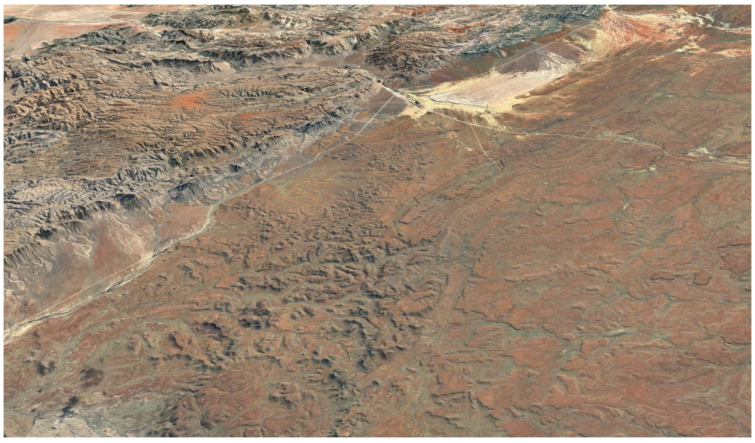
APP - 004526

# ENVIRONMENTAL MANAGEMENT PLAN FOR SCIENTIFIC CORE DRILLING ON FARM KYFFHAUSER, HARDAP REGION

## ENVIRONMENTAL MANAGEMENT PLAN



**Prepared by:**

**Prepared for:**

**Department of Earth Sciences, Faculty of Geosciences, Utrecht University**

September 2024

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|---|---|---|
| **Project:** | **ENVIRONMENTAL MANAGEMENT PLAN FOR SCIENTIFIC CORE DRILLING ON FARM KYFFHAUSER, HARDAP REGION** | |
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| **Report Approval** | **André Faul**<br>**Conservation Ecologist** | |

I Frits Hilgen acting as the Proponent's representative, hereby confirm that the project description contained in this document is a true reflection of the information which the Proponent has provided to Geo Pollution Technologies. All material information in the possession of the proponent that reasonably has or may have the potential of influencing any decision or the objectivity of this management plan is fairly represented in this report.

Signed at Utrecht, the Netherlands on the 24 day of September 2024.

Frits Hilgen
**Name**

**Signature**

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### ABBREVIATIONS

| | |
|---|---|
| **DEA** | Department of Environmental Affairs |
| **CITES** | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| **EMA** | Environmental Management Act |
| **EMP** | Environmental Management Plan |
| **IUCN** | International Union for Conservation of Nature |
| **MAWLR** | Ministry of Agriculture, Water and Land Reform |
| **MEFT** | Ministry of Environment, Forestry and Tourism |
| **MSDS** | Material Safety Data Sheet |
| **NASA** | National Aeronautics and Space Administration |
| **PPE** | Personal Protective Equipment |
| **SANS** | South African National Standards |
| **ECC** | Environmental Clearance Certificate |

# 1 INTRODUCTION

Researchers employed in the Utrectht University's Department of Earth Sciences, Faculty of Geosciences, The Netherlands (the Proponent), aim to perform scientific core drilling in the rocks of the Kuibus Subgroup, of the Nama Group, in the northern part of the Nama Basin (Zaris sub-basin). The scientific drilling is part of an international, multi-year research project in which Utrecht University collaborates with the Canadian universities McGill University, University of Toronto Mississauga and Université du Québec à Montréal. The project aims at drilling one 550 m core on Farm Kyffhauser (FMP/00018/00REM) in the Hardap Region (Figure 1-1). Should this drill target not deliver sufficient results, a second 450 m core will be drilled on Farm Zebra Rivier (FMP/00122). See Figure 1-2 for the locations of the drill targets.

The project aims to understand the role of cyclic climatic changes that result from variations in the Earth's orbit and spin axis, called astronomical climate forcing, in the terminal Ediacaran Period (around 550 million years ago). This time period covers critical evolutionary trends related to the earliest complex life, as well as other major climatic changes such as glaciations and oxygenation. The Nama Group, and in particular the Kuibus Subgroup, displays profound regularity in its weathering profile (i.e. resistant-recessive alternations), which could be an indication for the influence of astronomical climate forcing on its deposition. Fresh rock material from a drill core has the potential to provide high-quality and high-resolution proxy data. This can significantly improve the understanding of the climatic mechanism behind the observed regularity (resistant-recessive alternations). The selected scientific drilling target is the approximately 550 m thick mixed carbonate-siliciclastic sedimentary succession of the Kuibus Subgroup, in the northern Nama Basin.

The scientific team approached Geo Pollution Technologies to prepare an environmental management plan (EMP) as per the recommendations of the Ministry of Mines and Energy. The EMP will aim at prevention and mitigation of potential impacts of the project on the environment. The environment being defined in the Environmental Assessment Policy and Environmental Management Act as "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, paleontological or social values".

The EMP will be used to apply for an environmental clearance certificate (ECC) with the Ministry of Environment, Forestry and Tourism (MEFT) in compliance with Namibia's Environmental Management Act (Act No 7 of 2007) (EMA).

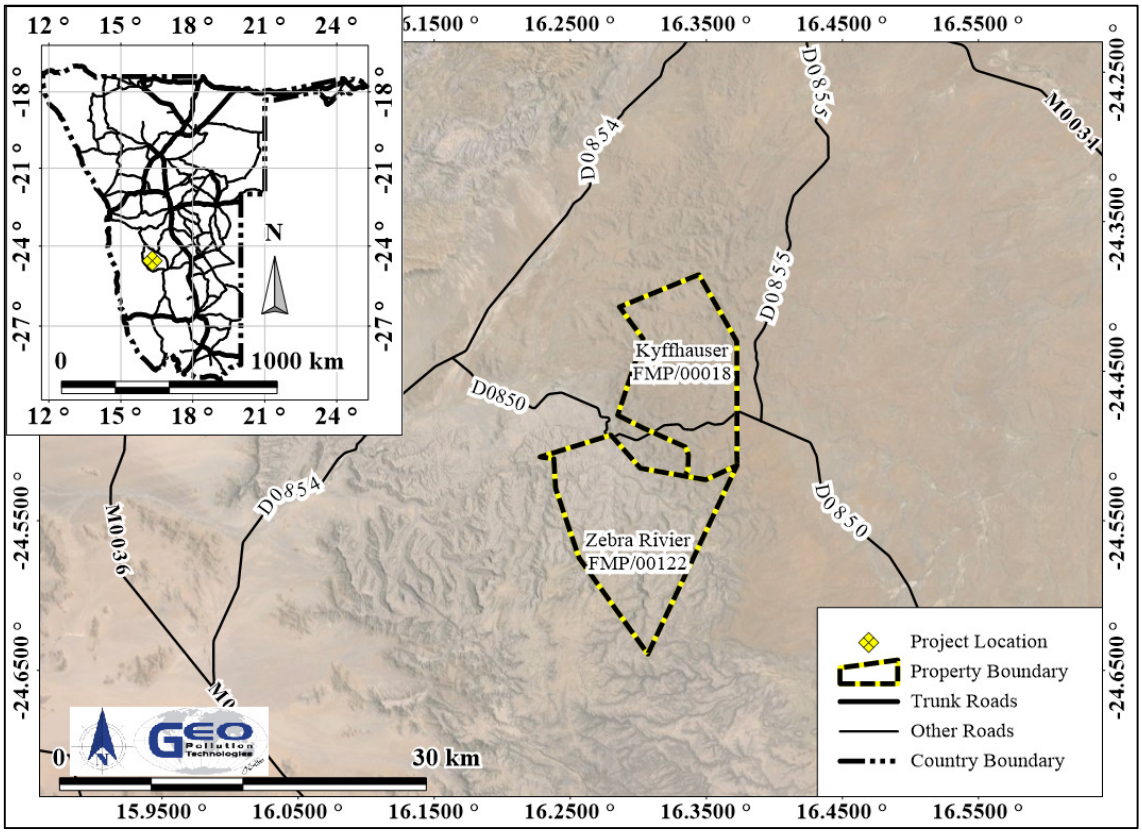


**Figure 1-1 Project location**

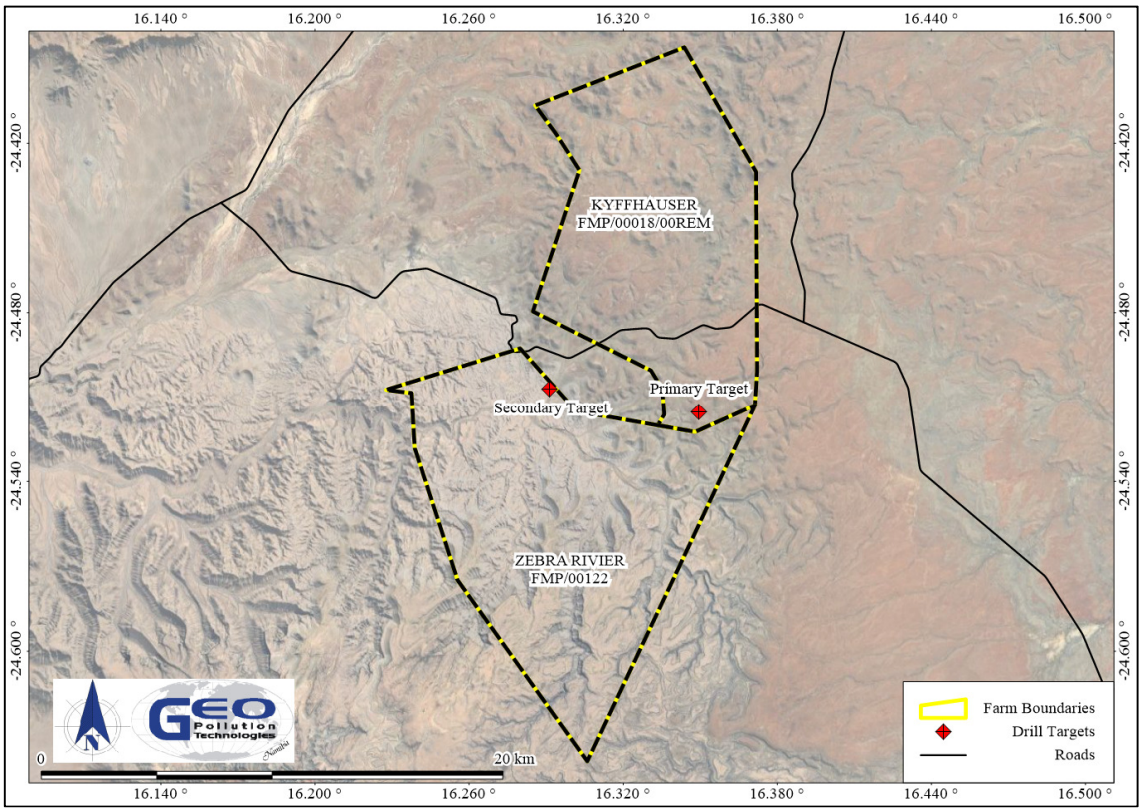


**Figure 1-2 Drill targets**

# 2 SCOPE

The approach of the environmental management plan is to: 1) provide a short project description, 2) provide a legal framework within which the project must be conducted; 3) a short environmental description, based on secondary data related to the proposed drill sites; 4) identify potential environmental impacts emanating from the proposed project; and 5) list possible enhancement measures for positive impacts while preventative / mitigation measures will be provided for negative impacts.

The aims and objectives of this report are to:

1. Determine the potential environmental impacts emanating from the project,
2. Identify a range of management actions which could mitigate the potential adverse impacts to acceptable levels,
3. Comply with the requirements of EMA,
4. Provide sufficient information to the relevant competent authority and MEFT to make an informed decision regarding the project.

# 3 PROJECT ACTIVITIES

It is anticipated that the project will commence in the first quarter of 2025, after an ECC has been issued by the MEFT. Drill locations were chosen based on the understanding of the geology of the area.

## 3.1 MOBILISATION

A local drilling company will be contracted to execute the drilling works. Once all planning and administrative procedures are in place, the drilling contractor will mobilise to the site. This will entail moving a trailer-mounted drilling rig, drilling rods and related equipment, as well as the drilling team, to the drill site on Farm Kyffhauser. The drill target is located near an existing farm road and no road construction will be required. A temporary drilling camp will be established at the drill site, where the drill team and researchers will stay in tents for the duration of the core drilling exercise. Establishment of the drill site may include some land levelling for the drilling pad, laydown area, camp and related facilities. As part of the camp, temporary ablution facilities, consisting of bush showers, basins and pit latrines, will be erected. The location of the ablution facilities will be carefully considered as to avoid potential pollution of water resources, and not to pose any health threats to the drill team and researchers.

Drilling is not expected to utilise drilling mud, but should it become necessary, shallow sumps to collect drilling mud will be excavated near the drill site. If water is not available from a nearby borehole, water for potable and drilling use will be brought in with a 5 $m^3$ tanker truck. A mobile diesel bowser for refuelling of vehicles and equipment will form part of the equipment and resources brought to the site.

## 3.2 DRILLING

Diamond core drilling will be performed as per standard operating procedures. A 550 m deep core, with a diameter of 63.5 mm, will be drilled on Farm Kyffhauser (approximate position:- 24.515200 °S, 16.349527 °E) (Figure 1-2). A meticulous drilling log will be kept for the entire drilling depth. Should drilling mud be used, it will be circulated through sumps for re-use.

Drilling cores will be collected, carefully packaged and labelled. Half of the core will be exported to the Proponent at the Utrecht University, while the remainder will be stored at the Ministry of Mines and Energy of Namibia.

A second drill target has been identified on Farm Zebra Rivier, in case the first target does not produce sufficient results (Figure 1-2). This core will also be 63.5 mm, but will only be to a depth of 450 m.

The mobile diesel bowser will be used for refuelling of vehicles and equipment. During all refuelling processes, or where emergency repairs have to be performed, drip trays will be used to prevent contamination of the environment. Spill kits will at all times be present for any fuel, oil or hydraulic fluid spillages that may occur.

### 3.3 DECOMMISSIONING

Site decommissioning will entail removal of all equipment and waste from the drilling site. If any soil is contaminated with hydrocarbons, such as fuel, oil, grease or hydraulic fluids, it will be collected for safe disposal. Major soil disturbances, such as drilling mud sumps, will be rehabilitated through land levelling and contouring to match that of the surrounding areas.

# 4 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

To protect the environment and achieve sustainable development, all projects, plans, programmes and policies deemed to have adverse impacts on the environment require an environmental assessment, as per the Namibian legislation. The legislation provided in Table 4-1 govern the environmental assessment process in Namibia and/or are relevant to the project.

**Table 4-1 Namibian law applicable to the project**

| Law | Key Aspects |
|---|---|
| **The Namibian Constitution** | ♦ Promotes the welfare of people<br>♦ Incorporates a high level of environmental protection<br>♦ Incorporates international agreements as part of Namibian law |
| **Environmental Management Act**<br>Act No. 7 of 2007, Government Notice No. 232 of 2007 | ♦ Defines the environment<br>♦ Promotes sustainable management of the environment and the use of natural resources<br>♦ Provides a process of assessment and control of activities with possible significant effects on the environment |
| **Environmental Management Act Regulations**<br>Government Notice No. 28-30 of 2012 | ♦ Commencement of the Environmental Management Act<br>♦ Lists activities that requires an environmental clearance certificate<br>♦ Provides environmental impact assessment regulations |
| **Water Resources Management Act**<br>Act No. 11 of 2013 | ♦ Provides for management, protection, development, use and conservation of water resources<br>♦ Prevention of water pollution and assignment of liability<br>♦ Requires authorisation from the Ministry of Agriculture, Water and Land Reform for any drilling activities in Namibia |
| **Forest Act**<br>(Act 12 of 2001, Government Notice No. 248 of 2001) | ♦ Makes provision for the protection of the environment and the control and management of forest fires<br>♦ Provides the licencing and permit conditions for the removal of woody and other vegetation as well as the disturbance and removal of soil from forested areas. |
| **Forest Regulations: Forest Act, 2001**<br>Government Notice No. 170 of 2015 | ♦ Declares protected trees or plants<br>♦ Issuing of permits to remove protected tree and plant species. |
| **Public and Environmental Health Act**<br>Act No. 1 of 2015, Government Notice No. 86 of 2015 | ♦ Provides a framework for a structured more uniform public and environmental health system, and for incidental matters<br>♦ Deals with integrated waste management including waste collection disposal and recycling; waste generation and storage; and sanitation. |

| Law | Key Aspects |
|---|---|
| **Labour Act**<br>Act No 11 of 2007, Government Notice No. 236 of 2007 | ♦ Provides for Labour Law and the protection and safety of employees<br>♦ Labour Act, 1992: Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997) |
| **Petroleum Products and Energy Act**<br>Act No. 13 of 1990, Government Notice No. 45 of 1990 | ♦ Regulates petroleum industry and provides for authorisation to keep fuel volumes in excess of 600 litres in a rural area. |
| **National Heritage Act**<br>Act No.27 of 2004; Government Notice No. 287 of 2004 | ♦ Provides for the protection of all archaeological, and palaeontological objects and meteorites.<br>♦ National Heritage Regulations (Government Notice No 106 of 2005).<br>♦ Provides for permitting and consent in respect of works at or near known (or potentially present) significant archaeological, and palaeontological objects. |
| **Soil Conservation Act**<br>Act No. 76 of 1969 | ♦ Law relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources in Namibia. |
| **Nature Conservation Ordinance**<br>Ordinance No. 4 of 1975 | ♦ Consolidates and amends the laws relating to the conservation of nature and the establishment of game parks and nature reserves.<br>♦ Assigns certain conservation categories to specific organism within Namibia. |
| **Pollution Control and Waste Management Bill (draft document)** | ♦ Not in force yet<br>♦ Provides for prevention and control of pollution and waste<br>♦ Provides for procedures to be followed for licence applications |

# 5 ENVIRONMENTAL CHARACTERISTICS

This section lists pertinent environmental characteristics of the study area and provides a statement on the potential environmental impacts on each.

## 5.1 LOCALITY AND SURROUNDING LAND USE

Both the drill locations are situated on privately owned commercial farms in the Hardap Region. Permission was obtained from all the land owners for the proposed core drilling activities (Appendix A). Surrounding land use all constitute privately owned commercial farms. The Namib Naukluft Park is located approximately 15 km northwest of Farm Kyffhauser.

**Table 5-1 Drill locations**

| Farm Name | District | Ownership | Coordinates |
|---|---|---|---|
| Kyffhauser | Maltahöhe | Private | 24.51520°S ; 16.34953°E |
| Zebra Rivier | Maltahöhe | Private | 24.50714°S ; 16.29140°E |

***Implications and Impacts***

No impact on neighbouring properties are expected as a result of the project as long as staff movement is kept on the relevant property or on the official movement corridor to the property.

## 5.2 BIOPHYSICAL CHARACTERISTICS

A summary of key biophysical characteristics of the general area where the drill targets are located is provided here. Information is based on the Atlas of Namibia digital data collection, unless otherwise specified (Atlas of Namibia Team, 2022).

### 5.2.1 Climate

According to the Köppen-Geiger Climate Classification system the area is a hot desert climate (BWh) (http://koeppen-geiger.vu-wien.ac.at/present.htm). This means that the area receives precipitation well below potential evapotranspiration and no more than 200 mm of precipitation annually, with a mean annual temperature of at least 18 °C.

Average annual rainfall is between 100 and 150 mm. Variation in annual rainfall is high at 60 to 70%. Monthly rainfall peaks in March with the winter months receiving rain only in exceptional circumstances. Actual rainfall measurements taken at the main residence on farm Kyffhauser from 1994 to 2024 corresponds with the Atlas of Namibia data, with a mean annual rainfall of approximately 175 mm/a (http://www.kyffhauser.co.za/weather.htm). During this period the lowest seasonal rainfall was recorded at 36 mm for the 2012/13 season, while the highest rainfall was 519 mm for the 210/11 season. Potential evapotranspiration is 2,200 to 2,300 mm/a. By dividing the mean annual precipitation with the mean annual potential evapotranspiration, an aridity index value of 0.06 is obtained. This confirms the aridity of the area.

At the primary target, the average annual minimum temperature is expected to be less than 2 °C, while the average annual maximum temperature is 26-28 °C. For the secondary target, the average minimum and maximum temperatures are expected to be slightly higher at between 2 and 4 °C and 28 and 30 °C, respectively. The average diurnal temperature (difference between daily minimum and maximum temperature) for both targets is thus between 14 and 16 °C.

Monthly temperature data was retrieved from the Modern-Era Retrospective analysis for Research and Applications version 2 (MERRA-2) data set, at a height of 2 m above surface (Ronald Gelaro, et al., 2017). This data set is a NASA atmospheric reanalysis, incorporating satellite data integration, and aims at historical climate analyses at 0.5 ° × 0.625 ° spatial resolution. Table 5-2 presents the Merra-2 statistics on daily data abstracted from the data set for the last 42 years. The lowest temperature (-2.46°C) over the data period was recorded in August, with, on average, 1 day in July and August respectively, being below freezing point. The maximum temperature of the data period is 41.18 °C which was measured in February. All four months from November to February have maximum temperatures exceeding 40 °C.

**Table 5-2 Temperature statistics based on Merra-2 data**

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimum (°C) | 7 | 9 | 6 | 2 | 1 | -2 | -2 | -2 | -2 | 3 | 2 | 7 |
| Maximum (°C) | 41 | 41 | 39 | 37 | 33 | 30 | 30 | 33 | 37 | 39 | 40 | 40 |
| Average (°C) | 27 | 26 | 25 | 22 | 19 | 15 | 15 | 17 | 20 | 23 | 24 | 26 |
| Diurnal (°C) | 16 | 15 | 15 | 16 | 16 | 16 | 17 | 18 | 19 | 18 | 18 | 18 |
| Average days < 0°C | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |

***Implications and Impacts***

Depending on the time of year drilling is conducted, extreme temperatures may affect the team members. Especially high temperatures and extreme ultraviolet radiation experienced during summer months can lead to dehydration, sunburn and sunstroke.

Flash floods can occur during storm events that do occur occasionally. This can impact the team during mobilisation to site, or if the drill target is close to a watercourse.

### 5.2.2 Ecology

This project area is located in the Nama Karoo biome in an area with a Dwarf shrub savanna vegetation type. According to the Atlas of Namibia (Atlas of Namibia Team, 2022), approximately 122 to 127 plant species occur in the general area of Farms Kyffhauser and Zebra Rivier. However, a photo record of plants occurring on Farm Kyffhauser is maintained by the owners. Based on this record, 360 plant species have been identified on the farm, with varying degrees of certainty, while four species that have not yet been identified to species level are present (http://www.kyffhauser.co.za/speciesABC.htm). This is a significant difference from the Atlas of Namibia data. A list of trees know to occur in the quarter degree square where the drill targets are situated, 2416CB, are presented in Table 5-3 (Curtis and Mannheimer, 2005).

Eighteen endemic plants are expected to occur in the area. Given the difference in the number of plants between the farm owner's own plant database, and that of the Atlas of Namibia, it is highly likely that many more endemic species occur in the project area. Due to the aridity of the area, woody species abundance is low, with between 5 and 10% coverage. Grassland is the main vegetation cover when good rains are received.

Of the 217 species of mammals in Namibia, between 61and 75 species may be encountered in the general area of the farms. Approximately 9 or 10 species of mammals in the area are endemics. Among others, leopards, cheetahs, spotted hyena, brown hyena, kudu, Hartmann's mountain zebra, springbok, klipspringer and aardvark are some of the larger mammals in the area. Between 111 and 140 bird species are expected to occur in the area. The owner of Farm Kyffhauser has a photographic record of 107 bird species in the area (http://www.kyffhauser.co.za/birdstable1.htm).

***Implications and Impacts***

Trees protected by forestry legislation or with other conservation concerns may be impacted on by the movement of machinery and vehicles onto the drill sites or when campsites are constructed. Illegal collection or poaching of plants and animals may occur. Encounters with dangerous or venomous animals like snakes and scorpions may occur. Due to the remote location and distance to the nearest hospital, this pose a risk to team members.

**Table 5-3 Trees know to occur in the quarter degree square 2416CB where the drill targets are located (Curtis & Mannheimer 2005)**

| Name | Common Name | Abundance Category for QDS 2416CB | General Conservation Concerns in Namibia |
|---|---|---|---|
| *Acacia erioloba* | Camel-thorn | Uncommon to Rare | Protected by forestry legislation |
| *Acacia hebeclada* subsp *hebeclada* | Candle-pod Acacia | Occasional | None |
| *Acacia hereroensis* | Mountain-thorn | Uncommon to Rare | None |
| *Acacia karroo* | Sweet-thorn | Occasional | None |
| *Acacia mellifera* subsp *detinens* | Blue-thorn Acacia | Common to Abundant | Aggressive invasive |
| *Acacia nebrownii* | Water-thorn | Common to Abundant | None |
| *Acacia senegal* var *rostrata* | Three-hook Acacia | Uncommon to Rare | None |
| *Acacia tortilis* subsp *heteracantha* | Umbrella-thorn | Occasional | None |
| *Adenolobus garipensis* | Butterfly-leaf | Common to Abundant | None |
| *Albizia anthelmintica* | Worm-cure Albizia; Aru | Occasional | Protected by forestry legislation |
| *Aloe dichotoma* | Quiver Tree | Uncommon to Rare | Assessed as vulnerable according to IUCN criteria. Protected by the Nature Conservation Ordinance and listed as CITES Appendix II species. Protected by forestry legislation. |
| *Amphiasma merenskyanum* | None | Uncommon to Rare | None |
| *Boscia albitrunca* | Shepherd's Tree | Common to Abundant | Protected by forestry legislation |
| *Boscia foetida* subsp *foetida* | Smelly Shepherd's-bush | Common to Abundant | None |
| *Calicorema capitata* | Grey desert bush | Uncommon to Rare | None |
| *Catophractes alexandri* | Trumpet-thorn; Rattlepod | Common to Abundant | Invasive in some areas |
| *Commiphora glaucescens* | Blue-leaved Corkwood | Common to Abundant | None |
| *Cryptolepis decidua* subsp *decidua* | Horn shrub | Common to Abundant | None |
| *Cyphostemma bainesii* | Gouty-Vine | Occasional | Rare and Endemic to Namibia. Protected by Nature Conservation Ordinance. Least concern (IUCN). Potentially threatened by Pachycaul trade. Protected by forestry legislation. |
| *Dichrostachys cinerea* subsp *africana* | Kalahari Christmas Tree; Sickle-bush | Common to Abundant | Of concern because of its effects on other species (invasive) |

| | | | |
|---|---|---|---|
| *Diospyros lycioides* | Bluebush; Monkey plum; Star-apple | Occasional | None |
| *Ehretia alba* | White-puzzle Bush | Occasional | None |
| *Euclea pseudebenus* | Wild Ebony | Common to Abundant | Protected by forestry legislation |
| *Euclea undulata* var *myrtina* | Common Guarri; Mountain Ebony | Occasional | None |
| *Euphorbia avasmontana* | Slender Candelabra-euphorbia | Uncommon to Rare | CITES Appendix II listed |
| *Euphorbia guerichiana* | Paper-bark Euphorbia | Occasional | CITES Appendix II listed |
| *Euphorbia virosa* | Candelabra Euphorbia | Common to Abundant | CITES Appendix II listed |
| *Ficus cordata* subsp *cordata* | Namaqua Rock-fig | Occasional | Protected by forestry legislation |
| *Ficus ilicina* | Rock-splitting Fig | Uncommon to Rare | None |
| *Ficus sycomorus* | Sycamore Fig | Occasional | Protected by forestry legislation |
| *Grewia flava* | Velvet Raisin | Common to Abundant | None |
| *Grewia flavescens* | Sandpaper Raisin | Uncommon to Rare | None |
| *Grewia tenax* var *tenax* | Small-leaved Cross-berry | Occasional | None |
| *Gymnosporia linearis* subsp *lanceolata* | Narrow-leaved Spikethorn | Uncommon to Rare | None |
| *Leucosphaera bainesii* | None | Common to Abundant | None |
| *Lycium bosciifolium* | Limpopo Honey-thorn | Common to Abundant | None |
| *Maerua schinzii* | Ringwood Tree | Occasional | Protected by forestry legislation. |
| *Montinia caryophyllacea* | Wild Clove-bush | Occasional | None |
| *Moringa ovalifolia* | Moringa; Phantom Tree | Uncommon to Rare | Potentially threatened by pachycaul trade. Protected by Nature Conservation Ordinance. Near endemic to Namibia extending into southern Angola. Protected by forestry legislation. |
| *Nymania capensis* | Chinese-lanterns | Occasional | Either overlooked or declined |
| *Ozoroa crassinervia* | Namibian Resin-tree | Common to Abundant | Near-endemic stretching into the Richtersveld. |
| *Parkinsonia africana* | Green-hair Tree | Occasional | None |
| *Pechuel-Loeschea leubnitziae* | Wild sage; Sweat bush; Stink bush | Occasional | None |

| | | | |
|---|---|---|---|
| *Phaeoptilum spinosum* | Brittle-thorn | Common to Abundant | None |
| *Prosopis* spp | Mesquite | Uncommon to Rare | Alien. Invasive in some areas. |
| *Rhigozum trichotomum* | Three-thorn Rhigozum | Common to Abundant | None |
| *Searsia burchellii* | Karoo Kuni-bush | Occasional | Fairly restricted in Namibia. More widespread in South Africa. |
| *Searsia lancea* | Willow Rhus | Occasional | Protected by forestry legislation. Previously *Rhus lancea.* |
| *Searsia marlothii* | Bitter Karee | Occasional | None |
| *Searsia tenuinervis* var *tenuinervis* | Kalahari Currant | Uncommon to Rare | None |
| *Searsia volkii* | Naukluft Rhus | Uncommon to Rare | Endemic and restricted |
| *Ricinus communis* | Castor-oil Bush | Uncommon to Rare | Alien. Should be controlled. |
| *Sarcocaulon marlothii* | Bushman's candle | Occasional | None |
| *Tamarix usneoides* | Wild Tamarisk | Uncommon to Rare | Protected by forestry legislation |
| *Tetragonia schenkii* | None | Uncommon to Rare | None |
| *Withania somnifera* | Winter Cherry; Poisonous Gooseberry; Deadly Nightshade | Common to Abundant | None |
| *Ziziphus mucronata* | Buffalo-thorn | Occasional | Protected by forestry legislation |
| *Zygophyllum microcarpum* | None | Common to Abundant | None |

## 5.3 GROUNDWATER

Borehole data from the MAWLR was utilised to present information on the local groundwater characteristics. The groundwater statistics were compiled for a 5 km radius around the proposed drill sites. Note that some data may not be available for relevant boreholes and that the database is generally outdated. More boreholes might be present.

Statistical grouping of parameters is for ease of interpretation, except for the grouping used for sulphate, nitrate and fluoride, which follow the Namibian guidelines for the evaluation of drinking-water quality for human consumption, with regard to chemical, physical and bacteriological quality. Group A indicates groundwater with excellent quality, Group B groundwater with acceptable quality, Group C groundwater with low health risk and Group D indicating groundwater with a high health risk, or water unsuitable for human consumption.

### 5.3.1 Primary Target

According to the MAWLR borehole database, there are four boreholes within a 5 km radius around the primary drill point at Kyffhauser FMP/00018/00REM. The average groundwater level is 21 m below surface. Chemical data for only one of the four boreholes is available. Total dissolved solids (TDS), sulphate, nitrate and fluoride concentrations of this borehole are classified as Group A. See Table 5-4 and Figure 5-1 for groundwater statistics and quality for the Kyffhauser drill site.

No indication of water quality changes with depth is evident, based on the limited information and limited chemical data from the boreholes. No artesian conditions were noted in the data, but some rise in the water level above the water strike depth is expected.

**Table 5-4. Summary of groundwater statistics for primary target**

| Area of Interest: | Primary Target Groundwater Statistics | | | | | | Query Radius: | 5 km |
|---|---|---|---|---|---|---|---|---|
| | Number of Known Boreholes | DEPTH (mbs) | YIELD ($m^3/h$) | WATER LEVEL (mbs) | TDS (ppm) | SULPHATE (ppm) | NITRATE (ppm) | FLUORIDE (ppm) |
| **Data points** | 4 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| **Minimum** | | 25.60 | 1.60 | 21.00 | 517.00 | 140.00 | 9.20 | 0.40 |
| **Average** | | 44.80 | 1.95 | 21.00 | 517.00 | 140.00 | 9.20 | 0.40 |
| **Maximum** | | 64.00 | 2.30 | 21.00 | 517.00 | 140.00 | 9.20 | 0.40 |
| **Group A** | | 50.00% | 0.00% | 0.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| *Limit* | | 50 | >10 | 10 | 1000 | 200 | 10 | 1.5 |
| **Group B** | | 50.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *Limit* | | 100 | >5 | 50 | 1500 | 600 | 20 | 2.0 |
| **Group C** | | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *Limit* | | 200 | >0.5 | 100 | 2000 | 1200 | 40 | 3.0 |
| **Group D** | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *Limit* | | >200 | <0.5 | >100 | >2000 | >1200 | >40 | >3 |

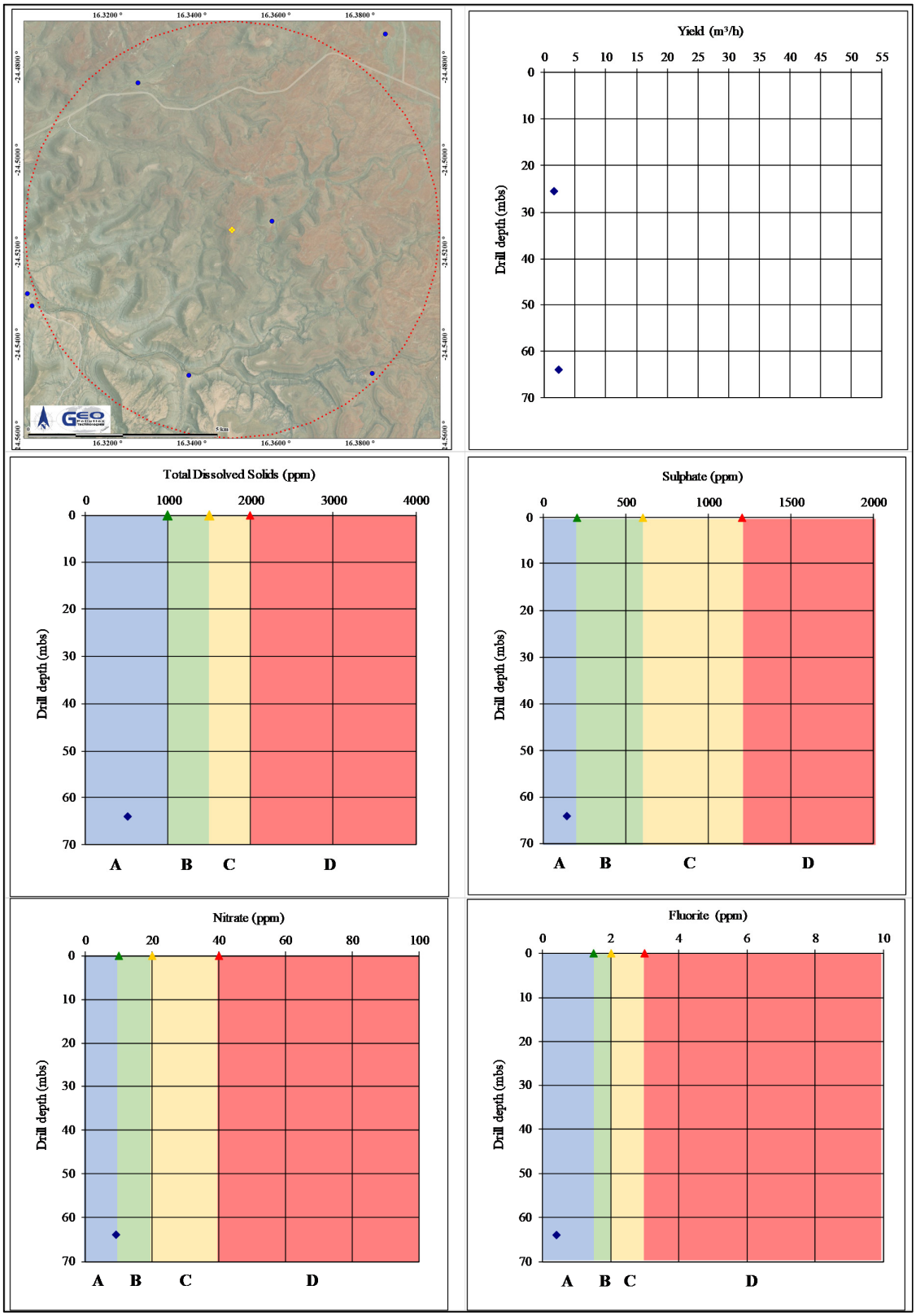


**Figure 5-1 Groundwater quality statistics for primary target**

### 5.3.2 Secondary Target

The secondary drill target is located on the farm Zebra Rivier FMP/00122. There are ten boreholes within a 5 km radius from the drill point on Zebra Rivier. The average groundwater level in the area is 44.54 m below surface. Chemical analysis of the borehole data was available for 5 of the 10 boreholes. TDS, Sulphide, Nitrate, and Fluorite are all within an acceptable range that falls in Group A. See Table 5-5 and Figure 5-2 for the groundwater quality statistics for the drilling location.

Based on the limited information and limited chemical data from the boreholes, no indication of significant water quality changes with depth is evident. Groundwater is likely interlinked and separate aquifers are not expected. No artesian conditions were noted in the data, but some rise in the water level above the water strike depth is expected.

***Implications and Impacts***

Contamination of the groundwater can occur via infiltration through the sediments or through the infiltration through fractures, joints and faults that are present in the subsurface. Groundwater remains an important resource and would be at risk if fuel spills are not contained, cleaned and disposed of properly.

**Table 5-5 Summary of groundwater statistics for secondary target**

| Area of Interest: | Secondary Target Groundwater Statistics | | | | | Query Radius: 5 km | | |
|---|---|---|---|---|---|---|---|---|
| | Number of Known Boreholes | DEPTH (mbs) | YIELD ($m^3/h$) | WATER LEVEL (mbs) | TDS (ppm) | SULPHATE (ppm) | NITRATE (ppm) | FLUORIDE (ppm) |
| **Data points** | **10** | 9 | 6 | 5 | 5 | 5 | 5 | 5 |
| **Minimum** | | 37.00 | 0.90 | 16.00 | 343.00 | 29.00 | 3.50 | 0.30 |
| **Average** | | 88.36 | 2.70 | 44.54 | 435.40 | 65.40 | 5.18 | 0.46 |
| **Maximum** | | 150.00 | 4.70 | 70.00 | 517.00 | 140.00 | 9.20 | 0.60 |
| **Group A** | | 11.11% | 0.00% | 0.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| *Limit* | | 50 | >10 | 10 | 1000 | 200 | 10 | 1.5 |
| **Group B** | | 44.44% | 0.00% | 60.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *Limit* | | 100 | >5 | 50 | 1500 | 600 | 20 | 2.0 |
| **Group C** | | 44.44% | 100.00% | 40.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *Limit* | | 200 | >0.5 | 100 | 2000 | 1200 | 40 | 3.0 |
| **Group D** | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *Limit* | | >200 | <0.5 | >100 | >2000 | >1200 | >40 | >3 |

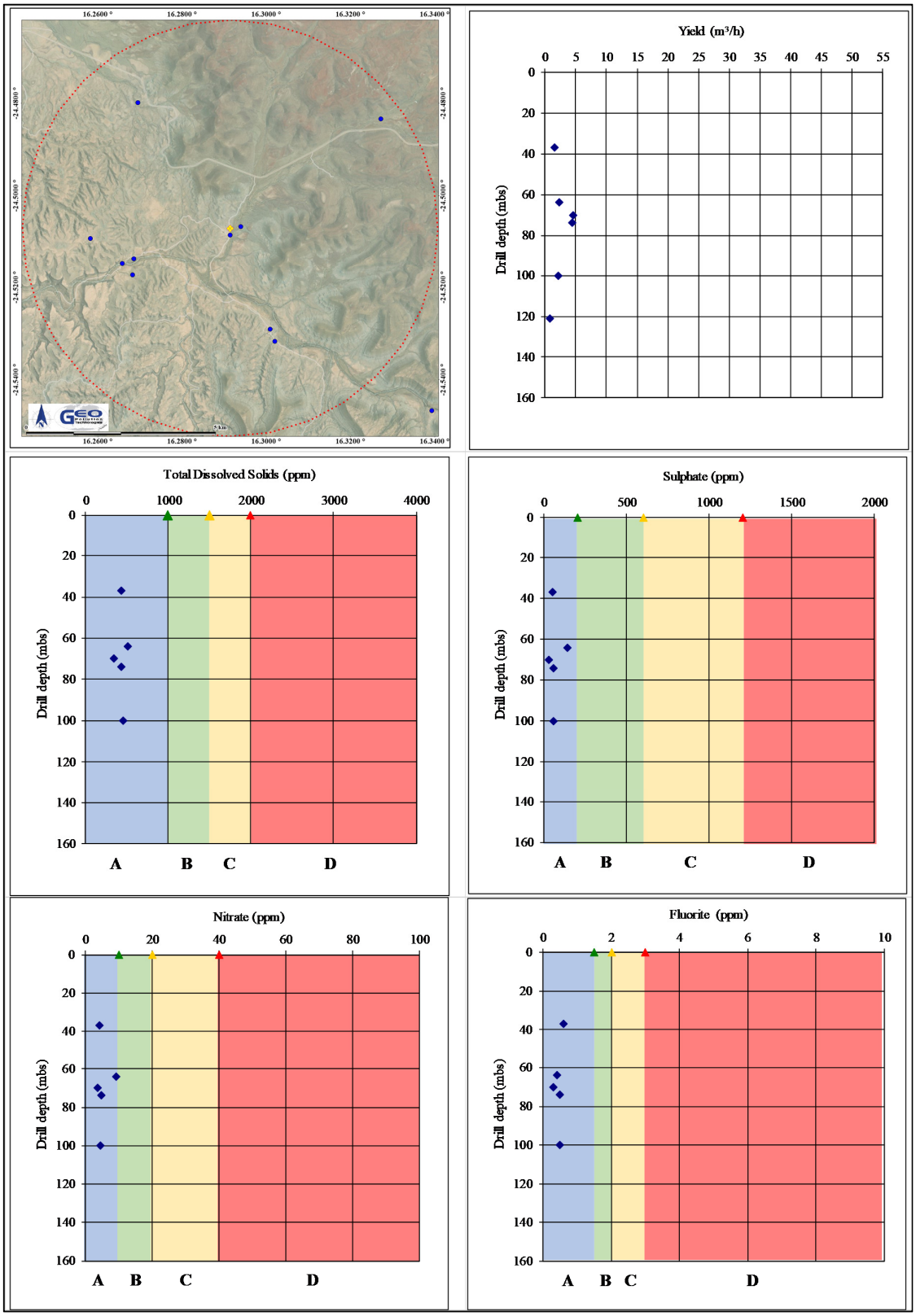


**Figure 5-2 Groundwater statistics for secondary target**

# 6 ASSESSMENT AND MANAGEMENT OF IMPACTS

The purpose of this section is to assess and identify the most pertinent environmental impacts that are expected from the project. An Environmental Management Plan based on these identified impacts are also incorporated into this section.

For each impact an Environmental Classification was determined based on an adapted version of the Rapid Impact Assessment Method (Pastakia, 1998). Impacts are assessed according to the following categories: Importance of condition (A1); Magnitude of Change (A2); Permanence (B1); Reversibility (B2); and Cumulative Nature (B3) (see Table 6-1)

Ranking formulas are then calculated as follow:
Environmental Classification = A1 x A2 x (B1 + B2 + B3).

The environmental classification of impacts is provided in Table 6-2.

The probability ranking refers to the probability that a specific impact will happen following a risk event. These can be improbable (low likelihood); probable (distinct possibility); highly probable (most likely); and definite (impact will occur regardless of prevention measures).

**Table 6-1 Assessment criteria**

| Criteria | Score |
|---|---|
| **Importance of condition (A1) – assessed against the spatial boundaries of human interest it will affect** | |
| Importance to national/international interest | 4 |
| Important to regional/national interest | 3 |
| Important to areas immediately outside the local condition | 2 |
| Important only to the local condition | 1 |
| No importance | 0 |
| **Magnitude of change/effect (A2) – measure of scale in terms of benefit / disbenefit of an impact or condition** | |
| Major positive benefit | 3 |
| Significant improvement in status quo | 2 |
| Improvement in status quo | 1 |
| No change in status quo | 0 |
| Negative change in status quo | -1 |
| Significant negative disbenefit or change | -2 |
| Major disbenefit or change | -3 |
| **Permanence (B1) – defines whether the condition is permanent or temporary** | |
| No change/Not applicable | 1 |
| Temporary | 2 |
| Permanent | 3 |
| **Reversibility (B2) – defines whether the condition can be changed and is a measure of the control over the condition** | |
| No change/Not applicable | 1 |
| Reversible | 2 |
| Irreversible | 3 |
| **Cumulative (B3) – reflects whether the effect will be a single direct impact or will include cumulative impacts over time, or synergistic effect with other conditions. It is a means of judging the sustainability of the condition – not to be confused with the permanence criterion.** | |
| Light or No Cumulative Character/Not applicable | 1 |
| Moderate Cumulative Character | 2 |
| Strong Cumulative Character | 3 |

**Table 6-2 Environmental classification (Pastakia 1998)**

| Environmental Classification | Class Value | Description of Class |
|---|---|---|
| 72 to 108 | 5 | Extremely positive impact |
| 36 to 71 | 4 | Significantly positive impact |
| 19 to 35 | 3 | Moderately positive impact |
| 10 to 18 | 2 | Less positive impact |
| 1 to 9 | 1 | Reduced positive impact |
| 0 | 0 | No alteration |
| -1 to -9 | -1 | Reduced negative impact |
| -10 to -18 | -2 | Less negative impact |
| -19 to -35 | -3 | Moderately negative impact |
| -36 to -71 | -4 | Significantly negative impact |
| -72 to -108 | -5 | Extremely Negative Impact |

## 6.1 RISK ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

The EMP provides management options to ensure impacts of the project are minimised. An EMP is a tool used to take pro-active action by addressing potential problems before they occur. This should limit the corrective measures needed, although additional mitigation measures might be included if necessary. The environmental management measures are provided in the tables and descriptions below. These management measures should be adhered to during the project. All personnel taking part in the project should be made aware of the contents of this section, so as to plan and execute the project accordingly and in an environmentally sound manner.

The objectives of the EMP are:

- to include all components of the project;
- to prescribe the best practicable control methods to lessen the environmental impacts associated with the project;
- to monitor and audit the performance of operational personnel in applying such controls; and
- to ensure that appropriate environmental training is provided to responsible operational personnel.

Some impacts will emanate from the execution of the project. The majority of these impacts can be mitigated or prevented. The impacts, risk rating of impacts, as well as prevention and mitigation measures are listed below. Impacts are expected to mostly be of medium to low significance and can mostly be mitigated to have a low significance. The extent of impacts are mostly site specific to local and are not of a permanent nature. Due to the remote nature of the surrounding areas, cumulative impacts are not likely.

### 6.1.1 Planning

During the phases of planning for the project, it is the responsibility of proponent to ensure they are and remain compliant with all legal requirements. The proponent must also ensure that all required management measures are in place prior to, and during all phases of the project, to ensure potential impacts and risks are minimised. The following actions are recommended for the planning phase and should continue during various other phases of the project:

- Ensure that all necessary permits from the various ministries, local authorities and any other bodies that governs any aspect of the project remains valid.
- Ensure all appointed contractors and employees enter into an agreement which includes the EMP. Ensure that the contents of the EMP are understood by the contractors, sub-contractors, employees and all personnel present or who will be present on site.

- Make provisions to have a health, safety and environmental (HSE) coordinator to implement the EMP and oversee occupational health and safety as well as general environmental related compliance at the site.
- Have the following on site where reasonable to deal with all potential emergencies:
    - EMP / risk management / emergency response plan and HSE Manuals
    - Adequate protection and indemnity insurance cover for incidents;
    - Relevant health and safety standards;
    - Procedures, equipment and materials required for emergencies.
- Establish and / or maintain a reporting system as outlined in the EMP.
- Bi-annual monitoring report submission to MEFT based on the EMP, this is a requirement by MEFT. If project is finalised within six months only one report should be submitted.
- Appoint a specialist environmental consultant to update the EMP and apply for renewal of the environmental clearance certificate prior to expiry (if required).

### 6.1.2 Employment

The project will aid in sustaining existing jobs while possibly allowing for some temporary contract positions to be filled.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Sustaining existing jobs and provision of temporary contract positions | 2 | 1 | 2 | 2 | 1 | 10 | 2 | Definite |
| Indirect Impacts | Decrease in unemployment, contribution to local economy | 3 | 1 | 2 | 2 | 1 | 15 | 2 | Definite |

**Desired Outcome:** Provision of employment to local Namibians.

**Actions**

**Mitigation:**

- The Proponent must employ or contract local Namibians where possible.
- If the skills exist locally, contract employees must first be sourced from the town, then the region and then nationally.
- Deviations from this practice must be justified.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- Summary report based on employee records.

### 6.1.3 Skills, Technology and Development

Collaboration between international scientists results in sharing expertise and knowledge. Drill rig supervisors, operators and general assistants and workers gain experience and skills.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Employment, technological development and transfer of skills | 2 | 1 | 2 | 3 | 1 | 12 | 2 | Definite |
| Indirect Impacts | Increasing the international scientific knowledge database | 4 | 2 | 3 | 3 | 2 | 64 | 4 | Definite |

**Desired Outcome:** To see an increase in skills of local Namibians, as well as development and technological advancements. Increasing the scientific knowledge database.

**Actions**

**Mitigation:**

- The Proponent must contract or employ Namibians where possible. Deviations from this practise should be justified appropriately.
- If the skills exist locally, contract workers must first be sourced from the region, and then nationally. Deviations from this practice must be justified.
- Employees to be informed about parameters and requirements for references upon employment.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- Record should be kept of training provided and managerial reference provided to contract workers.

### 6.1.4 Health, Safety and Security

The project is reliant on human labour they will be exposed to health and safety risks. Activities such as the operation of machinery, lifting of heavy equipment, and handling of hazardous chemicals (inhalation and carcinogenic effect of fuel), will pose the main risks to employees. Security risks will be related to unauthorized entry and criminal activity, although this risk is considered low due to the location of the project.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Physical injuries, exposure to chemicals and criminal activities | 1 | -2 | 2 | 3 | 1 | -12 | -2 | Probable |

**Desired Outcome:** To prevent injury, health impacts and theft.

**Actions**

**Prevention:**

- Implement and maintain an integrated health and safety management system, to act as a monitoring and mitigating tool, which may include: operational, safe work and medical procedures, permits to work, emergency response plans, housekeeping rules, MSDS's and signage requirements (PPE, flammable etc.).
- All health and safety standards specified in the Labour Act should be complied with.
- Selected personnel should be trained in first aid and a first aid kit must be available on site.
- The contact details of all emergency services must be readily available.
- Clearly label dangerous and restricted areas as well as dangerous equipment and products.
- Ensure that all personnel receive adequate training on operation of equipment / handling of hazardous substances.
- Provide all employees with required and adequate personal protective equipment (PPE).
- Equipment that will be locked away on site must be placed in a way that does not encourage criminal activities (e.g. theft).
- Educate employees on potential dangerous animals in the area and instil an "avoid rather than confront" attitude among workers.
- Should cellular reception not be present at the drill sites, a satellite phone should be available for emergencies.

**Mitigation:**

- Treat all minor work related injuries immediately and obtain professional medical treatment if required.
- Assess any safety problems and implement corrective action to prevent future occurrences.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- A final report should be compiled of all incidents reported. The report should contain dates when training were conducted and when safety equipment and structures were inspected and maintained.

### 6.1.5 Fire

Operational activities may increase the risk of the occurrence of fires which may spread into the nearby veld.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Fire risk | 2 | -2 | 2 | 2 | 1 | -20 | -3 | Probable |

**Desired Outcome:** To prevent property damage, veld fires, possible injury and impacts caused by uncontrolled fires.

**Actions:**

**Prevention:**

- A holistic fire protection and prevention plan is needed. This plan must include an emergency response plan and firefighting plan.
- Selected staff should have fire fighting training and fire drills should be conducted regularly.
- Ensure all chemicals/ fuels are stored according to MSDS and SANS instructions.
- Maintain regular site, mechanical and electrical inspections and maintenance.
- Clean all spills / leaks.
- Fire used for purposes such as cooking must only be allowed within designated areas.
- Firefighting equipment must be placed near the drill rig in an easily reachable location during drilling.

**Mitigation:**

- In case of a fire, attempts to extinguish it should be made immediately as long as it is safe to do so.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- A final report should be compiled of all incidents reported. The report should contain dates when fire drills were conducted and when fire equipment was tested and training given.

### 6.1.6 Air Quality

During drilling there may be an increase in ambient dust levels. This will mostly be limited to the drill site and its immediate surroundings.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Dust from drilling activities | 1 | -2 | 2 | 2 | 1 | -10 | -10 | Probable |

**Desired Outcome:** To prevent health impacts and minimise the dust generated.

**Actions**

**Mitigation:**

- Personnel issued with appropriate dust masks where excessive dust are present.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- Any complaints received regarding dust should be recorded with notes on action taken.
- All information and reporting to be included in a final report.

### 6.1.7 Noise

Noise may be generated due to drilling activities and operations of machinery.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Noise generated from the operational activities | 1 | -1 | 2 | 2 | 1 | -5 | -1 | Probable |

**Desired Outcome:** To prevent hearing loss due to excessive noise generated.

**Actions**

**Prevention:**

- Follow Labour Act's health and safety regulations pertaining to noise to prevent hearing impairment.
- All machinery must be regularly serviced to ensure minimal noise production.

**Mitigation:**

- Hearing protectors as standard PPE for workers in situations with elevated noise levels.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- Labour Act's health and safety regulations.
- Final report on complaints and actions taken to address complaints and prevent future occurrences.

### 6.1.8 Waste production

Various forms of waste will be produced during the project. Waste may include hazardous waste associated with the handling of hydrocarbon products. Domestic waste and sewage will be generated by personnel staying on site. Waste presents a contamination risk and when not removed regularly may become a fire hazard.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Excessive waste production, littering, contaminated materials | 1 | -2 | 2 | 2 | 2 | -12 | -2 | Probable |

**Desired Outcome:** To reduce the amount of waste produced, and prevent pollution and littering.

**Actions**

**Prevention:**

- Educate all staff on proper importance of waste handling and disposal.
- Waste reduction measures should be implemented and all waste that can be re-used / recycled must be kept separate.
- Ensure adequate waste storage facilities are available.
- Ensure waste cannot be blown away by wind.
- Prevent scavenging (human and non-human) of waste storage.

**Mitigation:**

- All waste must be removed from the drill sites and camps once drilling is complete. Waste should be disposed of at appropriately classified disposal facilities, this includes hazardous material (empty chemical containers (e.g. oil containers), contaminated rugs, paper water and soil). Empty chemical containers must be destroyed in a way that would prevent reuse as a container after disposal.
- Any sewage generated must be disposed of in such a way that it does not pose any health and safety impacts for humans or animals and that it does not contaminate groundwater.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- A register of hazardous waste disposal should be kept. This should include type of waste, volume as well as disposal method/facility.
- Any complaints received regarding waste should be recorded with notes on action taken.
- All information and reporting to be included in a bi-annual report.

### 6.1.9 Ecosystem and Biodiversity Impact

The drill sites are in undisturbed areas with natural vegetation, some of which may require removal. Poaching and illegal collection of plant and animal materials may occur. Impacts may also be related to pollution of the environment.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Impact on fauna and flora. Loss of biodiversity | 1 | -1 | 2 | 2 | 2 | -6 | -1 | Probable |

**Desired Outcome:** To avoid pollution of, and impacts on, the ecological environment.

**Actions**.

**Prevention:**

- Educate all contracted and permanent employees on the value of biodiversity.
- Where possible, removal of trees, especially protected species and large trees, must be avoided.
- The necessary permits from the Directorate of Forestry of the MEFT must be obtained for removal of any protected species.
- Avoid drilling in areas where active animal dens and burrows are present.
- Strict conditions prohibiting harvesting and poaching of fauna and flora should be part of employment contracts. This includes prohibitions or regulations on the collection of firewood.
- Limit staff movement to the operational area or on the official movement corridor to the site.
- Disciplinary actions to be taken against all employees failing to comply with contractual conditions.
- Contain all equipment to a designated laydown area.

**Mitigation:**

- Report any extraordinary animal sightings to the farm owner and MEFT.
- Mitigation measures related to waste handling and the prevention of groundwater, surface water and soil contamination should limit ecosystem and biodiversity impacts.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- All information and reporting to be included in a final report.

### 6.1.10 Groundwater, Surface Water and Soil Contamination

Infiltration of as much uncontaminated precipitated water is greatly desired so as to recharge groundwater resources. Care must thus be taken to avoid contamination of soil and therefore groundwater. Groundwater may spread pollutants to neighbouring receptors. Contamination of the groundwater can occur via infiltration through the sediments or through the infiltration through fractures, joints and faults that are present in the subsurface.

Soil contamination can occur from fuel storage tanks, at dispensing points and during maintenance of equipment and machinery. The transport of fuel and the refuelling of vehicles like drilling rigs is a concern. Hydraulic oil leaks are common on drilling rigs and pipe bursts may release large volumes of oil into the environment. Contamination of groundwater could also occur through infiltration of waste from field toilets. This is specifically applicable to camp sites.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Contamination from hazardous material spillages and hydrocarbon leakages | 2 | -2 | 2 | 2 | 1 | -20 | -3 | Probable |

**Desired Outcome:** To prevent the contamination of water and soil.

**Actions**

**Prevention:**

- All machinery should be maintained to be in a good working condition during operations.
- Employ drip trays and spill kits during refuelling or when servicing / repairs of equipment is needed.
- The procedures followed to prevent environmental damage during service and maintenance, and compliance with these procedures, must be audited and corrections made where necessary.
- Proper training of operators must be conducted on a regular basis (fuel handling, spill detection, spill control).
- Any sewage generated must be disposed of in such a way that it does not pose any health and safety impacts for humans or animals and that it does not contaminate groundwater.

**Mitigation:**

- Any fuel spillage of more than 200 litre must be reported to the relevant authority (Ministry of Mines and Energy).
- Spill clean-up means must be readily available on site as per the relevant MSDS.
- Any spill must be cleaned up immediately.
- Hazardous waste must be disposed of at a suitably classified hazardous waste disposal facility.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- A report should be compiled of all spills or leakages reported.

### 6.1.11 Groundwater Impacts Caused by Abandonment of Boreholes

If the borehole is abandoned without backfilling or securely closing it, it presents an avenue for pollution of the groundwater when objects, organic matter or surface runoff enters the borehole.

Drilling of exploration holes may penetrate a confining aquifer layer (aquitard). This may cause mixing of aquifer water where the one aquifer may contain water of a poor quality, causing contamination of the aquifer having better quality. An alternative impact may be the leaking of water from one aquifer into another, causing existing boreholes to dry up or springs to dry up.

Based on the limited amount of information available it is not expected that such impacts would occur within the project area. It would however be advisable to take care during drilling that proper monitoring is taking place to evaluate for such conditions and that appropriate remedial actions be implemented where needed – precautionary principal.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Contamination from hazardous material spillages and hydrocarbon leakages | 1 | -1 | 2 | 2 | 2 | -6 | -1 | Probable |

**Desired Outcome:** To prevent the contamination of groundwater, to prevent organisms from falling into the borehole, to prevent aquifer cross contamination, to prevent loss of artesian conditions through water leaking to the surface or to higher lithologies above a confining layer.

**Actions**

**Prevention:**

- Install sanitary seals and casing with lockable caps to allow for future groundwater monitoring or proper backfilling of boreholes.
- Drill cuttings should not be used for backfilling boreholes as minerals in the cuttings may have oxidised and will then potentially be released into the groundwater, together with salts present in the cuttings. Clean sand or clay should be used where possible.
- Monitoring for confining layers that might separate aquifers or causing confining conditions. Careful monitoring for water strikes and quality thereof.
- Boreholes should be cemented where boreholes intersect confining layers separating aquifers with different water quality or causing artesian conditions.

**Mitigation:**

- No mitigation is prescribed as impacts must be prevented.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- A report should be compiled of borehole abandonment practises used as well as groundwater information obtained.

### 6.1.12 Visual Impact

This is an impact that affects the aesthetic appearance of the project sites.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Aesthetic appearance | 1 | -1 | 2 | 2 | 1 | -5 | -1 | Probable |

**Desired Outcome:** To minimise aesthetic impacts associated with the drill sites.

**Actions**

**Mitigation:**

- Regular waste disposal, good housekeeping will ensure a low visual impact is maintained.

**Responsible Body:**

- Proponent

**Data Sources and Monitoring:**

- A report should be compiled of all complaints received and actions taken.

### 6.1.13 Impacts on Utilities and Infrastructure

Any damage caused to existing infrastructure and services supply like roads, pipelines and electricity supply where present.

| Project Activity / Resource | Nature (Status) | (A1) Importance | (A2) Magnitude | (B1) Permanence | (B2) Reversibility | (B3) Cumulative | Environmental Classification | Class Value | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Daily Operations | Disruption of services and damage to infrastructure | 2 | -1 | 2 | 2 | 1 | -10 | -2 | Improbable |

**Desired Outcome:** No impact on utilities and infrastructure.

**Actions**

**Prevention:**

- The Proponent must determine exactly where infrastructure like pipelines are situated. Liaison with owners of the land or suppliers of services (if applicable) is essential.

**Mitigation:**

- Emergency procedures for corrective action available on file.

**Responsible Body:**

- Proponent
- Land owner or suppliers of services

**Data Sources and Monitoring:**

- A report should be compiled of all incidents that occurred and corrective action taken.

### 6.2 DECOMMISSIONING AND REHABILITATION

Decommissioning will entail the complete removal of all equipment from drill sites. Any pollution present on the site must be remediated. Waste should be contained and disposed of at an appropriately classified and approved waste facility and not dumped in the surrounding areas.

### 6.3 ENVIRONMENTAL MANAGEMENT SYSTEM

The proponent could implement an Environmental Management System (EMS) for their operations. An EMS is an internationally recognized and certified management system that will ensure ongoing incorporation of environmental constraints. At the heart of an EMS is the concept of continual improvement of environmental performance with resulting increases in operational efficiency, financial savings and reduction in environmental, health and safety risks. An effective EMS would need to include the following elements:

- A stated environmental policy which sets the desired level of environmental performance;
- An environmental legal register;
- An institutional structure which sets out the responsibility, authority, lines of communication and resources needed to implement the EMS;
- Identification of environmental, safety and health training needs;
- An environmental program(s) stipulating environmental objectives and targets to be met, and work instructions and controls to be applied in order to achieve compliance with the environmental policy; and
- Periodic (internal and external) audits and reviews of environmental performance and the effectiveness of the EMS.
- The Environmental Management Plan

## 7 CONCLUSION

The proposed project will provide valuable scientific information and contribute to the knowledge database. By using a local drilling company, employment is provided to Namibians and jobs are sustained.

Negative impacts are limited and of low significance and can successfully be mitigated. Noise pollution should at all times meet the prescribed health and safety regulations of the Labour Act to prevent hearing loss. Fire prevention should be adequate, and health and safety regulations should be adhered to in accordance with the regulations pertaining to relevant laws and internationally accepted standards of operation. Any waste produced must be removed from site and disposed of at an appropriate facility or re-used or recycled where possible. Hazardous waste must be disposed of at an approved hazardous waste disposal site. Poaching of wild animals or illegal collection of plant material must be prohibited and all workers must be educated on the value of biodiversity and the need for its protection. Vegetation must be disturbed as little as possible and protected tree species may not be removed unless no other option exist. The necessary permits must then be obtained for their removal. Proper borehole abandonment is required to prevent groundwater impacts.

The EMP (Section 6) should be used as an on-site reference document for the duration of the project. Parties responsible for transgressing of the environmental management plan should be held responsible for any rehabilitation that may need to be undertaken. The Proponent could use an in-house Health, Safety, Security and Environment Management System in conjunction with the environmental management plan. All operational personnel must be taught the contents of these documents.

Should the Directorate of Environmental Affairs find that the impacts and related mitigation measures, which have been proposed in this report, are acceptable, an ECC may be granted to the Proponent. The ECC issued, based on this document, will render it a legally binding document which should be adhered to. Focus should be placed on Section 6, which is the EMP for this project.

# 8 REFERENCES

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# Appendix A: Land Owner Consent

Universiteit Utrecht

**To Whom This May Concern**

**Faculty of Geosciences**
***Department of Earth Sciences***

**Visiting address**
Princetonlaan 8a
3584 CB Utrecht
The Netherlands
**Postal address**
P.O. Box 80.021
3508 TA Utrecht
The Netherlands

**Date** 18-7-2024
**Subject** Permission for scientific drilling

Researchers employed at Utrecht University, namely Bianca Spiering and Frederik Hilgen, aim to perform scientific drilling in the rocks of the Kuibus Subgroup (Nama Group) in the northern part of the Nama Basin (Zaris subbasin). The scientific drilling is part of an international, multi-year research project in which Utrecht University collaborates with Canadian universities (McGill University, University of Toronto Mississauga, and Université du Québec à Montréal). The project aims to understand the role of cyclic climatic changes that result from variations in Earth's orbit and spin axis, called astronomical climate forcing, in the terminal Ediacaran Period (around 550 million years ago). This time period covers critical evolutionary trends related to the earliest complex life, as well as other major climatic changes such as glaciations and oxygenation. The Nama Group, and in particular the Kuibus Subgroup, displays profound regularity in its weathering profile (i.e., resistant-recessive alternations), which could be an indication for the influence of astronomical climate forcing on its deposition. Fresh rock material from a drill core has the potential to provide high-quality and high-resolution proxy data that significantly improves our understanding of the climatic mechanism behind the observed regularity (resistant-recessive alternations).

The selected scientific drilling target is the approximately 650 m thick mixed carbonate-siliciclastic sedimentary succession of the Kuibus Subgroup in the northern Nama Basin. A 650-m-long core with a diameter of 63.5 mm will be drilled on Farm Kyffhauser (approximate position: -24.515200 latitude, 16.349527 longitude). In case the drilling at Farm Kyffhauser is unsuccessful, a 450-m-long core with a diameter of 63.5 mm will be drilled on Farm Zebra River (approximate position: -24.50713575 latitude, 16.2914049 longitude). Only half of the core will be exported to Utrecht University in the Netherland, while the other half will remain in Namibia and will be stored at the Ministry of Mines and Energy.

**Hereby, Alex Dreyer, owner of Farm Kyffhauser, gives permission to the researchers Bianca Spiering and Frits Hilgen to drill a 650-m-long core on the land of Farm Kyffhauser.**

Signed by Alex Dreyer on 18/07/2024 in Groenkloof, Pretoria:

Contact details of Alex Dreyer:
Email: alex.dreyer@kelvion.com
Phone: +27 11 861 1500 / +27 82 851 1440

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Universiteit Utrecht

**Hereby, Jeanette Lubbe, financial manager of Farm Zebra River, gives permission to the researchers Bianca Spiering and Frits Hilgen to drill a 450-m-long core on the land of Farm Zebra River.**

Signed by Jeanette Lubbe on 18/07/2024 in Stampriet Namibia

J Lubbe.

Contact details of Jeanette Lubbe:
Phone: +264 81 253 5969
Email: jeanettelubbe7@gmail.com

With Kind regards,

Bianca Spiering
PhD Candidate at Utrecht University
Email: b.r.spiering@uu.nl

Signed by Bianca Spiering on 18 July 2024 in Utrecht, the Netherlands:

Frederik Hilgen
Associate Professor at Utrecht University
Email: f.j.hilgen@uu.nl

Signed by Frederik Hilgen on 18 July 2024 in Utrecht, the Netherlands:

F.J. Hilgen

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# Appendix B: Consultants' Curriculum Vitae

**ENVIRONMENTAL SCIENTIST** **André Faul**

André entered the environmental assessment profession at the beginning of 2013 and since then has worked on more than 230 Environmental Impact Assessments including assessments of the petroleum industry, harbour expansions, irrigation schemes, township establishment and power generation and transmission. André's post graduate studies focussed on zoological and ecological sciences and he holds a M.Sc. in Conservation Ecology and a Ph.D. in Medical Bioscience. His expertise is in ecotoxicological related studies focussing specifically on endocrine disrupting chemicals. His Ph.D. thesis title was The Assessment of Namibian Water Resources for Endocrine Disruptors. Before joining the environmental assessment profession he worked for 12 years in the Environmental Section of the Department of Biological Sciences at the University of Namibia, first as laboratory technician and then as lecturer in biological and ecological sciences.

## CURRICULUM VITAE ANDRÉ FAUL

| | | |
|---|---|---|
| Name of Firm | : | Geo Pollution Technologies (Pty) Ltd. |
| Name of Staff | : | ANDRÉ FAUL |
| Profession | : | Environmental Scientist |
| Years' Experience | : | 23 |
| Nationality | : | Namibian |
| Position | : | Environmental Scientist |
| Specialisation | : | Environmental Toxicology |
| Languages | : | Afrikaans – speaking, reading, writing – excellent<br>English – speaking, reading, writing – excellent |

**EDUCATION AND PROFESSIONAL STATUS:**

| | | |
|---|---|---|
| B.Sc. Zoology | : | University of Stellenbosch, 1999 |
| B.Sc. (Hons.) Zoology | : | University of Stellenbosch, 2000 |
| M.Sc. (Conservation Ecology) | : | University of Stellenbosch, 2005 |
| Ph.D. (Medical Bioscience) | : | University of the Western Cape, 2018 |

| | |
|---|---|
| First Aid Class A | EMTSS, 2017; OHS-Med 2022 |
| Basic Fire Fighting | EMTSS, 2017; OHS-Med 2022 |

**PROFESSIONAL SOCIETY AFFILIATION:**

Environmental Assessment Professionals of Namibia (Practitioner)

**AREAS OF EXPERTISE:**

Knowledge and expertise in:

- Environmental Assessment and Environmental Management Plans
- Water Sampling, Extractions and Analysis
- Biomonitoring and Bioassays
- Biodiversity Assessment
- Toxicology
- Restoration Ecology

**EMPLOYMENT:**

| | | |
|---|---|---|
| 2013-Date | : | Geo Pollution Technologies – Environmental Scientist |
| 2005-2012 | : | Lecturer, University of Namibia |
| 2001-2004 | : | Laboratory Technician, University of Namibia |

**PUBLICATIONS:**

| | |
|---|---|
| Publications: | 5 |
| Contract Reports | +230 |
| Research Reports & Manuals: | 5 |
| Conference Presentations: | 1 |