo region has an HDI of 0.670 and is second only to the Karas region in the south, with a score of 0.730 (NPC, 2000a). The lowest HDI is recorded in the Caprivi region with 0.468 (NPC, 2000a).

Another measure that can be used to assess the human development and poverty status of the Erongo region is that of the Human Poverty Index (HPI). This index measures the proportion of the population deprived of basic elements of life (NPC, 2000a). The following four attributes are contributing to the HPI (NPC, 2000a):

- longevity (in terms of life expectancy),
- knowledge (in terms of literacy),
- health indicators (percentage of underweight children and percentage of population without access to safe water and health services), and
- access to resources (the proportion of households with less than 20% of income available for non-food consumption and the percentage of poor households in the population).

In the Erongo region, an average of 15.3% of the population live in poverty compared to 23.4% of the total population of Namibia (NPC, 2000a).

In 1999 the UNDP examined the HDI and HPI for the Erongo region according to language groups (see Table 5.3; NPC, 2000a). In the region the German-speaking community has the highest HDI, followed by Afrikaans-speakers with the Nama/Damara-speaking community the lowest. The highest percentage living in poverty is recorded within the Oshiwambo-speaking community, followed by Otjiherero and Nama/Damara. German- and Afrikaans-speaking communities show the lowest percentage of people living in poverty.

**Table 5.3** Human development and poverty indices, based on language group, for the Erongo region.

Language group	HDI	HPI (%)
Nama/Damara	0.578	23.7
Otjiherero	0.628	24.6
Oshiwambo	0.612	29.4
Afrikaans	0.810	9.3
German	0.917	9.2

### 5.13.7 Marginalised groups

Although the Erongo region is socially and economically better off than most other regions in Namibia, there is a wide variety of living situations and standards within region. Two groups were identified as being particularly marginalised, namely, the Topnaar Nama and residents of previous mining communities (NPC, 2000b).

There are two Topnaar Nama communities in Namibia, with one living along the Kuiseb river, a seasonal river forming the border between the northern stone desert and the southern sand dune sea; and the second in the Kunene region near Sessfontein (van den Eynden *et al.*, 1992). The Topnaar is one of the oldest inhabitants of the Namib desert and earliest records date back to 1670. Oral tradition mentioned that the Topnaar Nama arrived from the North prior to occupying the Walvis Bay area. Traditionally the Topnaar Nama of the lower Kuiseb Valley lived by herding cattle, gardening and gathering the !nara (curcubit, *acanthosicyos horridus*). They were nomadic, restricted only by the availability of waterholes within the Kuiseb river and the !nara distribution (van den Eynden *et al.*, 1992). In 1907 the Namib Naukluft Park was declared and restricted the movement of the Topnaar drastically (van den Eynden *et al.*, 1992). At present, the Topnaar have a number of settlements along the Kuiseb river, some located within the Namib-Naukluft Park.

### 5.13.8 Health services

A total of 39 hospitals, 30 health centres and 251 clinics exist nationwide in Namibia, all being operated by the government (MHSS, 2000); with 15.4% of the hospitals, 3% of the health centres and 6.4% of the clinics located in the Erongo region (NPC, 2000b). The main hospitals are located at Walvis Bay, Swakopmund and Usakos (NPC, 2000b). According to Mendelsohn *et al.* (2002), the municipalities of Walvis Bay and Swakopmund both have sufficient health facilities. In the Erongo region 87% of the people live within 10 km of a public health facility.

### 5.13.9 Education

In the Erongo Region 91% of learners live within 5 km of schools (Mendelsohn *et al.*, 2002). Tertiary education facilities have not been established in the region. The literacy rate (4 years or more of schooling) is 83% for females and 78% for males in the Erongo region, with illiteracy highest amongst the older generation.

## 5.14 Economic environment

### 5.14.1 Introduction

Between 1990 and 1995 Namibia experienced a real increase in gross domestic product (GDP) per capita of 1.6% per annum (economic indicators are not available on a regional level). However, between 1996 and 1998 the GDP growth was outstripped by population growth of 2% per annum (Hansohm and Mupotola-Sibongo, 1998). This decline represents Namibia's (and the study area's) vulnerability to external factors, including recurring drought, volatile international mineral markets and highly variable outputs from fisheries (Hansohm and Mupotola-Sibongo, 1998).

The Namibian economic policy during the period 1990 to 1995 encouraged foreign investment by targeting value-added natural resource manufacturing and tourism partnerships. Incentives included the promulgation of the Foreign Investment Act (1990) and the formation of export processing zones. These effectively reduced export production costs and provided tax-free profits and exemptions from indirect taxes and import duties (Agribo, 1998). These incentives facilitated present trade with Britain, Spain, and to a lesser extent, other EU members and Japan. The main activities of the economy of the Erongo region are:

- exploitation of mineral resources,
- offshore fishing,
- small stock and ostrich farming, and
- tourism.

Main economic activities in the Erongo region are concentrated in the two coastal towns of Walvis Bay and Swakopmund, as well as the mining sites of Rössing, Karibib and Navachab (NPC, 2000b). The smaller towns offer limited employment opportunities; while opportunities in agriculture, small-scale mining and tourism are scattered widely throughout the region.

### 5.14.2 Agriculture and fishing

Although agriculture has been the backbone of Namibian society for the past century, this sector only contributed 5.4% to the national GDP in 2008, which is a decrease from the 6.1% in 2000 (NPC, 2009). With the potential for agricultural production being limited due to natural factors, for example, semi to arid conditions, caused by erratic rainfall, and the sensitive ecology of the region; the potential for expansion of traditional farming methods is limited. However, the Regional Development Plan (NPC, 2000b) suggests that, *inter alia*, the possibility of cultivating desert plants with commercial potential, coastal fog harvesting for growing plants and algae, as well as the production of non-traditional, high value agricultural products should be investigated further.

With Namibia having one of the richest fishing grounds in the world, due to the cold Benguela stream of its west coast; the Namibian government subsequently sees commercial fishing as one of the main pillars of its economy (NPC, 2001). The fisheries sector contributed 3.3% to the national GDP in 2008 (NPC, 2009).

Walvis Bay is one of only two harbours in Namibia, the other being Lüderitz in the Karas region. Since independence the fish production industry has increased in both towns significantly. However, the development potential of the fishing industry in the Erongo region is very much determined by resource availability. Despite the attempt of good management practices, stock levels, and thus fishing quotas, vary (NPC, 2000b) and the fishing industry is largely seasonal, offering mainly contract employment.



### **5.14.3 Mining**

Due to the scale of its influences across social, economic and environmental spheres, mining is a key activity within Namibia and the Erongo region. The mining contribution to GDP during 2008 was 15.8% (NPC, 2009). In Namibia up to 50% of its exports are mining-related, and mining earns the largest share of the country's foreign exchange (Agribo, 1998; NPC, 2009). Although mining is central to the national economy, it accounts for only 4% of employment (Agribo, 1998).

The mining operations of economic significance within the Erongo region are Rössing Uranium, Navachab Gold, Langer Heinrich Uranium and the coastal salt works (NPC, 2000b). In the Erongo region, over 10% of the population are employed in the mining sector (MRCC, 1999).

### **5.14.4 Infrastructure**

The national road network connects the Erongo region to the rest of the country via Okahandja, Windhoek and Otjiwarongo. The trunk roads between Windhoek, Okahandja, Swakopmund, Walvis Bay and Omaruru are tarred. Railway connections exist between Walvis Bay, Otjiwarongo and Windhoek. This railway network connects further to South Africa. A class A airport is located at Walvis Bay. The harbour at Walvis Bay is one of the key economic features of the region (NPC, 2000b). The harbour has two bulk terminals, cold storage facilities and ship repair and marine engineering services. A border post exists at the harbour as well as at the Walvis Bay airport. Swakopmund and Walvis Bay are linked by a 220 kV power line from the national grid. (Friend *et al.*, 2005)

### **5.14.5 Tourism**

The potential of tourism in addressing alternative sustainable land-use options and livelihood creation is becoming increasingly important. Tourism has been advocated for its potential to drive both regional and national economic development (NPC, 2001). Furthermore, it has been conceptualised as an important vehicle for social transformation, promoting local ownership, local benefits, capacity building and skills development (Ashley and Garland, 1994). Importantly, tourism provides incentives for nature conservation and enhanced resource utilisation. (Friend *et al.*, 2005)

As the sector is inextricably linked to Namibia's resource base, sound environmental management is required. In terms of impact assessment, tourism introduces a range of activities, which are widely distributed, variable in extent and largely uncontrolled. Inherent in tourism is a drive to explore, and ultimately penetrate, remote wilderness areas. Therein lay both an opportunity and a threat to Namibia and the Erongo region. (Friend *et al.*, 2005)

Tourism can act as a "drought-buffer", as it is not adversely affected by the arid climate. The main tourist attractions of the Erongo region are the northern Namib-Naukluft Park, the Spitzkoppe area and the coastal town of Swakopmund. Economic analysis of the tourism sector challenges traditional economic models. The product is usually purchased from a distance, consists of a range of goods/services, and is reliant on non-priced environmental assets. Economic impacts are widespread and often unaccounted for. Adequate analysis is costly and time-consuming, requiring substantial data collection. The numerous economic impacts attributed to tourism include: income generation, employment opportunities, cross-sectorial linkages, foreign exchange earnings and government revenues. These benefits have the potential to be spatially widely dispersed. (Friend *et al.*, 2005)

## 6. ALTERNATIVES

### 6.1 Ecologically sustainable development

The goal of ecologically sustainable development (ESD) is to achieve development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (EPA, 1995a). The objectives of ESD are to (EPA, 1995a):

- enhance the individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations;
- provide for equity within and between generations; and
- protect biological diversity and maintain essential ecological processes and life support systems.

The challenge for governments and the mining industry is to develop further the mining industry and efficiently manage the renewable and non-renewable resources on which it depends, in accordance with the principles of ESD. Governments are committed to achieving this by pursuing a number of strategic approaches and initiatives to ensure that sound environmental practices are used and promoted throughout all key sectors of the mining industry. (EPA, 1995a)

The precautionary principle is a major principle of ESD that underlines Reptile Uranium Namibia's environment protection approach to efficient management of the renewable and non-renewable resources on which it depends. The principle states that (EPA, 1995a):

*where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

In the application of the precautionary principle, public and private decisions should be guided by (EPA, 1995a):

- careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and
- an assessment of the risk-weighted consequences of various options.

The specific designs, approaches and locations used for the proposed development in Section 3, are largely dependent on the physical, biological and social environments impacting on, and being impacted upon, the proposed development. However, ESD principles guided the approaches used to design the Shiyela Iron project's processing facilities, the manner in which mining will proceed and strategies for rehabilitation. These principles are as follows (EPA, 1995a):

- adoption of external and internal code of practice, guidelines, standards and principles for exploration, environmental management, rehabilitation and community relations activities;
- comprehensive study, planning, evaluation and development of project proposals;
- extensive consultation with government, landowners and community groups;
- objective and comprehensive environmental impact and risk assessment of projects;
- comprehensive environmental management systems;
- research and development programmes;

- industry environmental review, education and knowledge-sharing networks;
- integration of long-term economic, environmental, social and equity goals in policies, actions and activities;
- ensuring that environmental assets are appropriately valued;
- involving communities in decisions and actions on issues that affect them;
- developing environmentally sound international competitiveness and an economy that can enhance environment protection; and
- recognising the global dimension of the environment and impacts on it.

## **6.2 Assessment of alternatives**

In terms of Section 26(1)(b) of the draft environmental assessment regulations it is a requirement to provide a description of any feasible and reasonable alternatives that have been identified. Alternatives are different means of meeting the general purpose and need of a proposal (DEAT, 2006) and can be categorised into the following (DEAT, 1998):

- demand alternatives (for example, using energy more efficiently rather than building more generating capacity),
- activity alternatives (for example, providing public transport rather than increasing road capacity),
- location alternatives (for example, either for the entire proposal or for components of the proposal, like the location of a processing plant for a mine),
- process alternatives (for example, the re-use of process water in an industrial plant, waste minimising or energy efficient technology, different mining methods),
- scheduling alternatives (for example, staggering the travelling to and from a plant during off peak times), and
- input alternatives (for example, use of alternative raw materials or energy sources).

The no-go alternative is the option of not undertaking the proposed activity or any of its alternatives. The no-go alternative also provides the baseline against which the impacts of other alternatives should be compared. It should be noted that the no-go alternative may sometimes not be a “real” or “implementable” alternative (for example, where the capacity of a sewage pipeline has to be increased to cope with current demand). It should, however, remain the default option and must always be included to provide the baseline for assessment of the impacts of other alternatives and also to illustrate the implications of not authorising the activity. (DEAT, 2006)

With all the categorised alternatives, the location (site) alternative normally plays the biggest role in assessment of an activity and its related impacts. However, in the case of mining operations the location is seldom available for alternative selection as the proposed mineral for extraction is by its very nature exactly at a particular selected site. It is thus imperative that alternatives in some of the other categories be investigated for mining operations, inclusive of alternative extraction methods and relevant processing operations. Scheduling and input alternatives can also be assessed for future benefits to the environment. These alternative options were evaluated and assessed as part of the overall design of the proposed mining operation, findings of specialist investigations (Sections 5 and 8) considered and the final proposed mining and process design presented in Section 3.



### 6.3 Consequences of not proceeding

Namibia presently is a net importer of raw iron ore, specifically for use at Rössing as a source of ferric in their processing plant. Shiyela Iron would be capable of supplying the requirements of Rössing and that of any other consumers of imported iron. The advantage is that Namibia will save on foreign exchange and Rössing will save on the transport costs. Failure to proceed (no-go alternative) will negate these benefits and savings for Namibia and Namibian companies. Furthermore, failure of the proposed Shiyela Iron project to proceed may not significantly affect world iron ore markets in the longer term (in excess of 20 years), but will certainly benefit Namibia's competitors in the shorter term. The proposed Shiyela Iron development is cost effective and capable of producing a high quality iron ore product at competitive prices.

The construction phase of the proposed Shiyela Iron project will create some 500 to 1,000 jobs in Namibia (during peak construction phase). During the actual operational phase, approximately 150 employment opportunities will exist at the mine. At increased production levels it will be no less than 300 employment opportunities. Although much of these newly created job opportunities will occur in the mining industry, additional job creation effects will take place in various other sectors as well; for example, personal services, transport and equipment manufacturing. There will be no employment benefit if the mine does not proceed.

The proposed Shiyela Iron development will generate new income opportunities for the Namibian government and to the Swakopmund/Walvis Bay regional communities. These income derived sources will include:

- royalties,
- indirect government taxes,
- licence fees and charges,
- pay as you earn (PAYE) taxes, and
- company taxes paid to government.

The proposed development will also contribute to regional development in Namibia, through sourcing of materials, services and labour. Recent estimates indicate that, when fully operational, direct and indirect taxes to the Namibian government will be in the order of N\$ 370 million per year. In addition, about N\$100 million will be spent on diesel fuel, N\$216 million for mining contractor, N\$72 million for ore transportation and N\$118 million on electricity. This income will be foregone if the mine does not proceed. Purchases and acquired services in the Swakopmund/Walvis Bay regional area, associated with full operation, are estimated to be approximately N\$20 million per year, and in the rest of Namibia, approaching N\$10 million per year. During the construction phase of approximately 12 months, an estimated N\$1.4 billion to N\$2 billion will be spent on the project, of which at least 30% will be locally sourced. These purchases will not be made if the mine does not proceed.

Benefits for not proceeding with the project can be summarised as the following primary benefits:

- the resource will remain in place for possible future development,
- there will be no further visual impact of development,
- there will be no disruption to local communities arising from construction and operation, and
- there will be no alteration to local biodiversity arising from construction and operation.

## 7. ASSESSMENT METHODOLOGY

The objective of the assessment of impacts is to identify and assess all the significant impacts that may arise from the undertaking of an activity and the findings used to inform the competent authority's decision as to whether the activity should be either authorised, authorised subject to conditions that will mitigate the impacts to within acceptable levels, or should be refused (DEAT, 2006). In this sense impacts are defined by DEAT (2006) as the changes in an environmental parameter that result from undertaking an activity. These changes are the difference between effects on an environmental parameter where the activity is undertaken compared to that where the activity is not undertaken, and occur over a specific period and within a defined area (DEAT, 2006).

### 7.1 Impact types

Different types of impacts may occur from the undertaking of an activity, which may be positive or negative, and can be categorised as being either direct (primary), indirect (secondary) or cumulative impacts. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (for example, dust generated by blasting operations on the site of the activity).

These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable. However, indirect impacts are induced changes that may occur as a result of the activity (for example, the use of water from a natural source at the activity will reduce the capacity for supply to other users). These types of impacts include all the potential impacts that either do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity. (Jain *et al.*, 1993; Fuggle and Rabie, 1994; DEAT, 2006)

Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (for example, removal of vegetation may cause soil erosion, leading to excessive sediments in a receiving stream, leading to reduced sunlight penetrating the water and thus reducing dissolved oxygen in the water and adversely affecting aquatic life and water quality). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts. (Jain *et al.*, 1993; DEAT, 2006)

### 7.2 Identification of impacts

The identification of the potential impacts of an activity on the environment should include impacts that may occur during the start/construction, operation and decommissioning/rehabilitation phases of an activity (DEAT, 2006). The process of identification and assessment of impacts includes, *inter alia*, the (Jain *et al.*, 1993; DEAT, 2006):

- determination of current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- determination of future changes to the environment that will occur if the proposed activity does not take place;
- understanding of the activity in sufficient detail to understand its consequences; and
- identification of significant impacts that are likely to occur if the activity is undertaken.

### 7.3 Impact mitigation

Once impacts have been identified and predicted for a particular activity, appropriate mitigation measures need to be established (DEAT, 2006). Mitigation measures are the modification of certain activities in such a way as to reduce the impacts on the environment (Jain *et al.*, 1993). The objectives of mitigation are to (DEAT, 2006):

- find more environmentally sound ways of doing things;
- enhance the environmental benefits of a proposed activity;
- avoid, minimise or remedy negative impacts; and
- ensure that residual negative impacts are within acceptable levels.

When mitigation is considered for (certain) impacts, it should be organised in a hierarchy of actions, namely (DEAT, 2006):

- avoid negative impacts as far as possible through the use of preventative measures,
- minimise or reduce negative impacts to “as low as practicable” levels, and
- remedy or compensate for negative residual impacts that are unavoidable and cannot be reduced further.

#### **7.4 Impact assessment methodology**

The concepts for environmental impact assessments in this report will relate to risk assessment (the process whereby certain impacts to the environment are identified), risk valuation (by using a stipulated assessment criteria whereby impacts are given a rating or weighting and obtaining an overall rating or significance of an impact) and risk management (relating directly to applicable mitigation measures to be implemented to manage a risk of an impact in the "best" interest of a society; Shogren, 1990). Such an assessment is also a requirement in terms of Sections 26(1)(g) and 26(1)(i)(iii) of the environmental assessment (EA) regulations (MET, 2009). The guideline criteria set out in Section 27(k) of the EA regulations, in conjunction with assessment criteria from DEAT (1998), Friend *et al.* (2005), DEAT (2006) and Friend and Van Rooyen (2009); will be followed in this report and are presented in the following sections.

##### **7.4.1 Nature or status of the impact**

An appraisal of the type of effect the activity would have on the affected environment; rated as either positive (beneficial impact on the environment), neutral (no impact on the environment), or negative (adverse impact on and at a cost to the environment).

##### **7.4.2 Extent or scale of the impact**

Indicates whether the impact will be either site specific (impacting within the boundaries of the site), local (within an area of 5 km of the site), regional (Namib-Naukluft Park area), on a national scale (Namibia) or across international borders (Southern Africa).

##### **7.4.3 Duration of the impact**

Indicates whether the lifetime of the impact will be either short term (0 - 5 years), medium term (5 - 15 years), long term (where the impact will cease after the operational life of the activity, either because of natural process or human intervention), or permanent (where mitigation either by natural process or human intervention will not occur in such a way or in such a time span that the impact can be considered transient).

##### **7.4.4 Intensity or magnitude of the impact**

Establishes whether the impact is destructive or benign and is indicated as either low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected), medium (where the affected environment is altered but natural, cultural and social functions and processes continue, albeit in a modified way), high (natural, cultural or social functions or processes are altered to the extent that it will temporarily cease); or very high (natural, cultural or social functions or processes are altered to the extent that it will permanently cease).



#### 7.4.5 Probability of the impact

Describes the likelihood of the impact actually occurring and is indicated as either improbable (the possibility of the impact to materialise is very low, either because of design, historic experience or implementation of adequate corrective actions), probable (there is a distinct possibility that the impact will occur), highly probable (it is most likely that the impact will occur), or definite (the impact will occur regardless of any prevention or corrective actions).

#### 7.4.6 Determination of significance

After assessment of an impact in accordance to the preceding five criteria, the significance of an impact can be determined through a synthesis of the aspects produced in terms of their nature, extent, duration, intensity and probability. In Table 7.1 various ratings are accorded to these criteria. These ratings are now used to calculate a significance (S) rating and are formulated by adding the sum of ratings given to the extent (E), duration (D) and intensity (I) and then multiplying the sum with the probability (P) of an impact as follows:

$$\text{Significance (S)} = (E + D + I) \times P$$

The resultant ratings are now described as follows (see also Table 7.1):

- S < 25 implies a low impact (meaning this impact would not have a direct influence on the decision to develop in the area),
- S = (25 - 50) implies a medium impact (where the relevant impact could influence the decision to develop in the area unless it is effectively mitigated), and
- S > 50 implies a high impact (this impact must have an influence on the decision process to develop in the area).

**Table 7.1** Ratings used for determining impact significance.

Nature of impact (N)		Extent of impact (E)		Duration of impact (D)	
positive	+	site specific	1	short term	1
neutral	0	local	2	medium term	2
negative	-	regional	3	long term	3
		national	4	permanent	4
		international	5		

Intensity of impact (I)		Probability of impact (P)		Significance of impact (S)	
low	1	improbable	2	low	< 25
medium	2	probable	4	medium	25 - 50
high	3	highly probable	6	high	> 50
very high	4	definite	8		

#### 7.4.7 Additional evaluation criteria

Apart from the assessment criteria presented in the preceding sections; impacts will also be evaluated and assessed based on cumulative impacts, relevant reversibility, potential for irreplaceable loss of resources and level of confidence.

Cumulative impacts (see Table 7.2) can arise from one or more activities and can be defined as being either an additive impact, that is where it adds to the impact caused by other similar impacts; or an interactive impact, that is where a cumulative impact is caused by different impacts that combine to form a new impact.

Interactive impacts may cause either countervailing (the nett adverse cumulative impact is less than the sum of the individual impacts), or synergistic (the nett adverse cumulative impact is greater than the sum of the individual impacts). (DEAT, 2006)

The reversibility of an impact simply indicates to what degree its influence on the relevant environment can be negated and is presented in Table 7.2. The potential for irreplaceable loss of resources, based on a relevant impact, indicates the degree to which the impact may cause such loss and is presented in Table 7.2.

The level of confidence indicates the level of certainty that specialists have in the accuracy of their predictions with regard to a relevant assessment and its related determined significance. This will be based on any factors that could bring into doubt the accuracy of their relevant predictions, (for example, an investigation undertaken during a non-ideal season, key research data being unavailable) and thus compromise the level of confidence in the assessment of an impact. The levels of confidence used in this report are presented in Table 7.2 and for levels with either a medium or low level applicable, an additional explanation will be provided as to what the relevant impacting factors were.

**Table 7.2** Additional assessment criteria.

Cumulative impacts		Reversibility of impacts		Potential for resource loss	
none expected	no	complete	yes	will not take place	no
additive	yes	intermediate	probably	there is a possibility of this happening	probably
interactive countervailing	int cou	not possible	no	this will definitely happen	yes
interactive synergistic	int syn				

Level of confidence	
No uncertainty is associated with the prediction of the impact and all necessary information was available.	definite
The prediction was based on virtually all necessary information being available, with the exception of insignificant information that will not materially affect the outcome of the prediction.	high
Although the majority of the necessary information was available, there is some uncertainty associated with the impact predicted.	medium
There is a high degree of uncertainty associated with the impact predicted as certain key information was unavailable at the time of the prediction.	low

#### 7.4.8 Impact assessment presentation

All relevant impacts on the environment are rated and evaluated as set out in the preceding sections and presented via impact tables. It should be noted that impacts are evaluated after mitigation measures, where relevant and indicated as such in the impact tables, have been taken into account. The project impacts are further subdivided into the following three phases\*, from which impacting activities can be identified (DEAT, 1998):

- construction phase [CP] – all activities on and off site, including the transport of material,
- operational phase [OP] – all activities, including operation and maintenance of structures, and
- decommissioning/rehabilitation (closure) phase [DP] – any activity related to the physical dismantling of the structures and/or restoring of process/mining land to some degree of its former state.

\* note that while planning and design is recognised as a project phase, it is for this project and generally for most projects, of no negative impact significance.

## 8. ENVIRONMENTAL IMPACTS AND MITIGATION

### 8.1 Geology

By the very nature of the activity, mining will impact detrimentally on the physical composition of the environment. The removal of mineralised rock for feed to the iron processing plant will change the geological formation at the mining site permanently. Using a conventional open pit operation, large open pits will be created and pre-stripping of the initial open pit will also require the construction of waste stockpiles. During operation of the proposed mine, barren ore from the iron processing plant will also be stockpiled on the waste stockpiles.

The removal of mineralised rock and changing of the geological composition at the site cannot be mitigated. However, as mining progresses to different sections of the mine, it should be feasible to facilitate backfilling of the waste burden into some of the mined out areas. Rehabilitation of the mined out areas and the stockpile facility will be progressive throughout the life of the mine. Any remaining waste rock stockpiles will be shaped and contoured to blend into the surrounding environment. The environmental impact assessment table for geology is presented below.

<b>Environmental aspect</b>		Geology				<b>Phase</b>	CP/OP/DP
<b>Description:</b> Mining excavation.							
<b>Mitigation:</b> Implementation of a properly engineered rehabilitation strategy, inclusive of backfilling.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	1	4	2	8	42
<b>Potential for irreplaceable loss of resources</b>		yes	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	no

### 8.2 Land use capabilities

Albeit that the proposed mining activity is situated within a national park, the overall area is not pristine as previous mineral exploration, drilling campaigns and mining operations have been undertaken either on or near the proposed project site intermittently during earlier ownerships. However, environmental rehabilitation offers the opportunity to sustain land development and use, and reduces the burden on the taxpayer to fund rehabilitation of abandoned mines (MME, 2002). Rehabilitation based on the *polluter pays principle* should ensure protection of the environment, both during and after mining operations (MME, 2002). The primary objectives for decommissioning and rehabilitation at the Shiyela Iron project will thus be:

- the removal of process facilities and the closure of open pit areas,
- the rehabilitation of stockpile facilities,
- the removal or other disposition of supporting infrastructure such as fences, water supply pipeline (if required for project) and power supply line (if not required for future tourist or other land use in the vicinity),
- the rehabilitation of the landscape to a similar condition as the surrounding areas (note, not to present condition, which reflects adverse impacts due to previous mining and exploration activities), and
- the return of the land for use by tourism or an equivalent use.

The final land use objective should take into account the land capability of the rehabilitated area, and the level of management that will be required to maintain this land use (EPA, 1995b). The environmental impact assessment table for land use capabilities is presented below.



<b>Environmental aspect</b>	Land use capabilities					<b>Phase</b>	CP/OP/DP
<b>Description:</b> Mining operation on project site.							
<b>Mitigation:</b> Implementation of a properly engineered rehabilitation strategy, decommissioning and closure.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	1	2	2	4	20
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

### 8.3 Hydrology

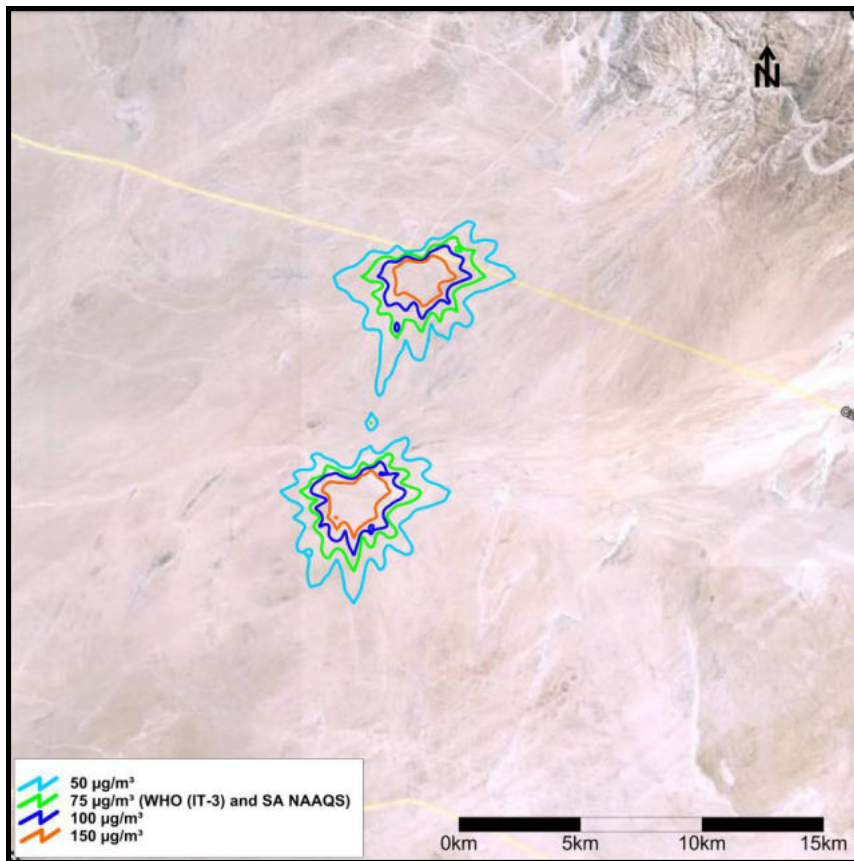
By the very nature of the proposed Shiyela Iron project's location within the Namib Naukluft Park, where water remains a scarce resource, it is of the utmost importance that there are no adverse impacts on groundwater resources in the environment. However, the high salinity groundwater in the project area (see Section 5.6), making the water unusable for human consumption, will be treated to potable water quality for use in the project and thus negate any adverse impacts on the environment. Also, no reagents or chemicals are used in the ore beneficiary process except for possible biodegradable flocculants or flotation media, thus negating adding any additional components to the existing water's composition. However, should water be obtained from sources other than the groundwater available on site, such water use will have a negative impact on the water resources of the region. The environmental impact assessment table for hydrology is presented below.

<b>Environmental aspect</b>	Hydrology					<b>Phase</b>	CP/OP/DP
<b>Description:</b> Surface and groundwater pollution, reduction in usable water sources.							
<b>Mitigation:</b> Using saline groundwater for process requirements and implementing feasible water management policies and processes.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	2	2	4	24
<b>Potential for irreplaceable loss of resources</b>		probably	<b>Cumulative impacts</b>		yes	<b>Reversibility</b>	yes

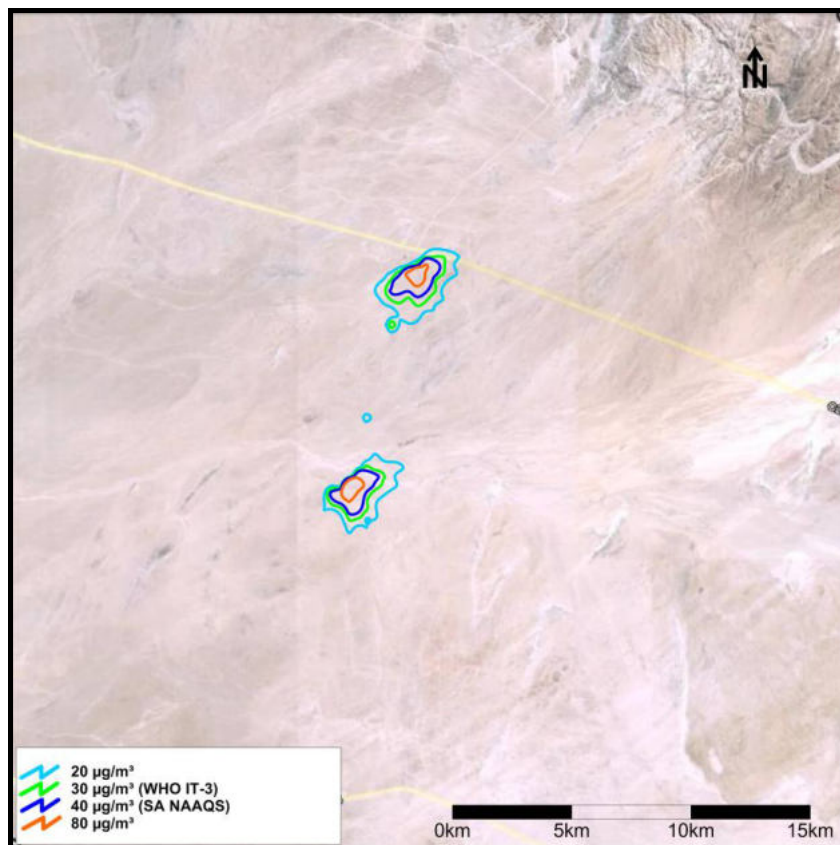
### 8.4 Air quality

Exceedances of the relevant evaluation criteria for average highest daily PM<sub>10</sub> concentrations were predicted at the proposed project site boundary as a result of unmitigated mining operations (without taking background concentrations into consideration). However, the application of suitable mitigation measures to the main contributing sources of PM<sub>10</sub> and total suspended particle (TSP) emissions would result in the reduction of impacts at the proposed project site boundary. With the consideration of background concentrations, exceedances of the relevant evaluation criteria for PM<sub>10</sub> were predicted for all the modelled scenarios. It should be noted that this is primarily due to windblown dust from natural background sources. (Khumalo and Liebenberg-Enslin, 2010)

Dispersion models for the highest daily average predicted PM<sub>10</sub> and average daily predicted PM<sub>10</sub> groundlevel concentrations (in µg/m<sup>3</sup>) for all sources due to mitigated emissions are illustrated in Figures 8.1 and 8.2 respectively (Khumalo and Liebenberg-Enslin, 2010). Detailed mitigation measures are described in Appendix B (Khumalo and Liebenberg-Enslin, 2010). Environmental impact assessment tables for air quality impacts during construction, operational and closure phases are provided below (Khumalo and Liebenberg-Enslin, 2010).



**Figure 8.1** Highest daily average predicted PM<sub>10</sub> groundlevel concentrations (in µg/m<sup>3</sup>) for all sources due to mitigated emissions.



**Figure 8.2** Average daily predicted PM<sub>10</sub> groundlevel concentrations (in µg/m<sup>3</sup>) for all sources due to mitigated emissions.

<b>Environmental aspect</b>	Air quality					<b>Phase</b>	CP
<b>Description:</b> The construction phase will comprise land clearing, site development operations and erecting the associated infrastructure. Each of these activities will have a potential for dust generation.							
<b>Mitigation:</b> General mitigation measures for dust include wet suppression and wind speed reduction.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
low	yes	negative	3	1	2	6	36
<b>Potential for irreplaceable loss of resources</b>		n/a	<b>Cumulative impacts</b>		yes	<b>Reversibility</b>	yes

n/a – not applicable to air quality.

<b>Environmental aspect</b>	Air quality					<b>Phase</b>	OP
<b>Description:</b> The proposed operational phase will include dust generating activities such as excavation, drilling, blasting, materials handling activities, wind erosion of stockpiles, hauling of ore and waste on unpaved roads and crushing and screening.							
<b>Mitigation:</b> General mitigation measures for dust include wet suppression on unpaved roads, materials handling activities and crushing and screening.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
medium	yes	negative	3	3	2	6	48
<b>Potential for irreplaceable loss of resources</b>		n/a	<b>Cumulative impacts</b>		yes	<b>Reversibility</b>	yes

n/a – not applicable to air quality.

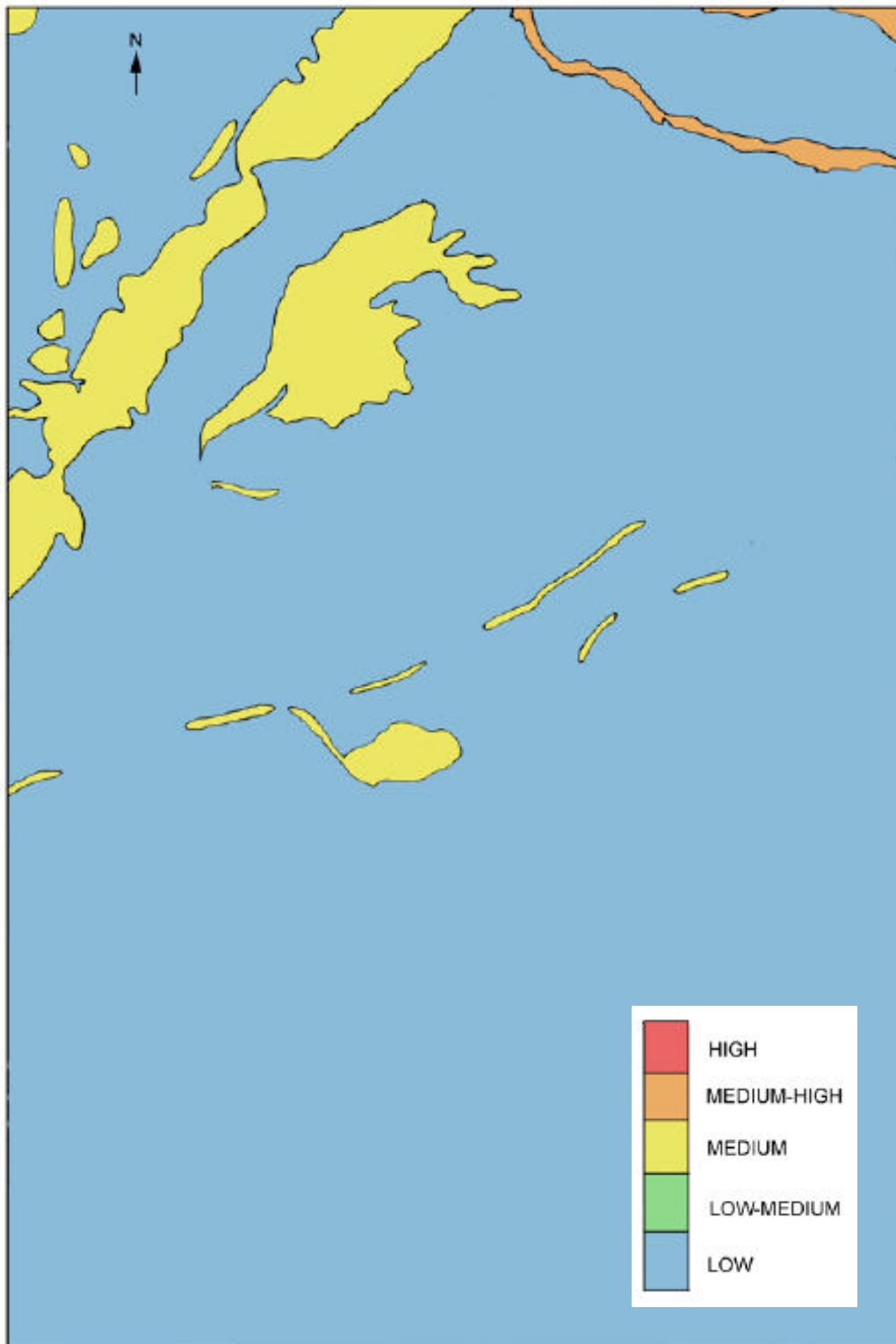
<b>Environmental aspect</b>	Air quality					<b>Phase</b>	DP
<b>Description:</b> The decommissioning/rehabilitation (closure) phase will comprise demolition and rehabilitation activities. Each of these activities has a potential for dust generation.							
<b>Mitigation:</b> General mitigation measures for dust include wet suppression.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
low	yes	positive	3	1	2	6	36
<b>Potential for irreplaceable loss of resources</b>		n/a	<b>Cumulative impacts</b>		yes	<b>Reversibility</b>	yes

n/a – not applicable to air quality.

## 8.5 Natural vegetation

The vegetation types on site were subjectively evaluated in terms of sensitivity and illustrated on a sensitivity map for the Shiyela Iron project's area in Figure 8.3. The following categories of sensitivity were used based on a number of parameters that is, low, low-medium, medium, medium-high and high. Low and low-medium sensitivity means the sensitivity is not significant enough and should not have an influence on the decision about the project. However, any protected trees and other scheduled rare species may not be removed/destroyed without a permit. (Van Rooyen, 2010)

Medium means a sensitivity rating that is real and sufficiently important to require management, for example, management or protection of the rare/threatened flora, protection of the specific habitat on the property and/or rehabilitation. Medium-high means a sensitivity rating where the habitat could be excluded from any development. High means a sensitivity rating that should influence the decision whether or not to proceed with the project. (Van Rooyen, 2010)



**Figure 8.3** Sensitivity map for the Shiyela Iron project area.

Environmental impact assessment tables for impacts on indigenous vegetation during construction, operational and closure phases are provided below. Further impact assessment tables are provided for impacts of vegetation removal through mining on faunal species; mining on ephemeral drainage lines; vehicles, off-road driving and other forms of trampling and compaction on vegetation; alien invasive vegetation; loss of topsoil; and dust levels on vegetation in Appendix D. Detailed rehabilitation measures are also presented in Appendix D. (Van Rooyen, 2010)



<b>Environmental aspect</b>	Natural vegetation	<b>Phase</b>	CP				
<b>Description:</b> Indigenous vegetation/plant communities.							
<b>Mitigation:</b> The prominent rocky ridges, rocky outcrops, inselbergs and main watercourses should not form part of any mining activities and should be regarded as no-go areas. Besides the no-go option, the next option is to identify particularly valuable plant species and to try to avoid areas in which they occur, for example, <i>Welwitschia mirabilis</i> and significant lichen fields. Protected plant species may not be removed or damaged without permits issued by the relevant authorities. Other aspects are provided in Appendix D.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
medium	yes	negative	1	4	3	6	48
<b>Potential for irreplaceable loss of resources</b>		yes	Cumulative impacts		yes	Reversibility	no

<b>Environmental aspect</b>	Natural vegetation	<b>Phase</b>	OP				
<b>Description:</b> Indigenous vegetation/plant communities.							
<b>Mitigation:</b> The prominent rocky ridges, rocky outcrops, inselbergs and main watercourses should not form part of any mining activities and should be regarded as no-go areas. Besides the no-go option, the next option is to identify particularly valuable plant species and to try to avoid areas in which they occur, for example, <i>Welwitschia mirabilis</i> and significant lichen fields. Protected plant species may not be removed or damaged without permits issued by the relevant authorities. Other aspects are provided in Appendix D.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	1	4	4	6	54
<b>Potential for irreplaceable loss of resources</b>		yes	Cumulative impacts		yes	Reversibility	no

<b>Environmental aspect</b>	Natural vegetation	<b>Phase</b>	DP				
<b>Description:</b> Indigenous vegetation/plant communities.							
<b>Mitigation:</b> The prominent rocky ridges, rocky outcrops, inselbergs and main watercourses should not form part of any mining activities and should be regarded as no-go areas. Rehabilitation should be initiated from the start of the mining operations. It should include aspects such as landscaping to recreate the original habitat, dressing with topsoil, re-seeding and transplanting if possible. Other aspects are provided in Appendix D.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
medium	yes	positive	1	3	2	4	24
<b>Potential for irreplaceable loss of resources</b>		no	Cumulative impacts		yes	Reversibility	probable

\* shading indicates inversion due to positive nature.

## 8.6 Animal life

All developments either change or are destructive to the local fauna to some or other degree. Assessing potential impacts is occasionally obvious, but more often difficult to predict accurately. Such predictions may change depending on the scope of the development, that is, the development, once initiated, may have a different effect on the fauna as originally predicted. Thus continuing monitoring of such impacts during the development phase(s) is imperative. Faunal loss with the proposed mining development would be localised. Environmental impact assessment tables for the construction, operational and closure phases are provided below, indicating the potential/envisaged impacts expected regarding faunal loss (vertebrate), which is obviously closely linked to habitat destruction. (Cunningham, 2010)

<b>Environmental aspect</b>	Animal life	<b>Phase</b>	CP				
<b>Description:</b> Certain habitats are viewed as sensitive with unique species.							
<b>Mitigation:</b> Sensitive habitats (that is, drainage lines, rocky outcrops/ridges and inselbergs) should be avoided. Off road driving should be prohibited throughout the area. Illegal collection of veld foods, poaching and killing of fauna viewed as dangerous, for example, snakes and carnivores, should be prohibited. Destruction of habitat, for example, larger trees, should be avoided.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	2	2	4	24
<b>Potential for irreplaceable loss of resources</b>		yes	<b>Cumulative impacts</b>		yes	<b>Reversibility</b>	probably

<b>Environmental aspect</b>	Animal life	<b>Phase</b>	OP				
<b>Description:</b> Certain habitats are viewed as sensitive with unique species.							
<b>Mitigation:</b> Sensitive habitats (that is, drainage lines, rocky outcrops/ridges and inselbergs) should be avoided. Off road driving should be prohibited throughout the area. Illegal collection of veld foods, poaching and killing of fauna viewed as dangerous, for example, snakes and carnivores, should be prohibited. Destruction of habitat, for example, larger trees, should be avoided.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	3	2	4	28
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

<b>Environmental aspect</b>	Animal life	<b>Phase</b>	DP				
<b>Description:</b> Certain habitats are viewed as sensitive with unique species.							
<b>Mitigation:</b> Recreate habitats that are favourable to unique species should these have been damaged and/or destroyed during the construction and operational phases, that is, replant vegetation to recreate the original habitat to lure species (colonisers).							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	positive	1	3	3	4	28*
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

\* shading indicates inversion due to positive nature.

Environmental impact assessment tables for impacts on invertebrate habitats by footprint of the project area during construction and operational phases are provided below. Further impact assessment tables are provided for impacts on invertebrate habitats due to water extraction, due to disruption of surface water flow, due to discharge to groundwater, due to dust and on invertebrate populations due to habitat fragmentation in Appendix F. Detailed mitigation measures are also presented in Appendix F (Irish and Scholtz, 2011).

### 8.7 Archaeological, heritage and cultural impacts

For the impact assessment methodology used in assessing impacts relating to archaeological aspects, the construction phase of the project is taken to include the on-going exploration programme. Confidence levels for the assessment are high because the assessment is focused on specific exploration targets. The results indicate that mitigation will be required to offset negative impacts, although these will have a local or site specific extent. The duration and intensity of these impacts will be high, due to the fact that archaeological sites are sensitive and damage to the archaeological record cannot be reversed.

<b>Environmental aspect</b>	Invertebrates					<b>Phase</b>	CP
<b>Description:</b> Disruption and destruction of invertebrate habitats by the footprint of the project. (Further detail provided in Appendix F.)							
<b>Mitigation:</b> Avoid no-go and highly sensitive habitats as far as possible. Design footprints of all facilities to be as small as possible and to restrict unnecessary collateral damage around the periphery. Other aspects are provided in Appendix F.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	3	4	3	6	60
<b>Potential for irreplaceable loss of resources</b>		yes	Cumulative impacts		int syn	Reversibility	probably

<b>Environmental aspect</b>	Invertebrates					<b>Phase</b>	OP
<b>Description:</b> Disruption and destruction of invertebrate habitats by the footprint of the project. (Further detail provided in Appendix F.)							
<b>Mitigation:</b> Avoid no-go and highly sensitive habitats as far as possible. Design footprints of all facilities to be as small as possible and to restrict unnecessary collateral damage around the periphery. Other aspects are provided in Appendix F.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	3	4	3	6	60
<b>Potential for irreplaceable loss of resources</b>		yes	Cumulative impacts		int syn	Reversibility	no

The significance of the impacts is considered to be relatively low, although it will lead to an irreplaceable loss. For present purposes, the operation and decommissioning (closure) phases of the project are treated as having the same impacts (unaltered) as the construction phase. This view is based on impacts on archaeological sites tend to continue on mining properties during the operational phase, so this is taken as a precautionary principle. Also, decommissioning phases normally include landscape scale rehabilitation, which has a very high potential for negative archaeological impact in the Namib. (Kinahan, 2010)

<b>Environmental aspect</b>	Archaeological, heritage and cultural					<b>Phase</b>	CP/OP/DP
<b>Description:</b> Recognised archaeological and related sites.							
<b>Mitigation:</b> A number of archaeological sites are directly vulnerable to encroachment or damage as a result of their close proximity to access routes and work areas. More detail provided in Appendix G.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2*	4*	3*	4*	25*
<b>Potential for irreplaceable loss of resources</b>		yes*	Cumulative impacts		yes	Reversibility	no*

\* colours and value (significance) adjusted by specialist and presented as such.

## 8.8 Sensitive landscapes and visual impacts

The degree to which an activity adversely affects the visual quality of a landscape depends upon the amount of visual contrast that is created between the activity and the existing landscape character. The amount of contrast and the degree of visual dominance of a proposed activity in the landscape can be measured by predicting the magnitude of change in each of the basic visual elements (scale, colour, line, form, texture, space) in the landscape.

Together with the overall landscape alteration, the visual changes introduced by separate components of the proposed activity (land and water surfaces, vegetation and structures) can be measured in terms of the basic elements. (Smardon, 1979)

Assessing the amount of contrast for a proposed activity in this manner will indicate the severity of its visual impact (Smardon, 1979). The severity of visual impact of an activity depends upon (Smardon, 1979):

- visual contrast - the difference in appearance between two (or more) elements and/or an element and its background (Smardon *et al.*, 1988);
- visual dominance – that visual object(s) that exerts the greatest influence on the visual character of the landscape (Smardon *et al.*, 1988); and
- relative importance of its elements – severe impacts may occur where important elements are altered or where a new important element is added (Smardon, 1979).

In the case of the Shiyela Iron project access to the proposed mining area will be from the C14 road to the south, via an existing approved park track (see Figure 8.4). The track runs north from the C14 road, over a ridge to the Shiyela Iron proposed mining area. As can be seen from Figure 8.5, the view from behind the ridge, and the relevant distance away from the C14 road will result in the actual proposed siting of the plant and office building infrastructure will be such that it will not be clearly visible from outside of the mining area. However, during night time fugitive light could be noticeable to those travelling the C14 road. The environmental impact assessment table for sensitive landscapes and visual impacts is presented below.

<b>Environmental aspect</b>		Sensitive landscapes and visual impacts				<b>Phase</b>	CP/OP
<b>Description:</b> Impact on sensitive landscapes and visual impacts during construction and operational activities of the proposed activity.							
<b>Mitigation:</b> Development should take place behind the ridge north of the C14 road and additional screening implemented, if need be, to ensure no direct line of sight of mining activity from the C14 road.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	possibly	negative	2	3	2	4	28
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

### 8.9 Noise

During construction the predominant source of noise will be from, *inter alia*, trucks, diesel powered plant, drilling and grinding. Blasting will also take place during construction. The impacts from noise will be limited, predominantly due to the absence of any receptors within the vicinity of the site. There will be a slight effect on the fauna that will likely move out of the immediate vicinity. General vehicle and people activity will probably have a greater effect in this regard than noise alone. Consequently, the severity is considered moderate with low significance. (Cornelissen, 2010)

During operation the predominant continuous noise source will be from haul trucks and components of the process plant such as crushers and mills. Blasting will also have a substantial noise effect, particularly when shallow, before containment by the pit, but will be of a short duration and therefore more limited impact. Vibrations from blasting may also affect nearby receptors but there should be very little chance of structural damage being caused. As with construction, the impacts from noise will be limited, predominantly due to the absence of any receptors within the vicinity of the site. Once again, there will be a slight effect on the fauna that will likely move out of the immediate vicinity. General activity will probably have a greater effect in this regard than noise alone. The severity is considered moderate with medium significance. (Cornelissen, 2010)





**Figure 8.4** Entrance to Shiyela Iron project from Road C14, showing existing approved park track and continuing over ridge in background.



**Figure 8.5** View south in direction of Road C14.

Decommissioning noise sources will be similar to construction with heavy diesel equipment, grinders, pneumatic hammers and trucks generating most of the noise. As for construction and operation, general activity will have a greater effect than noise on fauna movement and the absence of receptors will reduce the severity of the impact. Consequently, the severity is considered medium to low with moderate significance. Environmental impact assessment tables for the construction, operational and closure phases are provided below, indicating the potential/envisaged impacts expected from noise. (Cornelissen, 2010)

<b>Environmental aspect</b>	Noise impacts					<b>Phase</b>	CP
<b>Description:</b> Adverse noise levels due to construction activities.							
<b>Mitigation:</b> Make use of noise abatement technologies where feasible. Select equipment with low sound power level rating and ensure it is well maintained. Limit loud activities to daylight hours as far as possible. Implement a noise monitoring programme coupled to a grievance procedure.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	1	2	4	20
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

<b>Environmental aspect</b>	Noise impacts - blasting					<b>Phase</b>	OP
<b>Description:</b> Adverse noise levels due to operational activities - blasting.							
<b>Mitigation:</b> Restrict blasting to daylight hours.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	1	2	4	20
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

<b>Environmental aspect</b>	Noise impacts - trucks					<b>Phase</b>	OP
<b>Description:</b> Adverse noise levels due to operational activities - trucks.							
<b>Mitigation:</b> Select vehicles with low sound power level rating, adequate exhaust silencers and ensure they are well maintained.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	2	2	4	24
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

<b>Environmental aspect</b>	Noise impacts – process plant					<b>Phase</b>	OP
<b>Description:</b> Adverse noise levels due to operational activities – process plant.							
<b>Mitigation:</b> Make use of noise abatement technologies where feasible. Select equipment with low sound power level rating and ensure it is well maintained. Ensure rollers used for conveyor systems are machined for optimum roundness. Limit loud activities to daylight hours as far as possible. Continue noise monitoring programme coupled to a grievance procedure.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	2	2	4	24
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

<b>Environmental aspect</b>	Noise impacts					<b>Phase</b>	DP
<b>Description:</b> Adverse noise levels due to decommissioning activities.							
<b>Mitigation:</b> Make use of noise abatement technologies where feasible. Select equipment with low sound power level rating and ensure it is well maintained. Limit loud activities to daylight hours as far as possible. Continue noise monitoring programme coupled to a grievance procedure.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	negative	2	1	1	4	16
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		no	<b>Reversibility</b>	yes

### 8.10 Social and economic environment

The impact of the proposed mining operation will be positive by creating approximately 150 new job opportunities in the region. The majority of these jobs will be filled by people recruited from the Swakopmund/Walvis Bay and surrounding area. During the construction phase it is estimated that the total workforce will peak at between 500 and 1,000 workers. With an average of 15.3% of the population in the Erongo region living in poverty, the advent of new job opportunities in the region will result in the social upliftment of many households. Naturally the advent of new job opportunities will also result in the migration of many people from other regions. This could negatively impact on the present opportunities available for local residents in the region.

Apart from providing new job opportunities in the region, RUN also intends participating in various social upliftment programmes. These will include distribution of information on environmental issues at the proposed visitor's centre and assisting in educational programmes within the region. Regular meetings with interested and affected parties with regard the proposed mining operation and associated (environmental) impacts will also be conducted on a quarterly basis prior to operation of the proposed mine, thereafter on at least an annual basis. The full operation of the proposed mine will have a significant economic impact on both regional and national levels. Recent estimates indicate that, when fully operational, direct and indirect taxes to the Namibian government will be in the order of N\$ 370 million per year. Although most of the direct employment effects will take place in the mining industry, the multiplier effect will result in job creation effects in areas such as transport, equipment manufacturing and personal services.

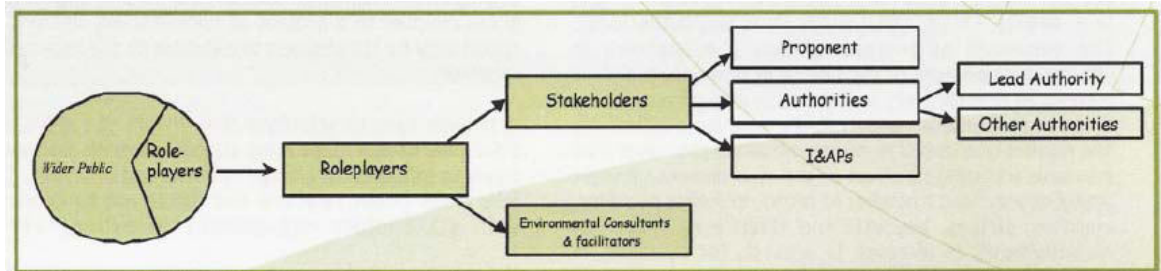
During the operational life of the mine, especially during the construction phase, the economic impact on the region and at national level will be positive. However, when the mine closes, the resultant loss in employment opportunities will have a negative effect on the region and the country as a whole. To address this impact it is proposed to notify relevant stakeholders three years in advance of mine closure. This should assist in negating the mainly negative economic impact during the decommissioning phase and eventual closure of the mine. The environmental impact assessment table for social and economic impacts is presented below.

<b>Environmental aspect</b>	Social and economic impacts					<b>Phase</b>	CP/OP/DP
<b>Description:</b> Increased employment opportunities and increased government revenues and local business community multiplier spinoffs.							
<b>Mitigation:</b> None.							
Confidence level	Mitigation required	Evaluation of impacts					
		Nature	Extent	Duration	Intensity	Probability	Significance
high	yes	positive	3	3	1	4	28*
<b>Potential for irreplaceable loss of resources</b>		no	<b>Cumulative impacts</b>		yes	<b>Reversibility</b>	n/a

\* shading indicates inversion due to positive nature.

## 9. PUBLIC PARTICIPATION PROCESS

In terms of Section 26(1)(h) of the draft EA regulations (MET, 2009) it is a requirement to provide details of the public participation process conducted in accordance with Section 32 of the draft EA regulations. Although the term stakeholder engagement is gaining acceptance worldwide as a replacement for the term public participation (DEAT, 2002), this is still the terminology used within the draft EA regulations and will be utilised throughout the report where relevant. Clarification of the term public versus stakeholder is provided in Figure 9.1 (DEAT, 2002).



**Figure 9.1** Clarification of the term "public" versus "stakeholder".

Public participation forms an integral part of any present day environmental assessment process. The objectives of public participation can be summarised as follows (Lakhani, 2000):

- informing stakeholders;
- presentation of views, concerns and values;
- maximising benefits and minimising risks;
- influencing project design;
- obtaining local knowledge;
- increasing public confidence;
- better transparency and accountability in decision-making; and
- less conflict (decision-making through consensus).

In order to address these objectives, information exchange meetings were held with the Ministries of Mines and Energy (MME) and Environment and Tourism (MET) on 30 November 2009 and on 23 March 2010. During these meetings representatives of Reptile Uranium Namibia and Softchem gave presentations of the proposed activity, and obtained feedback and suggestions from representatives of the MME and MET present at these meetings. Notification letters, minutes (30 November 2009 meeting) and meeting summary (23 March 2010) of these meetings are presented in Appendix I.

In addition to the above, the various other actions required for public participation, in terms of Section 32 of the draft EA regulations, are set out in the following sections.

### 9.1 Notification of potentially interested and affected parties

The requirements for the notification of potentially interested and affected parties of this application are set out in detail in Section 32(2)(b) of the draft EA regulations (MET, 2009). These requirements have been addressed and include, *inter alia*,

- forwarding letters to the owners and occupiers of land adjacent to the site (see Appendix J for copies of these letters);



- forwarding letters to government authorities (see Appendix J for copies of these letters);
- fixing of a notice board at a place conspicuous to the public (DEA, 2010); and
- placing of advertisements in at least one local newspaper (DEA, 2010).

## 9.2 Proof of notice boards and advertisements

Proof of the placement of a notice board (DEA, 2010) is given in Figures 9.2 and 9.3. The advertisements placed in the Republikein newspaper on 10 September 2010, the Namibian newspaper on 13 September 2010, and The Southern Times newspaper on 17 - 23 September 2010 are shown in Figures 9.4, 9.5 and 9.6 respectively.

## 9.3 Register of interested and affected parties

An interested and affected parties register has been opened, as required in terms of Section 33(1) of the draft EA regulations (MET, 2009), and the present edition is presented in Appendix K.

## 9.4 Public participation meetings

Public participation meetings were held in Windhoek on 3 November 2010 and in Swakopmund on 5 November 2010. Proof of the placement of advertisements for these meetings in the Republikein newspaper on 12 October 2010, the Namibian newspaper on 13 October 2010, and The Southern Times newspaper on 15 - 21 October 2010 are shown in Figures 9.7, 9.8 and 9.9 respectively. Attendance lists to these meetings are presented in Appendix K.

## 9.5 Summary of issues raised by interested and affected parties

Written comments on the project were received from interested and affected parties (stakeholders), with the written comments received presented in Appendix L, and a consolidation of stakeholder's feedback and project team responses given in Appendix M.



Figure 9.2 Placement of notice board at entrance to EPL3496.

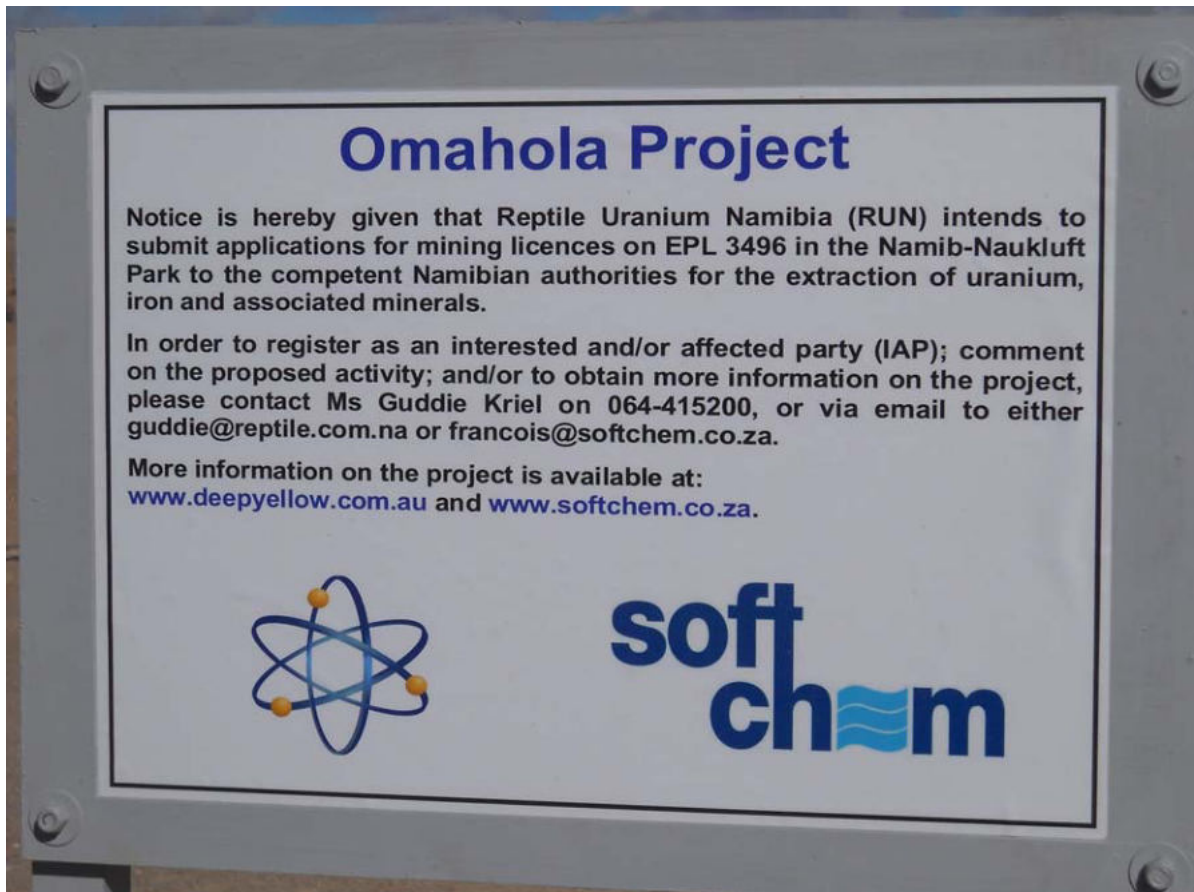


Figure 9.3 Wording on notice board placed at entrance to EPL3496.



Figure 9.4 Advertisement published in the Republikein newspaper on 10 September 2010.



### **Omahola Project**

Notice is hereby given of the intention of Reptile Uranium Namibia (RUN) to submit applications for mining licences on EPL 3496 in the Namib-Naukluft Park to the competent Namibian authorities for the extraction of uranium, iron and associated minerals.

In order to register as an interested and/or affected party (IAP); comment on the proposed activity; and/or to obtain more information, please contact Ms Guddie Kriel at 064-415200, or via email to either [guddie@reptile.com.na](mailto:guddie@reptile.com.na) or [francois@softchem.co.za](mailto:francois@softchem.co.za).

More information on the projects is available on websites [www.deeptyellow.com.au](http://www.deeptyellow.com.au) and [www.softchem.co.za](http://www.softchem.co.za).

### **Omahola Projek**

Kennis word hiermee gegee van die voornemens van Reptile Uranium Namibia (RUN) om aansoek in te dien vir myn lisensies op EPL 3496 in die Namib-Naukluftpark by die bevoegde Namibiese gesag vir die ontginning van uraan, yster en verwante minerale.

Om te registreer as 'n belanghebbende party; en/of enige kommentaar te lewer oor die projek; en/of meer inligting te bekom, kontak asseblief Me Guddie Kriel te 064-415200 of per epos aan [guddie@reptile.com.na](mailto:guddie@reptile.com.na) of [francois@softchem.co.za](mailto:francois@softchem.co.za).

Meer inligting aangaande die projek is beskikbaar vanaf die [www.deeptyellow.com.au](http://www.deeptyellow.com.au) en [www.softchem.co.za](http://www.softchem.co.za) webwerwe.

Figure 9.5 Advertisement published in the Namibian newspaper on 13 September 2010.



### **Omahola Project**

Notice is hereby given of the intention of Reptile Uranium Namibia (RUN) to submit applications for mining licences on EPL 3496 in the Namib-Naukluft Park to the competent Namibian authorities for the extraction of uranium, iron and associated minerals.

In order to register as an interested and/or affected party (IAP); comment on the proposed activity; and/or to obtain more information, please contact Ms Guddie Kriel at 064-415200, or via email to either [guddie@reptile.com.na](mailto:guddie@reptile.com.na) or [francois@softchem.co.za](mailto:francois@softchem.co.za).

More information on the projects is available on websites [www.deeptyellow.com.au](http://www.deeptyellow.com.au) and [www.softchem.co.za](http://www.softchem.co.za).

Figure 9.6 Advertisement published in The Southern Times newspaper on 17 - 23 September 2010.





**OPENBARE  
DEELNEMINGSVERGADERINGS**

Openbare deelnemingsvergaderings vir **Reptile Uranium Namibia (Pty) Ltd** se voorgestelde Omahola projek, geleë omtrent 40 km oos-suidoos vanaf Swakopmund, sal by die volgende plekke gehou word:

**WINDHOEK:**  
Woensdag 3 November 2010  
vanaf 12:00 – 18:00 by die Namibiese Wetenskaplike Vereniging

**SWAKOPMUND:**  
Vrydag 5 November 2010  
vanaf 12:00 – 18:00 by die Uranium Instituut

Die konsep omvangverslag sal vanaf Vrydag 15 Oktober 2010 by die Windhoek, Swakopmund en Walvisbaai publieke biblioteke beskikbaar wees.

Belanghebbende partye word uitgenooi om te registreer by:  
Guddie Kriel te (064) 415 200, of stuur 'n e-pos na [guddie@reptile.com.na](mailto:guddie@reptile.com.na) of [francois@softchem.co.za](mailto:francois@softchem.co.za)

ISSUE 1024884/PR1

**Figure 9.7** Advertisement published in the Republikein newspaper on 12 October 2010.



**PUBLIC PARTICIPATION  
MEETINGS**

Public participation meetings for the Reptile Uranium Namibia (Pty) Ltd's proposed Omahola project, located approximately 40 km east-southeast of Swakopmund, will be held at the following venues:

**Windhoek:** Wednesday 3 November 2010 from 12:00 - 18:00 at the Namibian Scientific Society.

**Swakopmund:** Friday 5 November 2010 from 12:00 - 18:00 at the Uranium Institute.

The draft scoping report will be available from Friday 15 October 2010 at the public libraries of Windhoek, Swakopmund and Walvis Bay.

Interested and affected parties are invited to register with:

Guddie Kriel at 064 415 200, or forward an e-mail to [guddie@reptile.com.na](mailto:guddie@reptile.com.na) or [francois@softchem.co.za](mailto:francois@softchem.co.za)

**Figure 9.8** Advertisement published in the Namibian newspaper on 13 October 2010.





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**Figure 9.6** Advertisement published in The Southern Times newspaper on 15 - 21 October 2010.

## 10. HEALTH AND SAFETY

### 10.1 Regulatory framework

Regulatory safety requirements for the project is presently set out in the tenth draft Mine Health and Safety regulations, regulations made under Section 138A of the Minerals (Prospecting and Mining) Act (No 33 of 1992): health and safety of persons employed or otherwise present in or at mines. These regulations shall apply to any mineral licence area in Namibia.

### 10.2 Input of health and safety controls at design stage

RUN intends that, to the maximum practical extend possible, hazards will either be designed-out or minimised at the design stage, rather than controlled by procedures during operation. In the design of the processing plant, review by the environmental and safety personnel/consultants will be a key requirement before design finalisation.

Design criteria adopted for safety will place special emphasis on spillage control by either bunding or cut-off/flow isolation. In terms of normal industrial safety, review of the design will include ease of access, maintenance, operation, operator ergonomics, safety zoning and other potential industrial hazards.

### 10.3 Hazards

Hazards that will be present at the Shiyela Iron mining site and require control will include:

- injuries from slips/trips/falls;
- manual handling injuries (including back injuries);
- entanglement in rotating machinery;
- falls from height (or into holes);
- injuries in use of hand and power tools;
- injuries from uncontrolled release of high-pressure fluids;
- machinery impacts and vehicle accidents;
- electrocution;
- fire, explosion, or burn injuries;
- solvent vapour intoxication; and
- skin damage by chemicals (either immediate or delayed).

A major safety concern at Shiyela Iron, associated with all remote sites, is the risk of vehicle accidents on gravel roads, with long travel distances to nearby facilities, and the likely presence of animals. RUN personnel will be instructed to allow adequate time for any trip, always to carry water, and to stop and rest periodically. Driving at night is to be undertaken only with extreme caution, and RUN will limit the necessity for travel at night. All travel off-site, as part of operations, will require formal approval and a log will be kept.

There is no workplace hazard that cannot be adequately controlled by either:

- physical design (including shields, guarding, or interlocks);
- operating procedures (for example, registers, logbooks and work permits);
- personal protective gear (for example, hardhats, gloves, goggles and respiratory equipment); or
- thorough and ongoing safety training and meetings.

RUN will strive to ensure, by employee training and by safety reviews, that all work will take place only after due consideration has been given to the proper control of all work-related hazards. The company will develop a culture of safety within the workforce and then work to maintain that culture through a structured and dynamic programme.

## **10.4 Safety management system**

### **10.4.1 Purpose**

At RUN formal systems and documentation will be put in place as part of the safety management system (SMS) to ensure:

- a safe work environment;
- safe systems of work;
- safe plant and equipment; and
- the availability of such information, instruction, and training as required to be able to work safely.

### **10.4.2 Training**

There will be a safety induction for all employees, whether directly employed or employed via contractors; with tests, reviews and ongoing safety education and discussion meetings, held on a regular basis, and formally minuted. Mandatory safety inductions will also be implemented for all visitors to the proposed mining site.

### **10.4.3 Ongoing safety reviews/audits**

A basic methodology for promoting a safe workplace and operation is to require regular safety reviews or audits. These reviews/audits will be scheduled on a yearly basis, typically on an employee's return from annual leave.

### **10.4.4 Formalisation of procedures**

Safety management procedures will include formal inspections, review of identified hazards and selection of control requirements, review of any accidents and near-misses, regular formal safety reviews and planning meetings. Active involvement of personnel (in the establishment, enforcement and review of these procedures) will ensure buy-in with the company's safety management system.

### **10.4.5 Management of chemicals**

All hazardous chemicals to be used on site will have material safety datasheets (MSDSs) collated and readily available. Chemicals will not be chosen for use until after health and safety reviews, consideration of alternatives, and identification of methods of hazard control. Chemical hazards training will be an integral part of safety training and induction. Procedures will be developed for use and handling of all dangerous chemicals. There will be proper personal protective equipment supplied and workers required to wear suitable protective clothing whenever the handling of certain chemicals necessitates such actions.

## 11. DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER

In terms of Section 26(1)(a) of the draft EA regulations (MET, 2009) it is a requirement to provide details of the environmental assessment practitioner (EAP) who prepared the report and the expertise of the EAP to carry out scoping procedures. This is provided in the following sections under general information, experience and related publications.

### 11.1 General information

**Name:** John Francois Curling Friend  
**Education:** BEng (Chem) Pretoria 1986  
MSc (Eng) Cape Town 1991  
Dip MktM IMM 1995  
**Affiliations:** FSAIChE (Fellow, South African Institution of Chemical Engineers)  
FIChemE (Fellow, United Kingdom Institution of Chemical Engineers)  
FWISA (Fellow, Water Institute of South Africa)  
FIWM(SA) (Fellow, Institute of Waste Management of Southern Africa)  
**Registrations:** PrEng (Professional Engineer, Engineering Council of South Africa)  
CEng (Chartered Engineer, United Kingdom Engineering Council)  
**Specialisation:** Water management, treatment and recycling. Air quality and waste management. Environmental management, economics, assessments and auditing. Technical audits and effluent treatment. Specialised computer applications.

### 11.2 Experience

#### **1991 - Present**

Softchem, founder member. Waste management (Eloptro), water management (Sasol Mining and Eskom), water treatment dedicated software (Anglo American Research Laboratories and Veolia Eau in France), functional specifications and operating manuals for water treatment plants (Saldanha Steel as subcontractor to DB Thermal), technical and environmental auditing (Eskom), environmental impact assessments (including public participation meetings) and evaluations (ABI/Coca-Cola, Necsa, Paladin Resources/Langer Heinrich Uranium and Gautrans), environmental management programme report (Eurocoal), environmental consulting and ISO 14001 environmental system implementation (Eskom, Midvaal Water Company and Vametco Alloys).

#### **2005 - Present**

SI Analytics (Pty) Ltd., Director Operations and Projects. Supplying air monitoring equipment to industry and government.

#### **1997 - Present**

Waterops (Pty) Ltd., Director: Operations and Marketing. Water treatment plant operations and troubleshooting, through Thermax representation supply of various chemicals and ion exchange resins.

#### **1998 - 2007**

University of Pretoria, Department of Chemical Engineering, Senior Lecturer. Responsible for the Environmental Engineering Group lecturing environmental engineering and postgraduate courses in environmental management, air quality management, waste management, air pollution control and water management.

#### **1992 - 1998**

Eskom Technical Audit Division, Chief Consultant (Water Management). Project leader for a variety of multi disciplinary audit projects. Environmental management and audits. Water management and treatment. SAATCA registered lead auditor. Chairman Eskom Waste Management Forum. International exposure in water treatment and flue gas desulphurisation through extended overseas visits to Japan, USA, United Kingdom, France and Germany.

#### **1990 - 1992**

Eskom Chemical Engineering Division, Design Engineer. Water management studies at numerous power stations and external to Eskom, eg Soda Ash Botswana. Effluent treatment plant design.



### **1988 - 1990**

Koeberg Nuclear Power Station, Engineer in Training. Water treatment plant operation and troubleshooting, sodium hypochlorite production, sewage treatment and water chlorination plants, ion exchange resins.

### **1985 - 1986**

Eskom Chemical Engineering and Chemistry Division, Engineering Assistant. Air pollution, flue gas desulphurisation processes, boiler acid cleaning. (National military service: 1986 - 1988).

## **11.3 Related publications\***

**BARNARD D, BARNARD C, FRIEND JFC and VISSER D (2003)** *Roadmap to environmental legislation*. Impact Books, Pretoria, South Africa. ISBN 0-620-31028-6.

**BARNARD D, BARNARD C, FRIEND JFC and VISSER D (2005)** *Roadmap to environmental legislation - Edition 2*. Impact Books, Pretoria, South Africa. ISBN 0-620-31028-6.

**BARNARD D, FRIEND JFC, BARNARD C and VISSER D (2006)** *Roadmap to environmental legislation - Edition 3*. Impact Books, Pretoria, South Africa. ISBN 0-620-37673-2.

**CAWOOD BL and FRIEND JFC (2005)** Evaluation of 38 years of radiological environmental data for the nuclear research facility in South Africa. *Journal of Environmental Radioactivity*, **79**, 255 - 271.

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**FRIEND JFC (1993)** *Management in a changing environmental sphere*. Technology Leadership Programme dissertation, Eskom, Johannesburg, South Africa.

**FRIEND JFC (1996)** Formulating and developing an environmental auditing system to add value to your business. Paper presented at the *Industrial Waste Management Solutions - 6th Annual Waste Management symposium*, 22 - 23 January 1996, Johannesburg, South Africa.

**FRIEND JFC (1996)** A practical guide to conducting environmental audits. Paper presented at the *Environmental Systems Standards and Auditing conference*, 20 - 21 May 1996, Johannesburg, South Africa.

**FRIEND JFC (1997)** Environmental audit - process and methodology. Paper presented at the *Conducting and Managing Environmental Audits conference*, 23 - 24 October 1997, Johannesburg, South Africa.

**FRIEND JFC (2001)** Possible solutions to the challenges facing environmental management in a first/third world developing country. Paper presented at the *6th World Congress of Chemical Engineering*, 23 - 27 September 2001, Melbourne, Australia. [Conference proceedings ISBN 0 7340 2201 8.]

**FRIEND JFC (2003)** The Blue Model, education and effective environmental management in South Africa. Paper presented at the *Building Capacity for Impact Assessment, 23rd International Association for Impact Assessment (IAIA) conference*, 17 - 20 June 2003, Marrakech, Morocco.

**FRIEND JFC (2003)** Water balances - an essential environmental tool for power stations. Paper presented at the *CHEMECA 2003, 31st Australasian Chemical Engineering conference*, 28 September - 1 October 2003, Adelaide, Australia. [Conference proceedings ISBN 0 86396 829 5.]

**FRIEND JFC (2003)** *Environmental management in South Africa: the Blue Model*. Impact Books, Pretoria, South Africa. ISBN 0-620-31258-0.

**FRIEND JFC (2004)** Practical implementation of environmental legislation in a first/third world country. Paper presented at the *24th International Association for Impact Assessment (IAIA) conference*, 24 - 30 April 2004, Vancouver, Canada.

**FRIEND JFC (2005)** Assessment criteria for determining environmental impact significance ratings. Paper presented at the *25th International Association for Impact Assessment (IAIA) conference*, 31 May - 3 June 2005, Boston, United States of America.

**FRIEND JFC (2005)** Selected studies for the proposed establishment of the Zone of Integration residential township. *Softchem confidential report*, No KWPREP/2005/01, December 2005, Johannesburg, South Africa.

**FRIEND JFC (2008)** Environmental and Process Solutions third party hazard classification for Lanxness feasibility study. *Softchem confidential report*, No EPSREP/2008/01, April 2008, Johannesburg, South Africa.

**FRIEND JFC (2011)** Water management and grey water legislation in South Africa. *Softchem information report*, No PUREP/2011/01, 16 May 2011, Johannesburg, South Africa.

**FRIEND JFC (2011)** Eskom Lethabo Power Station sludge characterisation and identification of management options. *Waterops confidential report*, No ELETREP/2011/01, 14 July 2011, Johannesburg, South Africa.

**FRIEND JFC (2011)** Omnia Fertilizer nitric acid cooling tower blowdown economic feasibility report assessment. *Softchem findings report*, No OMREP/2011/01, 1 August 2011, Johannesburg, South Africa.

- FRIEND JFC, BORSHOFF J, PRETORIUS LE, MARSH D, SIEBERT T, SLABBERT J, VAN ROOYEN N, DU TOIT L, KVASNICKA J, SPEISER A, KINAHAN J, POTGIETER F, BUTCHER D and VAN RENSBERG J (2004)** Langer Heinrich Uranium Mine environmental assessment draft report. *Softchem report*, No LHUEA2004.01, October 2004, Johannesburg, South Africa.
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- FRIEND JFC, NELL LR, GOOSEN AJ and CONLIN JB (1997)** An environmental assessment of water management at Eskom coal fired power stations. Paper presented at the *Power Plant and Environment 1997 VGB conference*, 16 - 17 April 1997, Düsseldorf, Germany.
- FRIEND JFC, NELL LR, GOOSEN AJ and CONLIN JB (1998)** An environmental assessment of water management at Eskom coal fired power stations. *VGB PowerTech*, 78(9), 71 - 74.
- FRIEND JFC, PRETORIUS LE, FRIELINGSBORGH K, VERSTER J and DE JAGER C (2010)** Scoping report for the Omahola project. *Softchem public access report*, No RUNSCOREP/2010/01, 11 October 2010, Johannesburg, South Africa.
- FRIEND JFC and VAN GREUNEN L (2005)** Estimation of dust impacts on Karan Beef feedlot due to proposed new coal mine. *Softchem confidential report*, No KARREP/2005/01, November 2005, Johannesburg, South Africa.
- FRIEND JFC and VAN ROOYEN N (2009)** Environmental risk analysis for the NECSA proposed water and effluent infrastructure upgrade. *Softchem public access report*, No EIMSREP/2009/01/R4, June 2009, Johannesburg, South Africa.
- FRIEND JFC, VAN ROOYEN N, JEWASKIEWITZ S and DE JAGER E (2011)** Environmental impact assessment report for the Vlakfontein waste treatment facility. *Softchem public access report*, No WGEIAREP/2011/01, 17 August 2011, Johannesburg, South Africa.
- FRIEND JFC and VAN TONDER H (2007)** GAUTRANS basic assessment report for upgrading of Lynnwood Road. *Gauteng Department of Agriculture, Conservation and Environment public access report*, No GAUT 002/07 - 08/N0242, August 2007, Johannesburg, South Africa.
- FRIEND JFC, VENTER C, POTGIETER F and McGEE D (2003)** NECSA Pelindaba evaluation of the environmental monitoring programme report. *Softchem confidential report*, No NECSA/REP/2003/03, July 2003, Johannesburg, South Africa.
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- MILLS JE, HANSEN AD and FRIEND JFC (2009)** Monitoring black carbon, its role in climate change and air pollution. Paper presented at the *National Association for Clean Air (NACA) conference*, 14 - 16 October 2009, Vanderbijlpark, South Africa.
- PRINSLOO NP, WRAY C and FRIEND JFC (2010)** Air quality impact assessment for the Vlakfontein waste treatment facility. *Softchem public access report*, No WGAIDMREP/2010/01, 24 November 2010, Johannesburg, South Africa.

\* additional publications available from the website [www.softchem.co.za](http://www.softchem.co.za).

## 12. DRAFT ENVIRONMENTAL MANAGEMENT PLAN

In terms of Section 27(o) of the draft EA regulations (MET, 2009) it is a requirement to complete a draft environmental management plan containing the aspects contemplated in Section 28 of the draft EA regulations. This is best utilised and formerly developed by the implementation of an environmental management system.

### 12.1 Environmental management system

RUN will strive to align its environmental management system (EMS) in accordance with the ISO 14001:2004 standard (even if not accredited under the standard). ISO 14001 is the world's most recognised EMS framework, enabling organisations to demonstrate sound environmental management by minimising harmful effects on the environment and achieving continual improvement through a formal environmental management system, which is subject to external audit verification.

### 12.2 Development of the environmental management system

In order to address all relevant environmental impacts and to assist in the development of a practical environmental management plan, RUN will implement the following four level documented environmental management system:

- Level 1* - this level of documentation will consist of the company's environmental policy and the environmental management system manual (roadmap to the complete EMS);
- Level 2* - environmental specific and company related documentation;
- Level 3* - environmental and related registers and activity specific work instructions; and
- Level 4* - records (for example, analyses and monthend reports) and related documentation (for example, feedback reports to authorities, management reviews and audit reports).

The following four EMS procedures will be developed, approved, authorised and implemented at the proposed mining site (ISO 14001, 2004):

- *Environmental policy and management review procedure;*
- *Environmental management system planning procedure* (addressing environmental aspects; legal and other requirements; and objectives, targets and programmes);
- *Environmental management system implementation and operation procedure* (addressing resources, roles, responsibility and authority; competency, training and awareness; communication; documentation; control of documents; operational control; and emergency preparedness and response); and
- *Environmental management system checking procedure* (addressing monitoring and measurement; evaluation of compliance; nonconformity, corrective and preventive action; control of records; and internal audit).

The following Level 3 documents are, *inter alia*, envisaged for the proposed mining site, for ISO 14001 alignment:

- environmental aspects and impacts register,
- environmental legal register,
- environmental objectives, targets and programme,
- environmental training register,
- environmental complaints register, and
- EMS audit schedule.

The company will strive to have the proposed environmental management system, with related documentation and practical requirements, implemented during/prior to the construction phase of the proposed project.

### **12.3 Development of the draft environmental management plan**

The environmental impacts identified in Section 8, proposed measures for mitigation of these impacts, monitoring actions and methods required for implementation of these mitigated measures, responsibilities and resources required for implementation form the basis of compiling a suitable draft environmental management plan in terms of the requirements stipulated by Section 28 of the draft EA regulations. The required draft environmental management plan is set out in Appendix N.



## 13. SPECIFIC INFORMATION REQUIRED BY COMPETENT AUTHORITY

### 13.1 Assumptions and uncertainties

In terms of Section 27(l) of the draft EA regulations (MET, 2009) it is required to give a description of any assumptions, uncertainties and gaps in knowledge encountered in the completion of this environmental impact assessment report. These were all addressed in individual specialist reports presented in the attached Appendices B to H, and where relevant, in Sections 3, 5 and 8 of this EIA report.

### 13.2 Reasoned opinion

It is the reasoned opinion of the EAP that compiled this report, based on his professional qualifications and experience, that the proposed activity be authorised. As further requested in Section 27(l) of the draft EA regulations for stipulating any conditions that should be made in respect of such an authorisation, no further conditions are prescribed apart from the recommended mitigation measures stated in Section 8 of this report and relevant specialist reports in Appendices B to H.

### 13.3 Irrevocable financial grantee (guarantee)

In terms of Section 27(p) of the draft EA regulations an applicant must provide an independently managed and irrevocable financial grantee as security for rehabilitation, decommissioning or reclamation measures with respect to a proposed activity (MET, 2009). Such financial grantee must be in accordance either to Section 30(1) of the draft EA regulations for a new application, or to Section 30(2) if already in existence before commencement of the draft EA regulations. As the draft EA regulations have not yet been implemented, Section 30(2) will be relevant for this application and in order to address the relevant requirements of Section 30(2), the applicant (RUN) has drafted the following:

*Reptile Uranium Namibia (Proprietary) (Limited) (RUN) is aware of its moral and legal responsibilities regarding the environment and rehabilitation guarantees. When granted a mining licence (ML) or licences, RUN will, in terms of the specified conditions, establish an environmental trust fund for the purpose of funding environmental rehabilitation and aftercare. This trust fund will be known as the Reptile Uranium Environmental Trust Fund (the Trust).*

*Under current Namibian legislation no particular legal framework (or benchmark) exists to determine environmental rehabilitation obligations and/or the type of resources the ML holder must make provision for, to meet such potential future environmental obligations. Clearly it is no longer prudent to make provision for future environmental rehabilitation in the RUN financial statements only.*

*The purpose of the Trust will be to meet RUN's environmental and associated financial obligations as a ML holder. The proposed structure of the Trust is detailed as follows:*

- RUN and its Australian and Namibian listed parent company, Deep Yellow Limited (DYL), respectively as founder and co-founder, will establish the Trust.*
- The sole beneficiary of the Trust will be RUN with the objective to ensure that RUN is in a position to meet its legal environmental obligations in Namibia.*
- The agreement between the Trust and RUN will make provision for the Trust to call on RUN to provide funds for environmental rehabilitation and aftercare.*
- DYL will support RUN's obligations with an appropriate parent company guarantee.*
- DYL's obligations will be secured by respective floating charges registered under Australian legislation.*
- The securities or assets held by the Trust will be adjusted from time to time and independently determined in accordance with the required environmental rehabilitation and aftercare costs.*

### 13.4 Other matters

Copies of specialist reports, completed in terms of this environmental impact assessment, are attached in Appendices B to H, as required by Section 27(q) of the draft EA regulations.

At this stage no other specific information is required by the relevant authority, as requested by Section 27(r) of the draft EA regulations.

### 13.5 Environmental impact statement

This proposed activity envisaged the design, construction and operation of an iron ore facility in EPL 3496. Key findings from the EIA include, *inter alia*, the following:

- extensive drilling on the Shiyela Iron project area indicate wide high-grade concentrations of magnetite that could sustain a large open-pit mining operation if continuity along strike is persistent;
- Namibia presently is a net importer of raw iron ore and supplying the requirements of Rössing and that of any other consumers of imported iron will save on foreign exchange;
- creation of new job opportunities;
- the full operation of the proposed mine will have a significant economic impact on both regional and national levels, with recent estimates indicating that, when fully operational, direct and indirect taxes to the Namibian government will be in the order of N\$ 370 million per year;
- although most of the direct employment effects will take place in the mining industry, the multiplier effect will result in job creation effects in areas such as transport, equipment manufacturing and personal services; and
- albeit that various negative impacts on the environment were identified through extensive specialist studies, none of them represented fatal flaws.

A further requirement of an environmental impact assessment statement in terms of Section 27(n) of the draft EA regulations is to include a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives. The above positive and negative implications of the proposed activity were assessed against various alternatives, inclusive of the no-go alternative, which is the option of not undertaking the proposed activity or any of its alternatives. With all the categorised alternatives, the location (site) alternative normally plays the biggest role in assessment of an activity and its related impacts. However, in the case of mining operations the location is seldom available for alternative selection as the proposed mineral for extraction is by its very nature exactly at a particular selected site. Alternative options were thus evaluated and assessed as part of the overall design of the proposed mining operation, inclusive of alternative extraction methods, relevant processing operations and scheduling and input alternatives. With the major alternative category being that of site (location) alternatives addressed, any other alternative categories (demand, activity, process, scheduling and input) can be suitably managed through mitigation measures to negate major negative implications.

In summary, the activity of mining will always result in some form of negative impact on the environment, whether impacts are mitigated or not. The ideal is to match the environment, social and economic issues to such an extent that the overall outcome of an activity will not result in a combined lesser value for the three issues. The economic benefit and potential social upliftment of the proposed Shiyela Iron project should outweigh the environmental impacts addressed in this report, through the implementation of mitigation measures, to result in an overall positive value for the combined environmental, social and economic issues identified.

## 14. REFERENCES

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