DRAFT BASIC ASSESSMENT REPORT

Basic Assessment for the proposed tilapia aquaponics project, on plot 413 of the farm Bosplaas West, north of the town of Hammanskraal, in the Moretele Municipality in Bojanala District, North West Province

DRAFT BASIC ASSESSMENT REPORT

Prepared for: Blue-Green Aquaculture (Pty) Ltd

CSIR Report No.: CSIR/02100/EMS/IR/2017/15674/A

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SEPTEMBER 2017

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CSIR Report Number: CSIR/02100/EMS/IR/2017/15674/A

September 2017

Prepared for:
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Authors:
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REPORT DETAILS

Title:	**Basic Assessment for the proposed tilapia aquaponics farm project, plot 413 on the farm Bosplaas West located north of Hammanskraal, in the Moretele Municipality in Bojanala District of the North West Province**
Purpose of this report:	The purpose of this BA Report is to: • Present the proposed project and the need for the project; • Describe the affected environment at a sufficient level of detail to facilitate informed decision-making; • Provide an overview of the BA Process being followed, including public consultation; • Assess the predicted positive and negative impacts of the project on the environment; • Provide recommendations to avoid or mitigate negative impacts and to enhance the positive benefits of the project; • Provide an Environmental Management Programme (EMPr) for the proposed project. This BA Report is being made available to all Interested and Affected Parties (I&APs) and stakeholders for a 30-day review period. All comments submitted during the review of the BA Report will be incorporated into the finalised BA Report as applicable and where necessary. This finalised BA Report will then be submitted to the North West Department of Rural, Environment and Agricultural Development (READ) for decision-making.
Prepared for:	Blue-Green Aquaculture (Pty) Ltd
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Authors:	Karabo Mashabela, Minnelise Levendal and Paul Lochner
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OPPORTUNITY FOR REVIEW

Opportunity for Review:

This Draft Basic Assessment Report, including the Draft Environmental Management Programme (EMPr), is hereby released for a 30-day review period by stakeholders.

This review period closes on 16 October 2017

Comments are to be submitted to the CSIR at the contact details below.

Project Manager – Karabo Mashabela

Council for Scientific and Industrial Research (CSIR)
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EXECUTIVE SUMMARY

INTRODUCTION AND BACKGROUND

Blue-Green Aquaculture (Pty) Ltd is a small scale commercial fish farming enterprise that was established in 2013 and is proposing to establish an aquaculture production facility to farm Mozambique tilapia (*Oreochromis mossambicus*), commonly known as Blue kurper. Blue-Green Aquaculture has leased land, i.e. Plot 413 in Bosplaas West, from Mr T J Kgomo for the establishment of this aquaculture production farm.

The proposed project will produce 20 000 kg per annum of tilapia fish in phase 1, increasing to 100 000 kg/year of fish in phase 2 and 200 000 kg/year of fish in phase 3. In all phases, lettuce will be produced from the aquaponics component of the project. This Basic Assessment includes all three phases of the project. The project will have a total footprint of approximately 2 hectares (20 000 m^2) and employ up to 24 people at full production.

ENVIRONMENTAL ASSESSMENT PROCESS

The Council for Scientific and Industrial Research (CSIR) was appointed by the national Department of Environmental Affairs (DEA) to manage the Special Needs and Skills Development Programme which is aimed at providing *pro-bono* environmental services to small-scale businesses. Under this programme, CSIR undertakes Basic Assessments (BAs) for applicants who can demonstrate that they have "special needs", in particular, where applicants cannot afford to undertake the necessary BA process. This led to the CSIR undertaking this BA for the proposed tilapia aquaponics farm project on Plot 413 on the Farm Bosplaas West, located north of Hammanskraal in the Moretele Municipality in the Bojanala District of the North West province.

The proposed development triggers listed activities in terms of the Environmental Impact Assessment (EIA) Regulations, Government Regulations (GNR) 327 and 324 of April 2017 promulgated under the National Environmental Management Act (NEMA) (Act no 107 of 1998). In terms of these Regulations, a Basic Assessment should be undertaken for the proposed project. The CSIR is providing the Environmental Assessment Practitioners (EAPs) and is managing the BA process on behalf of the project applicant.

In terms of the amended NEMA EIA Regulations published in GNR 324, 325, 326 and 327 on the 7 April 2017 Government Gazette Number 40772, a BA process is required as the project triggers the following listed activities (detailed in Table 1 below).

Table 1: Listed activities relating to this proposed tilapia aquaponics project

Relevant notice	Activity No. (in terms of the relevant notice):	Description of each listed activity as per the Government Notice
GN.327,7 April 2017	3.(iii)	The development and related operation of facilities or infrastructure for the slaughter of animals with a — (iii) wet weight product throughput of fish, crustaceans or amphibians exceeding 20 000 kg per annum.
GN. R 327, 7 April 2017	6. (i)	The development and related operation of facilities, infrastructure or structures for aquaculture of: (i) finfish, crustaceans, reptiles or amphibians, where such facility, infrastructure or structures will have a production output exceeding 20 000 kg per annum (wet weight);
GN. R 327, 7 April 2017	8	The development and related operation of hatcheries or agri-industrial facilities outside industrial complexes where the development footprint covers an area of 2 000 square metres or more.
GN. R 327, 7 April 2017	27	The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for: i) the undertaking of a linear activity; or ii) maintenance purposes undertaken in accordance with a maintenance management plan.

These listed activities require Environmental Authorisation from the provincial Department of Rural, Environment and Agricultural Development (READ) of the North West province.

AUTHORITY INVOLVEMENT AND PUBLIC PARTICIPATION

The Basic Assessment process was announced in the public domain in May 2017 via:

- placing Site Notices (in English and Setswana) on the farm fence (refer to Appendix I),
- posting and emailing written notices and a Background Information Document (BID) regarding the proposed development to Interested and Affected Parties, including neighbours, the competent authority and other relevant Government departments and agencies;
- placing an advertisement in the Brits POS on 14 September 2017 that invited potential Interested and Affected Parties to register and submit comments regarding the BA for the proposed project (refer to Appendix I).

The CSIR team has obtained inputs from a range of relevant authorities, including the Department of Water and Sanitation (DWS) and Department of Agriculture, Fisheries and Forestry (DAFF). A stakeholder database has been prepared that includes the community members, neighbours, industry and government stakeholders.

The Comments and Responses report has been compiled and it is included in Appendix I. All comments raised by I&APs during the review of the BID have been captured and addressed within

the Draft BA Report. The Draft BAR is being distributed for a 30 day review period and all registered I&APs and relevant organs of state have been informed.

For the public review, a copy of the draft BAR has been placed at the Hammanskraal Public Library and Mphe Batho primary school; and letters notifying I&APs of the release of the Draft BA Report for a 30 day review period have been distributed. The Draft Basic Assessment Report is also available on the project website: https://www.csir.co.za/environmental-impact-assessment.

IMPACT ASSESSMENT AND MITIGATION

The BA Report is informed by two specialist studies, an Ecological Impact Assessment and a Heritage Impact Assessment, together with inputs sourced by the environmental scientists in the CSIR team.

No negative impacts have been identified within this BAR that, in the opinion of the EAP, should be considered as "fatal flaws".

The main negative impacts of the Blue-Green Aquaculture project are predicted to be:

- Borehole collapsing at 30 metres
- Waste water management during the production phase and the waste from the processing fish house

The main positive benefits of the project are predicted to be:

- Employment of up to 24 persons during the construction and operation phases of the project
- Food security from the production of 200 000 kg per annum of tilapia as well as lettuce.

Mitigation actions have been included in the EMPr. The most important mitigation actions are:

- Development should be contained within the proposed 2 hectare footprint of the project and unnecessary disturbance adjacent to the site should be avoided
- Minimise clearance of natural vegetation and disturbance at the site
- Use existing and dedicated access roads to limit disturbance of the natural vegetation.

All relevant mitigation measures required to ensure that the project is planned and conducted in an environmentally responsible manner are listed in the EMPr. The EMPr is a dynamic document that should be updated as required and provides clear and implementable measures for the proposed project.

OPINION OF THE EAP

Based on the findings of the Basic Assessment process for Blue Green Aquaculture, it is recommended by the EAPs on the CSIR team that this project be authorised, subject to the conditions captured in the management actions in the EMPr (Appendix J). The EMPr must therefore form part of the conditions of the Environmental Authorisation and be adhered to by the applicant. This includes the recommendations of the ecological specialist that development must be contained within the proposed 2 hectare footprint of the project and unnecessary disturbance adjacent to the site should be avoided.

The project proponent, i.e. Blue Green Aquaculture, is being assisted under the DEA Special Needs and Skills Development Programme on a pro bono basis as the proponent qualifies as having "special needs", in particular, in that they do not have the financial means to conduct with BA process without financial support. Furthermore, the applicant does not have the resources to negotiate alternative sites other than the preferred site which was leased to them by Mr Kgomo.

Given that the site is of low environmental sensitivity, it is therefore recommended by the EAPs that the proposed layout and preferred site (this proposal) be included in the Environmental Authorisation (should such authorisation be granted for the proposed project).

CONCLUDING STATEMENT FROM EAP

Provided that the specified mitigation measures outlined in the EMPr are applied effectively, it is the opinion of the EAPs in the CSIR team that the benefits of the project outweigh the negative impacts and the project should receive Environmental Authorisation in terms of the EIA Regulations promulgated under the NEMA.

CONTENTS

TABLES

FIGURES

GLOSSARY

Aquaponics	**A** combination of aquaculture and hydroponics, i.e. an aquaculture system in which the waste produced by farmed fish (or other aquatic creatures) supplies the nutrients for plants grown hydroponically, which in turn purify the water.
Aquaculture	the cultivation of aquatic animals and plants, especially fish, shellfish, and seaweed, in natural or controlled marine or freshwater environments
BA	Basic Assessment
BAR	Basic Assessment Report
BID	Background Information Document
CA	Competent Authority
CV	Curriculum Vitae
CSIR	Council for Scientific and Industrial Research
DEA	National Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
Hydroponics	soil-less growing of plants in water
HSSE	Health, Security, Safety and Environment
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management Biodiversity Act (Act 10 of 2004)
NEM: AQA	National Environment Management: Air Quality Act (Act 39 of 2004)
NHRA	National Heritage Resources Act (Act 25 of 1999)
Recirculation aquaculture system (RAS)	are used in home aquaria and for fish production where water exchange is limited and the use of biofiltration is required to reduce ammonia toxicity
PPP	Public Participation Process
READ	Department of Rural, Environmental and Agricultural Development for the North West province
SACNASP	South African Council for Natural Scientific Professions
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANS	South African National Standards
SDF	Spatial Development Framework
Tilapia	Tilapia is the common name for nearly a hundred species of cichlid fish from the tilapiine cichlid tribe. Tilapia are mainly freshwater fish inhabiting shallow streams, ponds, rivers and lakes and less commonly found living in brackish water. Tilapia can feed on algae or any plant-based food, which reduces the cost of tilapia farming.
Tons	meaning metric tons, where 1 ton = 1000 kilograms (kg)
ToR	Terms of Reference

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read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
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CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

(For official use only)

Provincial Reference Number:	
NEAS Ref Number:	
Date Received:	

Basic assessment report in terms of the Environmental Impact Assessment Regulations, 2014, promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

Kindly note that:

1. This **basic assessment report** is a standard report that may be required by a competent authority in terms of the EIA Regulations, 2014 and is meant to streamline applications.
2. This report format is current as of **December 2014**. It is the responsibility of the applicant to ascertain whether subsequent versions of the form have been published or produced by the competent authority
3. The report must be typed within the spaces provided in the form. The size of the spaces provided is not necessarily indicative of the amount of information to be provided. The report is in the form of a table that can extend itself as each space is filled with typing.
4. Where applicable **tick** the boxes that are applicable in the report.
5. The use of "not applicable" in the report must be done with circumspection. An incomplete report or that does not meet the requirements in terms of Regulation 19 of the NEMA EIA Regulations, 2014, will be rejected to be revised and be resubmitted.
6. The report must be handed in at offices of the relevant competent authority as determined by each authority.
7. No faxed or e-mailed reports will be accepted.
8. The signature of the Environmental Assessment Practitioner (EAP) on the report must be an original.
9. The report must be compiled by an independent EAP.
10. Unless protected by law, all information in the report will become public information on receipt by the competent authority. Any interested and affected party should be provided with the information contained in this report on request, during any stage of the application process.
11. A competent authority may require that for specified types of activities in defined situations only parts of this report need to be completed.
12. Should a specialist report or report on a specialised process be submitted at any stage for any part of this application, the terms of reference for such report must also be submitted.
13. Two (2) colour hard copies and one (1) electronic copy of the report must be submitted to the competent authority.
14. Shape files (.shp) for maps must be included on the electronic copy of the report submitted to the competent authority.

SECTION A: ACTIVITY INFORMATION

A.1 Project description

a) Describe the project in association with the listed activities applied for

Overview of the proposed tilapia aquaculture project with lettuce grown using hydroponics

In South Africa, the aquaculture industry is still in its developmental stage in comparison to the global aquaculture community, however, it has the potential to grow and contribute towards job creation, food security, economic development and export opportunities. Blue-Green Aquaculture Pty Ltd is a small scale commercial fish farming enterprise that was established in 2013 and it is proposing to establish an aquaculture production facility for tilapia. Blue-Green Aquaculture has leased two hectares of land, i.e. Plot 413 in Bosplaas West, from Mr T J Kgomo for the establishment of an aquaculture production farm. The lease agreement includes the utilisation of a borehole on the farm Bosplaas West that is located north of Hammanskraal, in the Moretele Municipality in Bojanala District North West Province.

Blue-Green Aquaculture's production plan is set to increase production with three different phases over a period of five to ten years. The first phase will be the aquaponics with 20 metric tons of production (i.e. 20 000 kg) of Mozambique tilapia fish together with approximately 20 tonnes of lettuce; in the second phase the aquaculture increases to 100 tons of production of Mozambique tilapia fish together with approximately 20 tonnes of lettuce; and in the third phase on the fish production increases to 200 tons of tilapia together with approximately 20 tonnes of lettuce. The site has existing access from the R101 road.

The water requirement for Blue Green will be approximately 250 m^3 per annum for phase one for production of 20 tons of tilapia, increasing to 500 m^3 per annum for phase two of 100 tons of fish production, and lastly for phase three will be approximately 1500m^3 per annum for 200 tons of fish production. A water use licence general authorisation for phase one was obtained from the Department of Water Affairs in 07 July 2017 (Appendix I.3c). For phase two and three, the water use licence was logged with the Department of Water and Sanitation in 10 July 2017. Blue-Green Aquaculture Pty Ltd aims to produce approximately 20 tonnes of vegetables (lettuce from all phases). The vegetables will be produced annually from the waste water generated by the fish.

The greenhouse facility will have 18 deep water culture tanks (7.5m x 30m) for growing lettuce hydroponically; and the aquaculture component will include 10 tanks with the capacity to rear up to 200 metric tons per annum of Mozambique tilapia as production increases over 10 years through to phase three. The facility consists of a fish packing house, fish hatchery and a fish processing facility. During phase one, the project will transport live fish to a nearby fish processing facility. During phase two and three, Blue-Green aquaculture will develop their own fish processing facility to clean and freeze fish.

Mozambique tilapia (*Oreochromis mossambicus*), commonly known as blue kurper is native to southern Africa and is a popular fish species for aquaculture. It naturally occurs in coastal regions and the lower reaches of rivers in southern Africa and it generally prefers slow moving water bodies such as lagoons, rivers and impoundments, but can also colonise faster-flowing rivers and streams.

Technology choice and water management

The enterprise will start as an aquaponics facility (i.e. system of aquaculture in which the waste produced by farmed fish or other aquatic creatures supplies the nutrients for plants grown hydroponically, which in turn purify the water) and later it will be separated into an aquaculture farm and a hydroponics farm (where hydroponics is the process of growing plants in sand, gravel, or liquid, with added nutrients but without soil). Water will be sourced from the existing borehole on site and the effluent will be used to grow vegetables (i.e. lettuce) hydroponically. The technology to be employed on the farm is a recirculating aquaculture system (RAS) linked to hydroponic growbeds. Figure 1 is a simplified overview of the technology employed in an aquaponics system. The fish are grown in the fish rearing tanks (caption 1 in figure 1) and then the fish waste (faeces and uneaten food) flows into the settling tank (caption 2), where the process of biofiltration results in the conversion of toxic ammonia into plant friendly nitrates (caption 3) before the nitrate rich water is fed to the plants (caption 4). In the Deep Water Culture (DWC) beds (caption 5), the plants grow and take up the nitrates and other micronutrients thereby cleaning the water

(caption 6). The last step (caption 7) is the collection of clean water before being pumped back to the fish tanks.

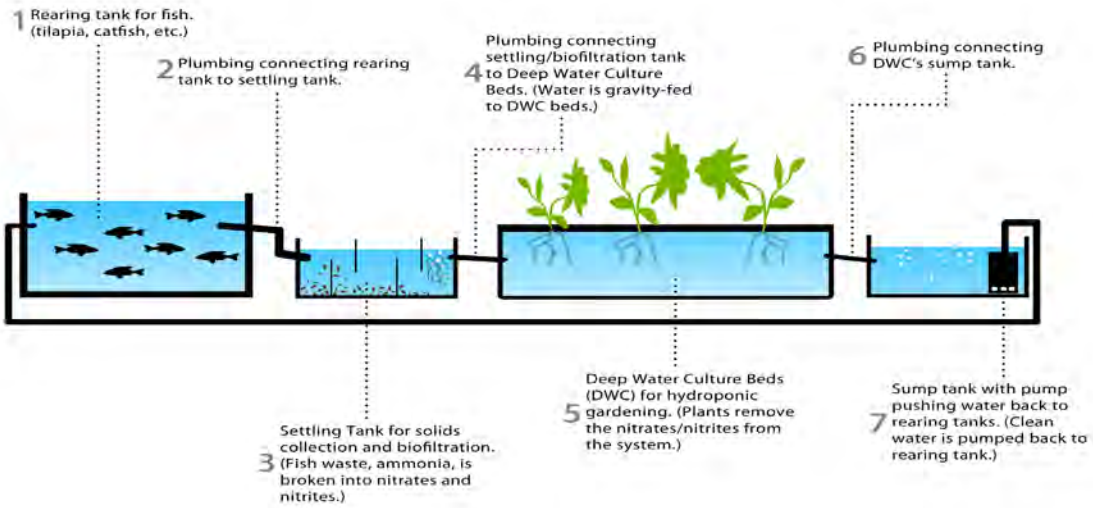

Figure 1: Simplistic overview of aquaponics technology

Proposed project components and layout

The main project components and the proposed layout plan for the full three phases of the project up to 200 000 kg per annum fish production is shown in Figure 2.

Figure 2: Layout plan for the proposed aquaculture facility

The proposed infrastructure of the aquaponics facility will entail the following:

- Pure tank 5000 litres with water supply
- 10 fish rearing tanks, consisting of:
  - Five 5000 litre fish rearing tanks of 2700 mm diameter
  - Five 2500 litre fish rearing tanks of 2200 mm diameter and 900 mm height
- 3 fish houses (30m length x 10m breadth)
  - Hatchery
  - Processing fish house
  - Packing of fish
- 9 greenhouses (30m length x 15m breadth), containing 18 deep water culture tanks for growing lettuce (each tank is 7.5m breadth x 30m length)
- Four clarifiers that are used to remove solid particulates or suspended solids from liquid for clarification and (or) thickening
- Sump that also serves as a reservoir
- Workers facilities (kitchen, toilet etc) (80m length x 40m breadth)
- Existing borehole and water storage dam.

On the layout plan for the aquaculture facility (Figure 2), the water from the fish tanks moves via gravity to the setting tanks (clarifiers) for the first step in removing solid waste. Water is further filtered and the conversion of toxic ammonia into nitrates and nitrites (plant food). The nitrate/nitrite rich food is fed to

the plants in the greenhouses. The plants clean the water for the fish. The clean water is stored in the pure tank. The lettuce is grown in hydroponic tanks (Deep Water Culture beds) in the greenhouses.

Construction phase activities

Quality of the water from the borehole is alkaline with a value of 230.75. The waste water produced from the proposed facility will contain fish excretions, nitrogenous waste products by diffusion and ion exchange through the gills, urine and feces. This facility will recycle water by running it through filters to remove fish waste and food and then recirculating it back into the tanks. The water from the system will be fed to a hydroponic system where the by-products are broken down by bacteria into nitrate and ammonium which are utilized by the plants as nutrients. The electricity demand will be minimal during construction phase, with a budget of approximately R 5000 to R 10 000 per month for electricity. The proposed facility during construction phase will create employment for 30 people and different construction companies will be hired from the Moretele local municipality e.g. drilling of a borehole.

Operations phase activities

During phase one, the proposed facility will transport live fish to a nearby processing facility and Pretoria markets. During phase 2 and phase 3, the proposed facility will process the fish onsite. This will include cleaning, gutting and storing the fish. During cleaning, the caught first are fish washed thoroughly in cold, clean water to remove bacteria, slime, blood, faeces, and mud, etc. from the body surface of the fish. After cleaning, the fishes are cut along their mid ventral side, and their visceral organs are removed. thereafter, the fish is preserved by methods like freezing and drying.

Water supply from an on-site borehole

Water for the aquaculture (for tilapia) and hydroponics (for lettuce) will be sourced from groundwater using a borehole on the site. A technical study was conducted that confirmed the potential for the borehole to provide a sustainable supply of water (ENVASS, 2017). Thereafter, a water use license application was the applicant submitted by the applicant to the Department of Water & Sanitation (DWS) for approval. A desktop level groundwater reserve determination for the site was completed by ENVASS and the CSIR in May 2017 to form part of the water use license application. The recharge for the site area was determined using two methods, namely extraction of values from the DWS dataset and the chloride mass balance (CMB) method. The values for recharge as per the GRDM dataset (DWS, 2012) are between 1% and 2% of mean annual precipitation (MAP). For the site, it was assumed that dry deposition was 10% of the chloride in rainfall value, which was taken as 1 mg/l. Based on the water quality data available for borehole at the site, the chloride in groundwater is 160.8 mg/l. Thus, the effective recharge for the site according to the CMB method is 3.7 mm/a which is 0.6% of MAP. The recharge values from both methods are similar; however the CMB method recharge value of 0.6% MAP was chosen to be representative for the site and was considered realistic and conservative. The applicable groundwater recharge for the site was calculated as 45 510 m^3/a, i.e. 0.045 Mm^3/a.

Water availability and use and management of liquid wastes

According to ENVASS, 2017 the water level of the on-site borehole was measured at 11.85 m below ground level (bgl) and the average water levels for the region varied between 1 and 60 m bgl, with an average water level of 15 m bgl. Water quality samples were taken at the site borehole following aquifer testing and submitted to a SANAS-accredited laboratory for analysis. The majority of parameters were compliant with the SAWQG guideline values, with the exception of total hardness, alkalinity and iron (as Fe). These elevated parameters are likely to be caused by natural rock-water interactions at the site with the exception of:

Alkalinity: 20-100: 230.75
Iron (as Fe): <0.01 0.02
Total Hardness: 20-100: 301

The proposed facility needs 1500 cm^3 of water for the production of 200 000 kg of fish in phase 3. This water will be abstracted from the existing borehole.

The site falls within the A23F quaternary catchment, and several boreholes are registered in this area.

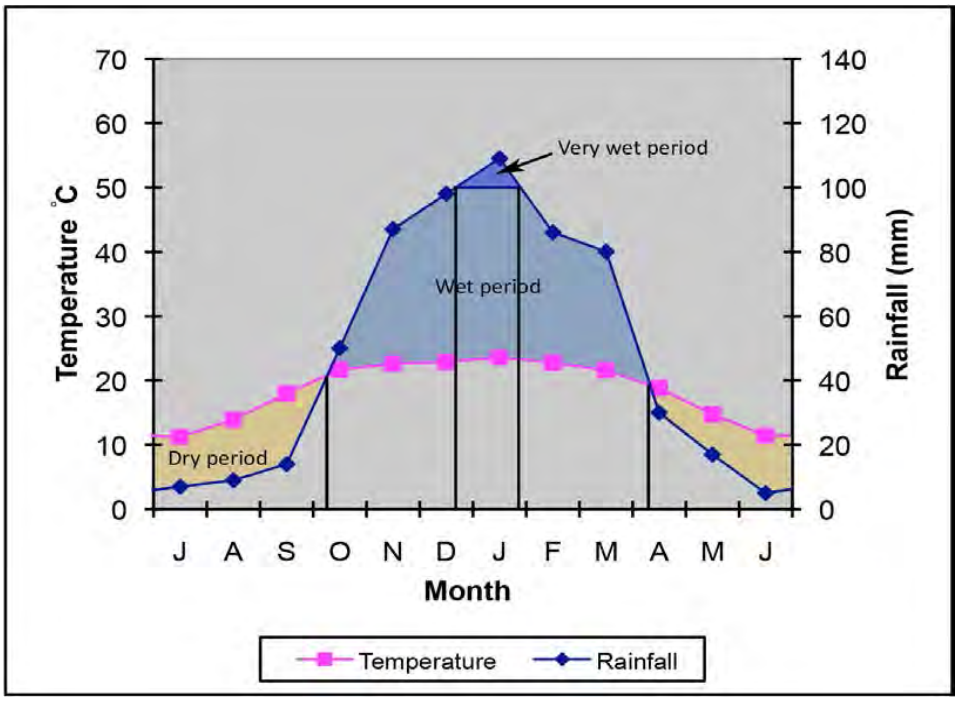

Figure 3: Temperature and rainfall within the area of the Moretele Municipality

Current land use planning and soils and agricultural potential

The current land use on the site and surrounding area is agriculture and the current zoning for the land is agricultural IDP Moretele, 2017). The soils on the site are rated as "moderate" and "moderate-high" on the national database (DAFF, 2016) as shown in Figure 4.

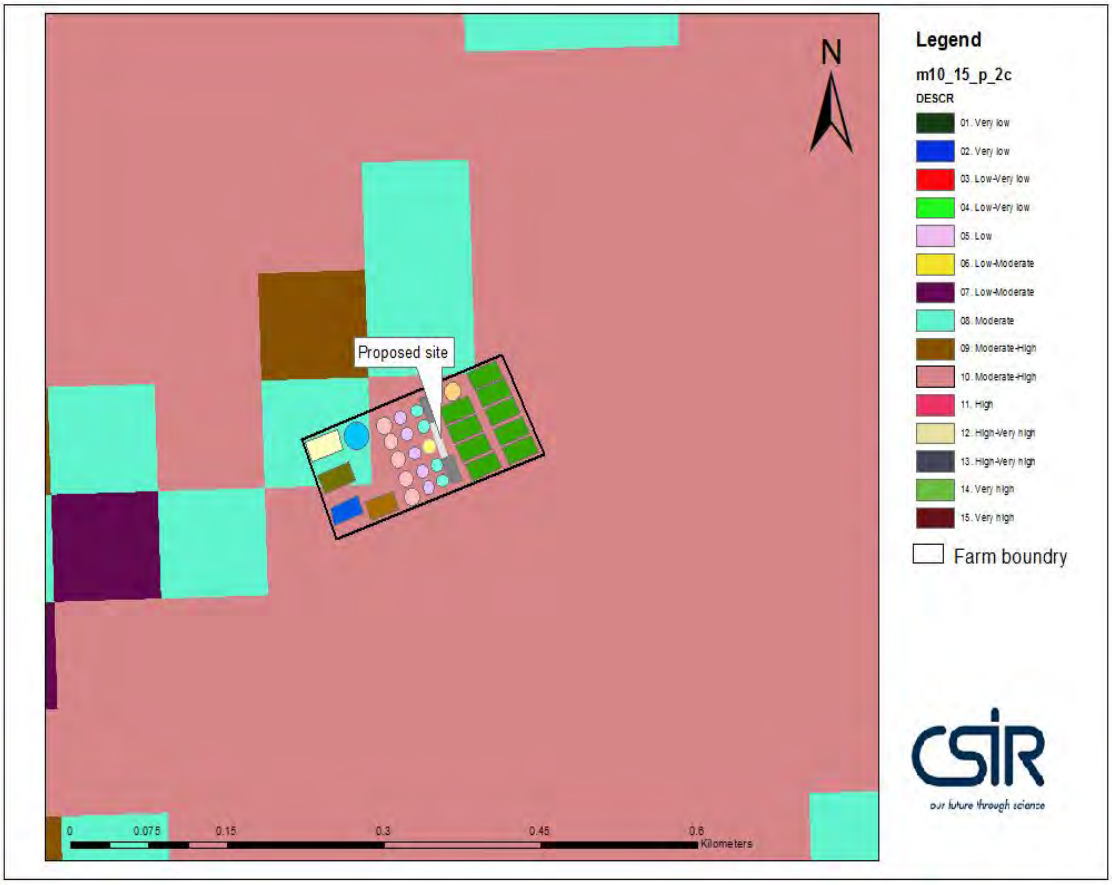

Figure 4 : Soils and land capability potential as provided by the national DAFF database

Determining the sustainable groundwater yield from the borehole on site

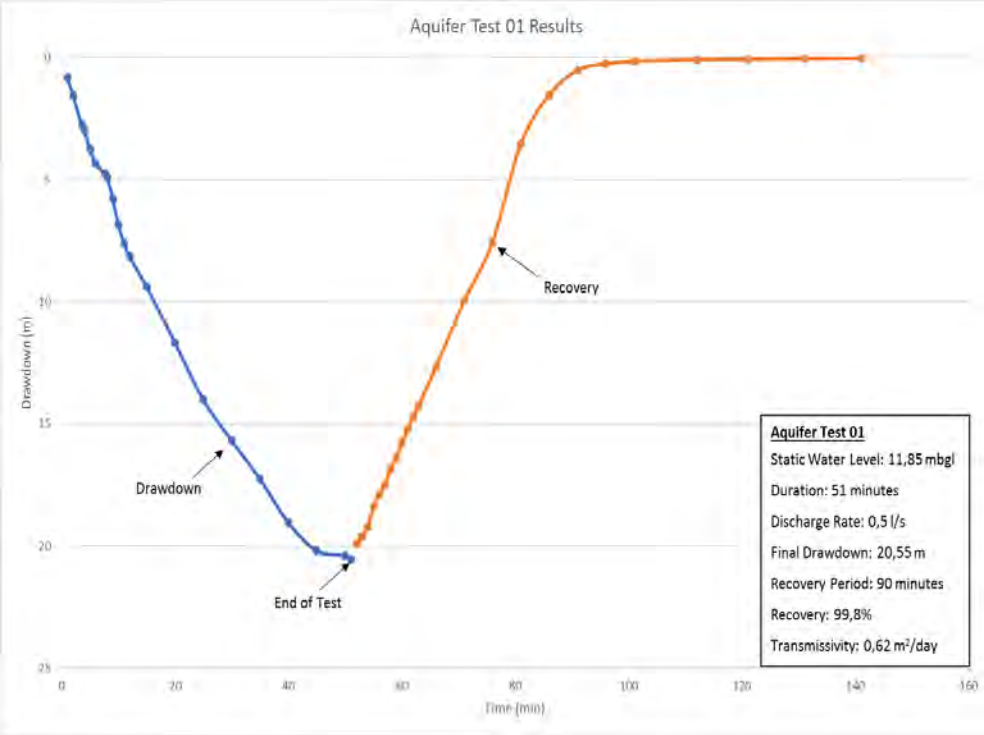

Figure 5: Aquifer Test 01 from the borehole on site

The first aquifer test was conducted on 8th June 2017 using the existing pump equipment at the site, which was installed to a depth of 33 m below ground level (bgl). The static water level for the test was 11.85 m bgl and the available drawdown was 21.15 m. The rate at which groundwater flows horizontally through an aquifer (an average transmissivity) was 0.62 m^2/day). The sustainable borehole yield was determined using the flow characteristic method and was determined to be 0.1 l/s for a 20-hour pumping cycle, or 0.2 l/s for an 8-hour pumping cycle. The sustainable yield of the borehole 8 hours pumping cycle was 5760 life/cycle.

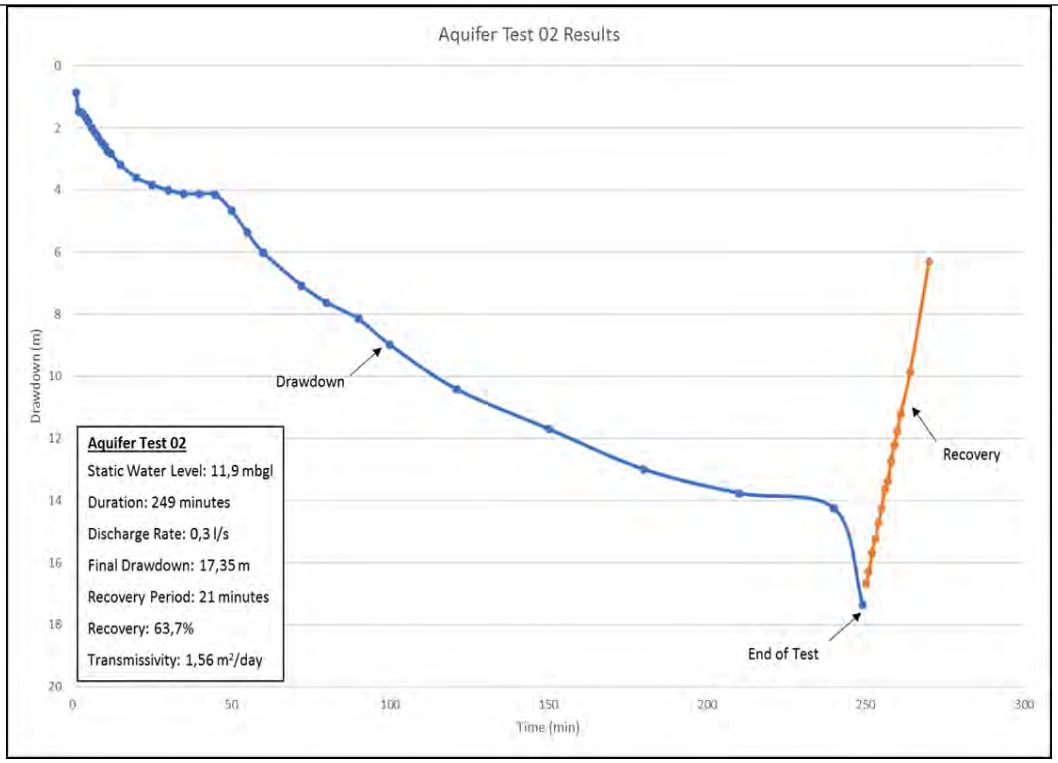

Figure 6: Aquifer Test 02 from the borehole on site

The second aquifer test was conducted on 8th June 2017 using the existing pump equipment at the site, which was installed to a depth of 33 m bgl. A ball valve was installed at the pump outlet to control the flow rate from the borehole. The static water level for the test was 11.9 m bgl and the available drawdown was 21.1 m. The test was conducted for 249 minutes at a constant rate of 0.3 l/s (i.e. 1.1 m3/hour). The final drawdown for the test was 17.35 m, and the sustainable yields are the same as the Aquifer test one.

b) Provide a detailed description of the listed activities associated with the project as applied for

Listed activity as described in GN R.324, 325 and 327	Description of project activity
GN. R 327, 7 April 2017 Activity 6 The development and related operation of facilities, infrastructure or structures for aquaculture of— (i) finfish, crustaceans, reptiles or amphibians, where such facility, infrastructure or structures will have a production output exceeding 20 000 kg per annum (wet weight);	The concentration of 200 000 kg Tilapia production per annum
GN. R.327, 7 April 2017 Activity 8 The development and related operation of hatcheries or agri-industrial facilities outside industrial complexes where the development footprint covers an area of 2 000 square meters or more.	The development of a 2 hectare Aquaculture facility with associated infrastructure including a, storage unit, workers quarters and office
GN.R.327, 7 April 2017 Activity 27: The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- i) the undertaking of a linear activity; or ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The development of a 2 hectare Aquaculture facility with associated infrastructure including a, storage unit, workers quarters and office.

c) Property description/physical address

Province	North West
District Municipality	Bojanala Platinum district
Local Municipality	Moretele Local Municipality
Ward Number(s)	Ward 22
Farm name and number	Bosplaas West
Portion number	Portion 413
21 digit Surveyor General Code	B0JR00000000009100413

Where a large number of properties are involved (e.g. linear activities) please attach a full list to this application including the same information as indicated above

A.2 Feasible and reasonable alternatives

"alternatives", **in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—**

(a) the property on which or location where it is proposed to undertake the activity;

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

(d) the technology to be used in the activity;

(e) the operational aspects of the activity; and

(f) the option of not implementing the activity.

Describe alternatives that are considered in this application as required by EIA Regulation, 2014 Appendix 1(h). Alternatives should include a consideration of all possible means by which the purpose and need of the proposed activity (NOT PROJECT) could be accomplished in the specific instance taking account of the interest of the applicant in the activity. The no-go alternative must in all cases be included in the assessment phase as the baseline against which the impacts of the other alternatives are assessed.

The determination of whether site or activity (including different processes, etc.) or both is appropriate needs to be informed by the specific circumstances of the activity and its environment. After receipt of this report the, competent authority may also request the applicant to assess additional alternatives that could possibly accomplish the purpose and need of the proposed activity if it is clear that realistic alternatives have not been considered to a reasonable extent.

Should the alternatives include different locations and lay-outs, the co-ordinates of the different alternatives must be provided. The co-ordinates should be in degrees, minutes and seconds using the Hartebeeshoek94 WGS84 co-ordinate system.

a) Site alternatives

List alternative sites, if applicable.

Site Alternatives	Description
Alternative Site 1 (preferred or only site alternative)	The applicant does not have an alternative site. To understand the reason for this, it is important to understand the context. DEA commissioned the CSIR to run the "Special Needs and Skills Development (SNSD) Programme" which is aimed at providing *pro bono* Environmental Impact Assessments (EIAs) for people who are classified as special needs clients/applicants. This specifically applies to applicants such as Small, Medium and Micro Enterprises (SMMEs), Community Trusts, Individuals or Government Programmes that cannot afford the cost for obtaining the Environmental Authorisation. The CSIR received an application from Blue-Green Aquaculture (Pty) Ltd under the SNSD Programme. The CSIR identified Blue-Green Aquaculture (Pty) Ltd as a client or a special needs applicant and has agreed to assist them with acquiring Environmental Authorization for the project on a *pro bono* basis, including the cost of the basic assessment, specialist studies and associated site visits. Blue-Green Aquaculture is a 100% black owned entity. The applicant has applied for funding through the Land Bank but he was advised to provide an Environmental Authorization as such there is a need for a Basic Assessment. The Land Bank provides support to previously disadvantaged individuals who do not have the start-up capital to launch their own enterprise. Thus, the site which is being investigated in this report is the only site available to this entity and there are no available alternative sites to be considered as Blue Green leased the land from Mr Kgomo for the period of 10 years with a high possibility of renewal.
Alternative Site 2	
Alternative Site 3	

Site Co-ordinates

	Latitude (S):			Longitude (E):		
Alternative S1 (preferred or only site alternative)	28°	14′	36.848′′	25°	19′′	38.9418″
Alternative S2 (if any)						
Alternative S3 (if any)						

In the case of linear activities:

Alternative:	**Latitude (S):**			**Longitude (E):**		
Alternative S1 (preferred or only route alternative)						
• Starting point of the activity						
• Middle/Additional point of the activity						
• End point of the activity						
Alternative S2 (if any)						
• Starting point of the activity						
• Middle/Additional point of the activity						
• End point of the activity						
Alternative S3 (if any)						
• Starting point of the activity						
• Middle/Additional point of the activity						

- End point of the activity

For route alternatives that are longer than 500m, please provide an addendum with co-ordinates taken every 250 metres along the route for each alternative alignment.

In the case of an area being under application, please provide the co-ordinates of the corners of the site as indicated on the lay-out map provided in Appendix A.

b) Lay-out alternatives

Alternatives	Description
Alternative 1 (preferred or only alternative)	The layout of the proposed project has been carefully informed by the findings of the Ecological Impact Assessment and the Heritage Impact Assessment (Appendix G) so as to avoid sensitive areas and loss of species of conservation concern. Furthermore the development is within areas that have already been transformed previously to limit the disturbance of natural habitats.
Alternative 2	
Alternative 3	

c) Technology alternatives

Alternatives	Description
Alternative 1 (preferred or only alternative)	The project uses aquaponics technology (refer to the project description).Heating technology to maintain suitable water temperatures for tilapia is a core part of the project technology. Electricity and solar will be used in winter to warm the water since Mozambique tilapia (*Oreochromis mossambicus*) prefers warm water environment. The optimal temperature range needed by Mozambique tilapia for growth and reproduction is 22–30°C. The species can, however, survive at temperatures between 16 and 39°C.
Alternative 2	
Alternative 3	

d) Other alternatives (e.g. scheduling, demand, input, scale and design alternatives)

Alternatives	Description
Alternative 1 (preferred or only alternative)	The proposed development is within the vicinity of and existing transformed agricultural land, thus suitable for agricultural related projects such as an Aquaculture Tilapia farm. The nature of the project was determined based on the farming experience, need and knowledge of the applicant in terms of Tilapia production, the need of fish as well as funding opportunities available for the development. Furthermore the operating plan for the proposed project has been informed by extensive market research and an assessment of the need of the products that will be produced.
Alternative 2	
Alternative 3	

e) No-go alternative

Should the No-Go Option be implemented, the site would maintain its status quo. The site is currently used for agriculture crop production. As such, the No-Go Option would not be environmentally, socially or economically feasible in the long-term and is thus not deemed feasible. However, the No-Go Option is nevertheless considered and assessed in relation to the potential implications of the proposed project, as required in terms of NEMA and its EIA Regulations

f) Please motivate for preferred site, activity and technology alternative

Motivation for the proposed site alternative as well as exclusion of alternatives:

Site location and layout alternatives

The applicant does not have an alternative site. To understand the reason for this, it is important to understand the context. The Department of Environmental Affairs DEA commissioned the CSIR to run the "Special Needs and Skills Development (SNSD) Programme" which is aimed at providing pro bono Environmental Impact Assessments (EIAs) for people who are classified as special needs clients/applicants, specifically Small, Medium and Micro Enterprises (SMMEs), Community Trusts, Individuals or Government Programmes. The CSIR received an application from Blue-Green (Pty) Ltd under the SNSD Programme. The CSIR identified Blue-Green as a client or a special needs applicant and has agreed to assist them with acquiring Environmental Authorization for the project on a pro bono basis, including the cost of the basic assessment, specialist studies, site visits and human resource. The layout of the proposed project has been carefully informed by the findings of the Ecological Impact Assessment, the Heritage Impact Assessment and the geohydrology (Appendix G) so as to avoid sensitive areas and loss of species of conservation concern. Furthermore the development is within areas that have already been transformed previously to limit the disturbance of natural habitats.

Design, technology & activity alternatives

The proposed development falls in the previously transformed agricultural land thus suitable for agricultural related projects such as Tilapia farming. The nature of the project was determined based on the farming experience, need and knowledge of the applicant in terms of fish production, the need of fish as well as funding opportunities available for the development. Furthermore the operating plan for the proposed project has been informed by extensive market research and an assessment of the need of the products that will be produced. In terms of the economic viability, the project does not make use of major technologies, which in turn results in the proposed development requiring very little energy. The following measures will be used as part of the resource efficiency of the proposed development:

Warming and lighting efficiency

Hydro Royal Solar water heating technology will be used in winter together with the electricity to minimise power usage and to warm up the water in order to sustain the lives of the fish. The sun will harvest heat and transfer it to the tank to reduce heating expenses in the fish farm and the Air Source Heat Pump. This water warming technology will be used in winter only to sustain the lives of the fish.

Waste water

Mozambique tilapia is opportunistic omnivores and will eat algae, plant matter, organic particles, small invertebrates (Morgan DL, 2004). Such a broad diet enables them to colonise different environments, since they don't rely on any particular food source. All waste water from the Aquaculture farm will be used to irrigate vegetables (lettuce) in the greenhouse. The jobs being created by the proposed development will be sourced to local communities. The operations of this facility will be under constant supervision.

Paragraphs 3 – 13 below should be completed for each alternative.

A.3 Physical size of the activity

a) Indicate the physical size of the preferred activity/technology as well as alternative activities/technologies (footprints):

Alternative:	**Size of the activity:**
Alternative A1[1] (preferred activity alternative)	20 000m^2
Alternative A2 (if any)	
Alternative A3 (if any)	

or, for linear activities:

Alternative:	**Length of the activity:**
Alternative A1 (preferred activity alternative)	
Alternative A2 (if any)	
Alternative A3 (if any)	

b) Indicate the size of the alternative sites or servitudes (within which the above footprints will occur):

Alternative:	**Size of the site/servitude:**
Alternative A1 (preferred activity alternative)	
Alternative A2 (if any)	
Alternative A3 (if any)	

A.4 Site access

Does ready access to the site exist?	**YES**
If NO, what is the distance over which a new access road will be built	

Describe the type of access road planned:

Include the position of the access road on the site plan and required map, as well as an indication of the road in relation to the site.

The proposed project is located north of the town of Hammanskraal, west of the N1 national road, with access from the R101 road (refer to Figures 7 and 8).

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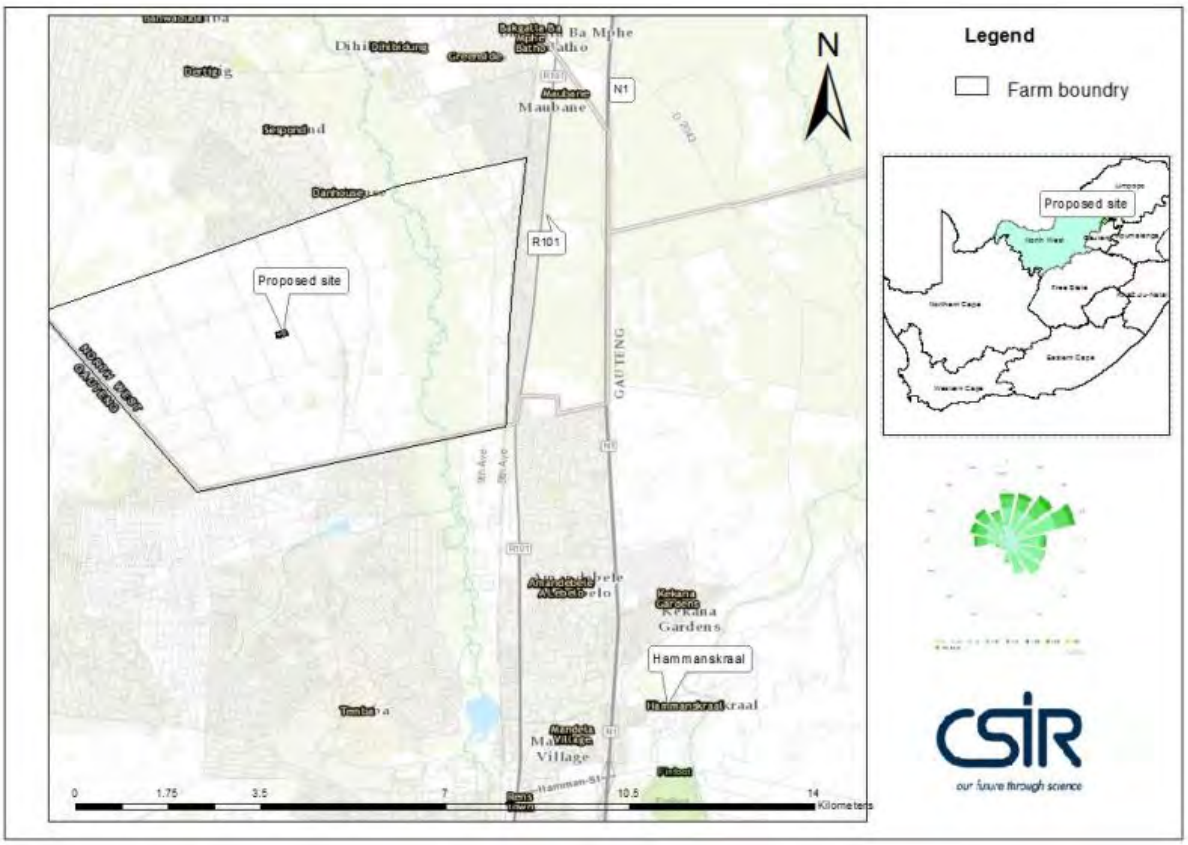


Figure 7: Map showing the locality of the site in the North West province

A.5 Locality map

An A3 locality map must be attached to the back of this document, as Appendix A. The scale of the locality map must be relevant to the size of the development (at least 1:50 000. For linear activities of more than 25 kilometres, a smaller scale e.g. 1:250 000 can be used. The scale must be indicated on the map.). The map must indicate the following:

- an accurate indication of the project site position as well as the positions of the alternative sites, if any;
- indication of all the alternatives identified;
- closest town(s;)
- the accurate indication of the site in relation to closest protected environments or national parks (i.e. within 2.5 km)
- road access from all major roads in the area;
- road names or numbers of all major roads as well as the roads that provide access to the site(s);
- all roads within a 1km radius of the site or alternative sites; and
- a north arrow;
- a legend; and
- locality GPS co-ordinates (Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees, minutes and seconds using the Hartebeeshoek94 WGS84 co-ordinate system

A.6 Layout/route map

A detailed site or route plan(s) must be prepared for each alternative site or alternative activity. It must be attached as Appendix B to this document.
The site or route plans must indicate the following:

- the property boundaries and numbers of all the properties within 50 metres of the site;
- the current land use as well as the land use zoning of the site;
- the current land use as well as the land use zoning each of the properties adjoining the site or sites;
- the exact position of each listed activity applied for (including alternatives);
- servitude(s) indicating the purpose of the servitude;
- a legend; and
- a north arrow.

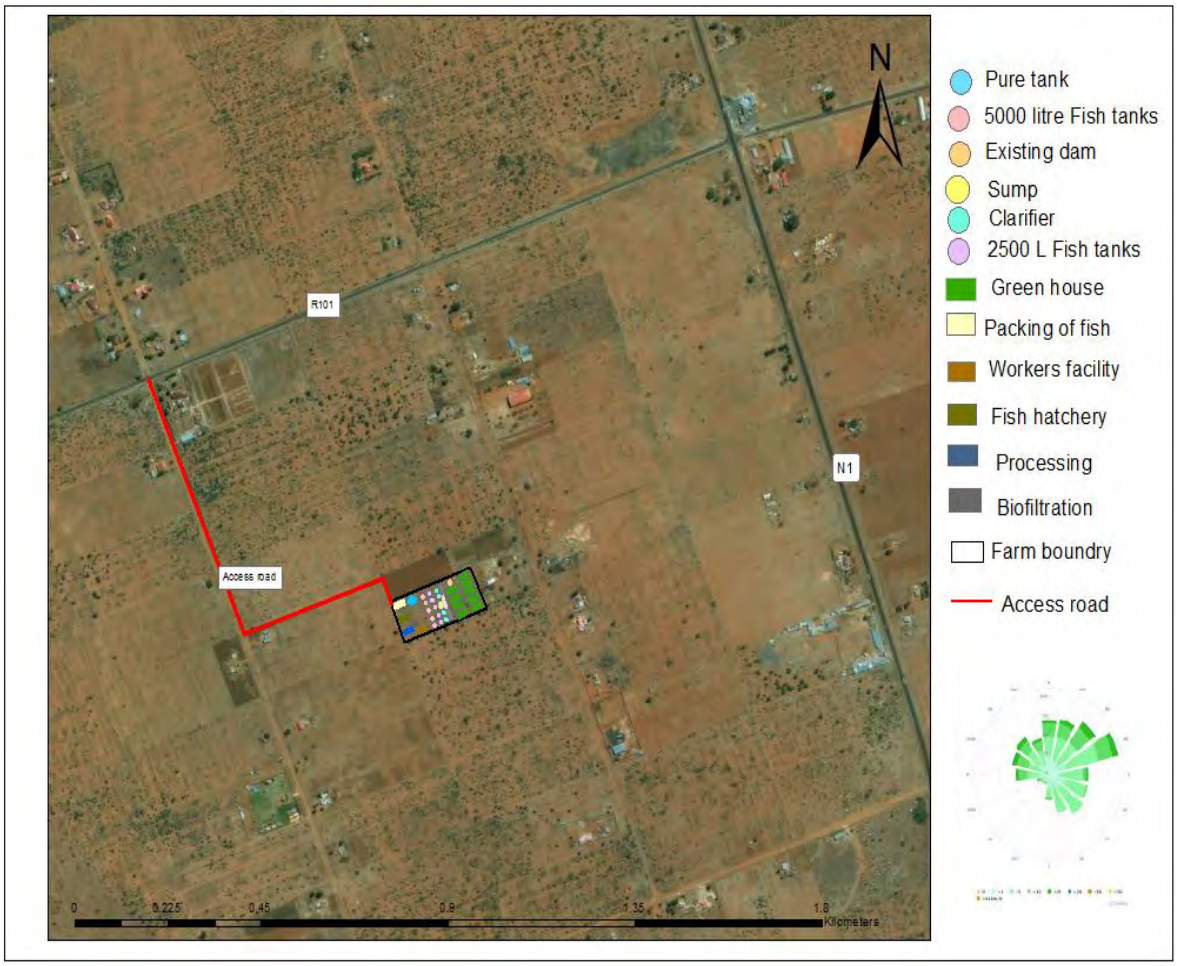


Figure 8: Map showing the location of the proposed aquaculture facility on the farm Bosplaas West Plot 413

A.7 Sensitivity map

The layout/route plan as indicated above must be overlain with a sensitivity map that indicates all the sensitive areas associated with the site, including, but not limited to:

- watercourses;
- the 1:100 year flood line (where available or where it is required by Department of Water and Sanitation);
- ridges;

- for gentle slopes the 1 metre contour intervals must be indicated on the plan and whenever the slope of the site exceeds 1:10, the 500mm contours must be indicated on the plan; and
- cultural and historical features;
- areas with indigenous vegetation (even if it is degraded or infested with alien species); and
- critical biodiversity areas and ecological support area.
- protected areas (e.g Magaliesberg Protected Environment, Pilanesberg National Park etc.)

The sensitivity map must also cover areas within 100m of the site and must be part of Appendix B.

A.8 Site photographs

Colour photographs from the centre of the site must be taken in at least the eight major compass directions with a description of each photograph. Photographs must be attached under Appendix C to this report. It must be supplemented with additional photographs of relevant features on the site, if applicable.

A.9 Facility illustration

A detailed illustration of the activity must be provided at a scale of at least 1:200 as Appendix D for activities that include structures. The illustrations must be to scale and must represent a realistic image of the planned activity. The illustration must give a representative view of the activity.

A.10 Activity motivation

Motivate and explain the need and desirability of the activity (including demand for the activity):

1. Is the activity permitted in terms of the property's existing land use rights?	**YES**	**NO**	**Please explain**
The proposed development site falls within agricultural zoning of the municipality			
2. Will the activity be in line with the following?			
(a) Provincial Spatial Development Framework (PSDF)	**YES**		
The agricultural sector in North West has been identified as the backbone of rural economy; this is mainly because it has the potential to improve food security as well as to stimulate economic growth within the province. The proposed development will contribute towards the agricultural growth of the province in terms of job creation, positive trade balance for agricultural growth as well as skills development. The framework also acknowledges the significant role of emerging farmers towards agricultural production.			
(b) Urban edge / Edge of Built environment for the area		**NO**	
The proposed development is situated within the rural area Thaba ya Batho (Bosplaas).			
(c) Integrated Development Plan (IDP) and Spatial Development Framework (SDF) of the Local Municipality (e.g. would the approval of this application compromise the integrity of the existing approved and credible municipal IDP and SDF?).	**YES**		
The proposed development promotes agricultural development and aligns with these objectives. According to the IDP of Moretele Local municipality, agriculture has become a focal point in all economic development prospects for the municipality. Furthermore, the strategic objectives outlined in the IDP have identified agricultural development within the municipality as key performance indicator to achieving economic growth			
(d) Approved Structure Plan of the Municipality			**Please explain**
The proposed site falls within agricultural transformed zone according to the municipal SDF the area is a local Agri-economic development			

(e) An Environmental Management Framework (EMF) adopted by the Department (e.g. Would the approval of this application compromise the integrity of the existing environmental management priorities for the area and if so, can it be justified in terms of sustainability considerations?)		**NO**	
According to the Draft environmental management By Law of the Moretele Municipality the municipality is yet to develop a sensitive habitat management and conservation plan. In addition, the environmental management By law also outlines the principles of NEMA which promotes development that is socially, economically and environmentally sustainable. The undertaking of the Basic Assessment ensures that negative environmental impacts are avoided and minimised where possible.			
(f) Any other Plans (e.g. Guide Plan)		**NO**	
The proposed development site falls in the cultivated land according to the North West Spatial Development Plan			
Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved SDF agreed to by the relevant environmental authority (i.e. is the proposed development in line with the projects and programmes identified as priorities within the credible IDP)?			
3. Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved SDF agreed to by the relevant environmental authority (i.e. is the proposed development in line with the projects and programmes identified as priorities within the credible IDP)?	**YES**		
Agriculture is currently a focal point in developmental prospects within the municipality. As such the proposed development of Aquaponics aligns with the priorities identified in the IDP.			
4. Does the community/area need the activity and the associated land use concerned (is it a societal priority)? (This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate.)	**YES**		
According to the IDP, 2017 the communities within this municipality have identified Aquaculture as a priority need that contributes towards local economic development and job creation.			
5. Are the necessary services with adequate capacity currently available (at the time of application), or must additional capacity be created to cater for the development? (Confirmation by the relevant Municipality in this regard must be attached to the final Basic Assessment Report as Appendix E.)	**YES**		
The applicant shall lodge an application with Eskom for electricity needs of the project. Furthermore the applicant will use groundwater. An application for a Water use License shall be lodged with the Department of Water and Sanitation.			
6. Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services and opportunity costs)? (Comment by the relevant Municipality in this regard must be attached to the final Basic Assessment Report as Appendix I.)			**Please explain**
No additional connection shall be required, the site already has infrastructure for the supply of electricity. The applicant shall lodge an application for additional capacity.			
7. Is this project part of a national programme to address an issue of national concern or importance?	**YES**		
The proposed development aims to address challenges of food security in South Africa on a local scale. This shall be done through rural economic growth, maintenance of positive trade balance for primary agricultural products as well as skills development and training for the local community.			

8. Do location factors favour this land use (associated with the activity applied for) at this place? (This relates to the contextualisation of the proposed land use on this site within its broader context.)	**YES**	
The proposed development is within low-moderate environmental sensitive area; furthermore it has a history of agricultural practices as such providing a suitable location for the fish tanks		
9. Is the development the best practicable environmental option for this land/site?	**YES**	
The proposed development site is not pristine; it has already been transformed as a result of past agricultural practices. The development footprint of the site has been carefully informed by the sensitivities on site and will occur in areas of low-moderate sensitivities ensuring minimal destruction of important flora and fauna.		
10. Will the benefits of the proposed land use/development outweigh the negative impacts of it?	**YES**	
The project benefits outweigh the negative impacts; the project will make a positive contribution to sustainable economic growth, skills development and employment opportunities in the Moretele Local Municipality. Furthermore it will be undertaken in a manner that aims to minimise environmental impacts of the Aquaponics farm.		
11. Will the proposed land use/development set a precedent for similar activities in the area (local municipality)?	**YES**	
The proposed development is within low-moderate environmental sensitive area; furthermore it has a history of agricultural practices as such providing a suitable location for the aquaculture facility		
12. Will any person's rights be negatively affected by the proposed activity/ies?		**NO**
The project will not affect the rights of the local community; in fact it will economically benefit the local community by creating job opportunities.		
13. Will the proposed activity/ies compromise the "urban edge" as defined by the local municipality?		**NO**
The proposed project is located outside the urban edge.		
14. Will the proposed activity/ies contribute to any of the 17 Strategic Integrated Projects (SIPS)?		**NO**
The proposed development is on a small scale and does not contribute towards the Strategic Integrated projects.		
15. What will the benefits be to society in general and to the local communities?		**Please explain**
The benefit of the project entails 100 permanent employment at during phase 3, food security, skills development and training for the local community.		
16. Any other need and desirability considerations related to the proposed activity?		**Please explain**
No		
17. How does the project fit into the National Development Plan for 2030?		**Please explain**
According to StatsSA, the Bosplaas community is poverty stricken with above 20% of the households with no income. The proposed development aims to maintain and increase South Africa's ability to meet its national food requirements, and also seeks to eliminate inequalities and poverty amongst households in Bosplaas and Moretele local municipality. According to Stats SA, about 14.3 million South Africans are vulnerable to food insecurity. As such the proposed development feeds into the food security stream. In addition, the main goals highlighted in the NDP which relate to the proposed project are employment and adequate nutrition. Chapter 6 of the National Development Plan highlights an "inclusive rural economy" and the objectives of this plan are to create jobs in agriculture, maintain a positive trade balance for primary and processed agricultural products and activating rural economies through service to small and micro farmers.		

18. Please describe how the general objectives of Integrated Environmental Management as set out in Section 23 of NEMA as amended have been taken into account.
The general objectives of Integrated Environmental Management were taken into account by considering all the potential negative and positive impacts of the proposed project on both the biophysical and socio-economic environments. In order to avoid potentially significant impacts, specialist inputs were obtained in relation to terrestrial and aquatic ecology. Based on the findings of the specialist studies a number of recommendations / mitigation measures have been identified for consideration in further project design and implementation. A Public Participation Process is being conducted for the project, where local farmers, landowners, communities and the local authority (Interested and Affected Parties) are being consulted from the throughout the Environmental Basic Assessment process in order to receive their views about the proposed development. The public and authorities will be given adequate opportunity to comment on the proposed project and to participate in the Basic Assessment Process. The Environmental Basic Assessment report together with the Environmental Management Programme will be submitted to the Department of Environmental Affairs for review and approval prior the implementation of the project.
19. Please describe how the principles of environmental management as set out in Section 2 of NEMA as amended have been taken into account.
All efforts are being made to ensure that the project achieves sustainability, environmental justice and that the environmental rights of Interested and Affected Parties (local stakeholders, communities and the construction employees) are protected. The basic needs of landowners and the public were taken into account during the planning phase of the proposed project, which aims to stimulate economic growth, create employment opportunities and make significant contribution towards food security. Minimisation of potential negative impacts and optimisation of potential positive impacts will be ensured by way of effective implementation of the Construction EMPr. Thus the proposed project is deemed to be socially, environmentally and economically sustainable.

A.11 Applicable legislation, policies or guidelines

List all legislation, policies and/or guidelines of any sphere of government that are applicable to the application as contemplated in the EIA regulations, if applicable:

Title of legislation, policy or guideline	Applicability to the project	Administering authority	Date
The Constitution of the Republic of South Africa (No. 108 of 1996)	The constitution states that “everyone has the right to an environment that is not harmful to their health or well-being”.	National and Provincial	1996
National Environmental Management Act, 1998 (Act 107 of 1998).	The proposed development triggers listed activities within this act	National Government, and National Department of Environmental Affairs	1998
National Environmental Management Act EIA Regulations (7 April 2017)	A number of listed activities have been identified that have triggered the need for a Basic Assessment in terms of these regulations	National Government, and National Department of Environmental Affairs	2017
National Water Act, 1998 (Act 36 of 1998).	The proposed development uses groundwater	Department of Water Affairs	1998
National Environmental Management: Waste Act (Act 59 of 2008) (as amended)	Protection of the surrounding environment through efficient waste management by the appointed Contractor.	National Government, and National Department of Environmental Affairs	2008
The National Heritage Resources Act, 1999 (Act No	The proposed development site has graves.	South African Heritage Resource	1999

Title of legislation, policy or guideline	Applicability to the project	Administering authority	Date
25 of 1999) as amended, particularly Chapter II, Section 38		Agency	
National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004)	The NEMBA aims to conserve and provide management of biodiversity in the country. The proposed development site is within a critical biodiversity area.	National Government, and National Department of Environmental Affairs	2004
Local Municipal By-Laws.	Any municipal by laws that may have jurisdiction over this project.	Rustenburg Local Municipality	

A.12 Waste, effluent, emission and noise management

a) Solid waste management

	YES	NO
Will the activity produce solid construction waste during the construction/initiation phase?		
If YES, what estimated quantity will be produced per month?	$200m^3$	

How will the construction solid waste be disposed of (describe)?

Waste generated during the construction activities will be collected by the trucks of the appointed Contractor and disposed of at the registered Bosplaas West landfill facility

Where will the construction solid waste be disposed of (describe)?

- Waste generated will be disposed of at the Bosplaas west landfill facility.
- Recyclable materials will be collected or delivered to haulers (recyclers): Who in turn give monetary remuneration for materials such as scrap metal.
- Debris such as brick, asphalt and concrete to be scattered over road to avoid muddiness during rain
- Assign dumpsters (bins) by reputable waste management companies e.g. Waste Group who will periodically pick the bin when it's full for disposing. This will remove materials from the construction site that is otherwise left behind by the haulers.

	YES	
Will the activity produce solid waste during its operational phase?		
If YES, what estimated quantity will be produced per month?	$8m^3$	

How will the solid waste be disposed of (describe)?

Most of the solid waste will be from fish carcases and it will be used to supply the plants with nutrients

If the solid waste will be disposed of into a municipal waste stream, indicate which registered landfill site will be used.

Municipal waste collected and dumped at the Bosplaas West landfill (dumpsite)

Where will the solid waste be disposed of if it does not feed into a municipal waste stream (describe)?

If for some reason the municipal waste is not collected periodically then the local authority will be immediately called to collect the waste and the councillor asked to intervene and investigate.

If the solid waste (construction or operational phases) will not be disposed of in a registered landfill site or be taken up in a municipal waste stream, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Can any part of the solid waste be classified as hazardous in terms of the NEM:WA?	NO

If YES, inform the competent authority and request a change to an application for scoping and EIA. An application for a waste permit in terms of the NEM:WA must also be submitted with this application.

Is the activity that is being applied for a solid waste handling or treatment facility?	NO

If YES, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA. An application for a waste permit in terms of the NEM:WA must also be submitted with this application.

b) Liquid effluent

Will the activity produce effluent, other than normal sewage, that will be disposed of in a municipal sewage system?	NO
If YES, what estimated quantity will be produced per month?	
Will the activity produce any effluent that will be treated and/or disposed of on site?	NO

If YES, describe the type of effluent and the disposal mechanism/method

The waste water will be used for irrigation of cultivated cash crops on site

Will the activity produce effluent that will be treated and/or disposed of at another facility?	NO

If YES, provide the particulars of the facility:

Facility name:			
Contact person:			
Postal address:			
Postal code:			
Telephone:		**Cell:**	
E-mail:		**Fax:**	

Describe the measures that will be taken to ensure the optimal reuse or recycling of waste water, if any:

c) Emissions into the atmosphere

Will the activity release emissions into the atmosphere other that exhaust emissions and dust associated with construction phase activities?	NO
If YES, is it controlled by any legislation of any sphere of government?	

If YES, the applicant must consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If NO, describe the emissions in terms of type and concentration:

d) Waste Licence/Registration

Will any aspect of the activity produce waste that will require a waste licence/registration in terms of the NEM:WA?	NO

If YES, please submit evidence that an application for a waste licence/registration has been submitted to the competent authority

e) Generation of noise

Will the activity generate noise?	YES	
If YES, is it controlled by any legislation of any sphere of government?		NO

If YES, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If NO, describe the noise in terms of type and level:

Noise during construction by trucks However, the noise will be of a short term, temporary, localised nature and will last only during the construction phase of the project. The EMPr specifies that the appointed Contractor should liaise with affected communities during construction to minimise noise impacts.

A.13 Water use

Please indicate the source(s) of water that will be used for the activity by ticking the appropriate box(es):

	Groundwater	

If water is to be extracted from groundwater, river, stream, dam, lake or any other natural feature, please indicate the volume that will be extracted per month:	10 000 litres (note that the groundwater extracted will be re-circulated and re-used, as explained in the project description)
Does the activity require a water use authorisation (general authorisation or water use license) from the Department of Water and Sanitation?	YES

If YES, please provide proof that the application has been submitted to the Department of Water and Sanitation.

A.14 Energy efficiency

Describe the design measures, if any that have been taken to ensure that the activity is energy efficient:

The following measures will be used as part of the resource efficiency of the proposed development:

Warming efficiency

Hydro Royal Solar water heating technology will be used in winter to warm up the water in order to sustain the lives of the fish. The sun will harvest heat and transfer it to the tank to reduce heating expenses in the fish farm and the Air Source Heat Pump. This water warming technology will be used in winter only to sustain the lives of the fish.

Describe how alternative energy sources have been taken into account or been built into the design of the activity, if any:

Has a specialist been consulted to assist with the completion of this section? NO

If YES, please complete the form entitled "Details of specialist and declaration of interest" for the specialist appointed and attach in Appendix F.

SECTION B: SITE / AREA / PROPERTY DESCRIPTION

Important notes:

1. For linear activities (pipelines, etc) as well as activities that cover very large sites, it may be necessary to complete this section for each part of the site that has a significantly different environment. In such cases please complete copies of Section B and indicate the area, as it appears on the Site Plan.

2. Paragraphs 1 - 6 below must be completed for each alternative.

Current land-use zoning as per local municipality IDP/records:	Agricultural

In instances where there is more than one current land-use zoning, please attach a list of current land use zonings that also indicate which portions each use pertains to, to this application.

Is a change of land-use or a consent use application required? YES

B.1 Gradient of the site

Indicate the general gradient of the site.

Alternative S1:

Flat

Alternative S2 (if any):

Flat

Alternative S3 (if any):

Flat

B.2 Location in the landscape

Indicate the landform(s) that best describes the site:

2.1 Ridgeline		2.4 Closed valley	
2.2 Plateau		2.5 Open valley	
2.3 Side slope of hill/mountain		2.6 Plain	
		2.7 Undulating plain / low hills	
		2.8 Dune	
		2.9 Seafront	

B.3 Groundwater, soil and geological stability of the site

Is the site(s) located on any of the following?

	Alternative S1:	Alternative S2 (if any):	Alternative S3 (if any):
Shallow water table (less than 1.5m deep)	NO		
Dolomite, sinkhole or doline areas	NO		
Seasonally wet soils (often close to water bodies)	NO		
Unstable rocky slopes or steep slopes with loose soil	NO		
Dispersive soils (soils that dissolve in water)	NO		
Soils with high clay content (clay fraction more than 40%)	NO		
Any other unstable soil or geological feature	NO		
An area sensitive to erosion	YES		

If you are unsure about any of the above or if you are concerned that any of the above aspects may be an issue of concern in the application, an appropriate specialist should be appointed to assist in the completion of this section. Information in respect of the above will often be available as part of the project information or at the planning sections of local authorities. Where it exists, the 1:50 000 scale Regional Geotechnical Maps prepared by the Council for Geo Science may also be consulted.

B.4 Groundcover

Indicate the types of groundcover present on the site. The location of all identified rare or endangered species or other elements should be accurately indicated on the site plan(s).

Natural veld - good condition[E]	Natural veld with scattered aliens[E]

If any of the boxes marked with an "[E] "is ticked, please consult an appropriate specialist to assist in the completion of this section if the environmental assessment practitioner doesn't have the necessary expertise.

B.5 Surface water

Indicate the surface water present on and or adjacent to the site and alternative sites?

Perennial River	YES	
Non-Perennial River		NO
Permanent Wetland		NO
Seasonal Wetland	YES	
Artificial Wetland		NO

If any of the boxes marked YES or UNSURE is ticked, please provide a description of the relevant watercourse.

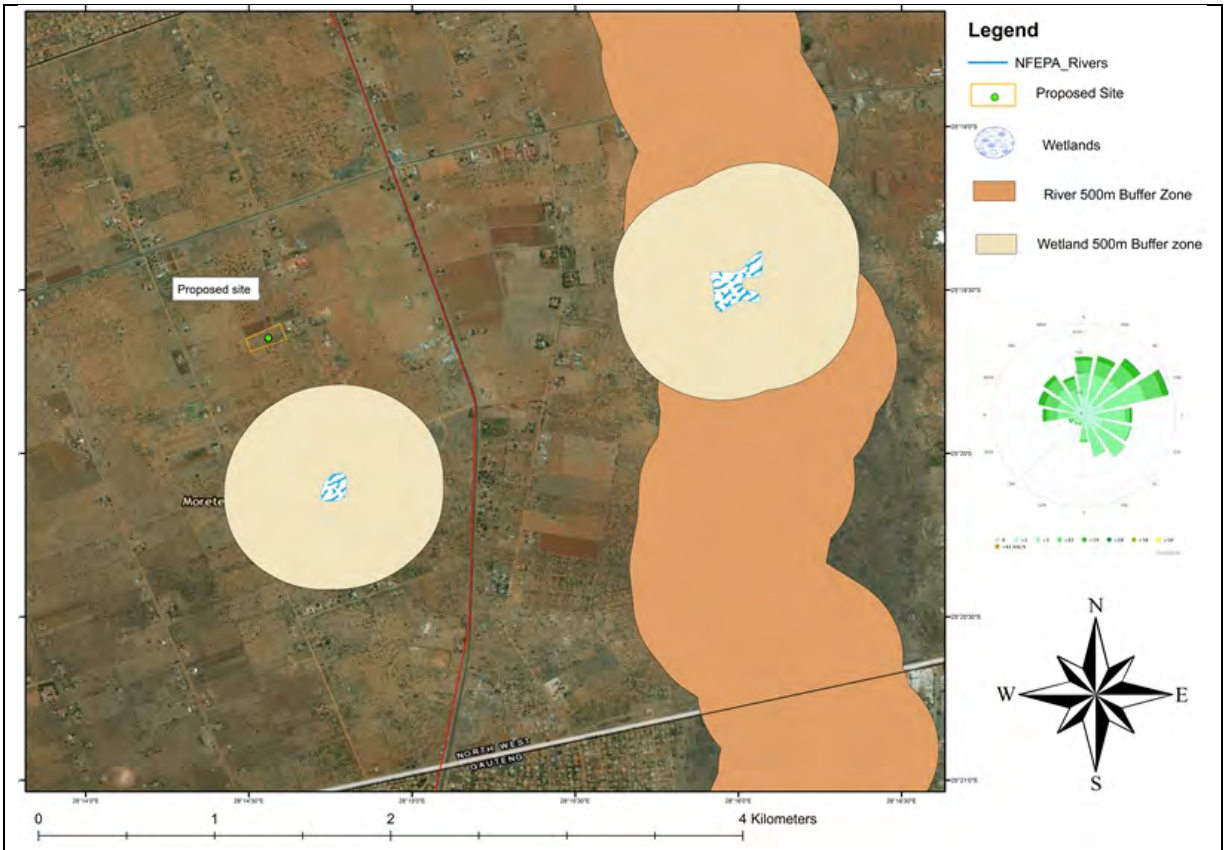


Figure 9: Watercourse Buffered map

The nearby wetland is located approximately 1km to the south of the proposed development site and as such does not trigger any listed activity in terms of NEMA or NFEPA

B.6 Land use character of surrounding area

Indicate land uses and/or prominent features that currently occur within a 500m radius of the site and give description of how this influences the application or may be impacted upon by the application:

Natural area	
Low density residential	
	Plantation
	Agriculture

If any of the boxes marked with an "N "are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain

If any of the boxes marked with an "AN" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

If any of the boxes marked with an "H" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

Does the proposed site (including any alternative sites) fall within any of the following:

Critical Biodiversity Area (as per provincial conservation plan)		NO
Core area of a protected area?		NO
Buffer area of a protected area?		NO
Planned expansion area of an existing protected area?		NO
Existing offset area associated with a previous Environmental Authorisation?		NO

If the answer to any of these questions was YES, a map indicating the affected area must be included in Appendix B (as part of sensitivity map).

B.7 Biodiversity

Please note: The Department may request specialist input/studies depending on the nature of the biodiversity occurring on the site and potential impact(s) of the proposed activity/ies. To assist with the identification of the biodiversity occurring on site and the ecosystem status consult http://bgis.sanbi.org or BGIShelp@sanbi.org. Information is also available on compact disc (cd) from the Biodiversity-GIS Unit, Ph (021) 799 8698. This information may be updated from time to time and it is the applicant/ EAP's responsibility to ensure that the latest version is used. A map of the relevant biodiversity information (including an indication of the habitat conditions as per (b) below) and must be provided as an overlay map to the property/site plan as Appendix B to this report.

a) Indicate the applicable biodiversity planning categories of all areas on site and indicate the reason(s) provided in the biodiversity plan for the selection of the specific area as part of the specific category)

Systematic Biodiversity Planning Category	**If CBA or ESA, indicate the reason(s) for its selection in biodiversity plan**
	According to B GIs 2015 data the proposed site does not fall in any CBA or ESA

b) Indicate and describe the habitat condition on site

Habitat Condition	**Percentage of habitat condition class (adding up to 100%)**	**Description and additional Comments and Observations (including additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc).**
Near Natural (includes areas with low to moderate level of alien invasive plants)	5%	Possible Acacia- Springbokvlakte Tree and 1 *Combretum imberbe* and *2 Sclerocarya birrea*
Transformed (includes cultivation, dams,	95%	

urban, plantation, roads, etc)		

c) Complete the table to indicate:

(i) the type of vegetation, including its ecosystem status, present on the site; and
(ii) whether an aquatic ecosystem is present on site.

Terrestrial Ecosystems		Aquatic Ecosystems
Ecosystem threat status as per the National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	**Vulnerable**	**Wetland (including rivers, depressions, channelled and unchanneled wetlands, flats, seeps pans, and artificial wetlands)**
		NO

d) Please provide a description of the vegetation type and/or aquatic ecosystem present on site, including any important biodiversity features/information identified on site (e.g. threatened species and special habitats)

From the field investigations the study area was largely monospecific and almost the entire site had been previously farmed (over 95%). Available aerial imagery from Google Earth dated back to 2009 and still showed past farming practices. Therefore it was very difficult to distinguish a diversity of habitat types. Large trees that have significance as roosting sites for species such as Owls and Raptors were mapped.

According to the specialist ecological study by Ekotrust (2017), a total of 116 indigenous and 37 alien species (32% of all species) were recorded on site. Fourteen declared invasive plant species were recorded on site. These include nine Category 1b species, two Category 2 species and three Category 3 species. Twenty-three other alien plant species were recorded on site.

The main findings of the habitat survey can be summarised as follows:

- About 80% of the site has been transformed by human activities in the past (ploughing).
- The site is not located in a protected area according to NEM:PAA.
- None of the listed North West province protected or specially protected plant species or the Red Data species listed for the 2528AC grid were recorded on site. Due to the relatively degraded state of the site, the chances of finding any of these species is regarded as negligible.
- None of the plant species recorded on site are listed in the NEM:BA (ToPS) lists of critically endangered, endangered or vulnerable species.
- All plant species recorded on site are considered as 'least concern'.
- None of the species are listed in CITES 2016 appendices.
- No protected tree species were recorded on the footprint of the proposed project site, but *Combretum imberbe* and *Sclerocarya birrea* do occur on the residential section of the property.
- No endemic species were recorded on site.

Faunal survey

No Red Data faunal species were recorded on the site.

Sensitivity

No sensitive terrestrial habitats occur on site and therefore the general sensitivity of the area is regarded as very low. Although the site was not cultivated within the last 10 years, the effect is still visible with the result that the sensitivity of the site was rated as very low (Table A).

Table A: Sensitivity assessment of the site

Environmental parameter (x weighting)	Score
Threatened status (x5)	10
% Red data species (x4)	0
% North West rare species (x4)	0
Number protected trees (x3)	0
% Endemic species (x2)	0
Conservation value (x4)	0
Species richness (x2)	6
Connectivity (x2)	6
Erosion (x2)	2
Resilence (x3)	6
Sum:	**30**
Sensitivity rating:	**Very low**

Very low sensitivity was recorded on site by EKOTRUST (2017) which means it is usually applicable to habitats that have been transformed, especially by human activities

Table 2: Vegetation units within the proposed development site

Vegetation Community	Conservation Significance	Area - Ha	Area -%
Drainage Habitat			
Possible Artificial Drainage	Low negative	0	0
Tree Clumps			
Combretum imberbe and Sclerocarya birrea	High	0.19	1.99
Transformed Habitat			
Transformed - *Springbokvlakte Thornveld*	Moderate-Low	5.92	20.28
Disturbed			
Built-up Areas	Low	0	0
Track	Low	0.14	1.54

According to the NFA (2016): List of Protected Tree Species, two protected tree species were recorded on the property (*Combretum imberbe* and *Sclerocarya birrea*) figure below 5.The site falls in the Springbokvlakte Thornveldd, which is classified as 'Vulnerable ' with less than 1% conserved in statutory reserves (Mucina & Rutherford 2006, NEMBA 2011). Almost half of the vegetation type has already undergone transformation primarily by cultivation, is already transformed by cultivation and urban sprawl, with dense rural populations in certain areas. Although the significance of habitat loss on the development site is low, the rating should be seen from the point of view of the history of land-use on the site.

Figure 10: Photographs of Conservation Important plant tree *Combretum imberbe and sclerocarya berera*

NB: These protected trees are not within the proposed development footprint but they are within the 4.4 hectare of the land.

Fauna:

Most of the plains have an open woody and grass layer and is marginally favourable for faunal occupation. However, the proximity of the site to the surrounding townships, the grazing by livestock and other farming activities, and the movement of people through the area will contribute to a sparse faunal population. However, the indigenous and endemic trees and shrubs should be protected as far as possible because they form important food sources and habitats for various fauna. The underbrush normally associated with these species also forms an important micro-habitat for a number of animal species.

B.8 Cultural/Historical Features

Are there any signs of culturally or historically significant elements, as defined in section 2 of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), including Archaeological or paleontological sites, on or close (within 20m) to the site? If YES, explain:	YES

A **heritage specialist study** (including archaeology, palaeontology, graves and cultural-historical features) was conducted as part of this Basic Assessment and the results are included in this section.

Palaeontology

The archaeological field study reported a flat, sandy land surface devoid of bedrock exposure. This lack of bedrock has meant that geological and palaeontological knowledge in this area stems largely from analysis of borehole data. Almond (2016:1) reports that the study area overlies the Irrigasie Formation which is comprised of "reddish-brown, readily-weathered mudrocks with subordinate sandstones and minor conglomerates". The kinds of fossils known to occur in the area are primarily trace fossils, while fossil pollens and spores and very rare dinosaur bones have also been reported. No fossils were seen during the archaeological survey.

Archaeology

The survey showed that a very low density scatter of Stone Age artefacts was present throughout the general area. There was no focus to these artefacts and no 'site' could be delineated; the artefacts can be ascribed to background scatter. Most were made from quartzite and some displayed cobble cortex indicating that they were made from river cobbles. Because of their very widespread distribution and very low density, these finds are of minimal heritage significance.

A ruined structure was located along the north-eastern boundary of the property. It was made from cement bricks. It is almost certainly less than 100 years of age and thus is not considered to be a heritage resource. It probably dates to the 1950s because historical aerial photography reveals that the area seemed unaltered in 1948-50 (the earliest available series), but by 1961 a number of 'bright spots' had appeared on the landscape. These spots indicate higher reflectivity from areas cleared of vegetation. One of these spots corresponds with the ruin. Another corresponds with the cement slab noted alongside the corrugated iron shack.

Graves

Two small informal cemeteries were located on the property. Each had three graves in it. The graves of the first were surrounded by cement bricks that were no doubt obtained from a nearby ruined structure made with the same bricks and located some 35 m away to the northwest. The graves are surrounded by a wire fence and aligned east-west. Because the ruin is relatively recent, the graves are also necessarily recent and must post-date the collapse of the brick structure. These graves are very likely less than 60 years of age and would thus not be regarded as heritage resources in terms of the NHRA. The second cemetery also has three graves in it. These graves are covered by stone mounds and are not enclosed by any fence. Two graves appear to be full (i.e. adult) size, while the third is far smaller and is likely that of a child. Larger stones have been placed at the head and foot of each grave. They are aligned east-west. These three graves are very likely older and perhaps completely unrelated to those in 'Cemetery 1'.

Cultural landscape

A survey of historical aerial photography reveals that the landscape on the site was little used during the mid-twentieth century. However, the wider region does show evidence of occupation with small cultivated lands and (presumably stone-built) structures in the south and north respectively.

If uncertain, conduct a specialist investigation by a recognised specialist in the field (archaeology or palaeontology) to establish whether there is such a feature(s) present on or close to the site. Briefly explain the findings of the specialist:

Will any building or structure older than 60 years be affected in any way?	NO
Is it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?	NO

If YES, please provide proof that this permit application has been submitted to SAHRA or the relevant provincial authority.

B.9 Socio-economic character

a) Local Municipality

Please provide details on the socio-economic character of the local municipality in which the proposed site(s) are situated.

The Moretele Local Municipality has a total population of 186 947. According to STATSsa Moretele Local Municipality is located in an area called Moretele, which is situated far north of Pretoria in the North West province. The Municipality comprises of 24 wards, which are made up of 66 villages and plots. Most villages are ruled by 4 traditional leaders (Dikgosi) who are recognised by law and who all represent their respective tribes/communities in council. The municipality was built in 2000, and covers an area of 1 369 km^2. It is located strategically to join four provinces, namely North West, Gauteng, Mpumalanga and Limpopo. Moretele is the Setswana name for a river that runs through the area, namely Noka ya Moretele (the Moretele River).The proposed site falls within Bosplaas in Moretele Local municipality. Bosplaas is Afrikaans name for 'bush farm'. The original name of the area was Boschplaats, and was under kingship of Moepi (GPS coordinates: 25.3274 S, 28.249 E). Bosplaas has a total population of 2670 people and 837 households. Majority of households in this community has electricity for lighting which is 81% and 22.8% water piped inside dwellings. Bosplaas has 52.40 % of male and 47.60% of female.

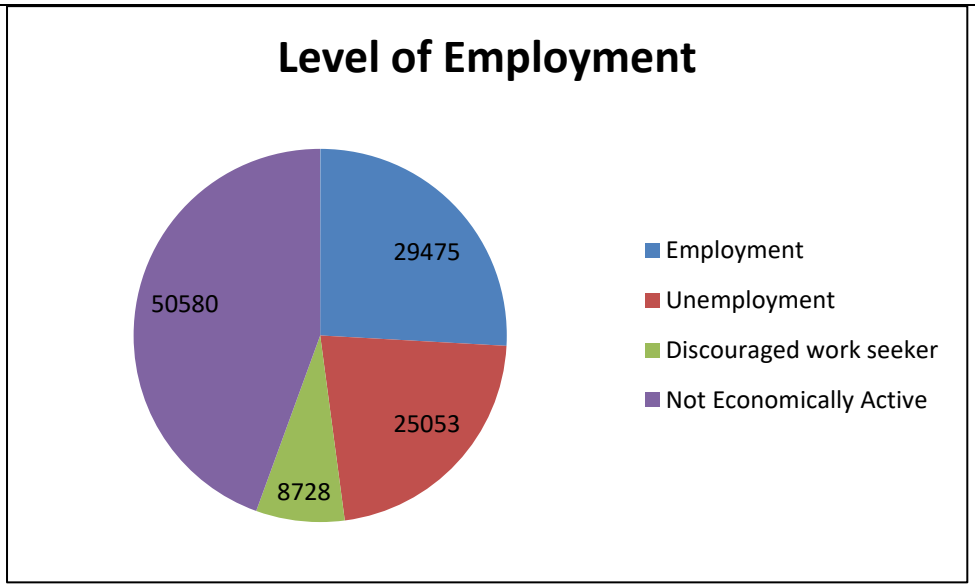


Figure 11: Level of unemployment

The Figure 11 above depicts the numbers employment status of Moretele municipality in numbers. According to the figure above majority of the Moretele municipality population 50580 are not economically active, 29475 of the population are employed whereas 25053 of the population are unemployed.

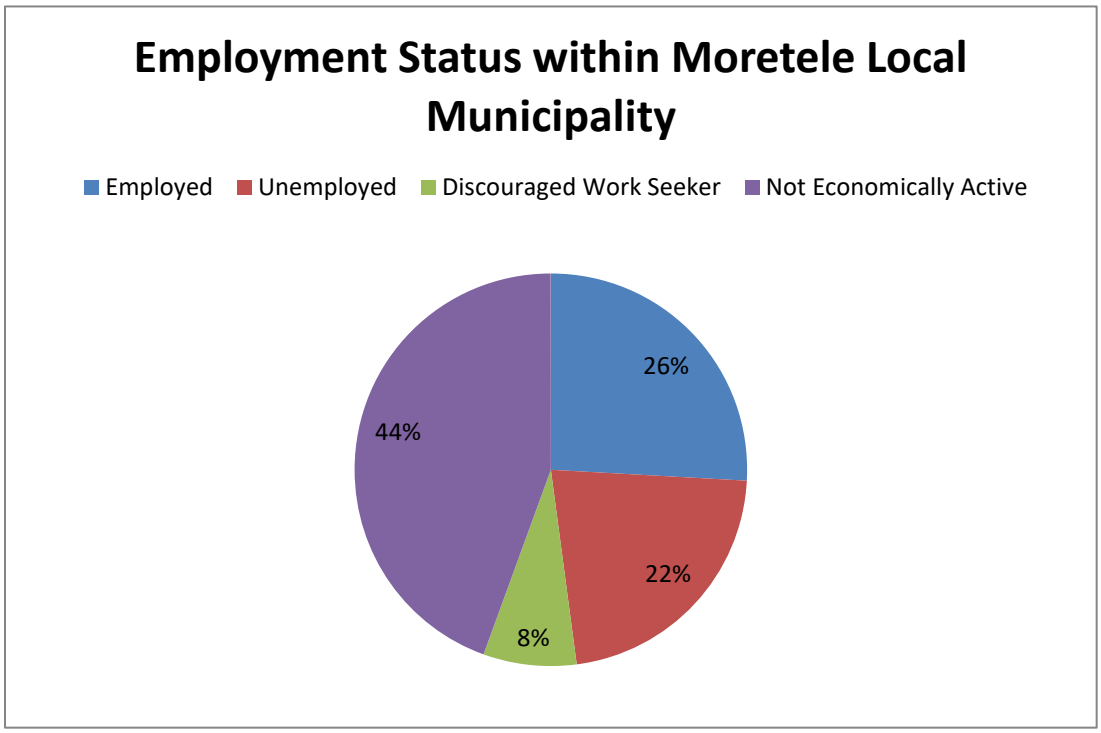


Figure 12: Employment status of Moretelele local municipality

The figure above depicts the percentage of employment status of Moretele municipality. According STATS S job creations need to be prioritised because majority of the population 44% are not economically active only 26% of the population are employed. The proposed development of an aquaculture facility will boost the economic growth of the municipality.

Figure 11: Level of education

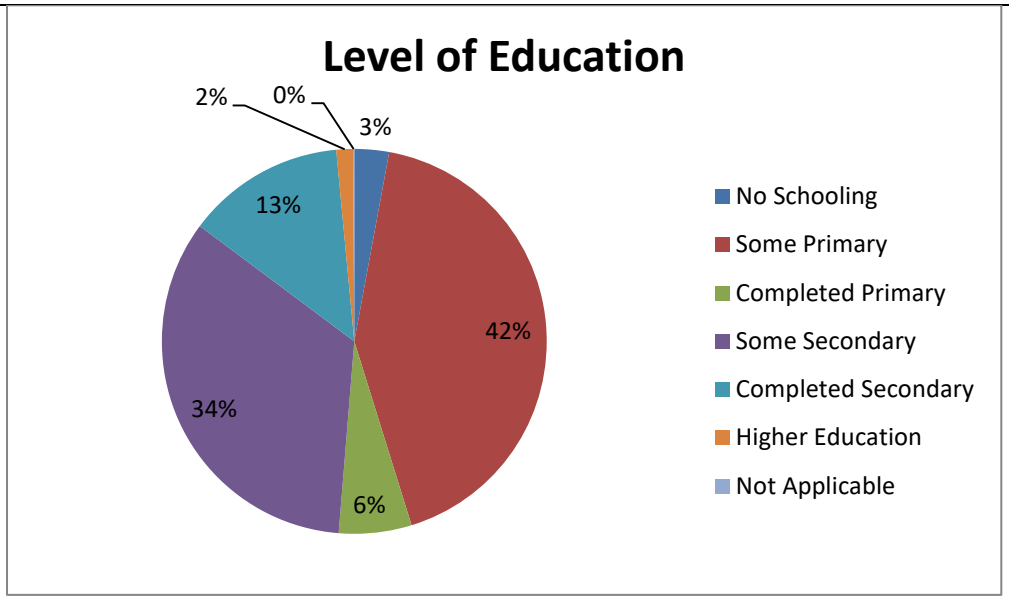


Figure 13: Level of education within Moretele Local Municipality

According to the figure above majority of the population in Moretele municipality had primary schooling or no schooling at all. Only 2% percent of the population have higher education. There is a need for education empowerment in the municipality.

b) Socio-economic value of the activity

What is the expected capital value of the activity on completion?	R 11 586 180.00
What is the expected yearly income that will be generated by or as a result of the activity?	R 1 414 274.00
Will the activity contribute to service infrastructure?	NO
Is the activity a public amenity?	YES
How many new employment opportunities will be created in the development and construction phase of the activity/ies?	+-200
What is the expected value of the employment opportunities during the development and construction phase?	R1 414 274.00
What percentage of this will accrue to previously disadvantaged individuals?	60%
How many permanent new employment opportunities will be created during the operational phase of the activity?	11 permanent employees
What is the expected current value of the employment opportunities during the first 10 years?	R2 591 380.00
What percentage of this will accrue to previously disadvantaged individuals?	100%

B.10 Specialist(s) consultation

Has a specialist been consulted to assist with the completion of this section?	**YES**	

If YES, please complete the form entitled "Details of specialist and declaration of interest" for each specialist thus appointed and attach it in Appendix F. All specialist reports must be contained in Appendix G and must meet the requirement in Appendix 6 of EIA Regulations, 2014.

SECTION C: IMPACT ASSESSMENT

The assessment of impacts must adhere to the minimum requirements in the EIA Regulations, 2014, and should take applicable official guidelines into account. The issues raised by interested and affected parties should also be addressed in the assessment of impacts.

C.1 Impacts that may result from the planning and design, construction, operational, decommissioning and closure phases as well as proposed management of identified impacts and proposed mitigation measures

Provide a summary and anticipated significance of the potential direct, indirect and cumulative impacts that are likely to occur as a result of the planning and design phase, construction phase, operational phase, decommissioning and closure phase, including impacts relating to the choice of site/activity/technology alternatives as well as the mitigation measures that may eliminate or reduce the potential impacts listed. This impact assessment must be applied to all the identified alternatives to the activities identified in Section A(2) of this report.

Activity	Impact summary	Significance	Proposed mitigation
Construction Phase			
Direct Impacts	*Loss of indigenous vegetation on the footprint of development*	Low (Negative)	• Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided. • No rare plant species were recorded on site and although the species richness of the plant community is fairly high most of the species are herbaceous and/or weedy species. No special measures are therefore necessary for the conservation of individual species. • Indigenous trees and shrubs should be established in the place of alien species • The denuded and disturbed areas on site should be landscaped and re-vegetated as soon as possible with indigenous plants
	Soil disturbance	Low (Negative)	• Dust control measures should be implemented during construction • Ensure that cleared (excavated) areas and unpaved surfaces are sprayed with water (obtained from an approved source) to minimise dust generation. • Approved soil stabilisers may be utilised to limit dust generation. • Ensure that construction vehicles travelling on unpaved roads do not exceed a speed limit of 40 km/hour. • Limit vehicles, people and materials to the construction site • Adequate dust control strategies should be applied to minimise dust deposition, for example: Periodic spraying of water on the entrance road when necessary
	Increased noise and dust levels	Low	• Limit vehicles, people and materials to the construction site. • Commence (and preferably complete) construction during winter, when the risk of erosion should be least. • Revegetate denude areas with locally indigenous flora a.s.a.p. • Vegetation of areas not to be developed. • Implement effective and environmentally-friendly dust control measures, such as mulching or periodic wetting.
	Loss of faunal habitat.	Low	• Commence (and preferably complete) construction during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least. • Check open trenches for trapped animals (e.g. hedgehogs, reptiles and frogs), and relocate trapped animals. • Prohibit disturbance and persecution (e.g. poaching) of fauna, and introduction of pets and other alien fauna (apart from the fish production). • Provide notices and training to inform workers about dangerous animals (e.g. venomous snakes and scorpions) and prohibited activities (e.g. poaching) • Walk fence lines to remove snares.
	Introduction and proliferation of alien species	Low	• Carefully regulate / limit access by vehicles and materials to the construction site. Demarcate or fence in the construction area. • Prohibit the introduction of domestic animals such as dogs and cats. • Remove any woody alien species that germinate. • Plant only locally indigenous flora if landscaping needs to be done • Keep construction activities neat and tidy. When complete, remove all sand piles and landscape all uneven ground while re-establishing a good topsoil layer • Remove Category species using mechanical methods, and minimize soil disturbance as far as possible.
	Stress Level Determination of a Groundwater Resource Unit	Moderate	• Another borehole should be implemented in the expansion of the project
	Present Status Category based on vulnerability and land use impact	Moderate	• Deterioration of water quality needs to be avoided and the current PES must be maintained or improved upon
	Present Ecological Status based on Current and Expected Contamination, Land Use and Vulnerability • Water Quality	Low Impact	• Protected areas (e.g. nature reserves) require a B class in water quality to ensure sustainability of protected ecology; • Deterioration of water quality needs to be avoided and the current PES must be maintained or improved upon • Adhere to the site groundwater management plan • The domestic waste would have a low impact on the receiving environment, however it should be disposed of at a suitable landfill site only and good housekeeping practices should be implemented and maintained at the site.
	• Water Quantity	Moderate	

Activity	Impact summary	Significance	Proposed mitigation
	• Combined	Moderate	
	Reduction in available groundwater quantity in the local area as a result of usage by the project during construction	Low	• Although unlikely to occur, should any local groundwater user's resource be impacted on by operations at the site the affected party should be provided with an alternative water source at the operator's cost. • Groundwater levels should be monitored regularly and should any negative trends in groundwater levels be observed suitable mitigation should be implemented. • Discharge water from the processing operations should be disposed of in a safe manner, should the water become contaminated over time it should either be stored in dedicated PCD's for reuse at the processing plant or treated prior to discharging into the environment.
	Destruction of palaeontological material	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of archaeological artefacts	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Potential spillage of by spillage or discharge of construction waste water	Low (Negative)	• Ensure that adequate containment structures are provided for the storage of construction materials on site. • Ensure the adequate removal and disposal of construction waste and material
	Potential Pollution of the surrounding water and ground as a result of generation of building rubble and waste scrap material	High (Negative)	• Ensure that adequate containment structures are provided for the storage of construction materials on site. • Ensure the adequate removal and disposal of construction waste and material
	Opportunities for employment and skills development	Medium (Positive)	• Enhance the use of local labour and local skills as far as reasonably possible. • Where the required skills do not occur locally, and where appropriate and applicable, ensure that relevant local individuals are trained. • Ensure that an equitable percentage allocation is provided for local labour employment as well as specify the use of small-to-medium enterprises and training specifications in the Contractors contract. • Ensure that goods and services are sourced from the local and regional economy as far as reasonably possible.
	Potential visual impacts as the result of construction activities	Low (Negative)	• No specific mitigation measures are required other than standard construction site housekeeping and dust suppression. These are included below: • The contractor(s) should maintain good housekeeping on site to avoid litter and minimise waste. • Litter and rubble should be timeously removed from the construction site and disposed at a licenced waste disposal facility. • The project developer should demarcate construction boundaries and minimise areas of surface disturbance. • Appropriate plans should be in place to minimise fire hazards and dust generation. • Night lighting of the construction site should be minimised within requirements of safety and efficiency.
	Potential impact on the safety of construction workers and Health injuries to construction personnel as a result of construction work	Medium (Negative)	• Ensure that a skilled and competent Contractor is appointed during the construction phase. The Contractor must be evaluated during the tender/appointment process in terms of safety standards. • The Contractor must ensure that all construction personnel are provided with adequate PPE for use where appropriate. • The Contractor must undertake a Construction Phase Risk Assessment. • A Construction Site Manager or Safety Supervisor should be appointed, in conjunction with the project manager, to monitor all safety aspects during the construction phase. This could be the same person that is assigned to co-ordinate the construction traffic.
	Traffic, congestion and potential for collisions	Low (Negative)	• Ensure that roads are not closed during construction, which may restrict access for emergency services. • The Contractor must ensure that all construction personnel are provided with adequate PPE for use where appropriate

Activity	Impact summary	Significance	Proposed mitigation
Indirect Impact	Loss of biodiversity	Low (Negative)	• Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided. • No rare plant species were recorded on site and although the species richness of the plant community is fairly high, most of the species are herbaceous and/or weedy species. No special measures are therefore necessary for the conservation of individual species. • Indigenous trees and shrubs should be established in the place of alien species
	Enhanced spread of alien vegetation	Low (Negative)	• Removal of alien species and the rehabilitation of the habitat may favour indigenous plant species. • Disturbance will favour alien species and without follow-up control, alien species may spread through the area. • Development should be restricted to the proposed development site and the disturbance to them surrounding natural or indigenous vegetation be kept to a minimum. • Establish a monitoring program for the early detection and control of alien invasive plant species. • No alien invasive species should be used in landscaping or gardens on the site.
	Destruction, displacement or disturbance of indigenous fauna	Low (Negative)	• Limit disturbance to the proposed site and ensure that minimum disturbance takes place in the, surrounding area. • Rehabilitate disturbed areas with indigenous species as soon as possible following construction of the facility. • Poaching of animals should be prohibited
	Some additional disturbance will inevitably occur in the direct surroundings of the site.	Medium (Negative)	• Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided.
	Increased dust levels during construction might negatively affect the plant growth.	Low (Negative)	• Dust control measures should be implemented during construction. • The denuded and disturbed areas on site should be landscaped and re-vegetated as soon as possible with indigenous plants
Cumulative impacts: Additional infrastructure development, for example, water pipelines, power lines and access roads and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.			
Residual impacts: Despite mitigation measures some loss of the natural vegetation will occur. The Springbokvlakte Thornveld vegetation type is considered “vulnerable” and should be conserved where possible. However, it covers 8797 km2 and the site, covering 1.5 ha, is already degraded and overall impact on the vegetation unit will therefore be small.			
Operational Phase			
Direct Impacts	Impact on natural vegetation	Medium (Negative)	• Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided. The indigenous vegetation, and especially the trees, should be retained as far as possible and buildings should be placed between trees. Protected trees should be conserved and not destroyed. The denuded and disturbed areas should be re-vegetated with indigenous species as soon as possible. • No trees may be damaged or cut. • No exotic trees may be planted in the gardens, use only indigenous plants. • Existing and dedicated roads should be marked and utilised by vehicles
	Dewatering Abstraction of water	Medium (negative)	• Groundwater depletion may take place at the abstraction borehole if not managed correctly as such the borehole should be managed constantly • Groundwater levels should be monitored regularly • Discharge water from the processing operations should be disposed of in a safe manner, should the water become contaminated over time it should either be stored in dedicated PCD's for reuse at the processing plant or treated prior to discharging into the environment.
	Bore hole yield (the volume of water that can be abstracted from a borehole)	Medium (negative)	• The borehole yield is most likely to be significantly lower than the original yield (when the borehole was 150 m deep), thus it is recommended that the borehole is redrilled/rehabilitated to its original depth and undergoes further aquifer testing to determine the sustainable yield. The borehole should be constructed using a combination of slotted and solid uPVC casing and have gravel pack installed in the annulus between the casing and borehole wall. This would prevent any further collapse of the borehole; • Should the rehabilitation of the borehole to 150 m not be feasible, it is recommended that uPVC casing (both solid and slotted) be installed at the existing borehole (at 33 m depth) to prevent further borehole collapse. This will ensure

Activity	Impact summary	Significance	Proposed mitigation
			sustainability of the borehole for site operations and prevent loss of equipment; • It is recommended that a new borehole pump is installed at the site, as per recommendations in section 35 of the Ground water report , and an automated control system with timers and float level switches installed to ensure the recommended pump cycles are strictly adhered to. The system should also include a flow meter to monitor abstraction volumes and preferably have an electronic diver installed with telemetry to monitor groundwater levels at the site; and • The water quality at the site was generally compliant with the SAWQG guidelines, however it is recommended that an appropriate water treatment plant is installed at the borehole to soften the water and remove excess iron prior to use. It is also recommended that a UV treatment unit is installed to remove microbiological parameters from the water prior to use.
	Water quality (the chemical, physical, biological, and radiological characteristics of water)	Medium	• Water softener unit is installed at the site to treat the water prior to use for production purposes • In-line UV treatment unit is placed between the borehole and end use tank to prevent any issues with fish production
	Hydrocarbon spills (oil spill released from a liquid petroleum of the transportation cars	Medium	• Staff and supervisors at workshops, yellow metal laydown areas and fuel storage areas should be trained in hydrocarbon spill response and each of these areas should be equipped with the appropriate spill response kits • Contaminated soil must be disposed of correctly at a suitable location. Should these management measures be put in place the impact on the receiving environment would be reduced to a low impact
	Environmental contamination from waste water produced and fish waste	Medium (Negative)	• Ensure that the facility is designed in accordance with international best practice norms, and with advice from an appropriate specialist, to ensure that there is no environmental contamination from effluent, fodder, carcasses and other waste, and to ensure that there is also effective storm water management • Adhere to best practice of waste disposal norms • Establish appropriate emergency procedures for accidental contamination of the surroundings. Waste recycling should be incorporated into the facility's operations as far as possible. Designate a secured, access restricted, signposted room for the storage of potentially hazardous substances such as herbicides, pesticides dips and medications. All hazardous waste should be disposed of at an appropriate licensed facility for this. • Rehabilitate contaminated areas a.s.a.p. in accordance with advice from appropriate contamination and environmental specialists • Educate workers regarding the handling of hazardous substances and about waste management and emergency procedures with regular training and notices and talks.
	Waste from fish Processing	High (Negative)	• The fish will be mobilised into the processing plant by a conveyor that drops the fish into a holding bin from there the fish are orientated correctly for effective head removal by a band saw.
	Fish carcases waste management	Medium (Negative)	• An offal collector and utilizer must be hired in order to collect offal from fish separating it into edible and inedible offal by the process of cutting, trimming, and skinning.
	Sewage management	Medium (Negative)	• All wastewater application on land must be in accordance with the Department of Water and Sanitation's guidelines in terms of wastewater use. • Ensure adherence to wetland buffer zones and soil quality monitoring requirements as stipulated in these guidelines. • The depth to aquifer must be more than 5m for dewatered sludge application and must be more than 10m for liquid sludge application. The distance from surface water or borehole must be more than 400m. • Mortalities must be stored in an enclosed area prior to being taken to the mortality pit. • The mortality pit must be regularly monitored and maintained, avoiding exceeding the capacity of the pit.
	Soil and water pollution as a result of poor waste management	Low (Negative)	• Construction waste must be disposed of at a licensed landfill site. • Waste containers must be available on site at all times. • A waste management plan must be adopted and implemented. This plan should consider the type of waste, storage, disposal method and facility as well as methods to reduce waste on site. • Ensure compliance with waste management legislation
	Impact on disease	Medium (Negative)	• Eggs or fish stocked in the facility must be absolutely disease free and preferably from a certified disease free strain. • Water used must be disease free or sterilised before going into the system; it is far better to use water from a borehole, a well, or a similar source than to use water coming directly from the sea, river or lake. • No visitors or stuff should enter the farm sick
	Impact on oxygen control	Medium (Negative)	• In cold water there is much more oxygen available for the fish to consume than in warm water, thus farming fish in warm water requires even more intense oxygen monitoring and control than farming in cold water
	Impact on water temperature regulation	Impact on water	• Using the intake water is a fairly simple way of regulating the temperature from day to day.

Activity	Impact summary	Significance	Proposed mitigation
		temperature regulation	• Heat pumps are an environmental friendly heating solution, and can utilize energy for heating from the river, a well or the air. • Hydro Royal Solar water heating technology should be used in winter to warm up the water in order to sustain the lives of the fish.
	Impact on waste water treatment	Medium (Negative)	• Faeces from the fish tanks should flow immediately to the mechanical filter without being crushed on the way. • The higher the rate of recirculation the less new water will be used, and the less discharge water will need to be treated.
	Impact on biosecurity and transmission of diseases.	Medium (Negative)	• Fish mortalities must be identified and removed immediately from the fish tank. • Training of workers to effectively handle sick and dead animals. • Emergency procedures that aim to address the potential for disease outbreaks must be developed and implemented where applicable.
	Storm water discharge into the surrounding environment during operations	Medium (Negative)	• Stormwater measures should be inspected regularly to ensure proper functioning of stormwater structures. • An operational phase Stormwater Management Plan should be designed and implemented, with a view to prevent the passage of concentrated flows from hardened surfaces and onto natural areas.
	Poor / Inappropriate control of animal pests	High (Negative)	• Ensure that there is effective storm water drainage around the facility • Ensure that the facility is sufficiently ventilated to keep floors, bedding, and fodder as dry as possible. • Prevent and manage unwanted animal access to fodder. • Check that fan louvers (if installed) work properly, and close fans completely when off. • Ensure that floors are sloped and slatted to facilitate drainage. • Screed concrete floors properly to seal all cracks and limit the pooling of effluent and water. • Effectively maintain and seal all pipes and reservoirs containing slurry, to prevent animals from accessing the effluent. • Clean floors regularly. • Clean up excess fodder regularly from under troughs and feed bins. • Keep areas surrounding the facility free of spilled manure and litter. • Remove all trash, and sources of feed and water for pests from the outside perimeter of the facilities. • Keep weeds and grass mowed to 5cm or less immediately around the facilities, to reduce the prevalence of insects. • Electrocution devices are available to kill flies, while other mechanical devices include traps, sticky tapes or baited traps. • Control rodents through effective sanitation, rodent proofing and (as humane as possible) extermination. • Rodenticides are not advised. • Ensure that measures to control pests are tightly restricted to areas where these are problematic. Pest control measures should be taxon-specific. If necessary, advice should be sought from an appropriate specialist.
	Disease transmission	Medium (Negative)	• Maintain appropriate pest control measures • Effectively maintain and seal all pipes and reservoirs containing slurry, to prevent animals from accessing the effluent.
	Altered burning	Medium (Negative)	• Create safe storage on the premises for flammable materials. If artificial burning is considered necessary, establish and implement a fire management plan with emergency fire procedures. • Maintain an effective fire break between the facility and the surrounding natural environment. • Educate workers about the fire plan and emergency procedures with regular training and notices
	Introduction and proliferation of alien species	High (Negative)	• Carefully regulate / limit access by vehicles and materials to the site • Prohibit the introduction of domestic animals such as dogs and cats. • Plant only locally indigenous flora if landscaping needs to be done. • Employ best practices regarding tilling of soil and weed management • Minimize the accumulation or dispersal of excess fodder on site. • Remove Category species using mechanical methods, and minimize soil disturbance as far as possible. Alien debris could be donated to a local community
	Loss of CI or medicinal flora	Medium (Negative)	• Educate the personnel prior to operation, and with yearly refresher talks.
	Sensory disturbance of fauna	Medium (Negative)	*Minimize essential lighting.* • Ensure that all outdoor lights are angled downwards and/or fitted with hoods. • Avoid using metal halide, mercury or other bulbs that emit high UV (blue-white) light that is highly and usually fatally attractive to insects. • Use bulbs that emit warm, long wavelength (yellow-red) light, or use UV filters or glass housings on lamps to filter out UV. *Minimize unavoidable noise* • Conduct regular maintenance of machinery and ventilation systems / fans (if any).

Activity	Impact summary	Significance	Proposed mitigation
	Destruction of palaeontological material	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of archaeological artefacts	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Emissions into the atmosphere as a result of staff vehicles.	Medium (Negative)	• Efficient movement of traffic through the entrance and exit in order to reduce congestion and vehicle emissions. • Ensure that the facility is operated in such a manner whereby potential odours are minimised.
	Improved service delivery with regards poultry products	Medium (Positive)	• Ensure that the proposed infrastructure is maintained appropriately to ensure that all facilities and infrastructure operate within its design capacity to deliver as the market requires.
	Opportunities for employment and skills development	Medium (Positive)	• Enhance the use of local labour and local skills as far as reasonably possible. • Where the required skills do not occur locally, and where appropriate and applicable, ensure that relevant local individuals are trained. • Ensure that an equitable percentage allocation is provided for local labour employment as well as specify the use of small-to-medium enterprises and training specifications in the Contractors contract. • Ensure that goods and services are sourced from the local and regional economy as far as reasonably possible.
	Night lighting of the development on the nightscape of the surrounding landscape	Medium (Negative)	• No specific mitigation measures are recommended as it is assumed that night lighting of the proposed storage facility will be planned in such a manner so as to minimize light pollution such as glare and light spill (light trespass) by: • Using light fixtures that shield the light and focus illumination on the ground (or only where light is required). • Avoiding elevated lights within safety/security requirements. • Using minimum lamp wattage within safety/security requirements. • Where possible, using timer switches or motion detectors to control lighting in areas that are not occupied continuously (if permissible and in line with minimum security requirements). • Switching off lights when not in use in line with safety and security
	Potential noise impact from operations and road transport of products	Medium (Negative)	• It is recommended that the drivers of the vehicles be discouraged from using air brakes at night. • Limit the effects of noise associated disturbances from operational activities on sensitive fauna such as owls and medium-large mammals (especially carnivores), potentially occurring hedgehogs and large terrestrial birds such as Korhaans and Secretary birds.
	Minor accidents to the public and moderate accidents to operational staff	Medium (Negative)	• An Emergency Plan should be compiled in order to deal with potential spillages and fires. Records of practices should be kept on site. • Scheduled inspections should be implemented by operating personnel in order to assure and verify the integrity of hoses, piping and storage lagoon. • Portable fire extinguishers and fire water hydrants (i.e. appropriate fire-fighting equipment) should be provided at the facility as required.
	Atmospheric pollution due to fumes, smoke from fires	Medium (Negative)	• Portable fire extinguishers and fire water hydrants (i.e. appropriate fire-fighting equipment) should be provided at the terminal as required. Mobile fire-fighting equipment should be provided at the berths as a safety precaution during the vessel offloading process. It should be noted that the products planned to be stored at the terminal have high flash points and low volatility. As a result, fires are unlikely, unsustainable, and can be extinguished with basic fire water and portable fire extinguishers.
Indirect impacts	Impact on natural vegetation	Low (Negative)	• Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided. The indigenous vegetation, and especially the trees, should be retained as far as possible and buildings should be placed between trees. Protected trees should be conserved and not destroyed. The denuded and disturbed areas should be re-vegetated with indigenous species as soon as possible. • No trees may be damaged or cut. • No exotic trees may be planted in the gardens, use only indigenous plants

Activity	Impact summary	Significance	Proposed mitigation
	Impact on alien vegetation	Low (Negative)	• Development should be restricted to the footprint of the proposed development site and the disturbance to the surrounding natural or indigenous vegetation be kept to a minimum. • Rehabilitate disturbed areas with indigenous species as soon as possible following construction of the facility. • Establish a monitoring program for the early detection and control of alien invasive plant species. • No alien invasive species should be used in landscaping or gardens on the site.
	Impact on fauna		• Limit disturbance to the proposed site and ensure that minimum disturbance takes place in the surrounding area. • Noise levels should be kept to a minimum at all times. • Rehabilitate disturbed areas with indigenous species as soon as possible following construction of the facility. • Poaching of animals should be prohibited
Decommission			
Direct Impacts	Introduction and proliferation of alien species	High (Negative)	• Remove Category species using mechanical methods, and minimize soil disturbance as far as possible.
	Increased dust and erosion	Medium (Negative)	• Limit vehicles to the construction site • Commence (and preferably complete) decommissioning during winter, when the risk of erosion should be least. • Revegetate denude areas with locally indigenous flora a.s.a.p. • Implement erosion protection measures on site to reduce erosion and sedimentation of the local drainage system. Measures could include bunding around soil stockpiles, and vegetation of areas not to be developed. • Implement effective and environmentally-friendly dust control measures, such as mulching or periodic wetting of the entrance road.
	Sensory disturbance of fauna	Low (Negative)	• Commence (and preferably complete) demolition / rehabilitation during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least. • Minimize noise to limit its impact on sensitive fauna. • Limit demolition activities to day time hours • Minimize or eliminate security and other lighting, to reduce the disturbance of nocturnal fauna.
	Destruction of palaeontological material	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of archaeological artefacts	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Discharge of contaminated stormwater into the surrounding environment	Medium (Negative)	• The appointed Contractor should compile a Method Statement for Stormwater Management during the decommissioning phase. • Provide secure storage for oil, chemicals and other waste materials to prevent contamination of stormwater runoff.
	Emissions from decommissioning vehicles and generation of dust	Medium (Negative)	• Ensure that cleared (excavated) areas and unpaved surfaces are sprayed with water (obtained from an approved source) to minimise dust generation. • Approved soil stabilisers may be utilised to limit dust generation. • Ensure that decommissioning vehicles travelling on unpaved roads do not exceed a speed limit of 40 km/hour.
	Noise generation from demolition activities	Medium (Negative)	• A method statement, including detailed procedures, must be drawn up prior to any decommissioning of existing tanks. • Decommissioning personnel must wear proper hearing protection, which should be specified as part of the Decommissioning Phase Risk Assessment carried out by the Contractor. • The Contractor must ensure that all decommissioning personnel are provided with adequate PPE, where appropriate.
	Pollution of the surrounding environment as a result of the handling, temporary storage and disposal of solid waste	Medium (Negative)	• General waste (i.e. building rubble, demolition waste, discarded concrete, bricks, tiles, wood, glass, plastic, metal, excavated material, packaging material, paper and domestic waste etc.) and hazardous waste (i.e. empty tins, paint and paint cleaning liquids, oils, fuel spillages and chemicals etc.) generated during the decommissioning phase should be stored temporarily on site in suitable (and correctly labelled) waste collection bins and skips (or similar). Waste collection bins and

Activity	Impact summary	Significance	Proposed mitigation
			skips should be covered with suitable material, where appropriate. • Should the on-site storage of general waste and hazardous waste exceed 100 m3 and 80 m3 respectively, then the National Norms and Standards for the Storage of Waste (published on 29 November 2013 under GN 926) must be adhered to • Ensure that general waste and hazardous waste generated are removed from the site on a regular basis and disposed of at an appropriate, licensed waste disposal facility by an approved waste management Contractor. Waste disposal slips or waybills should be kept on file for auditing purposes as proof of disposal. • Ensure that sufficient general waste disposal bins are provided for all personnel throughout the site. These bins must be emptied on a regular basis. • Appropriately time demolition / rehabilitation activities to minimise sensory disturbance to fauna.
Indirect impacts: *Cumulative impacts:*			
No-go option Direct impacts: Indirect impacts: Cumulative impacts:	*Direct impacts:* ▪ None of the impacts mentioned above will occur. ▪ If the proposed project does not proceed, increased income and economic spin-off activities will not be realised. ▪ Approximately 11 new permanent jobs will not be created during the operational phase. ▪ If the proposed project does not proceed, the industries that rely on the supply of poultry products could experience hindered economic growth potential. *Indirect impacts:* ▪ There are no indirect impacts during the construction phase for the No-go Option. *Cumulative impacts:* ▪ There are no cumulative impacts during the construction phase for the No-go Option		

A complete impact assessment which include process undertaken to identify, assess and rank the impacts, the activity will impose on the site through the life of the activity in terms of EIA Regulation 2014, Appendix 1(i) and (j) of GN R.327 must be included as Appendix H.

A complete impact assessment which include process undertaken to identify, assess and rank the impacts, the activity will impose on the site through the life of the activity in terms of EIA Regulation 2014, Appendix 1(i) and (j) of GN R.982 must be included as Appendix H.

C.2 Environmental impact statement

Taking the assessment of potential impacts into account, please provide an environmental impact statement that summarises the impact that the proposed activity and its alternatives may have on the environment after the management and mitigation of impacts have been taken into account, with specific reference to types of impact, duration of impacts, likelihood of potential impacts actually occurring and the significance of impacts.

Alternative A (preferred alternative)

The proposed development area is mostly transformed as a result of past agricultural practices (Tilling). About 60% of the habitat has been transformed in the past, mainly by agriculture. There is also an ongoing habitat loss due to expanding rural settlements, overgrazing and alien plant invasion. The main environmental impacts associated with the proposed project include:

Site clearance of previously transformed land and cultivated, this may lead to loss of destruction of an already transformed habitat and habitat destruction. Of most concern however is the number of trees that could be lost. These trees provide roosting and nesting habitat for birds and small raptors. The probability is however, considered to be low with mitigation. Furthermore the proposed development site shall ensure minimal removal of trees from site.

Earth-moving activities during the clearing of vegetation for the construction of the aquaponics facility are likely to increase the susceptibility of the site to soil erosion as the result of increased bare ground and dust generation. The potential impact of continued and increased dust during construction with mitigation was rated of low significance.

Graves are of heritage importance and could be easily destructed as a result of clearing of land and construction of the aquaponics facility. The initial layout of the proposed development site was within the buffer of the graves as such posing a high risk of the destruction of graves, the probability of occurrence of this impact was very likely. However this layout was amended to ensure that the proposed development does not affect the graves and a 10 meter buffer is respected. The potential impact of with mitigation was rated of very low significance.

Waste will be generated through-out the life cycle of the development. However with proper waste disposal measures, waste impacts will be of low probability post mitigation.

Please see Appendix H for full impact assessment and their significance**.**

Alternative B

Alternative C

No-go alternative (compulsory)

The 'No-Go' option assumes that a conservative approach that would ensure that the environment is not disturbed. It is important to state that this assessment is informed by the current condition of the area. Should the Competent Authority decline the application, the 'No-Go' option will be followed and the status quo of the site will remain.

SECTION D: PUBLIC PARTICIPATION

D.1 Advertisement and Notice

Publication name	**Brits Pos**	
Date published	**14 September 2017**	
Site notice position	**Latitude**	**Longitude**
	25^0 21' 45''	**28^0 13' 55''**
Date placed	**15 May 2017**	

Include proof of the placement of the relevant advertisements and notices in Appendix I.1.

D.2 Determination of appropriate measures

Provide details of the measures taken to include all potential I&APs as required by Regulation 41(2)(e) and 41(6) of GN R.982.

Key stakeholders (other than organs of state) identified in terms of Regulation 40(2)(d) of GN R.982:

Title, Name and Surname	Affiliation/ key stakeholder status	Contact details (tel number or e-mail address)
PP Mahlangu	Neighbouring Landowner- Plot 521 Bosplaas	0603480809
Nelson	Neighbouring Landowner- Plot 471 Bosplaas	0730339158
Elias	Neighbouring Landowner- Plot 410 Bosplaas	0723542007
Dumisani	Neighbouring Landowner- Plot 414 Bosplaas	0606109577
Tshiaison j	Neighbouring Landowner- Plot 413 Bosplaas	0715352505
Mr Ngema	Community Chairman- Plot 260 Jonathan	0791407720
P Mahlangu	Councillor	

Include proof that the key stakeholder received written notification of the proposed activities as Appendix I.2. This proof may include any of the following:

- e-mail delivery reports;
- registered mail receipts;
- courier waybills;
- signed acknowledgements of receipt; and/or
- or any other proof as agreed upon by the competent authority.

D.3 Issues raised by interested and affected parties

Summary of main issues raised by I&APs	Summary of response from EAP
The issue of criminal activity and tree removal were raised as a concern in the running of the project.	The proposed development shall ensure minimal removal of trees from the site but the protected trees shall remain protected. Furthermore security officers shall be hired to address this concern.

D.4 Comments and response report

The practitioner must make report (s) available to I&APs record all comments received from I&APs and respond to each comment before is submitted. The comments and responses must be captured in a comments and response report as prescribed in the EIA Regulations and be attached to the Final BAR as Appendix I.3.

D.5 Authority participation

Authorities and organs of state identified as key stakeholders. Key stakeholders identified in terms of Regulation 7(1) and (2) and Regulation 40(2) (a)-(c) of GN R.982:

Authority/Organ of State	Contact person (Title, Name and Surname)	Tel No	Fax No	e-mail	Postal address
Moretele Local Municipality	Amogelang Sefara	0127161327		amogelang.sefara@moretele.org.za	Private Bag X367, Makapanstad, North West, 0404
Bojanala Platinum District Municipality	Goitsimosimo Tau	0145904500	014592 6085	innocents@bojanala.gov.za	P O Box 1993, Rustenburg,0300
North West READ	Rhuleni Mathebula	0183895122		rmathebula@nwpg.gov.za	Private Bag X2039 Mmabatho 2735
North West Provincial Heritage Resources Authority	Natasha Higgitt	0214624502	021462 4509	nhiggitt@sahra.org.za	11 Harrington Street, Cape Town, 8001
Department of Agriculture Forestry and Fisheries	Mabule R	012 319 7634		MabuleR@daff.gov.za	Private bag X120 Pretoria 0001
North West READ	Ouma Skosana			oskosana@nwpg.gov.za	Private Bag X2039 Mmabatho 2735
DWS	Khuthadzo Mulaudzi	012 392 1363	012392 1408	mulaudzik@dws.gov.za	Private Bag X995, Pretoria, 0001

Include proof that the Authorities and Organs of State received written notification and draft reports of the proposed activities as Appendix I.4.

D.6 Consultation with other stakeholders

Note that, for any activities (linear or other) where deviation from the public participation requirements may be appropriate, the person conducting the public participation process may deviate from the requirements of that sub-regulation to the extent and in the manner as may be agreed to by the competent authority.

Proof of any such agreement must be provided, where applicable. Application for any deviation from the regulations relating to the public participation process must be submitted prior to the commencement of the public participation process.

A list of registered I&APs must be included as Appendix I.5.

Copies of any correspondence and minutes of any meetings held must be included in Appendix I.6.

SECTION E: RECOMMENDATION OF PRACTITIONER

Is the information contained in this report and the documentation attached hereto sufficient to make a decision in respect of the activity applied for (in the view of the environmental assessment practitioner)?	YES	

If "NO", indicate the aspects that should be assessed further as part of a Scoping and EIA process before a decision can be made (list the aspects that require further assessment).

If "YES", please list any recommended conditions, including mitigation measures that should be considered for inclusion in any authorisation that may be granted by the competent authority in respect of the application.

This Draft BA Report has investigated and assessed the significance of the predicted positive and negative impacts associated with the proposed development of an Aquaponics facility. No negative impacts have been identified within this BA that, in the opinion of the Environmental Assessment Practitioner who conducted this BA Process, should be considered "fatal flaws" from an environmental perspective, and thereby necessitate substantial re-design or termination of the project. The fact that development occurs on previously transformed land minimises the impacts on the proposed development site.

Taking into consideration the findings of the BA Process, including the findings of the specialist studies, it is the opinion of the Environmental Assessment Practitioner, that the project benefits outweigh the costs and that the project will make a positive contribution to sustainable economic growth, skills development and employment opportunities in the Moretele Local Municipality.

It is recommended that the project receive Environmental Authorisation in terms of the EIA Regulations promulgated under the National Environmental Management Act (Act 107 of 1998, as amended) subjected to the following conditions:

- The EMPr of the proposed development must be adhered to during all phases of the development
- A Water use license must be obtained
- All the recommendations of the specialists must be implemented for the proposed project

In order to ensure the effective implementation of the mitigation and management actions, a Draft EMPr has been compiled and is included in Appendix F of this Draft BA Report. The mitigation measures necessary to ensure that the project is planned, constructed, operated and decommissioned in an environmentally responsible manner are listed in this Draft EMPr. The EMPr is a dynamic document that should be updated regularly and provides clear and implementable measures for proposed development of an aquaponics facility.

The EMPr that meet the requirements of EIA Regulation,2014, Appendix 4, must be attached as Appendix J.

Is an EMPr attached?	YES	NO

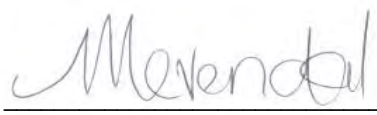
The details of the EAP who compiled the BAR and the expertise of the EAP to perform the Basic Assessment process must be included as Appendix K.

If any specialist reports were used during the compilation of this BAR, please attach the declaration of interest for each specialist in Appendix F.

any other information relevant to this application and not previously included must be attached in Appendix L.

SECTION F: AFFIRMATION BY EAP

I Minnelise Levendal (name of person representing EAP) of Council for Scientific and Industrial Research declare that the information provided is correct and relevant to the activity/ project and that, the information was made available to interested and affected parties for their comments. All specialist (s) reports are relevant for the competent authority to make informed decision.



SIGNATURE OF EAP

14 September 2017
DATE

Basic Assessment for the proposed tilapia aquaponics project, on plot 413 of the farm Bosplaas West, north of the town of Hammanskraal, in the Moretele Municipality in Bojanala District, North West Province

SECTION G: APPENDICES

SECTION G: APPENDICES

The following appendices are attached to this BA Report:

Appendix A	A3 Locality Map
Appendix B	Layout Plan and Sensitivity Maps
Appendix C	Photographs
Appendix D	Facility illustration(s)
Appendix E	Confirmation of services by Municipality (servitude and infrastructure planning)
Appendix F	Details and expertise of Specialist and Declaration of Interest
Appendix G	Specialist reports (including terms of reference)
Appendix H	Impact Assessment
Appendix I	Public Participation
Appendix J	Environmental Management Programme (EMPr)
Appendix K	Details of EAPs and expertise
Appendix L	Any other Information
Appendix M	Financial Provision (if applicable)
Appendix N	Closure Plan (where applicable) as described in Appendix 5 of EIA Regulations, 2014

Basic Assessment for the proposed tilapia aquaponics project, on plot 413 of the farm Bosplaas West, north of the town of Hammanskraal, in the Moretele Municipality in Bojanala District, North West Province

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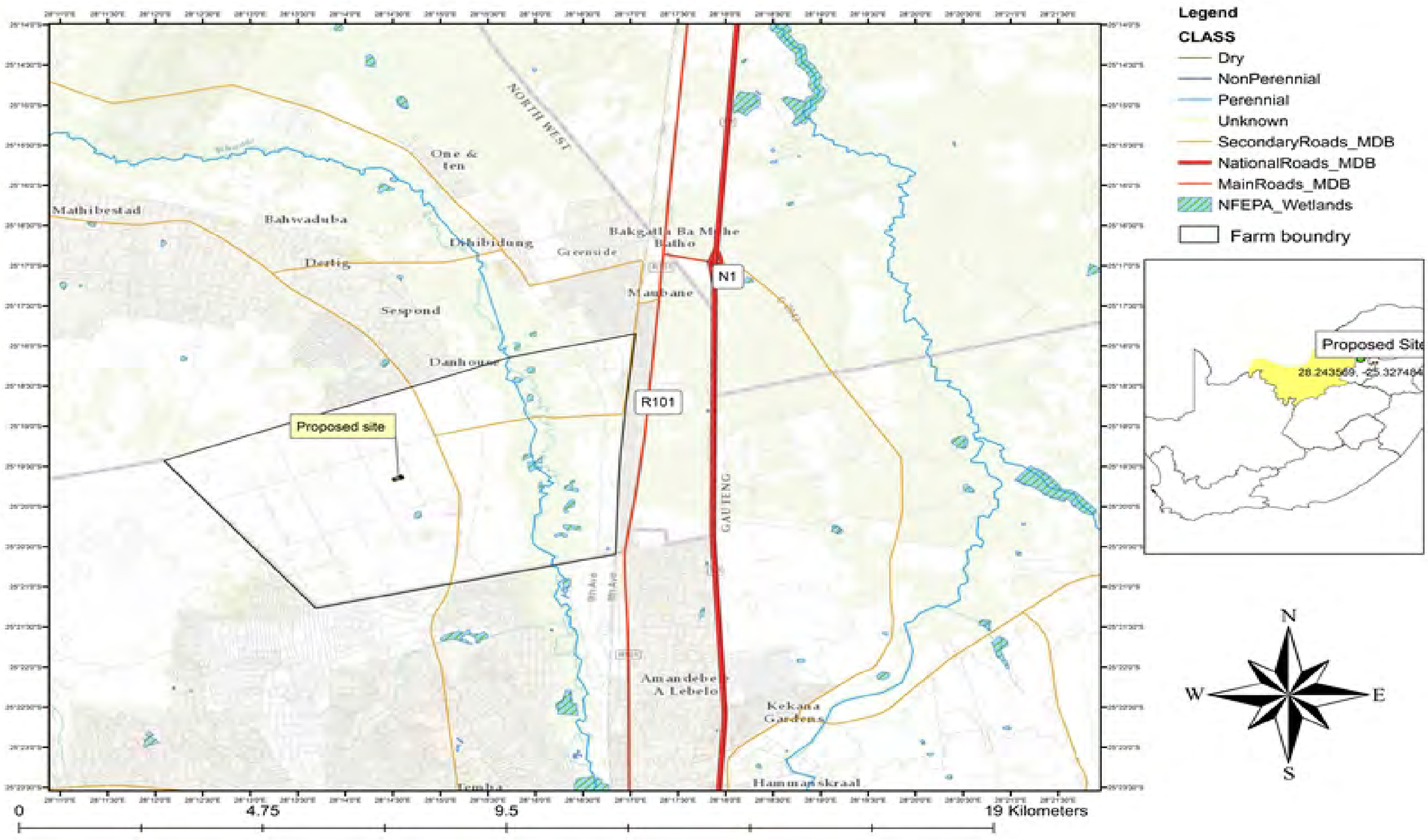
BASIC ASSESSMENT REPORT

APPENDIX A: SITE LAYOUT PLANS

CONTENTS

Appendix A.1: Locality map



Appendix A.2: Locality map.

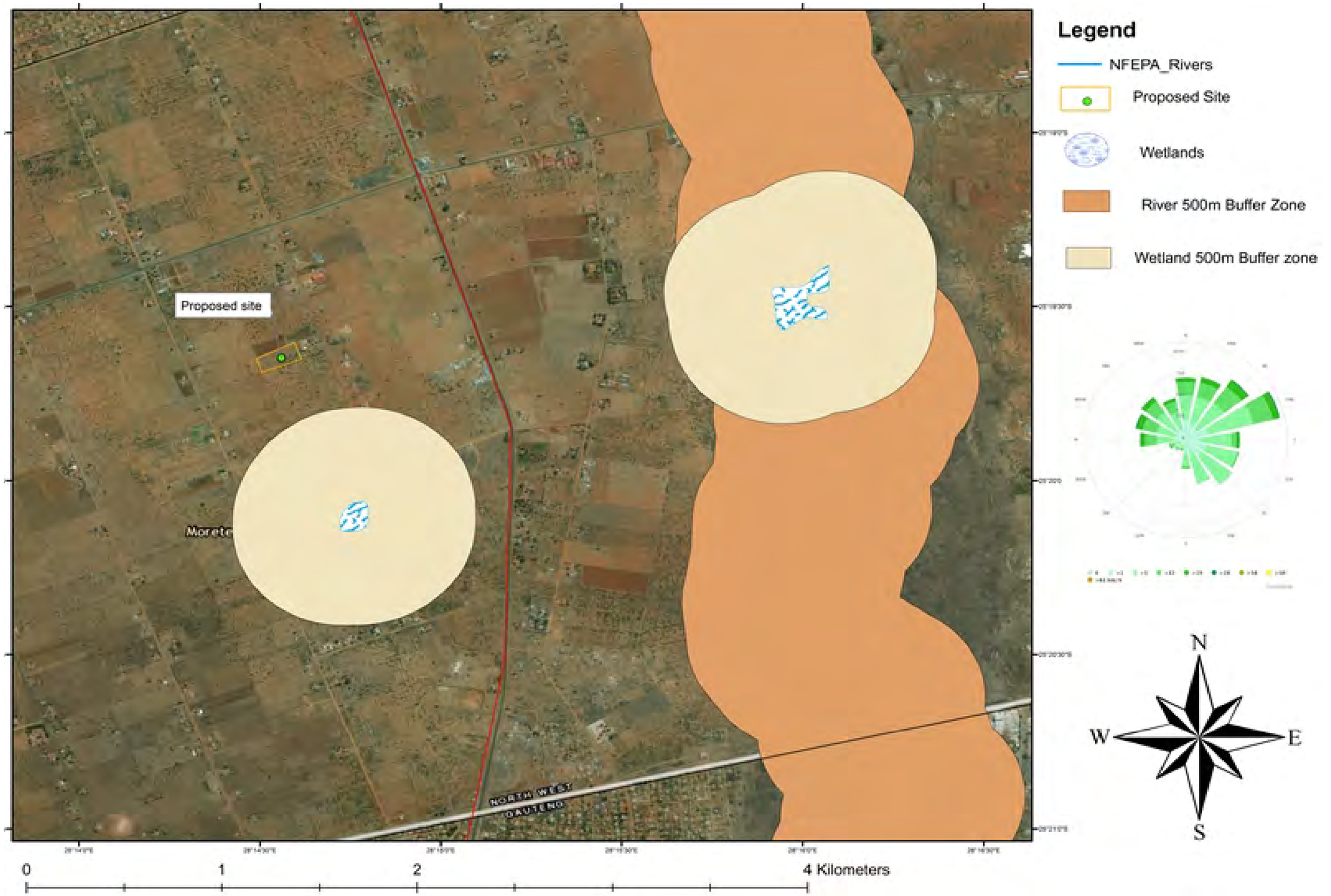
Appendix A.3: Locality map

BASIC ASSESSMENT REPORT

APPENDIX B:
LAYOUT PLAN AND SENSITIVITY MAP

CONTENTS

Appendix B: Layout Plan and Sensitivity Map

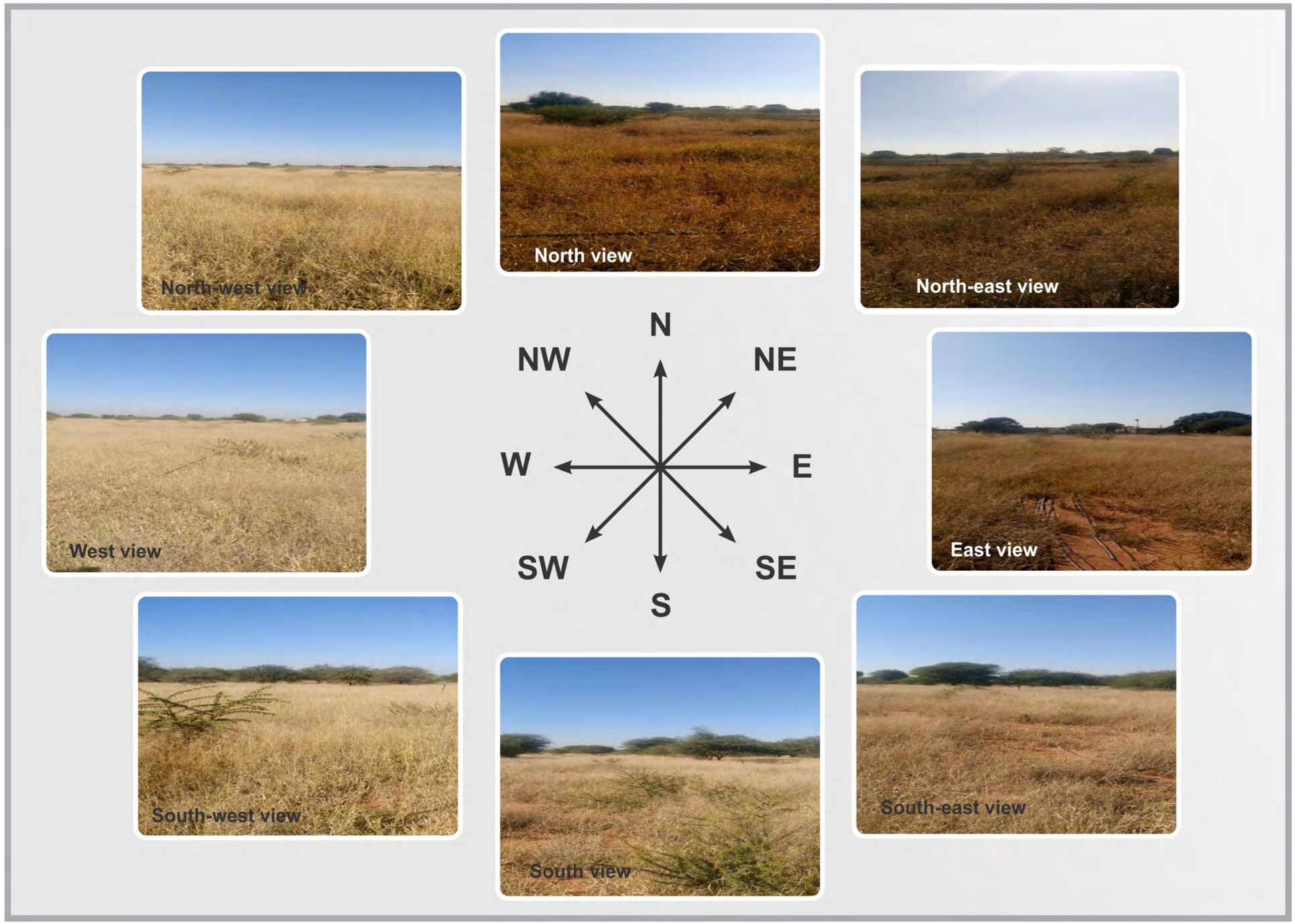


BASIC ASSESSMENT REPORT

APPENDIX C: PHOTOGRAPHS

CONTENTS

Appendix C: Photographs taken from centre point of the site
(25°19′ 38.09″ South 28°14′ 33.60″ East Coordinates)



BASIC ASSESSMENT REPORT

Appendix D: Facility Illustration(s)

CONTENTS

Appendix D: Facility illustration(s)

BASIC ASSESSMENT REPORT

Appendix E:
Confirmation of Services by Municipality (Servitude and Infrastructure Planning)

CONTENTS

Appendix E: Confirmation of services by Municipality (servitude and infrastructure planning)

BEP08001 *** MORETELE PRODUCTION *** 27/07 10:35
BEM08002 BO03S-Current Account Details AMATLALA
1018381 OWNER TJ KGOMO Term-D
Stand: 011 000 00000413 00000 0000 0000 Addr: 413 PLOT 413 BOSPLAAS WEST
Post.Add.: P O BOX 29170 BOSPLAAS 0409
Clearance Appl.Date: Clear Cert.Print: N Sect-Title:
Clear.Dates from to ID: 2408275256089 Cmplx:
Total H/O: Coll: Deb Tp: RE - RESIDENTIAL
Tran Date Description Reference Tariff Debit Credit Vat
191907 —— PENDING / UNALLOCATED Receipts 0.00 (See PF12 - Option 7)
_ 20170614 BALANCE B/F 6242.64
_ 20170720 INTEREST ON 0001 13.84
_ 20170721 ASSESSMENT VAAGRI 6.92
_ 20170721 BASIC REFUS BRRESI 34.00 4.76
_ 20170721 DOMESTIC TA BWDOM1 47.00 6.58
_ TOTAL 6355.74
_ CURRENT BAL: 6355.74
_ CASH UNTIL- 20170707
_
_
(Use D, L, T or S) Due-Date: 20170807 No-Dep: No-Notes: 1 No-Ext/Arr
Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12---
Help! Main Quit Owner Erf Acct O/T Meter Anal Sum CR More

MORETELE LOCAL MUNICIPALITY
Municipal Manager
27 JUL 2017
NORTH WEST

BASIC ASSESSMENT REPORT

Appendix F:
Details and Expertise of Specialist and Declaration of Interest

CONTENTS

Appendix F: Details and expertise of Specialist and Declaration of Interest

The following specialists provided input to this Basic Assessment and their declarations of independence and CVs are included in this Appendix:

Name	Company/organisation	Specialist topic
Noel van Rooyen	EKOTRUST	Flora fauna and wetlands
David van der Merwe	Environmental Assurance (Pty) Ltd	Geohydrology study
DuToit Wilken	Environmental Assurance (Pty) Ltd	Geohydrology study
Matthew Damhuis	Impulse water	Geohydrology study
Jaco Breytenbach	Impulse water	Geohydrology study
Jaco van der Walt	HCAC	Heritage impact assessment

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

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CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

DETAILS AND EXPERTISE OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Tilapia aquaponics farm project, Bosplaas West in north of Hammanskraal in the Moretele Municipality in Bojanala District, North West province

1. Details of Specialist

Specialist:	NOEL VAN ROOYEN		
Contact person:	NOEL VAN ROOYEN		
Postal address:	272 THATCHERS FIELDS, LYNNWOOD, PRETORIA		
Postal code:	0081	Cell:	082 552 0886
Telephone:	012 348 9043	Fax:	012 348 9043
E-mail:	noel@ekotrust.co.za		
Professional affiliation(s) (if any)	SACNASP 401430/83		

Project Consultant:	NOEL VAN ROOYEN		
Contact person:	NOEL VAN ROOYEN		
Postal address:	272 THATCHERS FIELDS, LYNNWOOD, PRETORIA		
Postal code:	0081	Cell:	082 552 0886
Telephone:	012 348 9043	Fax:	012 348 9043
E-mail:	noel@ekotrust.co.za		

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2. Expertise of the Specialist including Curriculum vitae (Appendix 6 (1)(a)(ii) of EIA Regulations, 2014)

See CV attached

3. **Declaration by Specialist**

I, NOELVAN Rooyen (Name of Specialist) of EKOTRUST cc (name of company) declare that;

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant/ Environmental Assessment Practitioner appointed by applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of Section 48B(2) of the Act.**

Signature of the specialist

EKOTRUST cc
Name of company (if applicable)

31 MAY 2017
Date

Signature of the Commissioner of Oaths

2017-05-31
Date

Designation

Official stamp:

2017 -05- 31

Curriculum vitae: DR NOEL VAN ROOYEN

1. Biographical information

Surname	Van Rooyen
First names	Noel
ID number	501225 5034 084
Citizenship	South African
Business address	Ekotrust CC 272 Thatcher's Field Lynnwood 0081 Pretoria South Africa
Tel & Fax	+27 (0) 12 348 9043
Cell	+27 (0) 82 882 0886
e-mail/web	noel@ekotrust.co.za; www.ekotrust.co.za
Current position	Ecologist/Botanist: member of Ekotrust cc
Professional registration	Professional Natural Scientist (Pr.Sci.Nat: Reg no. 401430/83). Professional Rangeland Scientist (GSSA)

Academic qualifications include BSc (Agric), BSc (Honours), MSc (1978) and DSc degrees (1984) in Plant Ecology at the University of Pretoria, South Africa. Until 1999 I was Professor in Plant Ecology at the University of Pretoria and at present I am a member of Ekotrust cc.

2. Publications

I am the author/co-author of 121 peer reviewed research publications in national and international scientific journals and was supervisor or co-supervisor of 9 PhD and 33 MSc students.

Books

Contributed to chapters on vegetation, habitat evaluation, wildlife and veld management in the book:

BOTHMA, J. du P. (Ed.) 2016. ***Game Ranch Management.*** 6th edition. Van Schaik, Pretoria.

Co-editor of the book:

BOTHMA, J. du P. & VAN ROOYEN, N. (eds). 2005. ***Intensive wildlife production in southern Africa.*** Van Schaik, Pretoria.

Wild flower field guide for the southern Kalahari:

VAN ROOYEN, N. (2001). ***Flowering plants of the Kalahari dunes.*** Ekotrust CC, Pretoria. (In collaboration with H. Bezuidenhout & E. de Kock).

Author / co-author of various chapters on the Savanna and Grassland Biomes in:

LOW, B. & REBELO, A.R. (1996). ***Vegetation types of South Africa, Lesotho and Swaziland.*** Department of Environmental Affairs and Tourism, Pretoria.

KNOBEL, J. (Ed.) (1999, 2006). ***The Magnificent Natural Heritage of South Africa.*** (Chapters on the Kalahari and Lowveld).

VAN DER WALT, P.T. 2010. **Bushveld.** Briza, Pretoria. (Chapter on Sour Bushveld).

2. Ekotrust cc: Core Services

Ekotrust cc specializes in vegetation surveys, classification and mapping, wildlife management, wildlife production and economic assessments, vegetation ecology, veld condition assessment, carrying capacity, floristic diversity assessments, rare species assessments, carbon pool assessments and alien plant management.

3. Examples of projects

Numerous vegetation surveys and vegetation impact assessments for Baseline, Scoping and Environmental Impact Assessments (EIA's) were made both locally and internationally.

Numerous projects have been undertaken in game ranches and conservation areas covering aspects such as vegetation surveys, range condition assessments and wildlife management. Of note are the Johannesburg City Parks & Zoo (6 nature reserves), Kgalagadi Transfrontier Park, iSimangaliso Wetland Park, Ithala Game Reserve, Phinda Private Game Reserve, Mabula Game

Reserve, Tswalu Kalahari Desert Reserve, Maremani Nature Reserve and Associate Private Nature Reserve (previously Timbavati, Klaserie & Umbabat Private Game Reserve).

Involvement in various research programmes: vegetation of the northern Kruger National Park, Savanna Ecosystem Project at Nylsvley, Limpopo; Kuiseb River Project (Namibia); Grassland Biome Project: Namaqualand and Kruger Park Rivers Ecosystem research programme.

4. Selected references of projects done by Ekotrust cc

VAN ROOYEN, N., THERON, G.K., BREDENKAMP, G.J., VAN ROOYEN, M.W., DEUTSCHLÄNDER, M. & STEYN, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Final report: Department of Environmental Affairs & Tourism, Pretoria.

VAN ROOYEN, N. 1999. The vegetation types, veld condition and game of Tswalu Kalahari Desert Reserve.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2000. Environmental audit of Namakwa Sands Mine at Brand-se-Baai, Western Cape.

VAN ROOYEN, N. 2000. Vegetation survey and mapping of the Kgalagadi Transfrontier Park. Peace Parks Foundation, Stellenbosch.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2005. The Alien Plant Strategic Management Plan for the Zululand Region. Report to Ezemvelo KwaZulu-Natal Wildlife.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, mapping and habitat evaluation of the Ithala Game Reserve, KwaZulu-Natal. Report to Ezemvelo KwaZulu-Natal Wildlife.

VAN ROOYEN, N. 2011. Vegetation and flora of the proposed ESKOM power transmission line from ETNA to GLOCKNER substations (South Gauteng). Report to Holistic Environmental Services, Polokwane.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2012. Vegetation and carbon stocks of the Sintoukola site, Republic of Congo. Report for FFMES, J. Gaugris. Ekotrust CC, Pretoria.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2012. Habitat evaluation and wildlife management on Letlapa Pula Game Ranch, Thabazimbi. Ekotrust CC, Pretoria.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2012. Biophysical assessment of the Herbert PV Solar Power site near Douglas, Northern Cape. Report for Van Zyl Environmental Consultants, Upington.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2012. Biophysical assessment of the Greefspan PV Solar Power site near Prieska, Northern Cape. Report for Van Zyl Environmental Consultants, Upington.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2013. Vegetation of the concession area of Reptile Uranium Namibia (RUN), Swakopmund, Namibia. Ekotrust CC, Pretoria.

VAN ROOYEN, N., & VAN ROOYEN, M.W. 2013. Vegetation and wildlife management of NECSA: Pelindaba. Ekotrust CC, Pretoria.

VAN ROOYEN, N., & VAN ROOYEN, M.W. 2013. Vegetation of the Ongolo and Tumas sites of RUN, Namibia. Ekotrust CC, Pretoria.

VAN ROOYEN, M.W. & VAN ROOYEN, N. 2014. Resource assessment of *Elephantorrhiza elephantina* on farms (or portions) of Abbey, Tweed, Concordia and Bellville, Northern Cape. DENC, Northern Cape. Ekotrust CC, Pretoria

VAN ROOYEN, N. & Van Rooyen, M.W. 2000 - 2015. Assessment of the impact of proposed developments on the biota of various sites in the Northern Cape, Gauteng, Mpumalanga, North-West and Limpopo provinces

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2014. Ecological Management Plans and biodiversity assessments of the Klipriviersberg, Kloofendal, Melville Koppies, Rietfontein, Fourways Koppies, Norscot Koppies and Lonehill Koppies Nature Reserves. Jhb City Parks & Zoo. Ekotrust CC, Pretoria

read
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CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

DETAILS AND EXPERTISE OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Pretoria – Borehole Pump Testing

1. Details of Specialist

Specialist:	Project Hydrogeologist/Manager		
Contact person:	Matthew Damhuis		
Postal address:	39 Manyaleti, Poplar Avenue, Craigavon, Johannesburg		
Postal code:	2191	Cell:	082 684 0801
Telephone:	011 568 2100	Fax:	
E-mail:	matthew@impulseint.co		
Professional affiliation(s) (if any)			

Project Consultant:	Environmental Assurance (Pty) Ltd		
Contact person:	DuToit Wilken		
Postal address:	394 Tram Street, Now Muckleneuk, Pretoria		
Postal code:		Cell:	084 588 2322
Telephone:	012 460 9768	Fax:	012 460 3071
E-mail:	dutoit@envas.co.za		

2. **Expertise of the Specialist including Curriculum vitae (Appendix 6 (1)(a)(ii) of EIA Regulations, 2014)**

Matthew Damhuis is a Project Hydrogeologist with a B.Sc degree in Geology and B.Sc Hons. Degree in Hydrogeology (Geohydrology). Matthew has 6 years' work experience in the hydrogeological field on multi-disciplinary projects such as: Groundwater Contamination Studies, Environmental Management Plans (EMP), Environmental Baseline Assessment (EBA), Environmental Impact Assessments (EIA), Mine Dewatering and Site Drainage Projects, Mine Closure, Groundwater Exploration and Water Supply Projects.

Key experience includes:

- Hydrogeological Field Work Management
- Project Management
- Numerical Modelling (Groundwater Flow and Contaminant Transport)
- Groundwater Exploration & Resource Assessments
- Technical Report Writing

Matthew gained international work experience in several countries outside of South Africa including, Democratic Republic of the Congo (DRC), Mali, Zambia, Tanzania and Madagascar. Extensive field & technical experience has led to the development of a broad, but in-depth understanding of the fundamentals of Hydrogeology and project management.

Field of Expertise:

- Groundwater Exploration & Resource Assessments;
- Dewatering Investigations (Planning, Designing, Implementing and Managing);
- Pit Slope Depressurization and Geotechnical Studies;
- Conceptual Hydrogeological Site Modelling;
- Extensive Numerical Modelling experience;
- Geographic Information Systems (ArcView, Global Mapper, Surfer & AutoCAD);
- Aquifer Testing and Data Analysis (Permeability & Sustainable Yield Estimates)
- Ground and Aerial Geophysics Surveys & Data Analysis (Mag, EM and Resistivity);
- Groundwater Level Monitoring, Hydrocensus and Water Samplings & Data Analysis;
- Geochemical Studies (Acid Rock Drainage Forming Potential & Environmental Isotopes);
- Supervision & Management of Drilling Contractors (Core, RC, Percussion);
- Geological Logging (Drill Chip and Core Samples);
- Mining Feasibility Studies (Pre-Feasibility and Bankable Feasibility Level);
- Environmental Impact Assessments (EIA);
- Environmental Monitoring Plans (EMP);
- Project Management & Budgeting; and
- Excellent knowledge of MS Office.

3. **Declaration by Specialist**

I, Matthew Damhuis of Impulse Water (Pty) Ltd declare that;

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant/ Environmental Assessment Practitioner appointed by applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of Section 48B(2) of the Act.**

Signature of the specialist

Environmental Assurance (Pty) Ltd
Name of company (if applicable)

2017-06-07
Date

Signature of the Commissioner of Oaths

2017-06-07
Date

Hydrogeologist
Designation

Official stamp:

COMMISSIONER OF OATHS
Nelene Naicker
Business Accountant in Practice (SA)
Ex Officio RSA
5 Jatinga Avenue, Paulshof
Johannesburg

Impulse Water Holdings
Johannesburg | Durban | Dubai
Tel: +27 11 568 2100
Fax: +27 11 568 0276
Email: info@impulseint.co
www.impulseinternational.co

Curriculum Vitae

Matthew John Damhuis

Project Hydrogeologist

1. Position in project	Technical Director		
2. Name of company	Impulse Water		
3. Name of staff	Matthew John Damhuis		
4. Position in the firm	Technical Director		
5. Year of birth	15 September 1988		
6. Years with the firm	Since February 2015		
7. Nationality	South African		
8. Membership	N/A		
9. Education	from	to	
	2007	2009	University Of Pretoria - Pretoria, South Africa Bsc Geology
	2010	2010	University Of The Free State, South Africa Bsc (Hons) Hydrogeology
10. Special Qualifications	N/A		
11. Experience Abroad	South Africa, Tanzania, Democratic Republic Of Congo (DRC), Mali, Zambia, Madagascar		
12. Professional Career	from since	to year	
	February 2015	Current	Hydrogeologist/Technical Director Impulse Water Holdings (Pty) Ltd
	June 2014	January 2015	Level 2 Hydro-Geologist/Sub-Unit Manager GCS Water And Environment (Pty) Ltd

Curriculum Vitae

Matthew John Damhuis

Project Hydrogeologist

	January 2011	June 2014	Level 2 Hydro-Geologist GCS Water And Environment (Pty) Ltd	
	June 2010	December 2010	Student Junior Hydro-Geologist GCS Water And Environment (Pty) Ltd	
	July 2007	December 2007	Core Logging, Diamond Core Drilling Supervision Weppelman Geotechnical Services	
	2006	January 2007	General Worker PK Welding & Robotics	
13. Language skills	Language	Read	Speak	Write
	English*	1	1	1
	Afrikaans	1	1	1
	(* = mother tongue, 1 = excellent, 5 = low)			
14. Activities performed				
Period	From : February 2015		To: Current	
Project location	Johannesburg			
Client	Impulse Water (Pty) Ltd - Various			
Project description	Hydrogeologist			
Services rendered in the project	1. **Digby Wells & Associates** **Project : Vmc Hydrogeology Study: Numerical Modelling** • Numerical Modelling • Data Analysis • Quality Control • Reporting • Project Management 2. **Eskom (Corporate Social Investment)** **Project : Majadibodu Creche Water Treatment Solution** • Water Treatment Selection & Design • Client Liaison • Project Management And Quality Control			

Curriculum Vitae

Matthew John Damhuis

Project Hydrogeologist

	3. **Environmental Assurance (Pty) Ltd** **Project : Palingpan Mine Hydrogeology** • Numerical Modelling • Data Analysis • Quality Control • Reporting • Project Management 4. **GCS Water & Environment (Pty) Ltd** **Project : Comide Bankable Feasibility Study** • Conceptual Model Development • Numerical Modelling • Data Analysis • Reporting • Project Management	
Period	From : June 2014	To: January 2015
Project location	Various	
Client	GCS Water And Environment (Pty) Ltd	
Project description	Level 2 Hydro-Geologist/Sub-Unit Manager	
Services rendered in the project	1. **DRA Global** **Project : Molo Graphite Project Bankable Feasibility Study (Madagascar)** • Field Work Management (Contractor And Resources) • Numerical Modelling (Flow And • Transport Modelling) • Technical Report Writing 2. **Hatch Goba** **Project : Mukulu Pre-Feasibility Study** • Numerical Modelling (Flow And Contaminant Transport) • Technical Report Writing • Field Work Management	
Period	From : January 2011	To: June 2014

Curriculum Vitae

Matthew John Damhuis

Project Hydrogeologist

Project location	Various
Client	GCS Water And Environment (Pty) Ltd
Project description	Level 2 Hydro-Geologist
Services rendered in the project	**1. EIMS (Pty) Ltd** **Project : Leiden Colliery Hydrogeological Study** • Numerical Modelling (Flow) • Field Work Management **2. DRA Global** **Project : Kinsenda Hydrogeological Investigation (DRC)** • Hydrogeological Borehole Siting • Drilling Supervision • Aquifer Test Data Interpretation • Technical Report Writing **3. Amatheon Agri** **Project : Big Concessions Water Supply (Zambia)** • Geophysics (Resistivity) Interpretation And Borehole Siting • Drilling Supervision • Conceptual Model Development • Reporting **4. Exxaro Resources** **Project : Grootgeluk Cyclic Ponds** • Data Analysis • Numerical Modelling (Flow & Contaminant Transport) • Reporting **5. Goldfields** **Projects : Yanfolila Hydrogeology (Mali)** • Drilling Supervision • Data Analysis • Slug Test (Conducting And Analysis)

	6. **Anglo Platinum** **Projects : Mototolo Concentrator: Groundwater Numerical Model** • Data Analysis • Numerical Modelling (Flow & Contaminant Transport) • Reporting • Presentation Of Results To Client 7. **Xstrata Western Alloys** **Projects : Kroondal Hydrogeological Investigation** • Project Management & Client Liaison • Hydrocensus • Data Analysis • Numerical Modelling (Both Flow And Contaminant Transport) • Reporting 8. **BHP Billiton** **Projects : Ermelo Mine Hydrogeological Study** • Data Analysis • Borehole Profiling Using Multiparameter Probe • Numerical Modelling (Flow & Contaminant Transport) • Reporting 9. **ENRC** **Projects : Mashitu Sud Hydrogeological Study (DRC)** • Geophysical Survey Design • Geophysical Data Interpretation And Borehole Siting • Drilling Supervision 10. **African Barick Gold** **Projects : Bulyanhulu TSF Boreholes (Tanzania)**

	• Drilling Supervision • Aquifer Test Data Interpretation **11. Gauteng Province (RSA)** **Projects : Gautrain Dewatering Study** • Data Interpretation • Report Writing • Scenario Modelling **12. TWP Projects (RSA)** **Projects : Eloff Baseline Investigation** • Hydrocensus • Data Interpretation • Report Writing **13. ENRC/Camrose** **Projects : Mashitu-DRC Hydrogeological Study** • Hydrocensus • Data Interpretation • Drilling Supervision And Borehole Design • Aquifer Test Interpretation • First-Order Numerical Modelling • Report Writing **14. Kumba Iron Ore (RSA)** **Projects : Sishen Hydrogeological Investigation** • Hydrocensus • Data Interpretation • Database Compilation **15. Ritchie Midgeley Consulting Engineers (RSA)** **Projects : Tutuka Power Station Hydrogeological Investigation** • Hydrocensus • Geophysics (EM And Mag) • Drilling Supervision • Aquifer Testing

	• Mechanical Soil Augering • Report Writing	
Period	From : June 2010	To: December 2010
Project location	Various	
Client	Ltd - Student Junior Hydro-Geologist	
Project description	Student Junior Hydro-Geologist	
Services rendered in the project	1. **Undislosed Client (RSA)** • Site Work For Phase 1 Hydrocarbon Assessment Including Soil Augering, Soil Sampling And Groundwater Sampling	
Period	From : July 2007	To: December 2007
Project location	Various	
Client	Weppelman Geotechnical Services	
Project description	Core Logging, Diamond Core Drilling Supervision	
Period	From : 2006	To: January 2007
Project location	Various	
Client	PK Welding & Robotics	
Project description	General Worker	

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
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CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

DETAILS AND EXPERTISE OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Pretoria – Borehole Pump Testing

1. Details of Specialist

Specialist:	Senior Hydrogeologist		
Contact person:	Jaco Breytenbach		
Postal address:	19, Karee Street, Wilropark Ext, Roodepoort, Johannesburg		
Postal code:	1724	Cell:	072 562 4702
Telephone:	011 568 2100	Fax:	
E-mail:	jaco@impulseint.co		
Professional affiliation(s) (if any)			

Project Consultant:	Environmental Assurance (Pty) Ltd		
Contact person:	DuToit Wilken		
Postal address:	394 Tram Street, New Muckleneuk, Pretoria		
Postal code:		Cell:	084 588 2322
Telephone:	012 460 9768	Fax:	012 460 3071
E-mail:	dutoit@envass.co.za		

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2. **Expertise of the Specialist including Curriculum vitae (Appendix 6 (1)(a)(ii) of EIA Regulations, 2014)**

Wynand Jacobus (Jaco) Breytenbach is a senior hydrogeologist, responsible for overall project management, planning of fieldwork programs, supervising junior hydrogeologist activities, field data interpretation and conceptualizing and hydrogeological models.

Jaco also gained more than 9 years' experience in the Hydrogeological and Environmental fields, as a hydrogeologist working on multi-disciplinary Water Supply and Mining Projects; such as Groundwater Exploration and Waters Supply Projects through Well fields and Individual Production Wells, Mine Dewatering studies, Groundwater and Pit Slope Depressurization Studies, Mine Closure, Specialist Hydrogeological Studies, Contamination Studies, Environmental Baseline Assessment (EBA), Environmental Impact Assessments (EIA), Environmental Monitoring Plans (EMP).

Jaco gained international work experience in several countries outside of South Africa like, Sierra Leone (2 years full time at London Mining), Mauritania, Madagascar, Democratic Republic of Congo (DRC), Mali, Tanzania, Uganda and Botswana. Extensive field & technical experience has led to the development of a broad, but in-depth understanding of the fundamentals of Hydrogeology.

Field of Expertise:

- Groundwater Exploration & Resource Assessments;
- Dewatering Investigations (Planning, Designing, Implementing and Managing);
- Pit Slope Depressurization and Geotechnical Studies;
- Conceptual Hydrogeological Site Modelling;
- Basic Numerical Groundwater Modelling (Visual Modflow);
- Geographic Information Systems (ArcView, Global Mapper, Surfer & AutoCAD);
- Aquifer Testing and Data Analysis (Permeability & Sustainable Yield Estimates)
- Structural Mapping (via Aerial & Satellite photography and Geophysical surveys);
- Ground and Aerial Geophysics Surveys & Data Analysis (Mag, EM and Resistivity);
- Groundwater Level Monitoring, Hydrocensus and Water Samplings & Data Analysis;
- Groundwater - Surface Water Interaction Studies;
- Geochemical Studies (Acid Rock Drainage Forming Potential & Environmental Isotopes);
- Supervision & Management of Drilling Contractors (Core, RC, Percussion);
- Geological Logging (Drill Chip and Core Samples);
- Hydrocarbon Contamination Studies;
- Environmental Baseline Studies;
- Environmental Impact Assessments (EIA);
- Environmental Monitoring Plans (EMP);
- Project Management & Budgeting; and
- Excellent knowledge of MS Office.

3. Declaration by Specialist

I, Jaco Breytenbach of Impulse Water (Pty) Ltd declare that;

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant/ Environmental Assessment Practitioner appointed by applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of Section 48B(2) of the Act.**

Signature of the specialist

Environmental Assurance (Pty) Ltd
Name of company (if applicable)

2017-06-07
Date

Signature of the Commissioner of Oaths

2017-06-07
Date

Hydrogeologist
Designation

Official stamp:

COMMISSIONER OF OATHS
Nelene Naicker
Business Accountant in Practice (SA)
Ex Officio RSA
5 Jatinga Avenue, Paulshof
Johannesburg

Impulse Water Holdings (Pty) Ltd
Johannesburg | Durban | Dubai
Tel: +27 11 568 2100
Fax: +27 011 568 0276
Email: info@impulsewater.co
www.impulsewater.co

Curriculum Vitae

Jaco Breytenbach

Senior Hydrogeologist

1. Position in project	Water Resources Manager
2. Name of company	Impulse Water Holdings
3. Name of staff	Jaco Breytenbach
4. Position in the firm	Water Resources Manager
5. Year of birth	18 May 1984
6. Years with the firm	Since October 2015
7. Nationality	South African
8. Membership	N/A

9. Education

from	to	
2007(Jan)	2007 (Dec)	University of the Free State, Bloemfontein. B.Sc. (Hons) Geohydrology (Hydrogeology).
2003	2006	University of Johannesburg, Auckland Park. BSc in Environmental Management, Geography and Geology.

10. Special Qualifications

- Groundwater Exploration & Resource Assessments *(Water Supply Studies, Pump Equipment Sizing);*
- Dewatering Investigations *(Planning, Designing, Implementing and Managing*);
- Conceptual Hydrogeological Site Modelling *(Rockworks15 software).*
- Numerical Groundwater Modelling *(Visual Modflow);*
- Geographic Information Systems *(ArcView, Global Mapper, Surfer & AutoCAD);*

Curriculum Vitae

Jaco Breytenbach

Senior Hydrogeologist

	• Aquifer Testing and Data Analysis (Permeability, Testing & Sustainable Yield Estimates) *(Aquifer Test Pro & AqteSolv Pro);* • Structural Mapping *(via Aerial & Satellite photography and Geophysical surveys);* • Ground and Aerial Geophysics Surveys & Data Analysis *(Mag, EM and Resistivity);* • Groundwater Level Monitoring, Hydrocensus and Water Samplings & Data Analysis; • Groundwater - Surface Water Interaction Studies; • Geochemical Studies *(Acid Rock Drainage Forming Potential & Environmental Isotopes);* • Supervision & Management of Drilling Contractors *(Core, RC, Percussion);* • Geological Logging *(Drill Chip and Core Samples);* • Hydrocarbon Contamination Studies; • Environmental Baseline Studies; • Environmental Impact Assessments (EIA); • Environmental Monitoring Plans (EMP); • Project Management & Budgeting; and • Excellent knowledge of MS Office.
11. Experience Abroad	Mauritania, Madagascar, Sierra Leone, Democratic Republic of Congo (DRC), Mali, Tanzania, Uganda and Botswana

12. Professional Career

from since	to year	
October 2015	Current	Water Resources Manager- Impulse Water Holdings
October 2013	September 2015	Senior Hydrogeologist- GCS (Pty) Ltd
2012	October 2013	Mine Hydrogeologist- London Mining Plc
2010	2012	Hydrogeological Consultant- ERM Southern Africa
2007	2009	Junior Hydrogeological Consultant- ERM Southern Africa

Page 2 of 6

Curriculum Vitae

Jaco Breytenbach

Senior Hydrogeologist

13. Language skills

Language	Read	Speak	Write
English	1	1	1
Afrikaans	*	*	*

(* = mother tongue, 1 = excellent, 5 = low)

14. Activities performed

Period	From : October 2015	To: Current
Project location	Johannesburg	
Client	Impulse Water Holding (Pty) Ltd	
Project description	Various Projects	
Services rendered in the project	Water resource manager, project management of hydrogeological investigations and groundwater resource development, as well as management of junior staff and contractors.	

Period	From : October 2013	To: September 2015
Project location	Southern Africa, Mauritania, Madagascar, Tanzania & Uganda.	
Client	For GCS (Pty) Ltd	
Project description	• Dwarsberg, Mareetsane, Mabeskraal & Moekavuma Police Station's Groundwater Exploration and Water Supply Studies, South African Police Service (SAPS) • Tasiast Gold Mining Operations (Mauritania), Sondage Well field Expansion Investigation, Kinross Mining • Lima Matiti Tented Camp (Tanzania), Second Water Supply Investigation, Four Seasons Hotel • Yanfolila Gold Mining Operations (Mali), Open Pit Mine Dewatering Investigation, Humming Bird Resources • Molo Graphite Project (Madagascar), Open Pit Mine Dewatering Investigation, Energizer Resources • Lima Matiti Tented Camp (Tanzania), Water Supply Investigation, Four Seasons Hotel • Newcastle Works, Groundwater and Soil Contamination Study, Arcelor Mittal South Africa • Kaweri Coffee Plantation Ltd (Uganda), Water Supply Investigation, Neumann Kaffee Gruppe	

Page 3 of 6

Curriculum Vitae

Jaco Breytenbach

Senior Hydrogeologist

Services rendered in the project	Senior Project Hydrogeological position within the Water Resource Department, based in the Johannesburg, RSA. Main responsibilities included were, Project Management of hydrogeological investigation, management of junior hydrogeologist and contractors, coordination of fieldwork activities, conceptualisation of hydrogeological models and numerical models.
Period	From : 2012 To: October 2013
Project location	Sierra Leone
Client	Marampa Iron Ore Operations For London Mining Plc
Project description	• Marampa Iron Ore Mine (Phase I B Mining Operations), Open Pit Mine Dewatering
Services rendered in the project	• Project hydrogeologist managing and conducting fieldwork activities: drilling supervisor, geological logging, aquifer testing supervisor, data analysis, surface water harvesting & sustainable long-term yield estimates. • Two-year contract with London Mining as their Mine Hydrogeologist reporting to GM of operations. Responsibilities were: Planning, implementation and management of all open pit mine dewatering and hydrogeological activities across the mining operations. Also provide technical input into mine planning & mining departments. Jaco leaded the mine dewatering team consisting out of 16 members.
Period	From : 2010 To: 2012
Project location	South Africa
Client	Various
Project description	• Shell, Pragma Africa's Hydrocarbon Soil Investigation • Vaalbank & Naudesbank, Environmental Baseline Assessment, BHP Billiton (Coal) • Weltevreden Collieries, Quarterly Groundwater & Surface water Monitoring, Northern Coal (Pty) Ltd • Mimosa Collieries, Water Use Licenses Application, Northern Coal (Pty) Ltd

Page 4 of 6

Curriculum Vitae

Jaco Breytenbach

Senior Hydrogeologist

	• Goedgevonden Collieries, Update of Groundwater Monitoring Network, Xstrata Coal SA • Boikarabelo, Groundwater and Surface Water Monitoring (EMP), Resource Generation (Pty) Ltd • Gounkoto Gold Project (Mali), Mine Dewatering Environmental Baseline Assessment, Randgold Resources • Kibali Gold Project (DRC), Mine Dewatering, Randgold Resources & Environmental Baseline Assessment • Kusipongo Expansion Project, Groundwater Specialist Study for Underground Mine Dewatering & Environmental Impacts Assessment (EIA), Kangra Coal • Marampa Iron Ore Mine, Phase IIA Mining-Environmental Baseline Assessment, London Mining
Services rendered in the project	Intermediate Hydrogeological Consultant position within the Integrated Water Management (IWM) division, based in the Johannesburg, RSA.
Period	From : 2007 To: 2009
Project location	South Africa & Botswana
Client	For Environmental Resources Management
Project description	• Nkomati Nicol Mine, Open Pit Mine Dewatering, Nkomati Joint Venture, 2007 to 2008. • Sheba's Ridge, Hydrogeological Baseline Assessment, Ridge Mining, 2008 • Booysendal, Baseline Assessment, Northam Platinum • Oaks Diamond Mine, Mine Closure and Groundwater Monitoring Plan, De Beers • Mafutha (EBA) Environmental Baseline Assessment, Sasol Mining • Sasol Midland, Hydrocarbon Contamination Investigation, Sasol Polymer, 2008 & 2009 • Bekoni (Richtrau No.177/ Atok), Groundwater Monitoring (EMP), Anglo Platinum • South Deep, Driefontein and Kloof Mines, Hydrogeological Baseline Investigation and Environmental Impact Assessment for the

Page 5 of 6

	proposed new Tailings Storage Facility, Gold Fields Mining • Natal Steam Coal, Environmental Monitoring Programme (EMP) • Umicore Specialised Hydrogeological Contamination Investigation • Caltex, Hydrocarbon Investigation, Chevron
Services rendered in the project	Junior Hydrogeological Consultant position within the Specialist Groundwater Team (SGT), based in the Johannesburg.

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

AgriCentre Building
Cnr. Dr. James Moroka and Stadium Rd
Private Bag X2039,
Mmabatho 2735
Republic of South Africa
Tel: +27 (18) 389 5156
Fax: +27(18) 384 0104
E-mail:oskosana@nwpg.gov.za

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

DETAILS AND EXPERTISE OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Pretoria – Borehole Pump Testing

1. Details of Specialist

Specialist:	Project Hydrogeologist/Manager		
Contact person:	Matthew Damhuis		
Postal address:	39 Manyaleti, Poplar Avenue, Craigavon, Johannesburg		
Postal code:	2191	Cell:	082 684 0801
Telephone:	011 568 2100	Fax:	
E-mail:	matthew@impulseint.co		
Professional affiliation(s) (if any)			

Project Consultant:	Environmental Assurance (Pty) Ltd		
Contact person:	DuToit Wilken		
Postal address:	394 Tram Street, New Muckleneuk, Pretoria		
Postal code:		Cell:	084 588 2322
Telephone:	012 460 9768	Fax:	012 460 3071
E-mail:	dutoit@envas.co.za		

2. Expertise of the Specialist including Curriculum vitae (Appendix 6 (1)(a)(ii) of EIA Regulations, 2014)

Matthew Damhuis is a Project Hydrogeologist with a B.Sc degree in Geology and B.Sc Hons. Degree in Hydrogeology (Geohydrology). Matthew has 6 years' work experience in the hydrogeological field on multi-disciplinary projects such as: Groundwater Contamination Studies, Environmental Management Plans (EMP), Environmental Baseline Assessment (EBA), Environmental Impact Assessments (EIA), Mine Dewatering and Site Drainage Projects, Mine Closure, Groundwater Exploration and Water Supply Projects.

Key experience includes:

- Hydrogeological Field Work Management
- Project Management
- Numerical Modelling (Groundwater Flow and Contaminant Transport)
- Groundwater Exploration & Resource Assessments
- Technical Report Writing

Matthew gained international work experience in several countries outside of South Africa including, Democratic Republic of the Congo (DRC), Mali, Zambia, Tanzania and Madagascar. Extensive field & technical experience has led to the development of a broad, but in-depth understanding of the fundamentals of Hydrogeology and project management.

Field of Expertise:

- Groundwater Exploration & Resource Assessments;
- Dewatering Investigations (Planning, Designing, Implementing and Managing);
- Pit Slope Depressurization and Geotechnical Studies;
- Conceptual Hydrogeological Site Modelling;
- Extensive Numerical Modelling experience;
- Geographic Information Systems (ArcView, Global Mapper, Surfer & AutoCAD);
- Aquifer Testing and Data Analysis (Permeability & Sustainable Yield Estimates)
- Ground and Aerial Geophysics Surveys & Data Analysis (Mag, EM and Resistivity);
- Groundwater Level Monitoring, Hydrocensus and Water Samplings & Data Analysis;
- Geochemical Studies (Acid Rock Drainage Forming Potential & Environmental Isotopes);
- Supervision & Management of Drilling Contractors (Core, RC, Percussion);
- Geological Logging (Drill Chip and Core Samples);
- Mining Feasibility Studies (Pre-Feasibility and Bankable Feasibility Level);
- Environmental Impact Assessments (EIA);
- Environmental Monitoring Plans (EMP);
- Project Management & Budgeting; and
- Excellent knowledge of MS Office.

3. Declaration by Specialist

I, Matthew Damhuis of Impulse Water (Pty) Ltd declare that;

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant/ Environmental Assessment Practitioner appointed by applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of Section 48B(2) of the Act.**

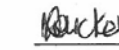
Signature of the specialist

Environmental Assurance (Pty) Ltd

Name of company (if applicable)

2017-06-07

Date



Signature of the Commissioner of Oaths

2017-06-07

Date

Hydrogeologist

Designation

Official stamp:

COMMISSIONER OF OATHS
Nelene Naicker
Business Accountant in Practice (SA)
Ex Officio RSA
5 Jatinga Avenue, Paulshof
Johannesburg

www.envass.co.za

Environmental Assurance (Pty) Ltd

Employee Curriculum Vitae

DUTOIT WILKEN
SENIOR OPERATIONS MANAGER
Environmental Assurance
Environmental consulting

ENVIRONMENTAL ASSURANCE (PTY) LTD
394 Tram Street, New Muckleneuk, Pretoria, 0181
T : 012 460 9768 ; M : 084 588 2322; F : 012 460 3071 ; E mail : dutoit@envass.co.za
Date of Birth : 6 January 1986; Place of Birth : South Africa
Ethnic Group and Gender : White Male ; Disabilities : None

AREAS OF EXPERTISE

- Legal Audits
- Fly Ash Amelioration
- ISO 14001:2004
- Alien Invasive Species Management
- Ground and Surface Water Quality
- Mine Closure Cost assessments
- Report Writing
- Ambient Air Quality
- Project Management
- Due Diligence
- Rehabilitation plan
- IWUL Audits

CAREER HISTORY

Employer: ENVIRONMENTAL ASSURANCE (PTY) LTD
Period: October 2010– Current
Position: SENIOR OPERATIONS MANAGER & MINE CLOSURE
Responsibilities: Senior operations manager and mine closure specialist: Responsible for the management of all operations and projects at ENVASS. Senior project manager of the EIA, Mine Closure, Audit, Compliance Monitoring and Specialist divisions. Development of Project plans and schedules, budget planning and review of reports. Day to day tasks include, Compliance audits and reporting, tender documents and marketing, risk management, client interaction and development of new products.

WORK EXPERIENCE AND SKILLS

Development of project plans, delivery schedules and budget planning. Project risk management. Development of audit protocol, conducting of audits. Environmental due diligences, WUL audits, EMPR PAR's and ROD audits. Specialist studies: Noise & Dust Baselines, EMP Performance Reviews, Air Emission Licenses (AEL), Visual Impact Assessment. Compilation of Scoping EIA, EIA, BAR and Environmental Management Plans for mines, industrial developments and residential developments. Application for Mining rights and prospecting rights. Development and implementation of various monitoring programs for water quality and air quality monitoring for mining and other industries. Development of Mine closure cost assessments in accordance with MPRDA regulations. Mine closure risk assessments, annual plans and final rehabilitation plans in terms of GNR 1147. The use of fly ash for the rehabilitation of coal mine disturbed areas. Environmental legislation interpretation, recommendations and implementation. Mentoring of Professional Natural Science in training towards professional registration.

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	Employee Curriculum Vitae

EDUCATION AND QUALIFICATIONS

Masters MSc. Environmental Science – 2015
- University of Pretoria;
- MSc Research Thesis: Value of classified class F fly ash as an ameliorant for degraded surface coal mine soils.

Honours BSc. Environmental Science – 2009
- University of Pretoria;

Degree BSc. Environmental Science – 2008
- University of Pretoria;

PROFESSIONAL STATUS
Registration
Membership

Member of the Society for Conservation Biology
Member of the South African Affiliate of the International Association for Impact Assessment (SA IAIA)

CONTINUED PROFESSIONAL DEVELOPMENT

COURSE	INSTITUTION	COMPLETED
Environmental Law Workshop	IMBEWU Sustainability Legal Specialists	2016
ISO 14001 Training SAATCA Registered	Centre for Environmental Management (CEM)	2014
Water Law in South Africa Workshop	IMBEWU Sustainability Legal Specialists	2013
Mining Law in South Africa Workshop	IMBEWU Sustainability Legal Specialists	2013
Post – Decision Environmental Monitoring and Enforcement	Centre for Environmental Management (CEM)	2012
Environmental Law for Environmental Managers	Centre for Environmental Management (CEM)	2011
Environmental Law (EMI)	University of Pretoria	2009
Arc GIS 10	University of Pretoria	2009

PROJECT EXPERIENCE

Environmental consulting services for

PROJECT DESCRIPTION	CLIENT
MONITORING AND COMPLIANCE	
Development and implementation of water and air quality monitoring programs	Samancor Chrome Mines – WCM
Development and implementation of water and air quality monitoring programs	Samancor Chrome Mines – ECM
Development and implementation of Air and water quality monitoring programs	Group Five - Everite
Development and implementation of water and air quality monitoring programs	Eastplats Steelpoort and CRM
Development and implementation of water and air quality monitoring programs	Mooiplaats, Woestalleen

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	Employee Curriculum Vitae

Development and implementation of water and air quality monitoring programs	Sublime, Sabrix, Ocon, Binkpan
AUDITS AND DUE DILIGENCE	
Legal Compliance Audit	Woestalleen Colliery
EMP performance review	Eastplats CRM
EMP performance review	VELE – Coal of Africa
ISO 14001:2004 impact aspect register and internal audit	Group Five - Everite
Water Use Licence Audit	Woestalleen Colliery
Water Use Licence Audit	VELE – Coal of Africa
Water Use Licence Audit	Lydenburg Smelter
Water Use Licence Audit	Mogale Alloys
Project U – Due Diligence	Coal of Africa
SPECIALIST WORK	
Visual Impact Assessment	Samancor, Usutu Coal Mine, Makoya ICT
EIA and Management Plant – Township development	Erasmia
Specialist input for EIA – Noise and Air quality baseline	Makoya ICT, Usutu Coal Mine
Environmental Management Plan – Mining right	Wes - Bricks
MINE CLOSURE COST ASSESSMENTS	
Mine Closure Cost Assessment	Samancor Chrome Western Chrome Mine
Mine Closure Cost Assessment	Stuart Coal
Mine Closure Cost Assessment	Vuna Colliery
Mine Closure Cost Assessment	Mooiplaats
Mine Closure Cost Assessment	Woestalleen
Mine Closure – Quantum update	Rosema Stene
Mine Closure – Quantum update	Sabrix
Mine Closure – Quantum update	Ocon Brick
Mine Closure – Quantum update	Victoria Bricks
Mine Closure – Quantum update	Rosema Stene

REFERENCES

CONTACT NAME	COMPANY	RELATIONSHIP	CONTACT NR
Kumari Pillay	Coal of Africa	Client	On request
Rinie Lombard	Group Five	Client	On request
Lukas Berrange	Eastplats	Client	On request
Mpho Mokone	Samancor WCM	Client	On request
Aubrey Nhlabathi	Samancor ECM	Client	On request
Refilwe Mokobodi	ESKOM	Client	On request

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	Employee Curriculum Vitae

CERTIFICATION

I, DUTOIT WILKEN

Declare that, to the best of my knowledge, all the information contained herein is true

Signature: _____

On the 29 day of September 2016.

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

AgriCentre Building
Cnr. Dr. James Moroka and Stadium Rd
Private Bag X2039,
Mmabatho 2735
Republic of South Africa
Tel: +27 (18) 389 5156
Fax: +27(18) 384 0104
E-mail:oskosana@nwpg.gov.za

CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

DETAILS AND EXPERTISE OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Pretoria – Borehole Pump Testing

1. Details of Specialist

Specialist:	Senior Hydrogeologist		
Contact person:	Jaco Breytenbach		
Postal address:	19, Karee Street, Wilropark Ext, Roodepoort, Johannesburg		
Postal code:	1724	Cell:	072 562 4702
Telephone:	011 568 2100	Fax:	
E-mail:	jaco@impulseint.co		
Professional affiliation(s) (if any)			

Project Consultant:	Environmental Assurance (Pty) Ltd		
Contact person:	DuToit Wilken		
Postal address:	394 Tram Street, New Muckleneuk, Pretoria		
Postal code:		Cell:	084 588 2322
Telephone:	012 460 9768	Fax:	012 460 3071
E-mail:	dutoit@envas.co.za		

2. **Expertise of the Specialist including Curriculum vitae (Appendix 6 (1)(a)(ii) of EIA Regulations, 2014)**

Wynand Jacobus (Jaco) Breytenbach is a senior hydrogeologist, responsible for overall project management, planning of fieldwork programs, supervising junior hydrogeologist activities, field data interpretation and conceptualizing and hydrogeological models.

Jaco also gained more than 9 years' experience in the Hydrogeological and Environmental fields, as a hydrogeologist working on multi-disciplinary Water Supply and Mining Projects; such as Groundwater Exploration and Waters Supply Projects through Well fields and Individual Production Wells, Mine Dewatering studies, Groundwater and Pit Slope Depressurization Studies, Mine Closure, Specialist Hydrogeological Studies, Contamination Studies, Environmental Baseline Assessment (EBA), Environmental Impact Assessments (EIA), Environmental Monitoring Plans (EMP).

Jaco gained international work experience in several countries outside of South Africa like, Sierra Leone (2 years full time at London Mining), Mauritania, Madagascar, Democratic Republic of Congo (DRC), Mali, Tanzania, Uganda and Botswana. Extensive field & technical experience has led to the development of a broad, but in-depth understanding of the fundamentals of Hydrogeology.

Field of Expertise:

- Groundwater Exploration & Resource Assessments;
- Dewatering Investigations (Planning, Designing, Implementing and Managing);
- Pit Slope Depressurization and Geotechnical Studies;
- Conceptual Hydrogeological Site Modelling;
- Basic Numerical Groundwater Modelling (Visual Modflow);
- Geographic Information Systems (ArcView, Global Mapper, Surfer & AutoCAD);
- Aquifer Testing and Data Analysis (Permeability & Sustainable Yield Estimates)
- Structural Mapping (via Aerial & Satellite photography and Geophysical surveys);
- Ground and Aerial Geophysics Surveys & Data Analysis (Mag, EM and Resistivity);
- Groundwater Level Monitoring, Hydrocensus and Water Samplings & Data Analysis;
- Groundwater - Surface Water Interaction Studies;
- Geochemical Studies (Acid Rock Drainage Forming Potential & Environmental Isotopes);
- Supervision & Management of Drilling Contractors (Core, RC, Percussion);
- Geological Logging (Drill Chip and Core Samples);
- Hydrocarbon Contamination Studies;
- Environmental Baseline Studies;
- Environmental Impact Assessments (EIA);
- Environmental Monitoring Plans (EMP);
- Project Management & Budgeting; and
- Excellent knowledge of MS Office.

3. Declaration by Specialist

I, Jaco Breytenbach of Impulse Water (Pty) Ltd declare that;

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant/ Environmental Assessment Practitioner appointed by applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of Section 48B(2) of the Act.**

Signature of the specialist

Environmental Assurance (Pty) Ltd
Name of company (if applicable)

2017-06-07
Date

Signature of the Commissioner of Oaths

2017-06-07
Date

Hydrogeologist
Designation

Official stamp:

COMMISSIONER OF OATHS
Nelene Naicker
Business Accountant in Practice (SA)
Ex Officio RSA
5 Jatinga Avenue, Paulshof
Johannesburg

www.envass.co.za

Environmental Assurance (Pty) Ltd

Employee Curriculum Vitae

DAVID VAN DER MERWE
ENVIRONMENTAL CONSULTANT AND FIELD TECHNICIAN
Environmental Assurance
Environmental consulting

ENVIRONMENTAL ASSURANCE (PTY) LTD
394 Trom Street, New Muckleneuk, Pretoria, 0181
T : 012 460 9768 ; M : 082 771 4380; F : 012 460 3071 ; E mail : david@envass.co.za
Date of Birth : 21 December 1991; Place of Birth : South Africa
Ethnic Group and Gender : White Male ; Disabilities : None

AREAS OF EXPERTISE

- Compliance Monitoring
- Ambient Air Quality
- Water Quality
- Site Investigation
- Hydrogeology
- Field Sampling
- Report writing
- Data Analysis
- Customer Relations

CAREER HISTORY

Employer: ENVIRONMENTAL ASSURANCE (PTY) LTD
Period: July 2015– Current
Position: ENVIRONMENTAL CONSULTANT AND FIELD TECHNICIAN
Responsibilities: Currently responsible for the compliance monitoring of various mining- and other industrial sites. The scope of work for these mining sites include: ambient air quality sampling, surface and ground water monitoring, project management, monitoring program layouts, geohydrological investigations and other specialist studies. Other responsibilities include assisting clients with online reporting on the South African Atmospheric Emission Licensing & Inventory Portal (SAAELIP) which includes online reporting to National Atmospheric Emissions Inventory System (NAIES).

WORK EXPERIENCE AND SKILLS

Work experience and skills obtained include: ambient air quality sampling (Gravimetric Dust Fallout, hydrogen fluoride, hydrogen sulphide, sulphur dioxide, carbon monoxide, carbon dioxide and PM10), surface and ground water sampling, site inspections, audits and environmental performance reviews. Specialist work experience include the monitoring, analysis and report writing of water, air and noise baseline studies as well as various geohydrological investigations and studies such as open pit inflow studies, numerical and analytical modelling etc.

Other skills obtained include: GIS map making, project management, monitoring program layouts and installation, environmental legislation interpretation, assistance with authorization requirements such as AEL applications and online reporting on the South African Atmospheric Emission Licensing & Inventory Portal (SAAELIP).

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	Employee Curriculum Vitae

EDUCATION AND QUALIFICATIONS

NWU; B.Sc (Hons) Hydrogeology *(cum laude)* - 2014
NWU; B.Sc Degree Environmental And Biological Sciences- 2013

PROFESSIONAL STATUS
Registration
Membership

In the process of registering for Candidate Natural Scientist with the South African Council of Natural Scientific Professions (SACNASP);
In the process of registering for Candidate Environmental Assessment Practitioner with the Environmental Assessment Practitioners of South Africa (EAPASA)

CONTINUED PROFESSIONAL DEVELOPMENT

COURSE	INSTITUTION	COMPLETED
NAEIS Data Management Policy Workshop (SAAELIP)	Department of Environmental Affairs (DEA)	Yes
IMBEWU Environmental Law Training	IMBEWU	Yes

PROJECT EXPERIENCE

Environmental consulting services for:

PROJECT DESCRIPTION	CLIENT
Air Quality Monitoring and Compliance Reporting	Makoya Supply Chain Holdings (Pty) Ltd
Total Compliance Monitoring and Reporting	Coal of Africa Ltd
Total Compliance Monitoring and Reporting and EMP Audits	South Africa Coal Mining Holdings Limited
Ambient Air Quality Monitoring and Reporting	SA Brix (Pty) Ltd
AEL and EMP Audits	SA Brix (Pty) Ltd
Rosema Olifantsfontein Ambient Air Quality Monitoring and Reporting	Era Stene (Pty) Ltd
Rosema Delmas Ambient Air Quality Monitoring and Reporting	Era Stene (Pty) Ltd
Total Compliance Monitoring and Reporting and EMP Audits	Victoria Bricks (Pty) Ltd
Ambient Air Quality Monitoring and Reporting	Sterkfontein Bricks (Pty) Ltd
Ambient Air Quality Monitoring and Reporting	Lock Sand CC
Noise Monitoring and Reporting	Lock Sand CC
Ambient Air Quality Monitoring and Reporting	Kilo Sand (Pty) Ltd
Ambient Air Quality Monitoring and Reporting	Rheinmetall Denel Munition (Pty) Ltd

www.envass.co.za	**Environmental Assurance (Pty) Ltd**
	Employee Curriculum Vitae

REFERENCES

CONTACT NAME	COMPANY	RELATIONSHIP	CONTACT NR
Emile van Druten	ENVASS	Managing Director	082 554 8051
Wika Esterhuizen	SA Brix	Safety, Health & Environmental Advisor	012 372 9502

CERTIFICATION

I, David van Der Merwe

Declare that, to the best of my knowledge, all the information contained herein is true.

Signature: _____

On the 23 day of June 2016.

read
Department:
Rural, Environment and Agricultural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

AgriCentre Building
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CHIEF DIRECTORATE: ENVIRONMENTAL SERVICES

DIRECTORATE: ENVIRONMENTAL QUALITY MANAGEMENT

DETAILS AND EXPERTISE OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Blue Green Aqua

1. Details of Specialist

Specialist:	Heritage Contracts and Archaeological Consulting CC		
Contact person:	Jaco van der Walt		
Postal address:	37 Olienhout Street Modimolle		
Postal code:	0510	Cell:	0823738491
Telephone:	0823738481	Fax:	0866916461
E-mail:	Jaco.heritage@gmail.com		
Professional affiliation(s) (if any)	ASAPA #159		

Project Consultant:	CSIR		
Contact person:	KARABO MASHABELA		
Postal address:	P.O.Box 320 Stellenbosch		
Postal code:	7599	Cell:	063 188 9863
Telephone:	021 888 2452	Fax:	021 888 2693
E-mail:	KMashabela1@csir.co.za		

2. **Expertise of the Specialist including Curriculum vitae (Appendix 6 (1)(a)(ii) of EIA Regulations, 2014)**

Jaco has been actively involved as a professional archaeologist within the heritage management field in Southern Africa for the past 17 years. Jaco obtained his Master's degree in Archaeology from the University of the Witwatersrand in 2012 and is enrolled for his PhD at the University of Johannesburg. Jaco is an accredited member of the Association of Southern African Professional Archaeologist (ASAPA Member #159) and acted as council member for SADC countries in the Cultural Resource Management (CRM) portfolio for two years (2011 – 2012). Jaco worked at various universities and in the private sector providing him with an excellent balance between academia and the challenges that development poses on our non-renewable heritage resources. Jaco has more than 17 years' experience conducting heritage assessments, grave relocation projects, heritage mitigation and management projects. Jaco has extensive experience working with projects complying with IFC Requirements. Jaco has worked in South Africa. Lesotho, Zambia, Zimbabwe, Mozambique, Botswana, the Democratic Republic of the Congo and in Tanzania. He is well respected in his field and published in peer reviewed journals and presented his findings on various national and international conferences.

3. Declaration by Specialist

Jaco van der Walt HCAC

I,----------(Name of Specialist) of ----------(name of company) declare that;

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant/ Environmental Assessment Practitioner appointed by applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of Section 48B(2) of the Act.**

Signature of the specialist

HCAC

Name of company (if applicable)

9 June 2017

Date

Signature of the Commissioner of Oaths

21/06/2017

Date

Ek sertifiseer dat hierdie fotostaat 'n ware afskrif is van die oorspronklike dokument wat aan my vir waarmerking voorgelê is. Ek sertifiseer verder dat, volgens my waarnemings, daar geen wysiging of verandering op die oorspronklike dokument aangebring is nie.

I certify that this document is a true copy of the original document which was handed to me for authentication. I further certify that, from my observations, no amendment or change was not made to the original document.

Designation

Official stamp:

Handtekening/Signature

21/06/2017

Datum/Date

DR CHRIS BOTHA
KOMMISSARIS VAN EDE / COMMISSIONER OF OATHS
PASTORALE BERADER
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DIE MEER STR 108, PIETERSBURG, 0700
TEL: 015 293 8177 SEL: +27 82 609 9849

Jaco van der Walt
Archaeologist

jaco.heritage@gmail.com
+27 82 373 8491
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Education:

Particulars of degrees/diplomas and/or other qualifications:

Name of University or Institution:		University of Pretoria
Degree obtained	:	BA Heritage Tourism & Archaeology
Year of graduation	:	2001
Name of University or Institution:		University of the Witwatersrand
Degree obtained	:	BA Hons Archaeology
Year of graduation	:	2002
Name of University or Institution	:	University of the Witwatersrand
Degree Obtained	:	MA (Archaeology)
Year of Graduation	:	2012
Name of University or Institution	:	University of Johannesburg
Degree	:	PhD
Year	:	Currently Enrolled

EMPLOYMENT HISTORY:

2011 – Present:	**Owner – HCAC (Heritage Contracts and Archaeological Consulting CC).**
2007 – 2010 :	**CRM Archaeologist,** Managed the Heritage Contracts Unit at the University of the Witwatersrand.
2005 - 2007:	**CRM Archaeologist**, Director of Matakoma Heritage Consultants
2004:	**Technical Assistant**, Department of Anatomy University of Pretoria
2003:	**Archaeologist**, Mapungubwe World Heritage Site
2001 - 2002:	**CRM Archaeologists,** For R & R Cultural Resource Consultants, Polokwane
2000:	**Museum Assistant,** Fort Klapperkop.

Countries of work experience include:
Republic of South Africa, Botswana, Zimbabwe, Mozambique, Tanzania, The Democratic Republic of the Congo, Lesotho and Zambia.

SELECTED PROJECTS INCLUDE:

Archaeological Impact Assessments (Phase 1)

Heritage Impact Assessment Proposed Discharge Of Treated Mine Water Via The Wonderfontein Spruit Receiving Water Body Specialist as part of team conducting an Archaeological Assessment for the Mmamabula mining project and power supply, Botswana
Archaeological Impact Assessment Mmamethlake Landfill
Archaeological Impact Assessment Libangeni Landfill

Linear Developments

Archaeological Impact Assessment Link Northern Waterline Project At The Suikerbosrand Nature Reserve
Archaeological Impact Assessment Medupi – Spitskop Power Line,
Archaeological Impact Assessment Nelspruit Road Development

Renewable Energy developments

Archaeological Impact Assessment Karoshoek Solar Project

Grave Relocation Projects

Relocation of graves and site monitoring at Chloorkop as well as permit application and liaison with local authorities and social processes with local stakeholders, Gauteng Province.
Relocation of the grave of Rifle Man Maritz as well as permit application and liaison with local authorities and social processes with local stakeholders, Ndumo, Kwa Zulu Natal.
Relocation of the Magolwane graves for the office of the premier, Kwa Zulu Natal
Relocation of the OSuthu Royal Graves office of the premier, Kwa Zulu Natal

Phase 2 Mitigation Projects

Field Director for the Archaeological Mitigation For Booysendal Platinum Mine, Steelpoort, Limpopo Province. Principle investigator Prof. T. Huffman
Monitoring of heritage sites affected by the ARUP Transnet Multipurpose Pipeline under directorship of Gavin Anderson.
Field Director for the Phase 2 mapping of a late Iron Age site located on the farm Kameelbult, Zeerust, North West Province. Under directorship of Prof T. Huffman.
Field Director for the Phase 2 surface sampling of Stone Age sites effected by the Medupi – Spitskop Power Line, Limpopo Province

Heritage management projects

Platreef Mitigation project – mitigation of heritage sites and compilation of conservation management plan.

development in the Greater Sekhukhune area, Limpopo Province. J van der Walt

- Paper read at the Southern African Association of Archaeologists Biennial Conference 2008

- Ceramic analysis of an Early Iron Age Site with vitrified dung, Limpopo Province South Africa.
  - J van der Walt. Poster presented at SAFA, Frankfurt Germany 2008

- Bantu Speaker Rock Engravings in the Schoemanskloof Valley, Lydenburg District, Mpumalanga (*In Prep)*
  - J van der Walt and J.P Celliers

- Sterkspruit: Micro-layout of late Iron Age stone walling, Lydenburg, Mpumalanga. W. Fourie and J van der Walt. A Poster presented at the Southern African Association of Archaeologists Biennial Conference 2011

- Detailed mapping of LIA stone-walled settlements' in Lydenburg, Mpumalanga. J van der Walt and J.P Celliers
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2011

- Bantu-Speaker Rock engravings in the Schoemanskloof Valley, Lydenburg District, Mpumalanga. J.P Celliers and J van der Walt
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2011

- Pleistocene hominin land use on the western trans-Vaal Highveld ecoregion, South Africa, Jaco van der Walt.
  - J van der Walt. Poster presented at SAFA, Toulouse, France. Biennial Conference 2016

REFERENCES:

1. Prof Marlize Lombard — Senior Lecturer, University of Johannesburg, South Africa
   E-mail: mlombard@uj.ac.za
2. Prof TN Huffman — Department of Archaeology Tel: (011) 717 6040
   University of the Witwatersrand
3. Alex Schoeman — University of the Witwatersrand
   E-mail:Alex.Schoeman@wits.ac.za

Basic Assessment for the proposed tilapia aquaponics project, on plot 413 of the farm Bosplaas West, north of the town of Hammanskraal, in the Moretele Municipality in Bojanala District, North West Province

Appendix G:
Specialist Reports (including Terms of Reference)

EKOTRUST

VEGETATION, FLORA AND FAUNA SURVEY:

Bosplaas West, Hammanskraal

Moretele Municipality, Bojanala District
North West province
(farm Boschplaats 91 JR)

N van Rooyen
MW van Rooyen

May 2017

CONTENTS

EXECUTIVE SUMMARY

Background:

Ekotrust cc was commissioned to assess the vegetation, flora and fauna of a part of the farm Boschplaats 91 JR near Hammanskraal within the Moretele Municipality at 25° 19' 38.9 S; 28° 14' 36.8 E. The quarter degree grid reference is 2528 AC.

The area is relatively flat and the site occurs at an altitude of approximately 1067 m above sea level. Drainage is towards the Apies River in the east which flows northwards towards the Pienaars River. The mean annual rainfall of the site is 616 mm (Tregenna rainfall station, neighbouring farm). The rainy season at Tregenna is predominantly from October to April when about 88% of the annual rainfall occurs, with January the wettest month. The driest months are from June to August, when less than 10 mm of rain is recorded per month. The mean annual temperature for the area is 15.9°C and the extreme maximum and minimum temperatures measured over a period of 33 years were 35.4°C and -8.2°C respectively.

The geology of the site consists mainly of quartzite, shale and conglomerate. The site falls in Land Type Ba 36. The site is located in the Springbokvlakte Thornveld vegetation type (SVcb 15), in the Central Bushveld Bioregion of the Savanna Biome. The Springbokvlakte Thornveld is classified as 'vulnerable' (NEMBA 2011). Only 1% of the vegetation type is statutorily protected and about half of the area is already transformed by cultivation, urban sprawl, dense rural communities and building of infrastructure.

Vegetation survey:

A total of 116 indigenous and 37 alien species (32% of all species) was recorded on site. Fourteen declared invasive plant species were recorded on site. These include nine Category 1b species, two Category 2 species and three Category 3 species. Twenty-three other alien plant species were recorded on site.

The main findings of the habitat survey can be summarised as follows:

- About 80% of the site has been transformed by human activities in the past (ploughing).
- The site is not located in a protected area according to NEM:PAA.
- None of the listed North West province protected or specially protected plant species or the Red Data species listed for the 2528AC grid were recorded on site. Due to the relatively degraded state of the site, the chances of finding any of these species is regarded as negligible.
- None of the plant species recorded on site are listed in the NEM:BA (ToPS) lists of critically endangered, endangered or vulnerable species.
- All plant species recorded on site are considered as 'least concern'.
- None of the species are listed in CITES 2016 appendices.
- No protected tree species were recorded on the footprint of the proposed project site, but *Combretum imberbe* and *Sclerocarya birrea* do occur on the residential section of the property.
- No endemic species were recorded on site.

- Twenty-five species with medicinal properties and 14 with poisonous properties were recorded on site.

Faunal survey:

No Red Data faunal species were recorded on the site.

Sensitivity:

No sensitive terrestrial habitats occur on site and therefore the general sensitivity of the area is regarded as very low. Although the site was not cultivated within the last 10 years, the effect is still visible with the result that the sensitivity of the site was rated as very low (Table A).

Table A: Sensitivity assessment of the site

Environmental parameter (x weighting)	Score
Threatened status (x5)	10
% Red data species (x4)	0
% North West rare species (x4)	0
Number protected trees (x3)	0
% Endemic species (x2)	0
Conservation value (x4)	0
Species richness (x2)	6
Connectivity (x2)	6
Erosion (x2)	2
Resilence (x3)	6
Sum:	**30**
Sensitivity rating:	**Very low**

Very low sensitivity means it is usually applicable to habitats that have been transformed, especially by human activities.

Impacts:

An assessment of the significance of the impacts revealed a low significance for the terrestrial ecosystem (see Table B). Low significance: If the negative impacts have little real effects it should not have an influence on the decision to proceed with the project.

Mitigation:

Mitigation measures during the construction and operational phases of the proposed development include the following:

- Development should be contained within the proposed footprint of the project and unnecessary disturbance adjacent to the site should be avoided.

- Minimise large-scale clearance of natural vegetation and disturbance at the site.
- Use existing and dedicated access roads to limit disturbance of the natural vegetation.

Table B: Significance assessment of impacts on the terrestrial ecosystem

	Terrestrial ecosystem
Certainty (ε)	5
Intensity (α)	1
Duration (β)	4
Scale (δ)	1
Significance (α+β+δ)*ε**:**	30
Significance rating:	**Low**

- Dust control measures should be implemented during construction.
- The areas that have been denuded and disturbed as a result of construction on site, should be landscaped and re-vegetated as soon as possible with indigenous plants.
- Prevent soil erosion from the disturbed areas.
- Two protected tree species were recorded on the property and should be conserved. No other rare plant species were recorded on site and although the species richness of the plant community is fairly high, most of the species are herbaceous and/or weedy species. Special measures are therefore necessary only for the proteced tree species.
- Indigenous trees and shrubs should be retained where possible or supplemented by planting of indigenous trees and shrubs.
- Implement a monitoring and control program to combat declared weedy and alien invasive plant species.
- No alien invasive plant species should be used in landscaping or gardens on site.

Monitoring should be done to verify environmental impact prediction and adequacy of mitigation measures.

GENERAL INFORMATION

Project: Proposed Tilapia aquaponics farm project on Bosplaas West, registered farm Boschplaats 91 JR, Moretele Municipality, Bojanala Platinum District Municipality, near Hammanskraal, North West province

Report prepared by:

Ekotrust cc
Dr. Noel van Rooyen, Pr. Sci. Nat.
Prof. M.W. (Gretel) van Rooyen, Pr. Sci. Nat.; SAAB; LAkadSA
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Brief *Curriculum Vitae's* of N van Rooyen and MW van Rooyen are attached as Appendices C & D to this document.

Report prepared for:

CSIR
PO Box 320
Stellenbosch 7599
Ms Karabo Mashabela
Tel: 021 888 2482
Fax: 021 888 2693
e-mail: kmashabela1@csir.co.za

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms of the EIA Regulations under the National Environmental Management Act, (Act No. 107 of 1998 (NEMA 2014))

Appointment of specialist

Ekotrust cc was commissioned by CSIR, Stellenbosch, to provide specialist services for the vegetation and faunal assessment of the Bosplaas West Tilapia aquaponics farm project near Hammanskraal in the North West province (CSIR Ref No: CSIR/02100/EMS/IR/2017/15674/A).

Company profile:

Name of Company: Ekotrust cc
(Registration number: CK90/05465/23)
Sole Member: Dr Noel van Rooyen
Founding date: 1990

Ekotrust cc specializes in habitat evaluation, vegetation classification and mapping, floristic diversity assessments, rare species assessments, alien plant assessments and management, wildlife management, wildlife production and economic assessments, veld condition assessment, bush encroachment, fire management, carrying capacity, wildlife numbers and ratios.

Declaration of independence

I, Noel van Rooyen, declare that:

- I am a member of Ekotrust cc: (CK90/05465/23);
- I act as an independent specialist consultant in the fields of ecology and botany;
- I regard the information contained in the report to be objective, true and correct within the framework of assumptions and limitations;
- I undertake to disclose to the applicant and the competent authority all information in my possession that reasonably has or may have the potential of influencing any decision to be taken by the competent authority; and
- I do not have any business, financial, personal or other interest in the activity or application other than fair remuneration for work performed in connection with the activity or application.

Indemnity and conditions relating to this report

The observations, findings, recommendations and conclusions provided in the current report are based on the compiler's best scientific and professional knowledge and other available information. If new information should become available Ekotrust cc reserves the right to modify aspects of the report. This report (hard copy and/or

electronic) must not be amended or extended without the prior written consent of the author. Furthermore, any recommendations, statements or conclusions drawn from or based on this report must make reference to the report. If these recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety (as an Appendix).

Although Ekotrust cc has exercised due care in preparing this report, it accepts no liability, and by receiving this document, the client indemnifies Ekotrust cc against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

Scope and purpose of report

The scope and purpose of the report are summarised in the "Terms of Reference" section of this report.

Dr Noel van Rooyen

Date: May 2017

TERMS OF REFERENCE

Assess the vegetation, Red Data flora and fauna of Plot 413 of the Bosplaas West region (farm Boschplaats 91 JR), located on land near Hammanskraal within the Moretele Municipality, Bojanala Platinum District Municipality.

- Summarise available literature on the vegetation and fauna of the area as well as the climate and physical environment, e.g. geology, land types, soil, topography and drainage;
- Do a field survey of the site to enable a description of the plant communities (habitats) on site;
- Describe the environment in terms of its ecology, including the vegetation type; level of degradation; possible Red Data species (flora and fauna) that may occur on the site and the likelihood of their occurrence on the particular site and surrounds;
- Compile a checklist of alien invaders and recommend management of these plant species;
- Assess the sensitivity and possible ecological impacts of the proposed development on the terrestrial ecosystem, plant taxa, assess their significance and propose mitigation measures.

CHAPTER 1

INTRODUCTION

Ekotrust cc was commissioned to assess the vegetation, flora and fauna of a 4.4 ha property on Bosplaas West on the registered farm Boschplaats 91JR near Hammanskraal within the Moretele Municipality within the Bojanala Platinum District Municipality, at 25° 19' 38.9 S; 28° 14' 36.8 E (Figures 1 & 2). The quarter degree grid reference is 2528 AC.

Loss of habitat due to urbanisation and other developments are regarded as the foremost cause of loss of biodiversity in the natural vegetation types of the region. It is essential that the impact of development on biodiversity in sensitive and irreplaceable habitats is minimized. Much of the impact can be minimized through careful planning and avoidance of sensitive areas. Large areas in the region of the site were cultivated in the past. The chances of finding rare plant species, especially bulbous plant species, in these areas are therefore very small.

The natural areas in the Moretele Municipality decreased by 13.6% between 1990 and 2014, from 103 304 ha to 84 582 ha (READ 2015a). This constitutes loss of natural habitat. A 74%, 6% and 31% change in area under cultivation, mining and settlement respectively occurred in the Moretele Municipality since 1990.

The aim of this survey was to record the occurrence/likely occurrence of Red Data plant and animal species and describe the habitat (vegetation) as well as its sensitivity and status. A sensitivity assessment was done and a sensitivity map compiled. The potential impacts of the project are discussed and mitigation measures proposed.

Assumptions, limitations or uncertainties

The following assumptions, limitations or uncertainties are listed regarding the habitat/botanical assessment of the site:

- This document has been prepared for the particular purpose outlined in the TOR and no responsibility is accepted for the use of this document for any other purpose or in other contexts.
- Rare and threatened plant and animal species are generally uncommon and/or localised and a once-off survey may fail to locate some species, especially since the surveys were made in the early winter (May 2017).
- The site is located in an area with small-holdings. Most of the site is an abandoned agricultural field and therefore the natural vegetation is in a degraded state. It is assumed that the likelyhood of recording Red Listed plant species or rare animal species on site is limited.

CHAPTER 2

ENVIRONMENTAL DESCRIPTION

2.1 Location

The site is situated on Plot 413 in Bosplaas West region (registered farm Boschplaats 91JR) near Hammanskraal within the Moretele Municipality at 25° 19' 38.9 S; 28° 14' 36.8 E (Figures 1, 2 & 3). The site covers approximately two hectares. The quarter degree grid reference is 2528 AC.

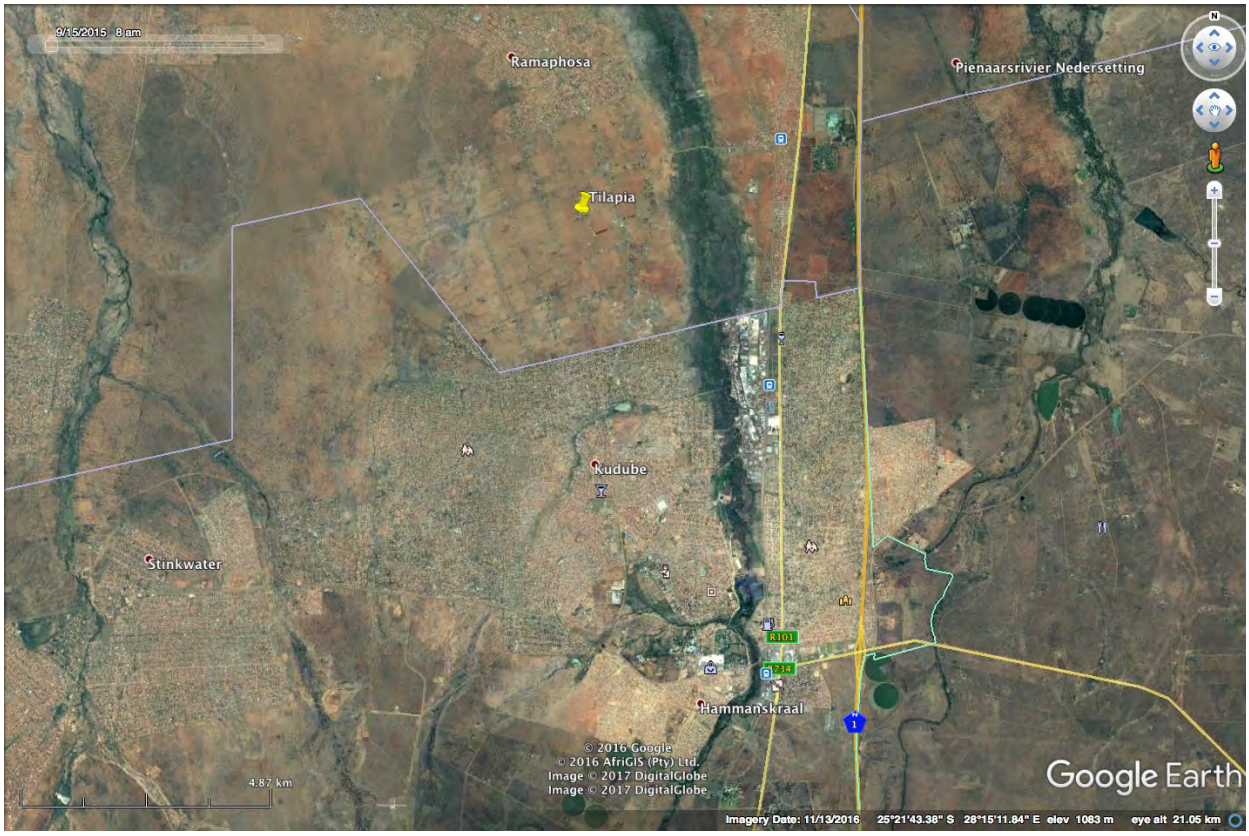

Figure 1: Satellite image of the region. The location of the site is indicated with a yellow pin. It occurs on the plains north of Hammanskraal and to the west of the Apies River and the N1 road.

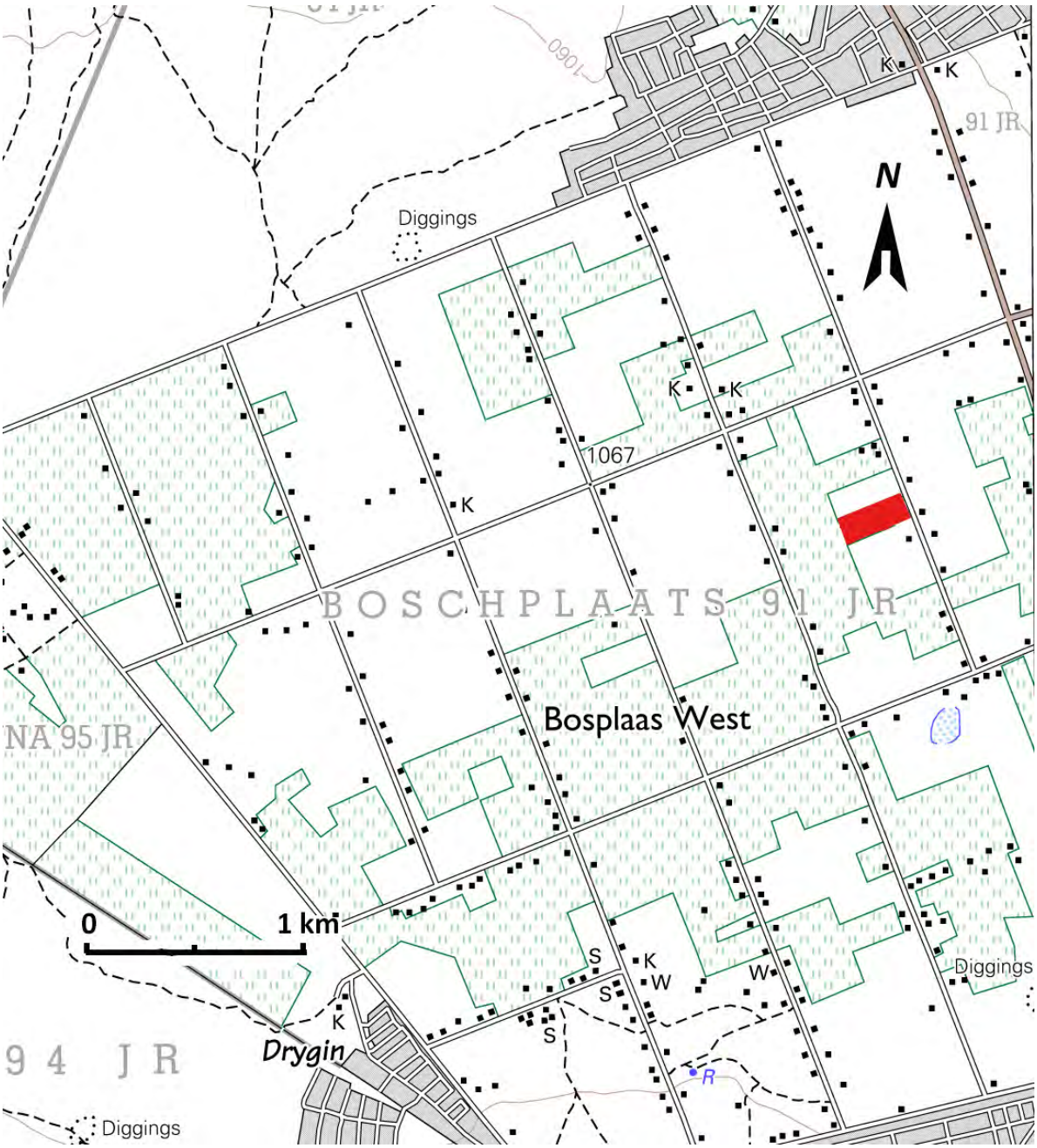

Figure 2: Topocadastral map of the Bosplaas West property near Hammanskraal (red rectangular area, covering 4.4 ha).

Figure 2: Satellite image of the property (yellow lines), covering approximately 4.4 ha, with the proposed development site indicated in red, covering approximately 1.5 ha.

2.2 Terrain morphology and drainage

Drainage

The area is relatively flat and the site occurs at an altitude of approximately 1067 m above sea level (Figure 1). Although no drainage lines occur on or near the property, the general direction of drainage is towards the Apies River in the east which flows northwards towards the Pienaars River.

Borehole

There is one borehole on the property.

Wetlands

No wetlands occur on the property.

2.3 Climate

2.3.1 Regional climate

The regional climate is described as summer rainfall with very dry winters (Mucina & Rutherford 2006). The annual precipitation ranges from 500 mm to 650 mm, with a mean of 567 mm, and a mean annual precipitation coefficient of variation of 29%. The winters are very dry and frost may occur on 11 days in winter).

2.3.2 Rainfall

The mean annual rainfall of the site is 616 mm (Tregenna rainfall station on the neighbouring farm) (Tables 1 & 2). The rainy season at Tregenna is predominantly from October to April when about 88% of the annual rainfall occurs, with January the wettest month (Table 1 and Figure 4). The driest months are from June to August, when less than 10 mm of rain is recorded per month. The annual rainfall may range from 394 mm in dry years to 979 mm in wet years (Table 2).

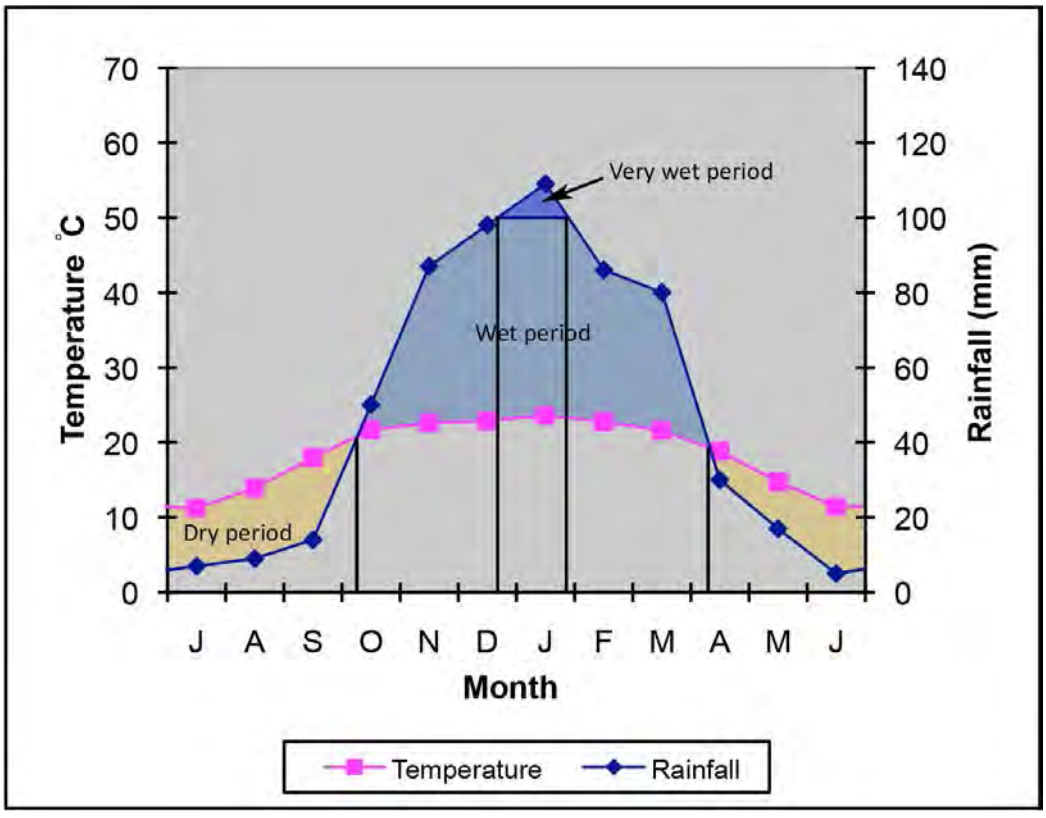

Figure 4: Climate diagram of the Bosplaas West region (Tregenna (rainfall data) and Kalkfontein (temperature data) (Erasmus 1987; Weather Bureau 1988).

2.3.3 Temperature

The mean annual temperature for the region is 15.9°C (Table 3). The extreme maximum and minimum temperatures measured over a period of 33 years were 35.4°C and -8.2°C respectively. The mean daily maximum for January is 25.3°C and for June it is 16.0°C. The mean daily minimum for January is 14.3°C and for June it is 4°C. Frost may occur from April to October.

Table 1: Rainfall data in the vicinity of the site at Bosplaas West, Hammanskraal

Location	Tregenna 0550/350	Hammanskraal 0550/475	Pienaarsrivier 0550/522	Makapaanstad 0550/133	Zoutpan 0550/144
Coordinates	25° 20' S 28° 12' E	25° 25' S 28° 16' E	25° 12' S 28° 18' E	25° 14' S 28° 07' E	25° 25' S 28° 05' E
Altitude	1070 m	1116 m	1042 m	1024 m	1059 m
Jan	109	112	105	78	100
Feb	86	70	82	71	98
Mar	80	66	70	62	72
Apr	30	44	31	45	33
May	17	13	9	17	19
June	5	3	4	9	7
July	7	0	4	7	8
Aug	9	6	8	3	4
Sept	14	19	11	8	15
Oct	50	61	45	42	49
Nov	87	87	80	91	95
Dec	98	80	88	98	102
Total	616	580	537	525	600

Table 2: Mean monthly rainfall, highest monthly maximum and lowest monthly minimum rainfall at Tregenna 0550/350; 25° 20' S; 28° 12' E; 1070 m altitude (data cover a period of 40 years)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Mean	109	86	80	30	17	5	7	9	14	50	87	98	616
*High	288	220	234	136	131	63	97	84	78	158	326	211	979
*Low	30	13	9	0	0	0	0	0	0	2	20	36	394

*Maximum = maximum rainfall recorded in 24 hours

*High = highest monthly and yearly maximum rainfall (mm)

*Low = lowest monthly and yearly minimum rainfall (mm)

Table 3: Temperature data (°C) for Kalkfontein Weather Station 0550/487 7; 25° 07' S; 28° 17' E; 1097 m (period of observation 17 years)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	29.9	29.3	28.3	26.3	23.3	21.1	20.6	23.4	27.1	30.1	29.7	29.7	26.6
*Max	37.6	38.3	35.9	34.0	32.2	30.7	28.7	31.4	36.8	37.8	39.2	40.1	40.1
Min	17.2	16.3	14.8	11.3	6.0	1.8	1.8	4.4	8.9	13.4	15.4	16.2	10.6
*Min	9.5	9.7	5.0	-0.8	-5.3	-6.6	-7.7	-4.4	-4.1	3.2	7.7	5.7	-7.7
Mean	23.6	22.8	21.6	18.8	14.7	11.4	11.2	13.9	17.9	21.7	22.6	22.9	18.6

Max = mean daily maximum temperature for the month

*Max = extreme maximum temperature recorded per month

Min = mean daily minimum temperature for the month

*Min = extreme minimum temperature recorded per month

Mean = mean monthly temperature for each month and for the year

2.4 Geology

The geology of the site and surrounds is summarized in Figure 5. The site occurs in a mapping nit (Pe) characterised by shale, sandstone, grit and conglomerate of the Ecca Formation, Karoo sequence. Other substrates to the north include siltstone, mudstone, shale and sandstone (P-Tr) of the Irrigasie Formation, Karoo Sequence and Nebo-granite (Mn) of the Lebowa Granite Suite, Bushveld Complex in the south.

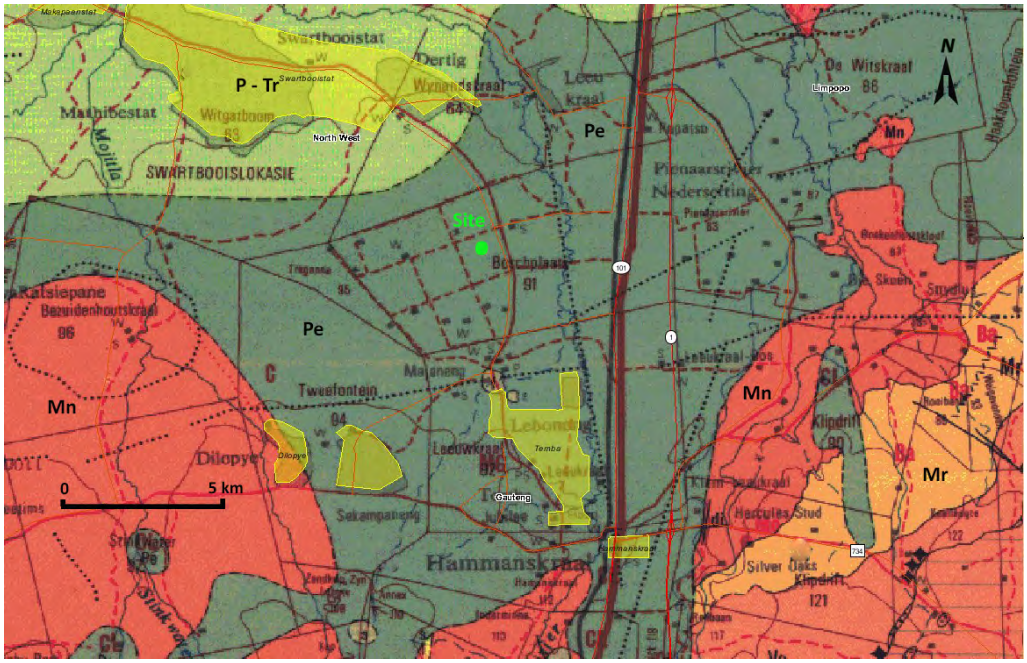

Figure 5: Geology of the region at Bosplaas West, Hammanskraal. The location of the site is indicated in light green.

Legend:

Pe - shale, shaly sandstone, grit, sandstone and conglomerate, Ecca Formation

P-Tr - multi-coloured siltstone, mudstone, shale, marl and sandstone, Irrigasie Formation

Mn - grey to pink coarse-grained granite, Nebo-granite, Lebowa Granite Suite, Bushveld Complex

2.5 Land Types

The site falls in the Ae Land Type (Figure 6). Land types are areas with a uniform climate, terrain form and soil pattern. A terrain unit is any part of the land surface with homogeneous form and slope. Examples of terrain units are crest, scarp, midslope, footslope, valley bottom and floodplain. One (1) represents a crest, 2 = scarp, 3 = midslope, 4 = footslope and 5 = valley bottom. A scarp is usually steeper than 70° (up to 100%).

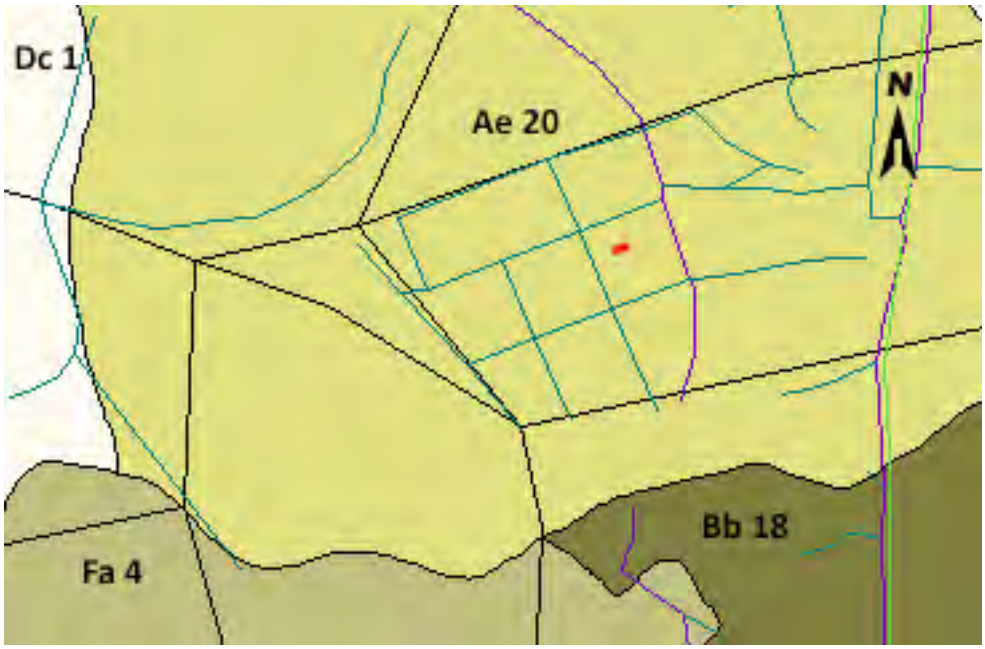

Figure 6: Land types of the region of the site (red mark in Ae20) at Bosplaas West, Hammanskraal.

Land Type Ae20 indicates land with red-yellow apedal freely drained soils; red, high base status, >300 mm deep with no dunes. The Ae Land Type is represented by Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly soil forms. Terrain units 1, 3, 4 and 5 occur in the Ae20 landscape and cover 20%, 70%, 9% and 1% of the landscape respectively. The slopes range from 0 - 1% in terrain unit 1, 1 - 2% in terrain unit 3, 0 - 1% in terrain unit 4, and 0 – 1% in terrain unit 5. The dominant soil form is Hutton in the uplands and Arcadia in the bottomlands. The soil texture of Land Type Ae20 varies from fine- to medium-textured sandy loam, sandy clayloam to clayey soils, with the clay content of the A-horizon ranging from 8 - 30% (up to 55% locally in bottomlands) and up to 45% in the B-horizon.

CHAPTER 3

ENVIRONMENTAL LEGISLATION

3.1 Introduction

The White Paper on the conservation and sustainable use of South Africa's biodiversity and the National Environmental Management Act (Act No. 107 of 1998) specify that due care must be taken to conserve and avoid negative impacts on biodiversity and that the sustainable, equitable and efficient use of biological resources must be promoted. Various Acts provide control over natural resources in terms of their conservation, the use of biological resources and avoidance of negative impacts on biodiversity. Some international conventions are also relevant to sustainable development.

3.2 Natural resources

Terrestrial and other ecosystems and their associated species are widely used for commercial, semi-commercial and subsistence purposes through both formal and informal markets. While some of this use is well managed and/or sustainable, much is thought to be unsustainable. "Use" in this case refers to direct use, such as collecting, harvesting, hunting and fishing for human consumption and production, as well as more indirect use such as ecotourism and wildlife ranching.

3.3 North West Nature Conservation Ordinance (Ordinance No 12 of 1983) (NWNCO)

The NWNCO lists twelve schedules of which Schedules 1- 10 refers to fauna and Schedules 11 & 12 to flora. The Biodiversity Sector Plan (READ 2015a) of North West was used to evaluate the conservation status of the site.

One of the provisions in the Bill is that no person may, without a permit issued in terms of this Ordinance, pick, be in possession of, sell, purchase, donate, receive as a gift, import into, export, convey, or transport a specimen of a protected plant.

3.4 National Environmental Management Act (No. 107 of 1998) (NEMA)

This report has been prepared in terms of the EIA Regulations 2014, under the National Environmental Management Act, (No. 107 of 1998)(Government Notice R. 982, Government Gazette No. 38282 of 4 December 2014, which took effect on 8 December 2014).

3.5 National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA)

The term biodiversity according to the Convention on Biodiversity (CBD) refers to the variability among living organisms from all sources including, *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity in species, between species and of ecosystems.

Section 53 of NEM:BA lists the threatened status of **ecosystems,** i.e. critically endangered ecosystems, endangered ecosystems, and vulnerable ecosystems. The list of threatened ecosystems was published in 2011 (NEM:BA 2011). Thirty-four percent of South Africa's 440 terrestrial ecosystems are threatened. Of these, 5% are critically endangered (mostly in fynbos and forest biomes), 13% are endangered (mostly in the Grassland and Savanna Biomes), and 16% are vulnerable (mostly in the Fynbos and Grassland biomes).

Lists of species that are threatened or protected, activities that are prohibited and exemption from restriction have been published in the Government Gazette Vol 574, No 36375 of 16 April 2013. Section 56 of NEM:BA makes provision for the listing of **species** that are of such high conservation value, national importance or threatened that they need protection, i.e. critically endangered species, endangered species and vulnerable species. The draft threatened or protected species (TOPS) regulations were published in 2013 (NEM:BA 2013a). The regulations include lists of species that are threatened or protected, activities that are prohibited, and activities that are exempted from restriction.

The draft national lists of invasive species, prohibited alien species and exempted alien species, were published in 2013 (NEM:BA 2013b). These lists were followed by the publication of lists of alien and invasive species in 2014 (NEM:BA 2014).

3.6 The National Environmental Management: Protected Areas Act (No. 57 of 2003) (NEM:PAA)

The Act provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national

norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

3.7 National Forests Act (No. 84 of 1998)(NFA)

The NFA makes provision for the declaration of e.g. specially protected areas, forest nature reserves, forest wilderness areas and protected woodlands. A list of Protected Trees is provided in the Act (NFA 2016).

3.8 National Water Act (No. 36 of 1998)

Applications for a Water Use License should be done in terms of this Act.

3.9 National Environmental Management: Waste Act (Act no. 59 of 2008) (NEM:WA)

The relevant activities, listed in terms of Government Notice 718 in terms of Article 19 of the National Environmental Management: Waste Act (Act 59 of 2008) (NEM:WA), are applicable to all developments.

3.10 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

The objectives of CARA are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land, by combating and preventing erosion and weakening or destruction of the water resources, and by protecting the vegetation and combating weeds and invader plants. In order to achieve the objectives, certain control measures are prescribed to which land users must comply. The activities which are mentioned relate to:

- the cultivation of virgin soil;
- the irrigation of land;
- the prevention or control of waterlogging or salinisation of land;
- the utilisation and protection of vleis, marshes and water courses;
- the regulation of the flow pattern of run-off water;
- the utilisation and protection of vegetation; and
- the restoration or reclamation of eroded land.

Lists of alien invasive plant species are provided with appropriate categories indicating the management of these problem species.

3.11 Convention on Biodiversity (CBD)

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

3.12 Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is an international agreement to which countries adhere voluntarily. The aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed in three appendices reflecting the degree of protection that the species needs. Appendix I includes species that are threatened with extinction and trade in these species is permitted only in exceptional circumstances. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III lists species that are protected in at least one country that has asked other CITES parties for assistance in controlling the trade (Website: www.cites.org).

CHAPTER 4

METHODOLOGY

4.1 Approach

The objective of the study was to assess the vegetation and flora of the study area in order to identify any sensitive areas that should be avoided during development.

The study commenced as a desktop-level study, followed by field-based surveys and verification. Hard copy and digital information from spatial databases such as GOOGLE, ENPAT, AGIS, topocadastral and geological maps and vegetation (Mucina & Rutherford 2006) were sourced to provide information on topography, geology, land types and broad vegetation types of the study area.

An enlarged Google image was used as background for the vegetation survey of the property.
The vegetation survey consisted of visiting the site and systematically recording all identifiable woody species, grasses, forbs and alien (exotic) plants within the area, and estimating their cover-abundance. Physical habitat features, e.g. geology, topography, soil colour and texture, and rock cover, were noted. A checklist of the plant species of the site was compiled. During the site visit, digital photographs of the site and some individual plant species were taken and representative photos are included in the report.

4.2 Data analyses

All plant species recorded in the sample plots are listed in Appendix A. An additional plant species checklist of the 2528AC quarter degree grid was obtained from the POSA 2017 database of the South African National Biodiversity Institute (SANBI) and lists 226 taxa. The list is included in this report.

4.3 Red Data plant species

The site was systematically surveyed for rare, threatened and/or endemic plant and animal species during May 2017. The Red Data status, conservation and protected status of plant species recorded on site were determined from the Threatened Species Programme 2017 (SANBI; relist.sanbi.org)), Red List of South African Plants (Raimondo *et al.* 2009), the protected trees according to the National Forests Act (no 84 of 1998)(NFA 2016), the threatened and protected species list (ToPS list) of the National Environmental Management: Biodiversity Act, (Act 10 of 2004) (NEM:BA 2013), CITES appendices (2016), and the North West Nature Conservation Ordinance (Ordinance No 12 of 1983).

4.4 Red Data fauna

The faunal survey involved a visit to the site and consulting of available databases and/or relevant literature to determine the diversity, conservation status and distribution of relevant faunal species.

4.5 Sensitivity assessment

A sensitivity assessment of each plant community was done and a rating awarded. A sensitivity map was compiled based on a number of criteria discussed in Chapter 8.

4.6 Impact assessment

The possible impacts of the proposed township development on the general ecology and flora of the area are discussed and their significance indicated. Mitigation measures are recommended.

CHAPTER 5

VEGETATION

5.1 Introduction

Large parts of the region have been disturbed in the past through mining, settlements, habitation, cultivation, excavations, dumping of rubble and livestock grazing.

Phytogeographically the site falls in the Central Bushveld Bioregion of the Savanna Biome (Rutherford & Westfall 1986; Mucina & Rutherford 2006). Acocks (1953) and Low & Rebelo (1996) described the area as Mixed Bushveld.

The proposed development site occurs in the Springbokvlakte Thornveld vegetation type (Mucina & Rutherford 2006).

Springbokvlakte Thornveld

This vegetation type covers 8797 km^2 of Limpopo, Mpumalanga, North West and Gauteng provinces on the plains between the Magaliesberg Mountains in the south to the Waterberg Mountains in the north (Figure 7). In North West, the vegetation type covers 92 892 ha of which 14 203 ha was lost between 1990 and 2014 (READ 2015a). The vegetation type occurs at altitudes ranging from 900 m to 1200 m above sea level (Mucina & Rutherford 2006). The vegetation type is not endemic to the Noth West province (READ 2015a) and the largest portion occurs in Gauteng.

The landscape is flat to slightly undulating, supporting open to dense low thorn savanna dominated by *Vachellia* and *Senegalia* species or a shrubby grassland with a very low shrub layer. Geologically the most abundant rocks include basalts, mudstones, shale and sandstone. The soils are red-yellow, apedal and freely drained with self-mulching black and red vertic clays.

The most prominent tree species include *Vachellia karroo, Vachellia luederitzii, Vachellia nilotica, Vachellia tortilis, Senegalia mellifera* and *Ziziphus mucronata*. The shrubs are represented by *Diospyros lycioides, Euclea undulata, Grewia flava* and *Dichrostachys cinerea*. The grass species include *Aristida bipartita, Dichantium annulatum, Ischaemum afrum* and *Setaria incrassata.* The forb layer is characterised by *Nidorella hottentotica, Senecio apiifolius* and *Orthosiphon suffrutescens.*

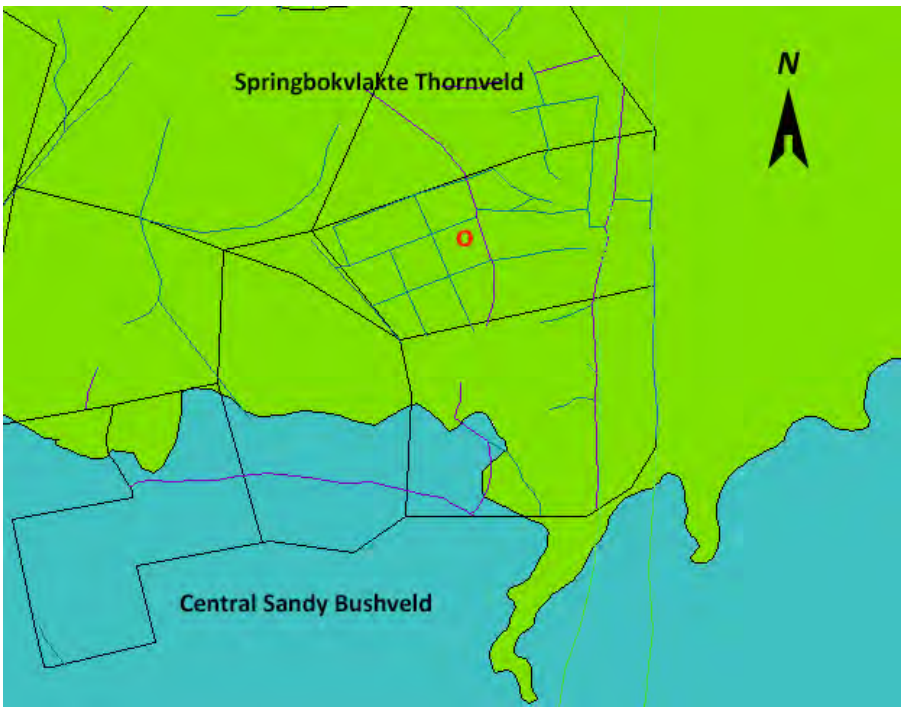

Figure 7: The site (red circle) is located in the Springbokvlakte Thornveld vegetation type (Mucina & Rutherford 2006).

5.2 Vegetation of the property

The property occurs on the plains of the Springbokvlakte and is approximately 4.4 ha in size. Part of the site is used for residential purposes while about two ha is currently under cultivation. Although the proposed development section of approximately 1.5 ha was also used for cultivation in the past, it is estimated to have been last cultivated more than 10 years ago (Mr J. Kgomo, pers. comm.). Therefore, according to NEM:BA (2014), the vegetation of the proposed development site should be regarded as "indigenous vegetation", i.e. vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.

The site is homogeneous in terms of geology and soils. The soils on site are red-yellow, apedal, freely-drained sandy-loam to sandy clay-loam in texture. Therefore the vegetation is homogeneous in composition and could be described as a single plant community consisting of wooded grassland, i.e. dense grass layer with scattered small to tall woody species (see Figures 8 - 10).

Figure 8: View of the proposed development site taken from east to west. Small shrubs of *Vachellia nilotica* and *Vachellia tortilis* occur scattered in the grassland.

Figure 9: View of the proposed development site taken from west to east.

Figure 10: The northern part of the property is currently under cultivation (photo taken from east to west).

The dominant woody species cover less than 5% of the site and include trees and shrubs of *Vachellia tortilis, Vachellia nilotica, Ziziphus mucronata* and *Dichrostachys cinerea.* Three individuals of the protected trees *Combretum imberbe* and one young individual of *Sclerocarya birrea* were recorded in the residential section of the property. The dwarf shrubs are represented by *Asparagus* spp., *Lagerra decumbens, Senna italica* and *Solanum campylacanthum*. The grass layer is well developed and covers more than 90% of the site. The dominant grass species are *Eragrostis rigidior, Eragrostis trichophora, Cynodon dactylon, Urochloa mosambicensis* and *Bothriochloa insculpta.* Other less common species include *Aristida adscensionis, Eragrostis superba, Heteropogon contortus* and *Tragus berteronianus.*

The forb species diversity is high although the forb layer includes many annual weedy species. The conspicuous species include *Barleria macrostegia, Felicia mossamedensis, Felicia muricata, Heliotropium ciliatum, Hibiscus trionum, Sesamum triphyllum* and *Tribulus terr*estris. Many herbaceous creepers and climbers are found and include various *Ipomoea* spp., *Xenostegia tridentata*, *Coccinia sessilifolia* and *Dicerocaryum eriocarpum*.

5.3 Alien plant species

An "invasive species" is any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health. Invasive alien plant species are globally considered as one of the greatest threats to biodiversity and ecosystem integrity.

Invasive alien plant species listed in terms of the Conservation of Agricultural Resources Act (No. 43 of 1983 - Regulation 15, 30 March 2001), and the National Environmental Management Act: Biodiversity Act (No. 10 of

2004)(NEM:BA 2014), should be controlled and eradicated with an emphasis on urgent action in biodiversity priority areas.

The purpose of the new draft legislation on alien species (NEM:BA 2014) is to prevent the illegal introduction of alien and potentially invasive species into the country, and to regulate listed invasive species and potentially invasive species within the country. Invasive species can have profound impacts on the environment, biological diversity, the economy and ecosystems and their services.

Most of the alien species on the property occur in the gardens or disturbed areas on the residential section of the property. These include Category 1b invasive species such as *Melia azedarach, Austrocylindropuntia subulata, Datura ferox, Datura stramonium, Morus alba, Canna indica, Catharanthus roseus* and *Xanthium strumarium*. A number of alien species were planted along the boundary fence, i,e, *Opuntia spinulifera, Austrocylindropuntia subulata, Euphorbia milii* and *Yucca gloriosa*.

Fourteen of the 37 exotic species on site are declared invasive and weedy species (categories 1, 2 & 3). The following categories of declared weeds and invader plants are recognized and the species recorded on site:

Category 1a plant species: landowners are obliged to take immediate steps to control Category 1a species.

None recorded.

Category 1b plant species: The requirement for Category 1b species is to "contain" the invasive species. However, where an Invasive Species Management Programme has been developed for a Category 1b species, then landowners are obliged to "control" the species in accordance with the requirements of that programme. Therefore, Category 1a triggers an immediate obligation to control, whereas that obligation only comes into effect for Category 1b species when an Invasive Species Management Programme is implemented for that species in the specific area. The Category 1b species recorded on the site were:

Austrocylindropuntia subulata
Canna indica
Catharanthus roseus
Datura ferox
Datura stramonium
Flaveria bidentis
Ipomoea purpurea
Opuntia spinulifera
Xanthium strumarium

Category 2 plant species: They are the only species requiring a permit, and are species that have economic, recreational, aesthetic or other valued properties, notwithstanding their invasiveness. These species will be allowed in areas and under conditions specified in the permit. For certain taxa (notably large mammals and fish species), maps will be developed to aid the process of granting permits. It is important to note that a Category 2 species that falls outside the demarcated area specified in the permit, becomes a Category 1b invasive species. Permit-holders must take all the necessary steps to prevent the escape and spread of the species, including the

growth or spread of seeds or any other specimens of the species, outside the area for which the permit is issued, and must take all necessary steps to control any specimen that escapes or spreads.

The following Category 2 species were recorded on site:

Leucaena leucocephala
Psidium guajava

Category 3 plant species**:** Category 3 species are less-transforming invasive species which are regulated by activity. The principal focus with these species is to ensure that they are not introduced, sold or conveyed. However, Category 3 plant species are automatically Category 1b species within riparian and wetland areas.

The following Category 3 species were recorded on site:

Melia azedarach (urban areas)
Morus alba
Passiflora edulis

Figure 11: A few individuals of *Austrocylindropuntia subulata* were planted in the garden and along the boundary fence.

Figure 12: An individual of *Opuntia spinulifera* along the western boundary.

Other alien species recorded on site are:

Abelmoschus esculentus
Acanthospermum australe
Alternanthera pungens
Amaranthus hybridus
Bidens pilosa
Citrus limon
Cucurbita pepo
Euphorbia milii
Ficus carica
Gomphrena celosioides
Guilleminea densa
Malus sylvestris
Opuntia ficus-indica (spineless cultivar)
Pergularia daemia
Physalis viscosa
Prunus persica
Schinus molle
Schkuhria pinnata
Tagetes minuta
Verbena aristigera
Verbesina encellioides
Yucca gloriosa
Zea mays

Various other vegetable cultivars are cultivated on the property.

Alien invaders should be controlled by mechanical and/or chemical means. Mechanical means include ringbarking (girdling), uprooting, chopping, slashing and felling. An axe or chain saw or brush cutter can be used. Stumps or ringbarked stems should be treated immediately with a chemical weedkiller. Follow-up treatment is sometimes needed.

CHAPTER 6

CONSERVATION: VEGETATION AND FLORA

6.1 Introduction

Thirty-four percent (34%) of South Africa's 440 terrestrial ecosystems are threatened. Of these, 5% are critically endangered (mostly in fynbos and forest biomes), 13% are endangered (mostly in the grassland and savanna biomes), and 16% are vulnerable (mostly in the Fynbos and Grassland Biomes).

6.2 Threats

In many areas it is not the direct use of biological resources such as subsistence harvesting (especially of medicinal plants) and illegal collection for commercial trade (particularly of groups such as succulents) that is threatening their sustainability, but rather indirect pressures such as changing of land use, land degradation, clearing of indigenous vegetation, overgrazing, invasion of land by alien species, informal settlements, urban development, industrial and agricultural pollution, mining, impoundments, cultivation, water abstraction and climate change. Loss of habitat is therefore regarded as the foremost cause of loss of biodiversity.

Development (or change in land use) usually contributes to habitat loss and degradation in many biodiversity important areas. Much of the impact can be minimized through careful planning and avoidance of sensitive areas.

6.3 Ecosystem status

Ecosystem status is based on how much of an ecosystem's original area remains intact, relative to certain thresholds (Driver *et al*. 2004).

Springbokvlakte Thornveld

This vegetation type is classified as 'endangered' by Mucina & Rutherford (2006). However, according to NEM:BA (2011), the Springbokvlakte Thornveld is classified as 'vulnerable'. This means the extent of the remaining natural habitat is equal to or less than 60% of the original area of the ecosystem. Only 1% of the vegetation type is statutorily protected and about half of the area is already transformed by cultivation and urban sprawl, with dense rural populations in certain areas.

6.4 The National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA)

The site under investigation is not located in a protected area according to the system of protected areas in South Africa (sections 9 to 15 of NEM:PA, 2003).

6.5 Species richness

A total of 79 indigenous and 37 alien species (32% of all species) was recorded on site, for a total of 116 plant species. Fourteen of these exotic species are declared invasive and weedy species (12% of all indigenous and alien plant species on site). In comparison, about 488 plant taxa were recorded in the Tswaing Meteorite Crater some 18 km to the west of the site (Van Rooyen & Schultz 1994). However, Tswaing is characterised by a diverse number of habitats (Van Rooyen & Schultz 1994; Reimold *et al*. 1999).

6.6 Rare plant species

Red Data Lists can provide a source of information for decision-makers and improve monitoring of the rate of loss of biodiversity and should include an assessment of the cause of a species' conservation status. Species threatened by habitat destruction need to be conserved through mechanisms that conserve the entire ecosystem, where possible.

The National Environmental Management, Biodiversity Act (Act 10 of 2004) (NEM:BA) requires authorities to publish lists of threatened species and species in need of protection from certain restricted activities.

No Red Data plant species were recorded on site (Threatened Species Programme, SANBI, (redlist.sanbi.org)).

According to the SANBI species list for the 2528AC quarter degree grid (POSA xxxx), only one Red Data species could potentially occur in the 2528AC grid, e.g. *Callilepis leptophylla* (Category: Declining). This species was however not encountered on site.

6.7 North West Nature Conservation Ordinance (Ordinance No 12 of 1983)(NWO)

The site does not fall in a Critical Biodiversity Area, biosphere reserve, conservancy, protected area, kloof, important plant habitat, hills and ridges, wetlands or biodiversity corridors (READ 2015a).

According to the North West Ordinance (NWO)(Nature Conservation Ordinance, No. 12 of 1983)(Proclamation No. 22 of 1995), the rare plant species of North West are categorised under the following schedules:

Schedule 11: Protected Plants

None recorded.

Schedule 12: Specially Protected Plants.

None recorded.

6.8 Biodiversity Sector Plan of North West province

The Biodiversity Sector Plan was formulated in 2015 by READ (2015a).

Critical Biodiversity Areas (CBA's)

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. 'Important Areas' are one of the features of a CBA besides irreplaceable areas and protected areas. 'Ecological Support Areas' are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic.

The site under investigating is mapped by North West under the category "No Natural Habitat Remaining" (READ 2015a). These are areas that have been irreversibly modified and do not contribute to maintaining biodiversity pattern or ecological processes. These include rural settlements, croplands, mining areas and forest plantations. The land management objective for this category is to manage land to optimise sustainable utilisation of natural areas. However, the section of land on the site where the project infrastructure is proposed was ploughed more than 10 years ago (Mr. J. Kgomo, pers. comm.). Therefore, according to the definition of NEM:BA (2014), under Listing R. 983, "indigenous vegetation" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where topsoil has not been lawfully disturbed during the preceding 10 years. Following this definition the vegetation of the site could possibly be classified as an Ecological Support Area 2 (ESA 2) (READ 2015a). These areas (ESA 2) still maintain some ecological functionality even though it has been substantially modified in the past. The ecosystem may **not** be in a natural or near-natural state, and may have been previously developed, e.g. ploughed. The objectives of such ESA 2 areas are to maintain current land uses, restore to a natural state, maintain landscape connectivity or permit less intensive land uses. Intensification of land use should be avoided, e.g. a transition from extensive agriculture to urban or mining. If cultivation is no longer viable then these areas should be targeted for ecological restoration.

Land Use Zones

The site falls under Land Use Zone 5 Agriculture (READ 2015a). Land use activities include agricultural infrastructure such as intensive animal production facilities, e.g. feedlot, dairy, piggery, chicken battery and fish farms in rivers.

6.9 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA Threatened and protected species (ToPS) list)

None of the plant species recorded on site are listed in the NEM:BA (2013)(ToPS) lists of critically endangered, endangered or vulnerable species.

6.10 Red List of South African Plants (Raimondo et al. 2009, POSA 2017: SANBI data bank)

All plant species recorded on site are considered as 'least concern' (LC). However, the red list plant species list of the 2528AC quarter degree grid according to the POSA 2017 Integrating Biodiversity Information data bank, SANBI, include the following:

Callilepis leptophylla Harv. Declining

This species was not recorded on site.

6.11 CITES lists (2016), Appendices I, II, & III)

No CITES species recorded on site.

6.12 Protected trees (National Forests Act, Act No. 84 of 1998)(NFA 2016)

According to the NFA (2016): List of Protected Tree Species, two protected tree species were recorded on the property.

Combretum imberbe
Sclerocarya birrea

Permits are required for the utilisation, such as harvesting for wood and medicinal purposes, of declared protected trees. The consequence of the Act is that no person may cut, disturb, damage or destroy any indigenous, living protected tree in a natural forest; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, or any forest product that was derived from a protected tree, except in terms of a license granted by the Minister (or a delegated authority) to an applicant and subject to a period and conditions as may be stipulated. Certain exemptions are also described in the Act. The listing of a tree species as protected does not mean it cannot be used, but it attemps to ensure sustainable use through licensing control measures.

Figure 13: One of three individuals of the protected tree *Combretum imberbe* on the eastern portion of the property, outside the proposed development site.

6.13 Endemic species

The only endemic species that was listed by Mucina & Rutherford (2006) for the Springbokvlakte Thornveld (SVcb 15) is the Central Bushveld endemic grass *Mosdenia leptostachys*. It was not recorded on site.

6.14 Medicinal plant species

The following plant species found on the site are used medicinally for different ailments (Watt & Breyer-Brandwijk 1962, Van Wyk *et al.* 1997; Van Wyk & Gericke 2000, Arnold *et al*. 2002, Van der Walt 2010)(*alien plants).

*Catharanthus roseus**
Corchorus asplenifolius
Cucumis zeyheri
*Datura ferox**
*Datura stramonium**
Dichrostachys cinerea
Ehretia rigida
Felicia muricata

Hermbstaedtia odorata
Hibiscus trionum
Kigelia africana
*Melia azedarach**
Monsonia angustifolia
Ocimum americanum
*Opuntia ficus-indica**
*Pergularia daemia**
*Psidium guajava**
Sclerocarya birrea
Vachellia tortilis
Senna italica
Sesamum triphyllum
Solanum campylacanthum
Vachellia tortilis
Xenostegia tridentata
Ziziphus mucronata

6.15 Poisonous plant species

A number of plant species found on site have poisonous properties, especially for livestock (see Watt & Breyer-Brandwijk 1962, Vahrmeijer 1987; Kellerman *et al.* 1990; Van Wyk *et al.* 2002)(*alien plants):

*Amaranthus hybridus**
*Cathranthus roseus**
Cucumis zeyheri
Cynodon dactylon
*Datura ferox**
*Datura stramonium**
*Ipomoea purpurea**
*Melia azedarach**
*Opuntia ficus-indica**
Solanum campylacanthum
Tribulus terrestris
Vachellia karroo
Vachellia nilotica
*Xanthium strumarium**

CHAPTER 7

FAUNAL ASSESSMENT

7.1 Introduction

The property is situated in an area that can be described as rural small-holdings. However, these properties are surrounded by urban development and residential properties. The area covered by the small-holdings were cultivated in almost its entirety in the past and cultivation of cash crops are still practised on many of these properties. Threatened mammalian fauna are in general highly secretive or nocturnal and it is unlikely that they would be located in surveys of short duration.

On the Dinokeng Game Reserve to the east, 40 mammal species, 96 reptile species and 364 species of bird have been identified. No mammals of conservation concern are known to occur at the Rust de Winter Nature Reserve (RdWNR 2013). Some 35 species of mammal occur on Tswaing (Reimold *et al*. 1999).

According to READ (2015a) and Desmet & Schaller (2015), the North West province as a whole supports a total of 43 vegetation types, eight being endemic to the province. A total of 15 threatened plant species, 24 threatened mammal species and 40 threatened bird species inhabit the province. The 15 threatened plant species includes two critically endangered (possibly extinct), one Data Deficient Critically Endangered, two Endangered and ten (10) Vulnerable species (Hahn 2015). The 24 threatened mammal species include two Critically Endangered species, four Endangered species, four Vulnerable species and 14 Near Threatened species (Power 2013). The 40 threatened bird species include one Endangered species, 18 Vulnerable species and 21 Near Threatened species (Tye 2012). The reptiles and amphibians of North West were listed by Power & Verburgt (2014) and the spiders and scorpions by Power (2014).

7.2 North West Nature Conservation Ordinance (Ordinance No 12 of 1983)

The North West Nature Conservation Ordinance (Ordinance No 12 of 1983) (NWO) recognises the following categories of animals:

Schedule 2: Protected Game (Mammals, reptiles and birds)

No species were recorded on site.

Schedule 2A: Specially protected wild animals

No species were recorded on site.

Schedule 3: Ordinary Game

No species were recorded on site.

Schedule 4: Protected Wild Animals

No species were recorded on site.

Schedule 5: Wild animals to which the provisions of Section 43 apply

No species were recorded on site.

Schedule 6: Exotic animals to which the provisions of Section 44 apply

No species were recorded on site.

Schedule 7: Invertebrata

No species were recorded on site.

Schedule 8: Problem animals

No species were recorded on site.

Schedule 9: Troutwaters

There are no rivers, wetlands or earth dams on site.

7.3 Mammals

7.3.1 Large herbivores

The historical distribution of large herbivores in the central parts of the Springbokvlakte is indicated in Table 4 (Du Plessis 1969; Friedmann & Daly 2004; Skinner & Chimimba 2005; DEA 2012, 2016; EWT 2016). None of the species which were historically present or with a marginal distribution are currently present on site.

IUCN terminology (IUCN 2012):

EN = Endangered
VU = Vulnerable
NT = Near Threatened

LC = Least Concern

DD = Data Deficient

Table 4: List of large mammals and their historic occurrence status in the region

Present	Marginal	Absent
Aardvark (LC)	Black rhinoceros	Blesbok
Blue wildebeest (LC)	Black wildebeest	Blue duiker
Cape eland (LC)	Cape buffalo	Bontebok
Grey duiker (LC)	Giraffe	Bushbuck
Impala (LC)	Oribi	Bushpig
Kudu (LC)	Red hartebeest	Cape grysbok
Plains zebra (LC)	Sable antelope	Cape mountain zebra
Roan antelope (EN)	Tsessebe	Gemsbok
Southern reedbuck (LC)	Waterbuck	Grey rhebok
Springbok (LC)		Hartmann's mountain zebra
Warthog (LC)		Hippopotamus
White rhinoceros (NT)		Klipspringer
		Lichtenstein's hartebeest
		Nyala
		Mountain reedbuck
		Red duiker
		Sharpe's grysbok
		Suni

7.3.2 Carnivores

Although various carnivores could occur in protected areas in the region, none of them are likely to occur on the property currently.

The following carnivores may be found in the region:

Aardwolf	LC
African Striped Weasel	NT
African Wild Cat	LC
Banded Mongoose	LC
Black-backed Jackal	LC
Brown Hyaena	NT
Caracal	LC
Cheetah	VU
Dwarf Mongoose	LC
Honey Badger	LC
Large-spotted Genet	LC
Leopard	VU
Slender Mongoose	LC
Small-spotted Genet	LC

Striped Polecat	LC
White-tailed Mongoose	LC
Yellow Mongoose	LC

7.3.3 Chiroptera

The site was not surveyed for bats but they may occur in structures or vegetation at or near the site. The following species of bat may occur in the region, occupying caves, savanna and urban structures:

Schreiber's Long-fingered Bat	LC
Cape Serotine Bat	LC
Egyptian Slit-faced Bat	LC
Bushveld Horseshoe Bat	LC
Yellow House Bat	LC
Mauritian Tomb Bat	LC

7.3.4 Insectivora

Insectivora that may occur in the region include the following

South African Hedgehog	NT
Lesser Red Musk Shrew	LC
Greater Dwarf Shrew	LC

No records of Red Data moles occur in the immediate region.

7.3.5 Lagomorphs

Lagomorphs such as the scrub or savanna hare (LC) may occur on site.

7.3.6 Primates

Primates such as the vervet monkey (LC) and Southern Lesser Galago (LC) may occur in the region.

7.3.7 Rodents

The following rodents may occur in the region:

Tete veld rat	- LC
Common mole-rat	- LC

Chestnut climbing mouse	- LC
Woodland dormouse	- LC
Porcupine	- LC
Single-striped mouse	- LC
Multi-mammate mouse	- LC
White-tailed Rat	- LC
Angoni Vlei Rat	- LC
Springhare	- LC
Striped mouse	- LC
Pouched mouse	- LC
Fat mouse	- LC
Highveld Gerbil	- LC
Bushveld Gerbil	- LC
Tree rat	- LC

7.3.8 Macroscelidae/Pholidota/Tubulidentata

The short-snouted elephant shrew (DD) and the aardvark (LC) may occur in the region.

7.4 Birds

The avifauna of the region is typical of savanna thornveld and mixed bushveld and is characterised by prolific bird diversity. At the Tswaing Crater to the west, 320 species of bird have been recorded, while 364 species of have been recorded in the Dinokeng Nature Reserve to the east. The rare species of bird in Dinokeng include the African Finfoot (Vu), Olive-tree Warbler, Golden Pipit, African Fish Eagle, Crimson-breasted Shrike and Eurasian Golden Oriole.

A total of 252 avian species have been recorded in the Rust de Winter Nature Reserve, of which nine occur on the IUCN Red List of Threatened Species (RdWNR 2013). These are the Blue Crane (*Vu), Lesser Kestrel (Vu), Black Stork (*NT), Black-winged Pratincole (NT), Lanner Falcon (NT), Melodious Lark (NT), Red-billed Oxpecker (NT), White-bellied Korhaan (Vu) and Yellow-billed Stork (NT). *NT = Near-threatened; *VU = Vulnerable.

7.5 Reptiles

All species of reptiles excluding the water monitor, rock monitor and *Varanus* species of snake, are Schedule 2 – Protected Game. Nine-six species of reptile have been recorded in the Dinokeng Nature Reserve and 40 reptile species in the Rust de Winter Nature Reserve to the east of the site. Rocky outcrops, open grassland, woodland, rivers and dams are consistent in attracting their own particular reptile and amphibian fauna. No reptiles were recorded during the present survey.

7.6 Amphibians

Most frogs are explosive breeders and only emerge for a few weeks during the peak rainy season after which they hibernate in burrows or other suitable areas. The proposed development will have no significant impact on the amphibian species that may be present at the site. Amphibians such as the giant bullfrog (*Pyxicephalus adspersus*) may occur in suitable habitat along the drainage lines and wetlands in the region, however no suitable habitat is available on site. The giant bullfrog is classified as Schedule 2 – Protected Game according to the North West Ordinance.

The following amphibians (all least concern) have been recorded in the 2528AC quarter degree grid (SAFAP database):

Family	Species
Petropedetidae	*Cacosternum boettgeri*
Hyperoliidae	*Kassina senegalensis*
Petropedetidae	*Phrynobatrachus natalensis*
Microhylidae	*Phrynomantis bifasciatus*
Ranidae	*Ptychadena anchietae*
Ranidae	*Afrana angolensis*
Ranidae	*Amietia vertebralis*
Bufonidae	*Schismaderma carens*

CHAPTER 8

ECOLOGICAL SENSITIVITY ANALYSIS

8.1 Introduction

Sensitivity is the vulnerability of a habitat to any impact, for example a dune, wetland or ridge system would be more vulnerable to development than would a sandy plain. Several sensitivity categories may be identified and assessed to derive an overall significance for each plant community on the site:

- threatened status of the regional vegetation type wherein the proposed site is situated;
- percentage of red list plant species per community or site (Raimondo *et al*. 2009);
- number of protected tree species per community or site;
- percentage of NCNCA (2009) protected plant species;
- percentage of endemic plant species per community or site (endemic to vegetation type, Van Wyk & Smith 2001; Mucina & Rutherford 2006);
- conservation value of community (habitat) or site;
- species richness per plant community or site (number of plant species);
- degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating;
- soil erosion potential; and
- resilience (this is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating).

8.2 Sensitivity model

An overall sensitivity model (Table 5) is developed for each plant community on site. This is achieved by weighting each criterion and calculating the sum for the community, which reflects the sensitivity and sensitivity ranking (see Sensitivity map, Figure 25).

The parameters that were used to allocate the different categories of sensitivity (very low, low, moderate, high and very high) were the following:

1. Threatened status of the ecosystem (depends on the percentage area intact, or degree of transformation) (Driver *et al*. 2005, Mucina & Rutherford 2006, NEM:BA 2011).

   The ecosystems are classified into the following categories:

   Zero sensitivity: totally transformed habitat.

Low sensitivity: If "Least Threatened", the vegetation type has most of its habitat intact, i.e. more than 80%; or the vegetation type is adequately statutory or formally conserved in parks and reserves.

Moderate sensitivity: If "Vulnerable", the vegetation type has from 60% to 80% of the ecosystem intact; less than 40% has been transformed which could result in some ecosystem functioning being altered, and/or the ecosystem is statutory poorly conserved. For example, the vegetation type is rich in plant species but is not a pristine example of a vegetation type, therefore some transformation or disturbance occurred, such as human structures and degraded veld due to overgrazing and/or bush encroachment.

High sensitivity: If "Endangered", the vegetation type has from 40% to 60% of the ecosystem intact; or 40% to 60% transformed due to disturbance, cultivation or alien species; or the ecosystem is statutory poorly conserved e.g. less than about 3% conserved.

Very high sensitivity: If "Critically Endangered", the vegetation type has only 16% to 36% of the ecosystem intact. The richer the ecosystem is in terms of species, the higher the percentage threshold.

Category rating:

Zero		= 0
Low	(LT)	= 1
Moderate	(VU)	= 2
High	(EN)	= 3
Very high	(CE)	= 4

2. Percentage of red list plant species (listed higher than 'least concern', LC)(POSA 2017; Raimondo *et al*. 2009).

The sensitivity scale ranges from low, moderate to high and the rating is determined by the presence of rare flora in a plant community (calculated as percentage of the total plant species in the community).

Category rating:

None	(0%)	= 0
Low	(<2%)	= 1
Moderate	(2 – 5%) = 2	
High	(>5%)	= 3

3. Presence of the North West protected plant species (North West Nature Conservation Ordinance (Ordinance No 12 of 1983)):

The presence of protected species in a vegetation type is rated as low, moderate or high depending on the number of protected species in relation to the total plant species in a plant community.

Category rating:

None	(0%)	= 0
Low	(<5%)	= 1

Moderate	(5 – 10%)	= 2
High	(>10%)	= 3

4. Presence of protected tree species (National Forests Act, Act No. 84 of 1998; NFA 2016)

The presence of protected tree species on the footprint of the site is rated as low, moderate or high. This rating depends on the availability of habitat in the community and the protection and management guidelines for these species and guidelines for biodiversity offsets of the Department of Forestry and Fisheries, DAFF).

Category rating:

None	(0 species)	= 0
Low	(2 or less)	= 1
Moderate	(3-4)	= 2
High	(>4)	= 3

5. Percentage of plant species endemic to the regional vegetation type (Van Wyk & Smith 2001; Mucina & Rutherford 2006).

The presence of endemic species should be considered as low, moderate to high, depending on the availability of habitat in the community.

Category rating:

None	(0%)	= 0
Low	(<2%)	= 1
Moderate	(2-5%)	= 2
High	(>5%)	= 3

6. Conservation value of the terrain type and/or habitat.

The criteria are low, moderate and high. The presence of e.g. quartz outcrops, ridges, wetlands and dunes should be considered to have a moderate to high conservation value. However, this should be seen in the context of the presence of representative habitat in the broader region or in conservation areas.

Category rating:

Zero	= 0
Low	= 1
Moderate	= 2
High	= 3

7. Plant community species richness

The species-richness (or number of species per plant community) will depend on the region, climate, topography, ecosystem and degree of transformation. The assessment consists of determining the number of species per plant community compared to the mean number of species found in relative unspoilt (pristine) vegetation types in the same region. The scale ranges from low, moderate to high.

Category rating:

Low	(<40)	= 1
Moderate	(40 – 60)	= 2
High	(>60)	= 3

8. Degree of connectivity and/or fragmentation of the ecosystem

The degree of connectivity with surrounding or adjacent natural areas and/or fragmentation of plant communities, is indicated as low, moderate or high, e.g. high connectivity with surrounding similar habitat, or low fragmentation of habitat is considered as having a low rating.

Category rating (note reverse order)*:*

Low	= 3
Moderate	= 2
High	= 1

9. Erosion potential of the soil

The erosion potential of the soil is indicated as low, moderate or high, e.g. coarse sandy soils on plains have a low erosion potential.

Category rating:

Low	= 1
Moderate	= 2
High	= 3

10. Resilience is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating.

Category rating (note reverse order):

Low	= 3
Moderate	= 2
High	= 1

8.3 Weighting of sensitivity criteria

Threatened status of the vegetation type	= x5
Percentage of red list plant species	= x4

Percentage of North West rare plant species	= x4
Number of protected tree species	= x3
Percentage of endemic species	= x2
Conservation value (habitat)	= x4
Plant community species richness	= x2
Degree of connectivity/fragmentation of habitat	= x2
Erosion	= x2
Resilience	= x3

8.4 Sensitivity rating

≤30	= very low	(VL)	(rating scale = 1)
31- 40	= low	(L)	(rating scale = 2)
41 - 50	= moderate	(M)	(rating scale = 3)
51 - 65	= high	(H)	(rating scale = 4)
>65	= very high	(VH)	(rating scale = 5)

The sensitivity assessment of the site is provided in Table 5. Although the site was not cultivated within the last 10 years, the effect is still visible with the result that the sensitivity of the site was rated as very low.

Table 5: Sensitivity assessment of the site

Environmental parameter (x weighting)	Score
Threatened status (x5)	10
% Red data species (x4)	0
% North West rare species (x4)	0
Number protected trees (x3)	0
% Endemic species (x2)	0
Conservation value (x4)	0
Species richness (x2)	6
Connectivity (x2)	6
Erosion (x2)	2
Resilience (x3)	6
Sum:	30
Sensitivity rating:	Very low

Explanation of sensitivity ratings:

- **Very low** (1) sensitivity means that a minimum score is allocated to almost all the sensitivity criteria used. It is usually applicable to habitats that have been transformed, especially by human activities.
- **Low** (2) sensitivity means the sensitivity is not significant enough and should not have an influence on the decision about the project. However, any protected species may not be removed/destroyed without a permit.

- **Moderate** (3) means a sensitivity rating that is real and sufficiently important to require management, e.g. management or protection of the rare/threatened fauna and flora, protection of the specific habitat on the property and/or rehabilitation.
- **High** (4) means a sensitivity rating where the habitat should be excluded from any development.
- **Very high** (5) means a sensitivity rating that should influence the decision whether or not to proceed with the project.

CHAPTER 9

ASSESSMENT OF ENVIRONMENTAL IMPACTS

9.1 Introduction

As with all land-uses, there are environmental impacts associated with development and these include the following:

- Invasion by alien plants
- Physical disturbance of soils and natural vegetation.
- Roads may potentially increase sediment loads and disrupt water flow patterns.
- Reduction in the connectivity of the vegetation with other natural areas in the landscape.

9.2 Significance of impacts

The significance of environmental impacts is assessed by means of the criteria of certainty, severity (intensity and duration), direction (negative, neutral or positive) and scale (extent) (Table 6).

Certainty (ε) describes the probability or likelihood of the impact actually occurring, and is rated as follows:

- Improbable – where the impact is unlikely to occur, either because of design, mitigation or historic experience.

  Rating = 1

- Probable - there is a good probability that the impact will occur (<50% chance of occurring).

  Rating = 3

- Highly probable – most likely that the impact will occur (50 – 90% chance of occurring).

  Rating = 4

- Definite – the impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).

  Rating = 5

Severity is calculated from the ratings given to intensity and duration of the impact. Reversibility should be evaluated along with intensity and is the ability of the impacted environment to return to its pre-impacted state once the cause of the impact has been removed.

An **intensity** (α) (magnitude) rating is awarded to each impact as follows:

- Low intensity – the ecosystem pattern, process and functioning are minimally affected and a minor impact may occur.

  Rating = 1

- Moderate intensity – valued, important, sensitive or vulnerable systems or communities are negatively affected but ecosystem pattern, process and functions can continue albeit in a slightly modified way.

  Rating = 2

- High intensity – environment affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily or permanently cease. Valued, important, sensitive or vulnerable systems, communities or species are substantially affected.

  Rating = 4

The **duration** rating (β) is awarded as follows:

- Short term – up to 5 years

  Rating = 2

- Moderate term - >5 – 15 years

  Rating = 3

- Long term – >15 – 30 years: The impact will occur during the operational life of the activity, and recovery may occur with mitigation (restoration and rehabilitation).

  Rating = 4

- Permanent – the impact will destroy the ecosystem functioning and mitigation (restoration and rehabilitation) will not contribute in such a way or in such a time span that the impact can be considered transient.

  Rating = 5

Scale rating (δ)**:**

Site specific	= 1
Local (surrounding areas)	= 3
Regional (provincial)	= 5

An assessment of the significance of the impacts was made for the terrestrial ecosystem (Table 6). This assessment produced a low significance for the terrestrial ecosystem.

The **significance rating** is determined through a synthesis of the characteristics described above where:

$S = (\alpha + \beta + \delta)*\varepsilon$

Table 6: Significance assessment of impacts on the terrestrial ecosystem

	Terrestrial ecosystem
Certainty (ε)	5
Intensity (α)	1
Duration (β)	4
Scale (δ)	1
Significance (α+β+δ)*ε**:**	30
Significance rating:	**Low**

The **significance rating** should influence the development project as follows:

- Low significance (significance rating ≤30)

If the negative impacts have little real effects it should not have an influence on the decision to proceed with the project.

- Moderate significance (significance rating >30 – 60)

Negative impact: it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved.

- High significance (significance rating >60)

Negative impact: this should weigh towards a decision to terminate the proposal, or mitigation should be formulated and performed to reduce significance to at least a moderate significance rating. In these circumstances the environmental resources have mostly been destroyed and the capacity of the environmental resources in the

area to respond to change and withstand further stress has been or is close to being exceeded. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

9.3 Impacts

The following tables summarise the direct, indirect, cumulative and residual impacts of the development on the natural vegetation and alien vegetation during the construction and operational phase.

9.3.1 IMPACTS: CONSTRUCTION PHASE

Project phase: Construction phase: IMPACT ON NATURAL VEGETATION
Direct impacts: • Loss of indigenous vegetation on the footprint of development. • Soil disturbance. • Increased noise and dust levels. • Loss of faunal habitat.
Indirect impacts: • Loss of biodiversity. • Some additional disturbance will inevitably occur in the direct surroundings of the site. • Increased dust levels during construction might negatively affect the plant growth.
Cumulative impacts: Additional infrastructure development, for example, water pipelines, power lines and access roads and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.
Residual impacts: Despite mitigation measures some loss of the natural vegetation will occur. The Springbokvlakte Thornveld vegetation type is considered “vulnerable” and should be conserved where possible. However, it covers 8797 km^2 and the site, covering 1.5 ha, is already degraded and overall impact on the vegetation unit will therefore be small.

Mitigation:

- Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided.
- No rare plant species were recorded on site and although the species richness of the plant community is fairly high, most of the species are herbaceous and/or weedy species. No special measures are therefore necessary for the conservation of individual species.
- Indigenous trees and shrubs should be established in the place of alien species.
- Dust control measures should be implemented during construction.
- The denuded and disturbed areas on site should be landscaped and re-vegetated as soon as possible with indigenous plants.

Project phase: Construction phase: IMPACT ON ALIEN VEGETATION
Direct impacts: • Removal of alien invasive plant species should be encouraged. • As a result of the loss of indigenous vegetation and resulting disturbance, declared alien species might invade the area.
Indirect impacts: • Removal of alien species and the rehabilitation of the habitat may favour indigenous plant species. • Disturbance will favour alien species and without folllow-up control, alien species may spread through the area.
Cumulative impacts: The establishment of declared weedy and alien invasive plant species on the disturbed site could lead to their spread into the surrounding natural vegetation and onto neighbouring properties. Their presence may also slow down the recovery of the natural vegetation.
Residual impacts: Low residual impact if the declared weedy and alien invasive species are controlled.
Mitigation: • Development should be restricted to the proposed development site and the disturbance to the surrounding natural or indigenous vegetation be kept to a minimum. • Establish a monitoring program for the early detection and control of alien invasive plant species. • No alien invasive species should be used in landscaping or gardens on the site.

Project phase: Construction phase: IMPACT ON FAUNA
Direct impacts: • Major loss of indigenous vegetation on the footprint of the development removes suitable habitat for animals.
Indirect impacts: • Loss of biodiversity. • Invasion by aliens may impact on suitable habitat to faunal species.
Cumulative impacts: Loss and/or disturbance of the natural vegetation and an increase in declared weedy and alien invasive species could have a significantly negative impact on the faunal component.
Residual impacts: Low residual impact.
Mitigation: • Limit disturbance to the proposed site and ensure that minimum disturbance takes place in the surrounding area. • Noise levels should be kept to a minimum during construction. • Rehabilitate disturbed areas with indigenous species as soon as possible following construction of the facility. • Poaching of animals should be prohibited.

9.3.2 IMPACTS: OPERATIONAL PHASE

Project phase: Operational phase: IMPACT ON NATURAL VEGETATION
Direct impacts: • Major loss of indigenous vegetation has occurred during the construction phase and loss of indigenous vegetation during the operational phase can be avoided. • Loss of faunal habitat.
Indirect impacts: • Loss of biodiversity. • Some additional disturbance will inevitably occur in the direct surroundings of the site. • As a result of the loss of vegetation seed production and propagation will be reduced
Cumulative impacts: Additional infrastructure development, for example, erection of new houses; and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.

Residual impacts: None, if mitigation is successful in avoiding all further disturbance to the natural vegetation.
Mitigation: • Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided. The indigenous vegetation, and especially the trees, should be retained as far as possible and buildings should be placed between trees. Protected trees should be conserved and not destroyed. The denuded and disturbed areas should be re-vegetated with indigenous species as soon as possible. • No trees may be damaged or cut. • No exotic trees may be planted in the gardens, use only indigenous plants. • Existing and dedicated roads should be marked and utilised by vehicles.

Project phase: Operational: IMPACT ON ALIEN VEGETATION
Direct impacts: • As a result of the loss of indigenous vegetation and resulting disturbance, declared alien species might invade the area.
Indirect impacts: • Removal of alien species and the rehabilitation of the habitat may favour indigenous plant species. • Disturbance will favour alien species and without folllow-up control, alien species may spread through the area. • Loss of biodiversity because invasion by alien plants may limit suitable habitat for faunal species.
Cumulative impacts: The establishment of declared weedy and alien invasive plant species on the disturbed site could lead to their spread into the surrounding natural vegetation and onto neighbouring properties. Their presence may also slow down the recovery of the natural vegetation.
Residual impacts: Low residual impact if the declared weedy and alien invasive species are controlled.
Mitigation: • Development should be restricted to the footprint of the proposed development site and the disturbance to the surrounding natural or indigenous vegetation be kept to a minimum. • Rehabilitate disturbed areas with indigenous species as soon as possible following construction of the facility. • Establish a monitoring program for the early detection and control of alien invasive plant species. • No alien invasive species should be used in landscaping or gardens on the site.

Project phase: Operational phase: IMPACT ON FAUNA
Direct impacts: • Major loss of indigenous vegetation on the footprint of the development limits suitable habitat for animals.
Indirect impacts: • Loss of biodiversity. • Invasion by aliens may impact on suitable habitat to faunal species.
Cumulative impacts: Loss and/or disturbance of the natural vegetation and an increase in declared weedy and alien invasive species could have a significantly negative impact on the faunal component.
Residual impacts: Residual impacts depend on the intensity and permanence of disturbance as to whether the faunal component returns to the site and to what degree this takes place.
Mitigation: • Limit disturbance to the proposed site and ensure that minimum disturbance takes place in the surrounding area. • Noise levels should be kept to a minimum at all times. • Rehabilitate disturbed areas with indigenous species as soon as possible following construction of the facility. • Poaching of animals should be prohibited.

9.4 Mitigation (construction and operational phases)

Mitigation measures during the construction and operational phases of the proposed development include the following:

- Development should be contained within the proposed footprint of the project and unnecessary disturbance adjacent to the site should be avoided.
- Minimise large-scale clearance of natural vegetation and disturbance at the site.
- Use existing and dedicated access roads to limit disturbance of the natural vegetation.
- Dust control measures should be implemented during construction.
- The areas that have been denuded and disturbed as a result of construction on site, should be landscaped and re-vegetated as soon as possible with indigenous plants.
- Prevent soil erosion from the disturbed areas.
- Two protected tree species were recorded on the property and should be conserved. No other rare plant species were recorded on site and although the species richness of the plant community is fairly high, most of the species are herbaceous and/or weedy species. Special measures are therefore necessary only for the protected tree species.

- Indigenous trees and shrubs should be retained where possible or supplemented by planting of indigenous trees and shrubs.
- Implement a monitoring and control program to combat declared weedy and alien invasive plant species.
- No alien invasive plant species should be used in landscaping or gardens on site.

Monitoring should be done to verify environmental impact prediction and adequacy of mitigation measures.

9.5 Summary

The site does not fall in any Critical Biodiversity Area, biosphere reserve, conservancy, protected area, kloof, important plant habitat, hills and ridges, wetlands or biodiversity corridors (READ 2015a).

Vegetation type (regional):

The site falls in the Springbokvlakte Thornveldd, which is classified as 'Vulnerable ' with less than 1% conserved in statutory reserves (Mucina & Rutherford 2006, NEMBA 2011). Almost half of the vegetation type has already undergone transformation primarily by cultivation, is already transformed by cultivation and urban sprawl, with dense rural populations in certain areas. Although the significance of habitat loss on the development site is low, the rating should be seen from the point of view of the history of land-use on the site. It is clear from aerial photographs and on-site inspection that the site was ploughed some time ago (>10 years), and other parts of the property are currently under cultivation. However, the proposed site recovered through succession and the vegetation (although secondary) marginally resembles the vegetation type of the region.

Terrestrial plant community and protected plant species on site:

The site is fairly homogeneous in terms of terrain, geology, soils and vegetation. The site was ploughed more than 10 years ago and although there was some recovery it can still be described as secondary vegetation. There are no sensitive habitats such as drainage channels, wetlands or ridges occurring on site. There are not any Red Data (POSA 2017), CITES (2016), ToPS (NEMBA 2013), North West protected or specially protected plant species (NWO 1983) or endemic plant species recorded on site. Two protected tree species (NFA 2016) were recorded on the property, i.e. *Combretum imberbe* and *Sclerocarya birrea*.

Alien plant species:

Most of the alien species on the property occur in the gardens or disturbed areas on the residential section of the property. These include Category 1b invasive species such as *Melia azedarach, Austrocylindropuntia subulata, Datura ferox, Datura stramonium, Morus alba, Canna indica, Catharanthus roseus* and *Xanthium strumarium*. A number of alien species were planted along the boundary fence, i.e. *Opuntia spinulifera, Austrocylindropuntia subulata, Euphorbia milii* and *Yucca gloriosa*. Fourteen of the 37 exotic species on site are declared invasive and weedy species (Categories 1, 2 & 3). Establishment and spread of declared alien weeds and invader plant species should be prevented.

Fauna:

Most of the plains have an open woody and grass layer and is marginally favourable for faunal occupation. However, the proximity of the site to the surrounding townships, the grazing by livestock and other farming activities, and the movement of people through the area will contribute to a sparse faunal population. However, the indigenous and endemic trees and shrubs should be protected as far as possible because they form important food sources and habitats for various fauna. The underbrush normally associated with these species also forms an important micro-habitat for a number of animal species.

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APPENDIX A

Plant species checklist of the site at Bosplaas West, Hammanskraal

Number of plant species per growth form:

	On site	Additional on property (off-site)
Trees	3	5
Shrubs	2	
Dwarf shrubs	5	
Herbaceous climbers	3	
Herbaceous creepers	9	
Forbs	35	1
Grasses	14	2
Aliens	18	19
Total	**89**	**27**

Total indigenous species recorded: 79
Total alien species recorded: 37
Total plant species on property: 116

A. Indigenous and alien plant species on the footprint of the proposed development site

Indigenous plant species:

Trees:

Vachellia tortilis
Vachellia nilotica
Ziziphus mucronata

Shrubs:

Dichrostachys cinerea
Ehretia rigida

Dwarf shrubs:

Asparagus africanus
Asparagus suaveolens
Lagerra decurrens
Senna italica

Solanum campylacanthum

Herbaceous climbers:

Coccinia adoensis
Coccinia sessilifolia
Merremia tridentata

Herbaceous creepers:

Acanthosicyos naudinianus
Cucumis zeyheri
Dicerocaryum eriocarpum
Ipomoea bathycolpos
Ipomoea gracilisephala
Ipomoea obscura
Ipomoea ommaneyi
Ipomoea sinensis
Ipomoea sp.

Forbs:

Abutilon austro-africanum
Aptosimum procumbens
Barleria macrostegia
Berkheya insignis
Blepharis integrifolia
Cleome monophylla
Corchorus asplenifolius
Crotalaria lotoides
Crotalaria sphaerocarpa
Evolvulus alsinoides
Felicia mossamedensis
Felicia muricata
Heliotropium ciliatum
Heliotropium ovalifolium
Hermannia sp.
Hermstaedtia odorata
Hibiscus calyphyllus
Hibiscus engleri
Hibiscus trionum
Justicia flava
Kyphocarpa angustifolia
Leucas glabrata

Monsonia angustifolia
Nidorella hottentotica
Ocimum americanum
Osteospermum muricatum
Phyllanthus maderaspatensis
Pollichia campestris
Portulaca kermesina
Sesamum triphyllum
Sida dregei
Sida rhombifolia
Tephrosia sp.
Tribulus terrestris
Vernonia poskeana

Grasses:

Aristida adscensionis
Aristida congesta subsp. *barbicollis*
Bothriochloa insculpta
Cynodon dactylon
Dactyloctenium aegyptium
Eragrostis biflora
Eragrostis rigidior
Eragrostis superba
Eragrostis trichophora
Heteropogon contortus
Hyparrhenia filipendula
Melinis repens
Tragus berteronianus
Urochloa mosambicensis

Alien plant species:

Acanthospermum australe
Alternanthera pungens
Amaranthus hybridus
Austrocylindropuntia subulata
Bidens pilosa
Datura ferox
Datura stramonium
Euphorbia milii
Gomphrena celosioides
Guilleminea densa
Ipomoea purpurea

Opuntia spinulifera
Pergularia daemia
Physalis viscosa
Schkuhria pinnata
Tagetes minuta
Verbena aristigera
Xanthium strumarium

B. Plant species on the property but outside the proposed development site

Indigenous plant species:

Trees:

Combretum imberbe
Kigelia africana (introduced)
Peltophorum africanum
Sclerocarya birrea
Vachellia karroo

Forbs:

Boerhavia diffusa

Grasses:

Hyperthelia dissoluta
Paspalum urvillii

Alien plant species (garden plants and under cultivation):

Abelmoschus esculentus
Canna indica
Catharanthus roseus
Citrus limon
Cucurbita pepo
Ficus carica
Flaveria bidentis
Leucaena leucocephala
Malus sylvestris
Melia azedarach
Morus alba
Opuntia ficus-indica
Passiflora edulis

Prunus persica
Psidium guajava
Schinus molle
Verbesina encellioides
Yucca gloriosa
Zea mays
Various vegetable cultivars

APPENDIX B

Plant species list of the 2528AC quarter degree grid (POSA databank, SANBI)

Abutilon ramosum (Cav.) Guill. & Perr.	LC
Acacia luederitzii Engl. var. retinens (Sim) J.H.Ross & Brenan	LC
Acacia nilotica (L.) Willd. ex Delile subsp. kraussiana (Benth.) Brenan	LC
Acacia tortilis (Forssk.) Hayne subsp. heteracantha (Burch.) Brenan	LC
Acalypha indica L. var. indica	LC
Acanthospermum australe (Loefl.) Kuntze	Alien
Acanthospermum hispidum DC.	Alien
Achyropsis leptostachya (E.Mey. ex Meisn.) Baker & C.B.Clarke	LC
Aerva leucura Moq.	LC
Aloe zebrina Baker	LC
Andropogon chinensis (Nees) Merr.	LC
Andropogon eucomus Nees	LC
Aneilema hockii De Wild.	LC
Anthephora pubescens Nees	LC
Archidium acanthophyllum Snider	Not evaluated
Aristida adscensionis L.	LC
Aristida canescens Henrard subsp. canescens	LC
Aristida effusa Henrard	LC
Aristida meridionalis Henrard	LC
Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis	LC
Artemisia afra Jacq. ex Willd. var. afra	LC
Asclepias densiflora N.E.Br.	LC
Asclepias eminens (Harv.) Schltr.	LC
Asparagus exuvialis Burch. forma ecklonii (Baker) Fellingham & N.L.Mey.	Not Evaluated
Blepharis integrifolia (L.f.) E.Mey. ex Schinz var. integrifolia	LC
Blepharis serrulata (Nees) Ficalho & Hiern	LC
Boscia albitrunca (Burch.) Gilg & Gilg-Ben.	LC
Bothriochloa insculpta (Hochst. ex A.Rich.) A.Camus	LC
Brachiaria brizantha (A.Rich.) Stapf	LC
Brachiaria deflexa (Schumach.) C.E.Hubb. ex Robyns	LC
Brachiaria nigropedata (Ficalho & Hiern) Stapf	LC
Brachiaria serrata (Thunb.) Stapf	LC
Brachiaria xantholeuca (Schinz) Stapf	LC
Brachystelma discoideum R.A.Dyer	EN
Bryum pycnophyllum (Dixon) Mohamed	Not evaluated
Bulbothrix isidiza (Nyl.) Hale	Not evaluated
Callilepis leptophylla Harv.	Declining
Caloplaca ferruginea (Huds.) Th.Fr. forma ferruginea	Not evaluated
Cenchrus ciliaris L.	LC

Chloris gayana Kunth	LC
Chlorophytum recurvifolium (Baker) C.Archer & Kativu	LC
Cleome monophylla L.	LC
Combretum apiculatum Sond. subsp. apiculatum	LC
Combretum imberbe Wawra	LC
Combretum molle R.Br. ex G.Don	LC
Combretum zeyheri Sond.	LC
Commelina africana L. var. lancispatha C.B.Clarke	LC
Commelina benghalensis L.	LC
Commicarpus plumbagineus (Cav.) Standl. var. plumbagineus	LC
Conyza sumatrensis (Retz.) E.Walker var. sumatrensis	Alien
Corallocarpus triangularis Cogn.	LC
Corchorus asplenifolius Burch.	LC
Crabbea ovalifolia Ficalho & Hiern	LC
Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken	LC
Craterostigma plantagineum Hochst.	LC
Cucumis zeyheri Sond.	LC
Cymbopogon pospischilii (K.Schum.) C.E.Hubb.	LC
Cynodon dactylon (L.) Pers.	LC
Cyperus decurvatus (C.B.Clarke) C.Archer & Goetgh.	LC
Cyperus difformis L.	LC
Cyperus laevigatus L.	LC
Cyperus rubicundus Vahl	LC
Cyperus rupestris Kunth var. rupestris	LC
Cyperus sexangularis Nees	LC
Dactyloctenium aegyptium (L.) Willd.	LC
Denekia capensis Thunb.	LC
Dicerocaryum senecioides (Klotzsch) Abels	LC
Dichrostachys cinerea (L.) Wight & Arn. subsp. africana Brenan & Brummitt var. setulosa (Welw. ex Oliv.) Brenan & Brummitt	LC
Diclis petiolaris Benth.	LC
Digitaria argyrograpta (Nees) Stapf	LC
Digitaria eriantha Steud.	LC
Digitaria milanjiana (Rendle) Stapf	LC
Digitaria seriata Stapf	LC
Diheteropogon amplectens (Nees) Clayton var. amplectens	LC
Dipcadi viride (L.) Moench	LC
Doellia cafra (DC.) Anderb.	LC
Dombeya rotundifolia (Hochst.) Planch. var. rotundifolia	LC
Dyschoriste transvaalensis C.B.Clarke	LC
Echinochloa colona (L.) Link	LC
Echinochloa holubii (Stapf) Stapf	LC
Ehretia rigida (Thunb.) Druce subsp. nervifolia Retief & A.E.van Wyk	LC
Elephantorrhiza elephantina (Burch.) Skeels	LC
Elionurus muticus (Spreng.) Kunth	LC
Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.	LC
Enneapogon scoparius Stapf	LC
Eragrostis barbinodis Hack.	LC
Eragrostis biflora Hack. ex Schinz	LC

Eragrostis chloromelas Steud.	LC
Eragrostis cilianensis (All.) Vignolo ex Janch.	LC
Eragrostis curvula (Schrad.) Nees	LC
Eragrostis gummiflua Nees	LC
Eragrostis hierniana Rendle	LC
Eragrostis inamoena K.Schum.	LC
Eragrostis obtusa Munro ex Ficalho & Hiern	LC
Eragrostis plana Nees	LC
Eragrostis racemosa (Thunb.) Steud.	LC
Eragrostis rigidior Pilg.	LC
Eragrostis stapfii De Winter	LC
Eragrostis superba Peyr.	LC
Eragrostis trichophora Coss. & Durieu	LC
Euclea crispa (Thunb.) Gürke subsp. crispa	LC
Eulophia welwitschii (Rchb.f.) Rolfe	LC
Euphorbia inaequilatera Sond.	LC
Eustachys paspaloides (Vahl) Lanza & Mattei	LC
Evolvulus alsinoides (L.) L.	LC
Fissidens rufescens Hornsch.	Not evaluated
Geigeria burkei Harv. subsp. burkei var. burkei	LC
Gisekia africana (Lour.) Kuntze var. africana	LC
Gnidia sericocephala (Meisn.) Gilg ex Engl.	LC
Gomphocarpus rivularis Schltr.	LC
Grewia flava DC.	LC
Grewia occidentalis L. var. occidentalis	LC
Gymnosporia buxifolia (L.) Szyszyl.	LC
Gymnosporia tenuispina (Sond.) Szyszyl.	LC
Haplocarpha scaposa Harv.	LC
Helichrysum argyrosphaerum DC.	LC
Helichrysum dasymallum Hilliard	LC
Helichrysum setosum Harv.	LC
Hermannia floribunda Harv.	LC
Hermannia grisea Schinz	LC
Hermannia parvula Burtt Davy	LC
Hermannia quartiniana A.Rich.	LC
Heteranthera callifolia Rchb. ex Kunth	LC
Heteropogon contortus (L.) Roem. & Schult.	LC
Hibiscus sidiformis Baill.	LC
Huernia transvaalensis Stent	LC
Hyparrhenia anamesa Clayton	LC
Hyparrhenia filipendula (Hochst.) Stapf var. pilosa (Hochst.) Stapf	LC
Hypoxis iridifolia Baker	LC
Indigofera heterotricha DC.	LC
Ipomoea gracilisepala Rendle	LC
Ipomoea magnusiana Schinz	LC
Ipomoea obscura (L.) Ker Gawl. var. obscura	LC
Juncus rigidus Desf.	LC
Justicia flava (Vahl) Vahl	LC
Kleinia fulgens Hook.f.	LC

Kohautia virgata (Willd.) Bremek.	LC
Lagarosiphon muscoides Harv.	LC
Lantana rugosa Thunb.	LC
Lippia javanica (Burm.f.) Spreng.	LC
Lippia wilmsii H.Pearson	LC
Loudetia flavida (Stapf) C.E.Hubb.	LC
Loudetia simplex (Nees) C.E.Hubb.	LC
Lycium cinereum Thunb.	LC
Marsilea macrocarpa C.Presl	LC
Melhania acuminata Mast. var. acuminata	LC
Melhania prostrata DC.	LC
Melinis repens (Willd.) Zizka subsp. repens	LC
Microchloa caffra Nees	LC
Mosdenia leptostachys (Ficalho & Hiern) Clayton	LC
Mundulea sericea (Willd.) A.Chev. subsp. sericea	LC
Nuxia congesta R.Br. ex Fresen.	LC
Ocimum americanum L. var. americanum	LC
Oxygonum sinuatum (Hochst. & Steud. ex Meisn.) Dammer	LC
Panicum coloratum L. var. coloratum	LC
Panicum deustum Thunb.	LC
Panicum maximum Jacq.	LC
Pappea capensis Eckl. & Zeyh.	LC
Parinari capensis Harv. subsp. capensis	LC
Pavetta zeyheri Sond. subsp. zeyheri	LC
Pellaea calomelanos (Sw.) Link var. calomelanos	LC
Peltophorum africanum Sond.	LC
Pentzia lanata Hutch.	LC
Perotis patens Gand.	LC
Persicaria lapathifolia (L.) Gray	LC
Plectranthus neochilus Schltr.	LC
Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC
Pollichia campestris Aiton	LC
Polygala krumanina Burch. ex Ficalho & Hiern	LC
Portulaca quadrifida L.	LC
Pouzolzia mixta Solms var. mixta	LC
Protea caffra Meisn. subsp. caffra	LC
Pseudognaphalium oligandrum (DC.) Hilliard & B.L.Burtt	LC
Pterodiscus speciosus Hook.	LC
Pupalia lappacea (L.) A.Juss. var. lappacea	LC
Rhynchosia albissima Gand.	LC
Rhynchosia densiflora (Roth) DC. subsp. chrysadenia (Taub.) Verdc.	LC
Rhynchosia monophylla Schltr.	LC
Rotheca louwalbertsii (P.P.J.Herman) P.P.J.Herman & Retief	LC
Sarcostemma viminale (L.) R.Br. subsp. viminale	LC
Schizachyrium sanguineum (Retz.) Alston	LC
Schmidtia pappophoroides Steud.	LC
Sclerocarya birrea (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro	LC
Searsia leptodictya (Diels) T.S.Yi, A.J.Mill. & J.Wen forma leptodictya	Not Evaluated
Searsia pyroides (Burch.) Moffett var. pyroides	LC

Searsia zeyheri (Sond.) Moffett	LC
Seddera suffruticosa (Schinz) Hallier f.	LC
Senecio pleistocephalus S.Moore	LC
Setaria incrassata (Hochst.) Hack.	LC
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata	LC
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton	LC
Setaria verticillata (L.) P.Beauv.	LC
Sida cordifolia L. subsp. cordifolia	LC
Sporobolus festivus Hochst. ex A.Rich.	LC
Sporobolus fimbriatus (Trin.) Nees	LC
Sporobolus ioclados (Trin.) Nees	LC
Sporobolus nitens Stent	LC
Sporobolus stapfianus Gand.	LC
Strychnos pungens Soler.	LC
Stylosanthes fruticosa (Retz.) Alston	LC
Talinum caffrum (Thunb.) Eckl. & Zeyh.	LC
Tephrosia longipes Meisn. subsp. longipes var. longipes	LC
Tephrosia rhodesica Baker f. var. rhodesica	LC
Terminalia sericea Burch. ex DC.	LC
Teucrium trifidum Retz.	LC
Themeda triandra Forssk.	LC
Thesium utile A.W.Hill	LC
Tragus berteronianus Schult.	LC
Tricholaena monachne (Trin.) Stapf & C.E.Hubb.	LC
Trichoneura grandiglumis (Nees) Ekman	LC
Trichostomum brachydontium Bruch	Not evaluated
Triumfetta sonderi Ficalho & Hiern	LC
Urochloa brachyura (Hack.) Stapf	LC
Urochloa mosambicensis (Hack.) Dandy	LC
Vernonia fastigiata Oliv. & Hiern	LC
Viscum combreticola Engl.	LC
Viscum verrucosum Harv.	LC
Vitex zeyheri Sond.	LC
Wahlenbergia magaliesbergensis Lammers	LC
Wahlenbergia undulata (L.f.) A.DC.	LC
Weissia latiuscula Müll.Hal.	Not evaluated
Xenostegia tridentata (L.) D.F.Austin & Staples subsp. angustifolia (Jacq.) Lejoly & Lisowski	LC
Xerophyta humilis (Baker) T.Durand & Schinz	LC
Ziziphus mucronata Willd. subsp. mucronata	LC

APPENDIX C

Curriculum vitae: DR NOEL VAN ROOYEN

1. Biographical information

Surname	**Van Rooyen**
First names	**Noel**
ID number	**501225 5034 084**
Citizenship	**South African**
Home address	**272 Thatcher's Field** **Lynnwood 0081** **Pretoria** **South Africa**
Tel & Fax	**+27 (0)12 348 9043**
Cell	**+27 (0) 82 882 0886**
e-mail	**noel@ekotrust.co.za; www.ekotrust.co.za**
Current position	**Professional Ecologist/Botanist/Rangeland scientist**
Professional registration	**Professional Natural Scientist (Pr.Sci.Nat; Reg no. 401430/83)**

Academic qualifications include BSc (Agric), BSc (Honours), MSc (1978) and DSc degrees (1984) in Plant Ecology at the University of Pretoria, South Africa. Until 1999 I was Professor in Plant Ecology at the University of Pretoria and at present I am a member of Ekotrust cc.

2. Publications

I am the author/co-author of 121 peer reviewed research publications in national and international scientific journals and was supervisor or co-supervisor of 9 PhD and 33 MSc students.

2.1 Books:

VAN ROOYEN, N. (2001). ***Flowering plants of the Kalahari dunes***. Ekotrust CC, Pretoria. (In collaboration with H. Bezuidenhout & E. de Kock).

2.2 Author / co-author of various chapters in books on the Savanna and Grassland Biomes in:

LOW, B. & REBELO, A.R. (1996). ***Vegetation types of South Africa, Lesotho and Swaziland*****,** Department of Environmental Affairs and Tourism, Pretoria.

KNOBEL, J. (Ed.) (1999, 2006). ***The Magnificent Natural Heritage of South Africa*****.** (Chapters on the Kalahari and Lowveld).

VAN DER WALT, P.T. 2010. **Bosveld**. Briza, Pretoria. (Chapter on Sour Bushveld).

2.3 Contributed to chapters on vegetation, habitat evaluation and veld management in the book:

BOTHMA, J. du P. (Ed.) 2010**.** ***Game Ranch Management*****.** 5th edition**.** Van Schaik, Pretoria.

2.4 Co-editor of:

BOTHMA, J. du P. & VAN ROOYEN, N**.** (eds). 2005**.** ***Intensive wildlife production in southern Africa.*** Van Schaik, Pretoria.

3. Ekotrust CC: Core Services

Ekotrust CC specializes in vegetation surveys, classification and mapping, wildlife management, wildlife production and economic assessments, vegetation ecology, veld condition assessment, carrying capacity, floristic diversity assessments, rare species assessments, carbon pool assessments and alien plant management.

4. Examples of projects

Numerous vegetation surveys and vegetation impact assessments for Baseline, Scoping and Environmental Impact Assessments (EIA's) were made both locally and internationally.

Numerous projects have been undertaken in game ranches and conservation areas covering aspects such as vegetation surveys, range condition assessments and wildlife management. Of note is the Kgalagadi Transfrontier Park; iSimangaliso Wetland Park, Ithala Game Reserve, Phinda Private Game Reserve, Mabula Game Reserve, Tswalu Kalahari Desert Reserve, Maremani Nature Reserve and Associate Private Nature Reserve (previously Timbavati, Klaserie & Umbabat Private Game Reserves).

Involvement in various research programmes: vegetation of the northern Kruger National Park, Savanna Ecosystem Project at Nylsvley, Limpopo; Kuiseb River Project (Namibia); Grassland Biome Project; Namaqualand and Kruger Park Rivers Ecosystem research programme.

5. Selected references of studies done by Ekotrust CC

VAN ROOYEN, N., THERON, G.K., BREDENKAMP, G.J., VAN ROOYEN, M.W., DEUTSCHLäNDER, M. & STEYN, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Final report: Department of Environmental Affairs & Tourism, Pretoria.

VAN ROOYEN, N. 1999. The vegetation types, veld condition and game of Tswalu Kalahari Desert Reserve.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2000. Environmental audit of Namakwa Sands Mine at Brand-se-Baai, Western Cape.

VAN ROOYEN, N. 2000. Vegetation survey and mapping of the Kgalagadi Transfrontier Park. Peace Parks Foundation, Stellenbosch.

VAN ROOYEN, N, VAN ROOYEN, M.W. & GROBLER, A. 2004. Habitat evaluation and stocking rates for wildlife and livestock - PAN TRUST Ranch, Ghanzi, Botswana.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Vegetation of the Langer Heinrich area, Namib-Naukluft National Park, Namibia.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification and habitat evaluation of the proposed Royal BigSix-Nsubane-Pongola Transfrontier Park, Swaziland.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, mapping and habitat evaluation of the Ithala Game Reserve, KwaZulu-Natal. Report to Ezemvelo KwaZulu-Natal Wildlife.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2010. Ecological evaluation of the Usuthu Community Conservation Area. Report to Wildlands, KwaZulu-Natal.

VAN ROOYEN, N. 2011. Evaluation of the vegetation and flora of the proposed ESKOM power transmission line from ETNA to GLOCKNER substations (South Gauteng). Report to Holistic Environmental Services, Polokwane.

VAN ROOYEN, N. 2012. Vegetation classification, mapping and habitat evaluation of the Thanda Game Reserve, KwaZulu-Natal. Report to Space for Elephants.

VAN ROOYEN, N. 2000 - 2017. Studies of the impact of proposed developments on the biota of various sites in Gauteng, Mpumalanga, North West, Limpopo and Northern Cape.

APPENDIX D

Curriculum vitae: PROF MW VAN ROOYEN

1. Biographical information

Surname	Van Rooyen	Maiden name	Rösch
First names	Margaretha Wilhelmine		
ID number	5004130033084	Citizenship	South African
Home address	272 Thatcher's Field Lynnwood Pretoria 0081 South Africa	Work address	Department of Botany University of Pretoria Pretoria 0002 South Africa
Tel (H)	+27 (0)12 348-9043	Tel (W)	+27 (0)12 420-2009
Fax (H)	+27 (0)12 348-9043	Fax (W)	+27 (0)12 362-5099
e-mail	gretel@ekotrust.co.za		
Current position	Honorary Professor in Plant Ecology		
Academic qualifications	BSc; BSc (Hons), HNOD, MSc (Botany), PhD (Plant ecology)		

2. Publications

I am author / co-author of more than 100 peer reviewed research publications and have presented / co-presented more than 100 posters or papers at international and national conferences. Five PhD-students and 32 Masters students have completed their studies under my supervision / co-supervision. I have co-authored a book as part of a series on the Adaptations of Desert Organisms by Springer Verlag (Van Rheede van Oudtshoorn, K. & Van Rooyen, M.W. 1999. *Dispersal biology of desert plants.* Springer Verlag, Berlin) and two wildflower guides (Van Rooyen, G., Steyn, H. & De Villiers, R. 1999. *Cederberg, Clanwilliam and Biedouw Valley*. Wild Flower Guide of South Africa no 10. Botanical Society of South Africa, Kirstenbosch, & Van der Merwe, H. & Van Rooyen, G. Wild flowers of the Roggeveld and Tanqua). I have also contributed to chapters in books: Van Rooyen, M.W. 1999. Functional aspects of short-lived plants. In: W.R.J. Dean & S.J. Milton (Eds) *The Karoo: Ecological patterns and processes*. Cambridge University Press, Cambridge. pp. 107-122. and Le Roux, A. & Van Rooyen, M.W. 1999. The Succulent Karoo. In: J. Knobel (ed.) *The magnificent heritage of South Africa.* Sunbird Publishing, Llandudno. pp. 94-107.

3. Research interests

My primary research interests lie in population biology and vegetation dynamics. The main aim of the research is to gain an understanding of ecosystem dynamics and to use this understanding to develop strategies to conserve,

manage, use sustainably or restore ecosystems. Geographically the focus of the studies has been in Namaqualand (Northern Cape Province, South Africa), Kalahari, Maputaland (Northern KwaZulu-Natal) and Namibia.

4. Examples of projects

Over the past 40 years my research has centred around the population biology, vegetation dynamics and classification of the vegetation in the Succulent Karoo (Namaqualand, Tanqua, Hantam, Roggeveld) and Kalahari (arid grassland).

Various studies have been undertaken in the Kalahari region. Of note are:

- The age-determination of *Acacia erioloba* in the Kgalagadi Transfrontier Park;
- Vegetation mapping of the Kgalagadi Transfrontier Park.
- The long-term vegetation monitoring project that has been running in the Kgalagadi Transfrontier Park for more than 35 years.
- A study was undertaken on behalf of the CSIR in the Hotazel/Severn region to determine the sustainability of harvesting *Elephantorrhiza elephantina.*
- A study is currently also undertaken on behalf of the Northern Cape Department of Environment and Nature Conservation (DENC) to refine the boundaries of the so-called Kathu Bushveld which stretches from the Molopo River in the north through Blackrock and Hotazel down to Kathu.
- A study is currently also undertaken on behalf of the Department of Agriculture, Forestry and Fisheries (DAFF) on the population structure of *Acacia erioloba* in the Kathu Bushveld region.

Studies in Namaqualand include:

- Development of scientifically sound management plans for the optimal land-use of this area whether it is for conservation, ecotourism or farming.
- Environmental Audit of Namaqua Sands on their rehabilitation activities.
- Several projects in Namaqualand were carried out on behalf of Northern Cape Nature Conservation Services on vegetation change and stocking densities in Goegap Nature Reserve.
- Long-term monitoring studies are also conducted in the Namaqua National Park for SANParks.
- Collaborator in the BIOTA Southern Africa team – a program that is funded by the German Ministry of Education and Research. This multidisciplinary program investigates changes due to land-use and climate change and aims at sustainable use and conservation of biodiversity.
- Collaborator in Succulent Karoo Ecosystem Plan (SKEP) funded by the Critical Ecosystem Partnership Fund (CEPF) which was a joint initiative of Conservation International (CI), the Global Environmental Facility (GEF), the Government of Japan, the MacArthur Foundation and the World Bank.
- Classified and mapped the vegetation; determined veld condition; calculated grazing capacity; and prepared a wildlife management plan for Vaalputs Waste Disposal Facility, Bushmanland on behalf of South African Nuclear Energy Corporation (NECSA).

Various studies have also been conducted on the sustainable utilization of plant species.

Carbon sequestration studies have been conducted at:

- Richards Bay Mineral, KwaZulu-Natal
- Exxaro properties, South Africa

- Sintoukola, Republic of Congo
- Mayoko, Republic of Congo
- Hinda, Republic of Congo
- Dish Mountain, Ethiopia

5. Selected project references

Van Rooyen, N., Theron, G.K., Bredenkamp, G.J., Van Rooyen, M.W., Deutschländer, M. & Steyn, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Final report on a project executed on behalf of the Department of Environmental Affairs & Tourism, Pretoria.

Van Rooyen, M.W., Theron, G.K. & Van Rooyen, N. 1997. Studies on the ephemerals of Namaqualand. Report on a project executed on behalf of the Department of Environmental Affairs and Tourism 1994 – 1996.

Van Rooyen, M.W. 2000. Effect of disturbance on the annual vegetation in Namaqualand. Final Report for South African National Parks on Skilpad Disturbance Plots.

Van Rooyen, N. & Van Rooyen, M.W. 2000. Environmental audit of Namakwa Sands Mine at Brand-se-Baai, Western Cape. Report for Namaqua Sands to Department of Mineral Affairs and Energy.

Veldsman, S. & Van Rooyen, M.W. 2003. An analysis of the vegetation of the Witsand Nature Reserve. Report to Northern Cape Nature Conservation.

Van Rooyen, N, Van Rooyen, M.W. & Grobler, A. 2004. Habitat evaluation and stocking rates for livestock and wildlife - PAN TRUST RANCH, Ghanzi, Botswana. Report to People and Nature TRUST, Botswana.

Van Rooyen, N. & Van Rooyen, M.W. 2004. Vegetation of the Langer Heinrich area, Swakopmund, Namibia. Report to SoftChem.

Van Rooyen, N. & Van Rooyen, M.W. 2005. The vegetation types of the Timbavati, Klaserie and Umbabat Private Nature Reserves. Report to the Associated Private Nature Reserves.

Van Rooyen, M.W., Stoffberg, G.H. & Van Rooyen, N. 2005. Quantifying the vegetative carbon stocks for the Tisand and Zulti-North lease areas at Richards Bay Minerals. Confidential report to Richards Bay Minerals.

Stoffberg, G.H. & Van Rooyen, M.W. 2005. Estimates of carbon sequestrated by the *Jacaranda mimosifolia* street trees in the City of Tshwane, South Africa. Report to City Council of Tshwane.

Van Rooyen, N. & Van Rooyen, M.W. 2005. The Alien plant strategic management plan for the Zululand Region. Report to Ezemvelo KwaZulu-Natal.

Van Rooyen, M.W, Van Rooyen, N., Bothma, J. du P. & Van den Berg, H.M. 2007. Landscapes in the Kalahari Gemsbok National Park, South Africa. Report to SANParks.

Van Rooyen, N. & Van Rooyen, M.W. 2007. The vegetation and management of Ithala Game Reserve. Ekotrust, Pretoria. Report to Ezemvelo KwaZulu-Natal Wildlife.

Van Rooyen, N. & Van Rooyen, M.W. 2008. The vegetation of Nsubane (Royal Jozini Big 6, Swaziland & Scheepers property). Report to proposed Transfrontier Park.

Uys, N. & Van Rooyen, M.W. 2008. The status of *Aloe dichotoma* subsp. *dichotoma* (quiver tree) populations in Goegap Nature Reserve. Report to Northern Cape Nature Conservation.

Van Rooyen, M.W., Van Rooyen, N. & Stoffberg, H. 2009. Baseline vegetative and soil carbon stock estimates on properties of Exxaro Resources. Ekotrust CC., Pretoria.

Van Rooyen, M.W. & Van Rooyen, N. 2010. Soil carbon report for Mthata Carbonworx site. Ekotrust CC, Pretoria.

Van Rooyen, N. Van Der Merwe, M.W. & Van Rooyen, M.W. 2011. The vegetation of Vaalputs. Report to NECSA.

Van Rooyen, M.W. & Van Rooyen, N. 2013. Carbon in the woody vegetation in the Mayoko area, Republic of Congo. Report to Flora, Fauna & Man Ecological Consultants.

Van Rooyen, M.W. & Van Rooyen, N. 2013. Resource assessment of *Elephantorrhiza elephantina* on farms (or portions) of Abbey, Tweed, Concordia and Bellville, Northern Cape. Report to CSIR.

Van Rooyen, M.W., Van Rooyen, N & Van den Berg, H. 2016. Kathu Bushveld study: Research offset for first development phase of Adams Solor Energy Facility. Project conducted for Department of Environment and Nature Conservation Northern Cape (DENC) and the Department of Agriculture, Forestry and Fisheries (DAFF).

6. Selected publications

VAN ROOYEN, M.W., THERON, G.K. & GROBBELAAR, N. 1979. Phenology of the vegetation in the Hester Malan Nature Reserve in the Namaqualand Broken Veld: 1. General observations. *Journal of South African Botany* 45: 279 - 293.

THERON, G.K., VAN ROOYEN. N. & VAN ROOYEN, M.W. 1980. Vegetation of the lower Kuiseb River. *Madoqua* 11: 327 - 345.

VAN ROOYEN, M.W. & GROBBELAAR, N. 1982. Saadbevolkings in die grond van die Hester Malan-natuurreservaat in die Namakwalandse Gebroke Veld. *South African Journal of Botany* 1: 41 - 50.

VAN ROOYEN, M.W., THERON, G.K. & GROBBELAAR, N. 1990. Life forms and dispersal spectra of the Namaqualand flora. *Journal of Arid Environments* 19: 133-145.

VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1991. The ephemerals of Namaqualand: Effects of photoperiod, temperature and moisture stress on development and flowering of three species. *Journal of Arid Environments* 20: 15 - 29.

VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1992. The ephemerals of Namaqualand. Effect of germination date on development of three species. *Journal of Arid Environments* 22: 51 - 66.

BENEKE, K., VAN ROOYEN, M.W., THERON, G.K. & VAN DE VENTER, H.A. 1993. Fruit polymorphism in ephemeral species of Namaqualand: III. Germination differences between polymorphic diaspores. *Journal of Arid Environments* 24: 333-344.

VAN ROOYEN, N., THERON, G.K. BEZUIDENHOUT, D.J., BREDENKAMP, G.J. & VAN ROOYEN, M.W. 1993. Patterns of change in the herbaceous layer of a mesic savanna, South Africa. *South African Journal of Botany*

GUTTERMAN, Y., KAMENETSKY, R. & VAN ROOYEN, M.W. 1995. A comparative study of seed germination of two *Allium* species from different habitats in the Negev Desert Highlands. *Journal of Arid Environments* 29: 305-315.

STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996. The phenology of Namaqualand ephemeral species: the effect of sowing date. *Journal of Arid Environments* 32: 407-420.

RÖSCH, H., VAN ROOYEN, M.W. & THERON, G.K. 1997. Predicting competitive interactions between pioneer plant species on the basis of plant traits. *Journal of Vegetation Science* 8: 489-494.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 1998. Vegetation of the south-western arid Kalahari: an overview. *Transactions of the Royal Society of South Africa.* 53: 113-140.

DE VILLIERS, A.J., VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1999. Vegetation diversity of the Brand-se-Baai coastal dune area, West Coast, South Africa: a pre-mining benchmark survey for rehabilitation. *Land Degradation and Development* 10: 207-224.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2002. Germination strategies of Strandveld Succulent Karoo plant species for revegetation purposes: I. Temperature and light requirements. *Seed Science & Technology* 30: 17-33.

BRITS, J., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2002. Ecological impact of large herbivores on the woody vegetation at selected watering points on the eastern basaltic soils in the Kruger National Park. *African Journal of Ecology* 40: 53-60.

VAN ROOYEN, M.W. 2002. Management of the old field vegetation in the Namaqua National Park, South Africa: conflicting demands of conservation and tourism. *Geographical Journal* 168: 211-223.

VAN ROOYEN, M.W., THERON, G.K., VAN ROOYEN, N., JANKOWITZ, W.J. & MATTHEWS, W.S. 2004. Mysterious circles in the Namib Desert: Review of hypotheses on their origin. *Journal of Arid Environments* 57: 467-485.

BOTHMA, J. DU P., VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Using diet and plant resources to set wildlife stocking densities in African savannas. *Wildlife Society Bulletin* 32: 840-851.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2004. The restoration of Strandveld Succulent Karoo degraded by mining: an enumeration of topsoil seed banks. *South African Journal of Botany* 70: 1-9.

VAN ROOYEN, M.W. & DE VILLIERS, A.J. 2005. Germination biology of Succulent Karoo plant species. *Transactions of the Royal Society of South Africa* 60:

GAUGRIS, J.Y, & VAN ROOYEN, M.W. 2006. Questionnaires do not work! A comparison of methods used to evaluate the structure of buildings and wood used in rural household, South Africa. *Ethnobotany Research & Applications* 4: 119-131.

KELLERMAN, M.J.S. & VAN ROOYEN, M.W. 2007. Seasonal variation in soil seed bank size and species composition of selected habitat types in Maputaland, South Africa. *Bothalia* 37: 249-258.

GAUGRIS, J.Y., VASICEK, C.A. & VAN ROOYEN, M.W. 2007. Selecting Tree Species for Sustainable Harvest and Calculating their Sustainable Harvesting Quota in Tshanini Conservation Area, Maputaland, South Africa. *Ethnobotany Research & Applications* 5: 373-389.

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WATER QUALITY AND SUSTAINABLE YIELD INVESTIGATION FOR AQUACULTURE PRODUCTION FARM

Boplaas West, Hammanskraal, North West Province

Submitted to:

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GLOSSARY

A list of commonly used acronyms, measurement units and definitions is included below for the purpose of ensuring uniformity in the interpretation of this report:

Aquifer:	A water-bearing geological formation capable of supplying economic quantities of groundwater to wells, boreholes and springs.
Aquiclude:	A geological unit with a very low permeability that severely restricts groundwater movement. Groundwater Resource Units (GRU) boundaries are commonly formed by aquicludes, e.g. dykes.
Aquitard:	A saturated geological unit with a relatively low permeability that retards, but does not prevent the movement of water; while it may not readily yield water to boreholes and springs, it may act as a storage unit.
Contamination:	The introduction of any substance into the environment by the action of man.
Fractured-rock Aquifer:	Aquifers where the movement and storage of groundwater is permitted via secondary features (e.g. fractures, fissures etc.).
Groundwater Flow:	The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone. Groundwater naturally drains from higher lying areas to low lying areas such as rivers, lakes and the oceans. The rate of flow depends on the gradient of the water table and the transmissivity of the geological formations.
Groundwater Recharge:	Refers to the portion of rainfall that actually infiltrates the soil, percolates under gravity through the unsaturated zone (also called the Vadose Zone) down to the saturated zone below the water table (also called the Phreatic Zone).
Groundwater Resource Units:	(GRU's) Represent provisional zones defined for the purposes of assessing and managing the groundwater resources of a region, in terms of large-scale abstraction from relatively shallow (depth < 300m) production boreholes. They represent areas where the broad hydrogeological characteristics (i.e. water occurrence and quality, hydraulic properties, flow regime, aquifer boundary conditions etc.) are anticipated to be similar.
Groundwater Resource:	All groundwater available for beneficial use, including by man, aquatic ecosystems and the greater environment.
Groundwater:	Refers to the water filling the pores and voids in geological formations below the water table.
Lithology	Lithology refers to the physical characteristics of rock.

Permeability:	The ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (expressed as m3/m2·d or m/d). It is an intrinsic property of the porous medium and is independent of the properties of the saturating fluid; not to be confused with *hydraulic conductivity*, which relates specifically to the movement of water.
Pollution:	The introduction into the environment of any substance by the action of man that is, or results in, significant harmful effects to man or the environment.
Quaternary Catchment	A fourth order catchment in a hierarchal classification system in which a primary catchment is the major unit
Saturated Zone:	The subsurface zone below the water table where interstices are filled with water under pressure equal to or greater than that of the atmosphere
Specific Yield:	Ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity from that mass.
Storage Coefficient/ Storativity (S):	The volume of water released from storage per unit of aquifer storage area per unit change in head.
Transmissivity	Transmissivity is the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. It is expressed as the product of the average hydraulic conductivity and thickness of the saturated portion of an aquifer
Unconfined Aquifer:	An aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate.
Unsaturated Zone:	That part of the geological stratum above the water table where interstices and voids contain a combination of air and water; synonymous with *zone of aeration* or *vadose zone*.
Water Table:	The upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

WATER QUALITY AND SUSTAINABLE YIELD INVESTIGATION FOR AQUACULTURE PRODUCTION FARM

15-06-2016

1. INTRODUCTION

Environmental Assurance (Pty) Ltd (ENVASS) as an independent environmental consulting company was contracted by the South African Council for Scientific and Industrial Research (CSIR) ('the client'), to conduct a Water Quality and Sustainable Yield Investigation for Aquaculture Production Farm.

Impulse Water Holdings (Pty) Ltd ('Impulse') was contracted by Environmental Assurance (Pty) Ltd ('Envass') on behalf of the CSIR ('the client') to complete a water yield and water quality assessment at a farm portion located at Boplaas West, Hammanskraal, North West Province ('the site').

The site is undergoing evaluation due to a grant application received by the client for the installation and operation of an aquaculture facility on a portion of the site. The objective of the project was to determine the sustainable yield of the borehole at the site, as well as the borehole water quality, and complete a basic geohydrological assessment at the site. The results of the project are presented in this letter report.

2. SCOPE OF WORK

The scope of work for the project included the following tasks:

- Desktop Review;
- Hydrocensus of Immediate Neighbours to the Site;
- Aquifer Testing;
- Water Quality Sampling;
- Groundwater Reserve Determination;
- Groundwater Impact Assessment; and
- Generation of Brief Letter Report.

The methodologies applied for each scope of work are presented in Appendix A.

3. SITE DESCRIPTION

The site is located on a sub-portion of Plot 413 in Boplaas West, within the Moretele Municipality in Bonjala District, North West Province and is accessible via a dirt road. Currently the land is occupied by Mr T J Kgomo and is utilised for minor cash crops and subsistence farming.

The site topography is generally flat, with elevations between 1070 and 1072 m amsl, sloping slightly from east to west. There are no surface water features located at the site, with the perennial Apies River located approximately 2.5 km east of the site. According to the client's background information document (BID) there is a wetland located approximately 1 km south of the site. Figure 4.4 shows the site locality and surface drainage features.

4. GEOLOGY

No detailed information was available for the site geology (e.g. borehole logs), thus the geology description was limited to a regional description.

The site is underlain by shale units of the Ecca Group (Karoo Supergroup), with localised occurrences of the Roodeplaat Suite foyaite south of the site (~3.5 km) and the mudstone units of the Irrigasie Formation ~3 km north of the site.

Two (2) major trends were identified for regional geological structures, namely north-south and west-east striking trends. A north-south trending structure is located at the Apies River (~2.5 km east) and a west-east trending structure is situated ~3.5 km south of the site. No major geological structures were located at the site.

The regional geology and geological structures for the site area are shown in Figure 4.5.

4.1. Hydrogeology

4.1.1. Aquifer Description

According to the 2526 Johannesburg hydrogeological map (Barnard, 1999) the site is underlain by a fractured and intergranular aquifer, with borehole yields expected to be between 0.1 and 0.5 l/s (i.e. 0.36 to 1.8 m^3/hour). Groundwater is typically associated with fractures within the shale unit and local perched water tables are found at the contact between weathered and competent rock.

Ninety-four (94) boreholes were identified within the A23F quaternary catchment on the National Groundwater Archive (NGA), as shown in Figure 4.6. According to the NGA data, average borehole depths were 80 m varying between 15 and 190 m below ground level (m bgl). Water strikes were encountered between 6 and 140 m bgl, with blow yields averaging between seepage (<0.1 l/s) and 5 l/s, with localized occurrences of yields more than 20 l/s at geological structures (e.g. faults). Figure 4.1 and Figure 4.2 show a summary of borehole and water strike depths and blow yield distribution, respectively, for the A23F catchment according to the NGA data available.

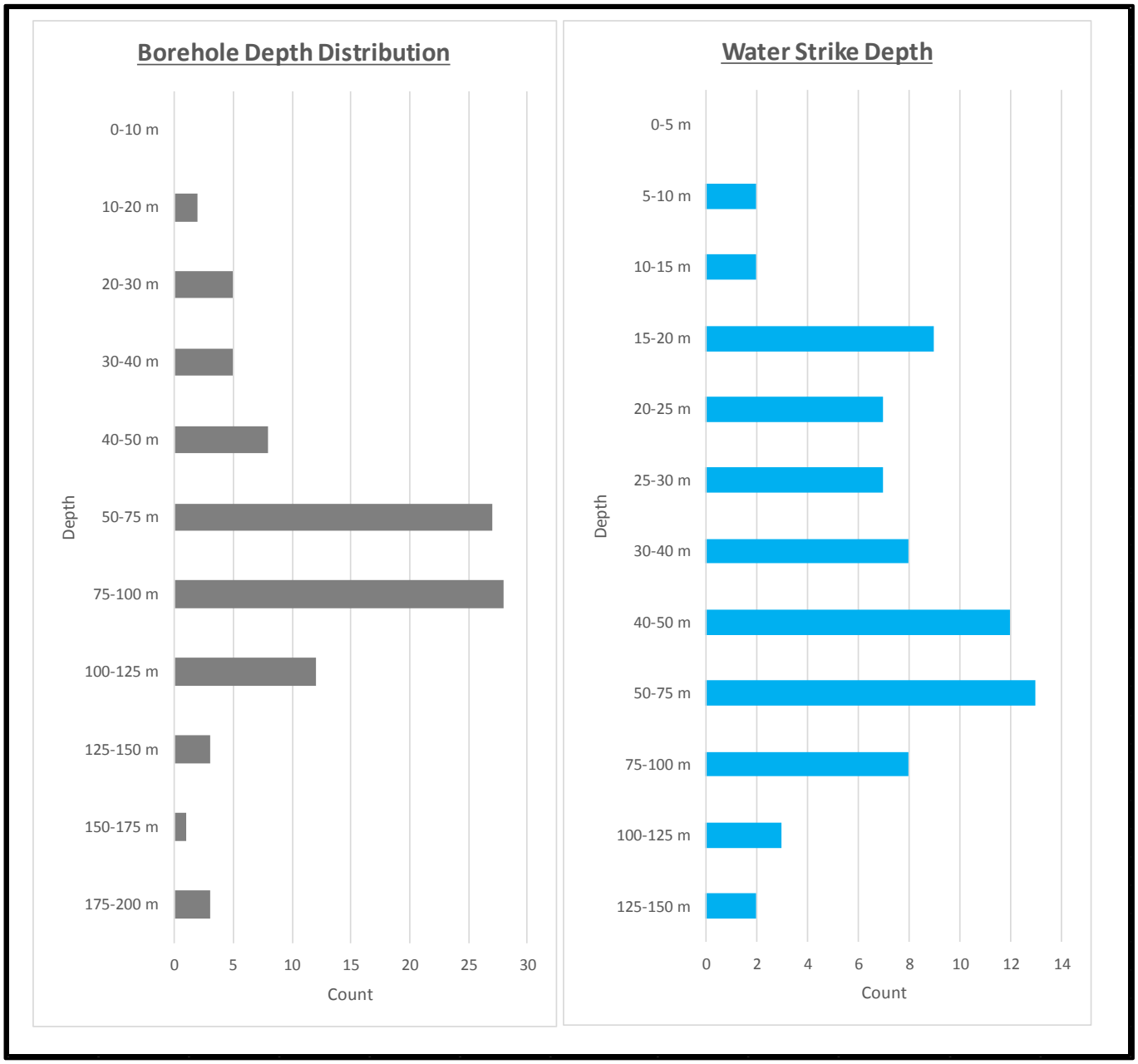


Figure 4.1: Borehole and Water Strike Depth Distribution

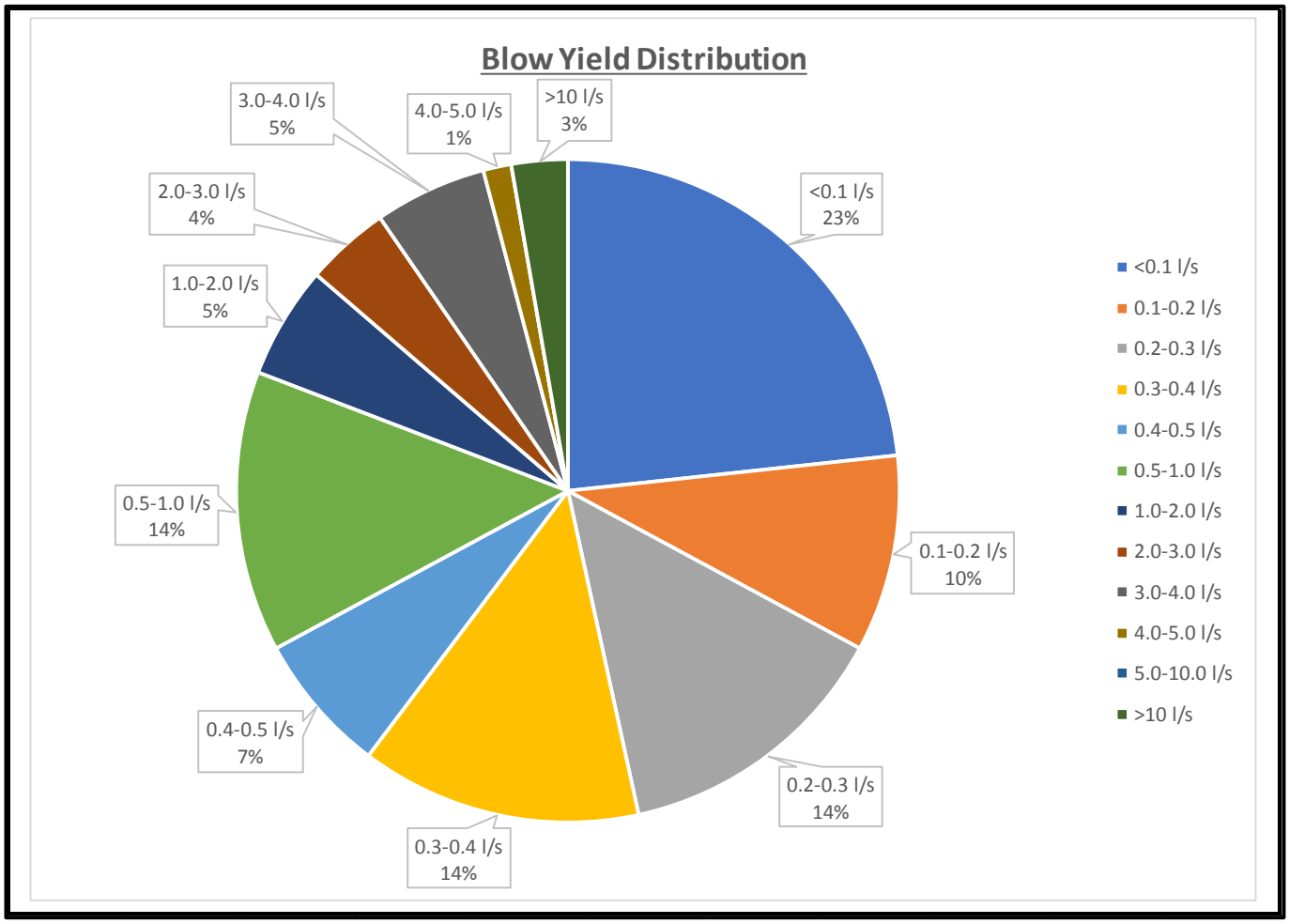


Figure 4.2: Blow Yield Distribution

4.1.2. Water Levels

Due to accessibility challenges at the site, no additional water levels were obtained at the site area. However, seventy-five (75) water levels were available from NGA data for the site area. The water level of the on-site borehole was measured at 11.85 m bgl and the average water levels for the region varied between 1 and 60 m bgl, with an average water level of 15 m bgl.

Groundwater levels showed a good correlation (Figure 4.3) (95%) with topographic elevations at the site, suggesting flow takes place under semi-confined conditions. The general groundwater flow direction at the site was from south to north, as shown in Figure 4.7.

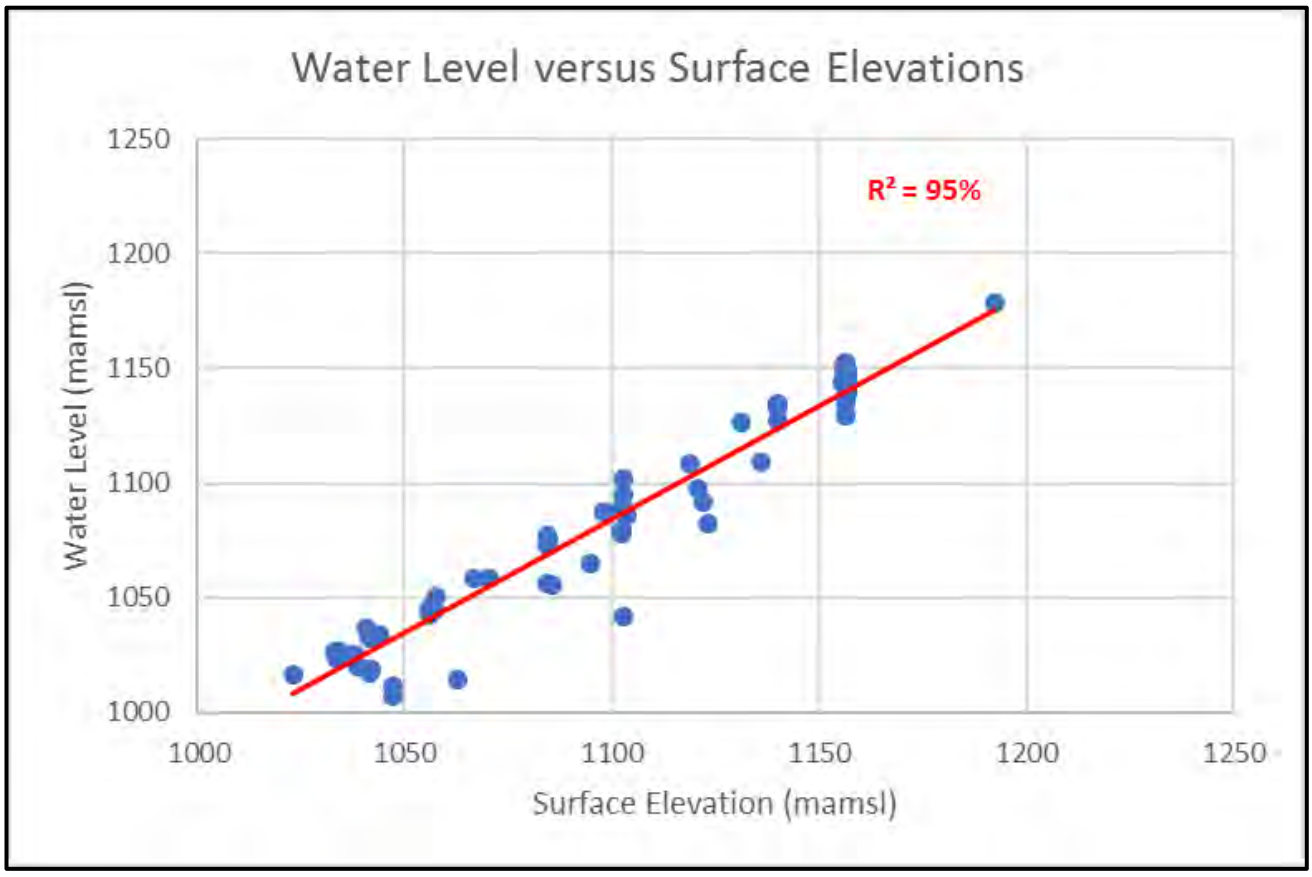


Figure 4.3: Groundwater Level and Surface Elevation Correlation

4.1.3. Water Quality

A water quality sample was taken at the site borehole following aquifer testing and submitted to a SANAS-accredited laboratory for analysis. The chemistry results were compared to the DWS[1] (1996) South African Water Quality Guidelines, Volume 6: Agricultural Water Use: Aquaculture and DWS (1996). The results are shown in Table 4.1 and the laboratory certificate for the borehole is presented in Appendix B.

The majority of parameters were compliant with the SAWQG guideline values, with the exception of total hardness, alkalinity and iron (as Fe). These elevated parameters are likely to be caused by natural rock-water interactions at the site. It is recommended that a water softener unit is installed at the site to treat the water prior to use for production purposes.

Although no guideline values are in place for E.Coli and Faecal coliforms, it must be noted that these parameters were detected at the borehole. It is recommended that an in-line UV treatment unit is placed between the borehole and end use tank to prevent any issues with fish production.

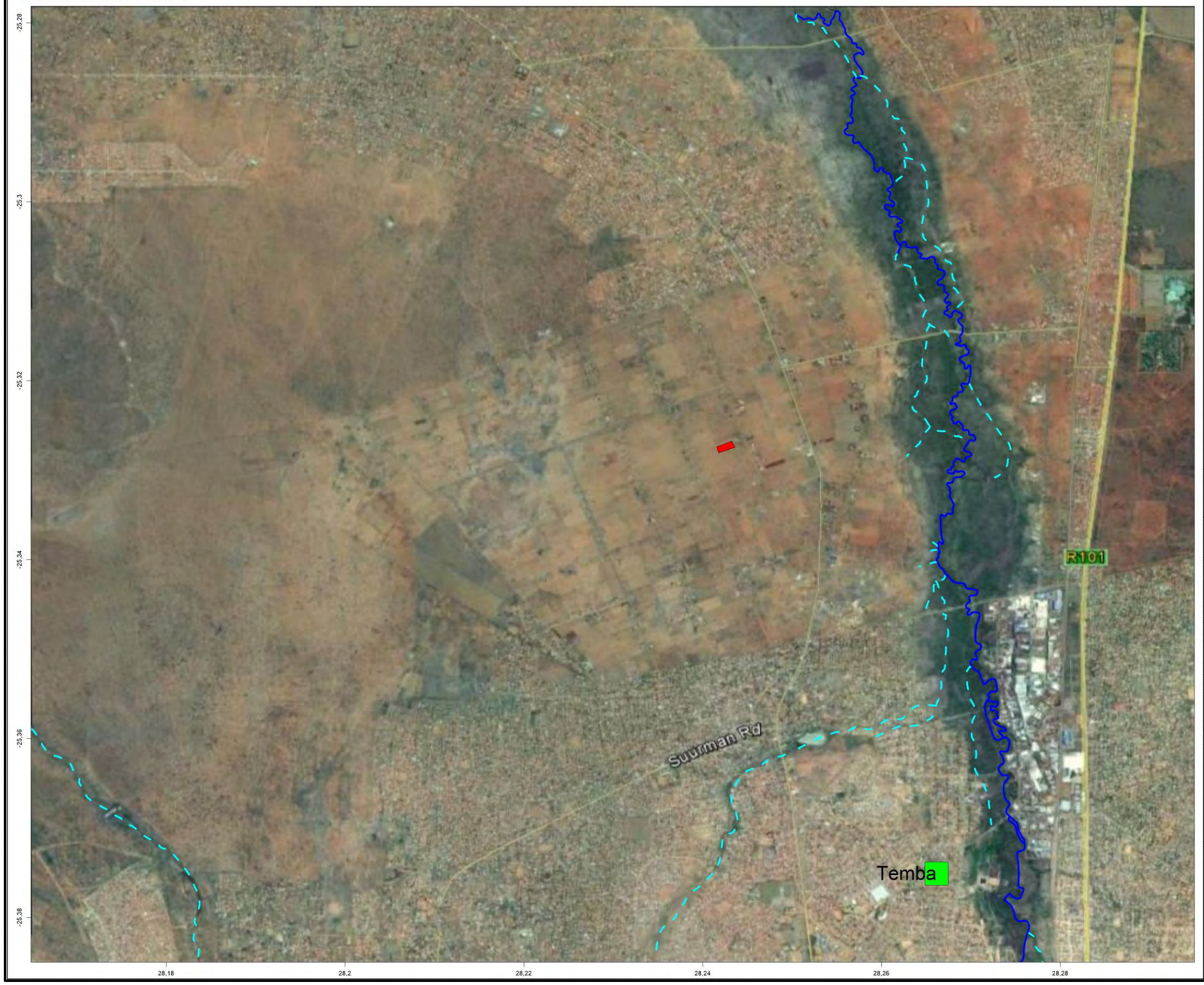
[1] Formerly known as Department of Water Affairs and Forestry (DWAF).

Table 4.1: Water Quality Results

South Afican Water Quality Guidelines Agricultural Use:			KBH01
Paramater	Unit	Target Quality Range	
		Volume 6 : Aquaculture	
pH at 25 C	pH	6.5 - 9.0	7.79
Alkalinity	mg CaCO3/l	20 - 100	230.75
Aluminium as Al	mg/l	< 0.03	BDL
Arsenic	mg/l	0 - 0.05	NA
Cadmium as Cd	Mg/l	Water Hadness (mg/CaCO3/l) 180 = 1.8 mg/l	BDL
Cloride as Cl	mg/l	600	160.8
Chromium as Cr	mg/l	< 20	BDL
Copper as Cu	mg/l	< 0.005	BDL
Iron as Fe	mg/l	< 0.01	0.02
Lead as Pb	mg/l	< 0.01	0.004
Manganese as Mn	mg/l	< 0.1	0.027
Nitrate (NO3) as N	mg/l	< 300	10.96
Nitrite (NO2) as N	mg/l	0 - 0.05	NA
Phenols (C6H5OH)	mg/l	< 1.0	NA
Phosphorus as Orthophosphate	mg/l	0.1	BDL
Selenium (Se(VI))	mg/l	< 0.3	NA
Sulphide	mg/l	< 0.001	NA
Total Hardness	mg CaCO3/l	20 - 100	301
Beryllium as Be	mg/l	NS	BDL
Boron as B	mg/l	NS	BDL
Fluoride as F	mg/l	NS	BDL
Lithium as Li	mg/l	NS	BDL
Molybdenum as Mo	mg/l	NS	BDL
Nickel	mg/l	NS	BDL
Sodium as Na	mg/l	NS	63.801
Electrical Conductivity	mS/m	Turbid Water Species < 20 000	107.4
Vanadium as V	mg/l	NS	BDL

Total Coliforms	CFU/100 ml	NS	NA
E.coli	CFU/100 ml	NS	118
NS : Not Specified			
NA: Not Analysed			
BDL: Below Detection Limit			

SITE LOCALITY



LEGEND

- Town
- Perennial River
- Non-Perennial River
- Site Location

Data Sources:
Google Earth Imagery, 2017

Drawn By:
Matthew Damhuis (Project Hydrogeologist)

Map Description:
17-060 Site Locality
Coordinate Datum:
Geographic DD, WGS84

Locality:
Hammanskraal Area,
North West Province

Scale:
0 m 500 m 1000 m 1500 m 2000 m

Client:
CSIR
our future through science

ENVIRONMENTAL ASSURANCE (Pty)Ltd
ENVASS

Figure 4.4: Site Locality

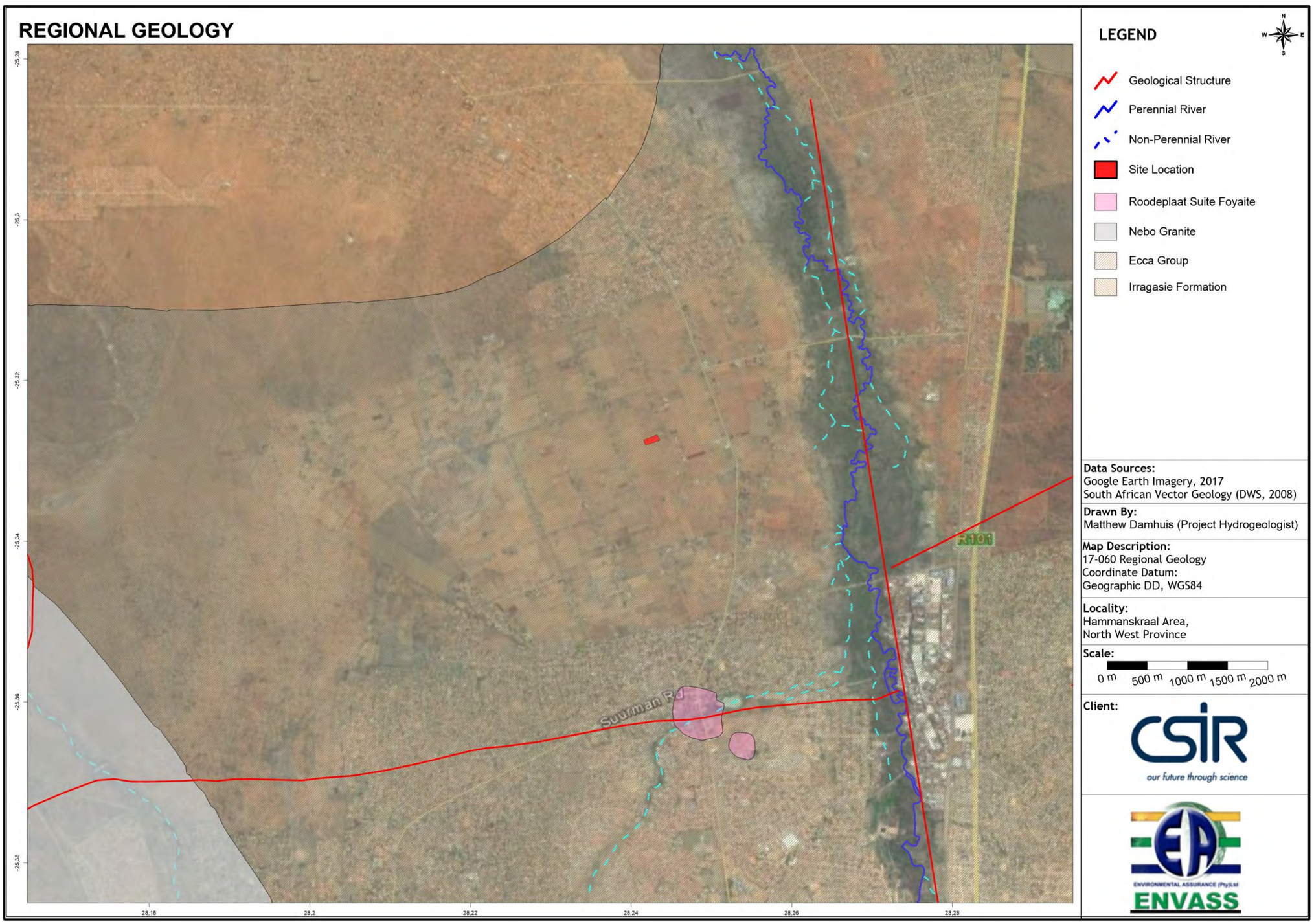


Figure 4.5: Regional Geology

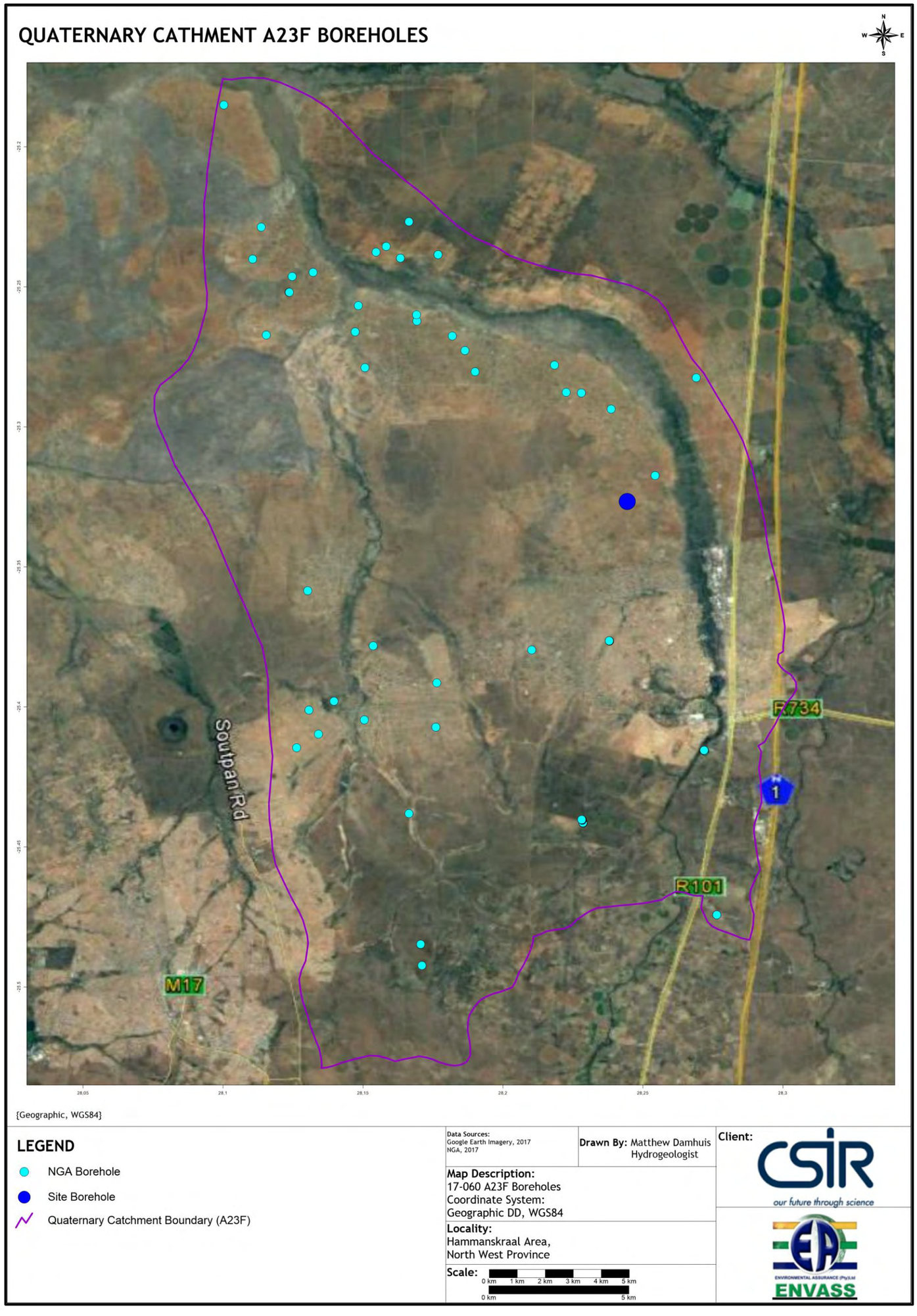


Figure 4.6: Quaternary Catchment A23F Boreholes (NGA)

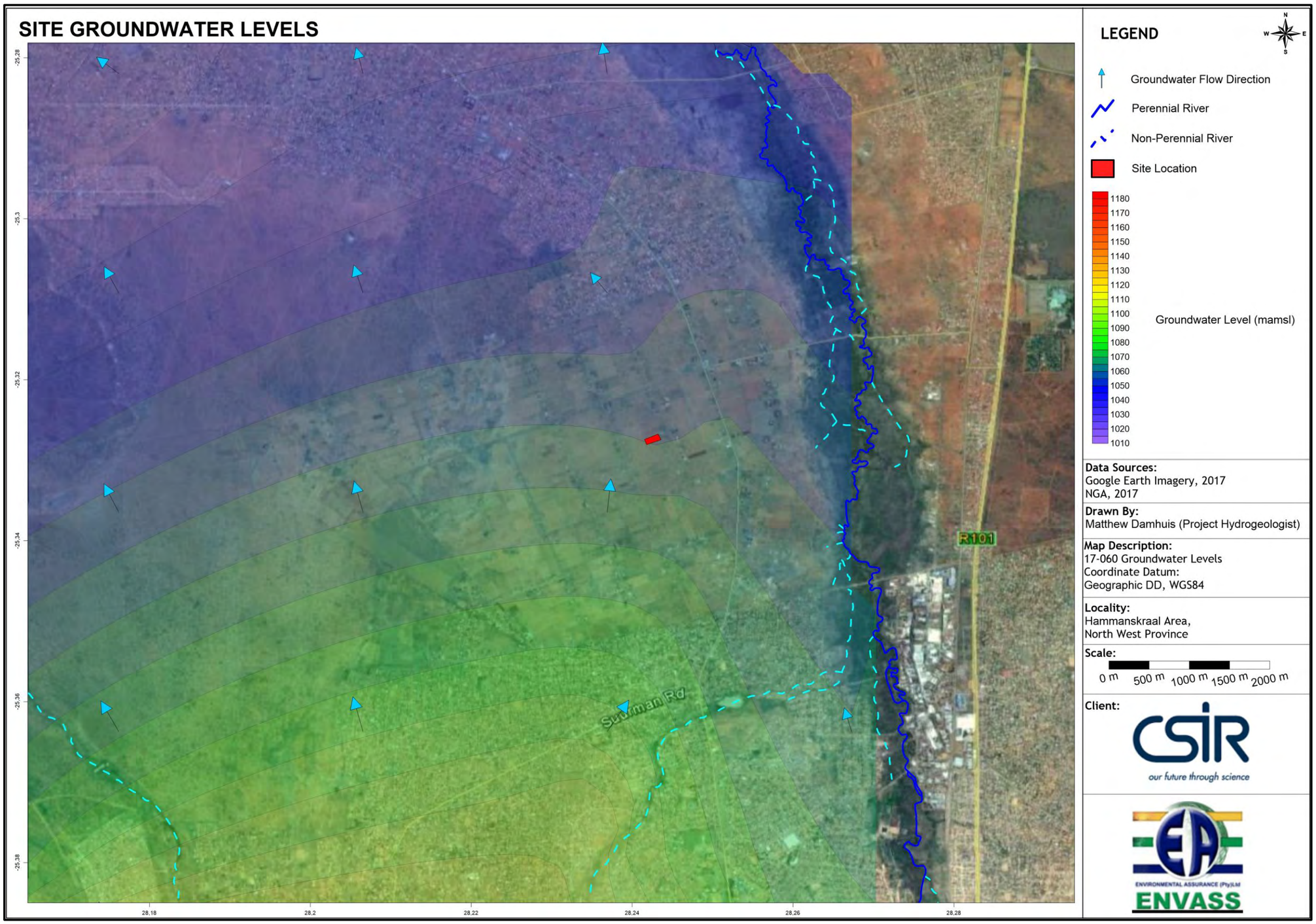


Figure 4.7: Groundwater Level

5. AQUIFER TESTING

Currently there is one (1) borehole at the site (KBH01), as shown in Figure 4.76, which is equipped and is currently used for water supply to the household and irrigation water for the site agricultural activities. The borehole was originally installed to a depth of 150 m (Mr Kgomo, 2017), but has since collapsed to a depth of 33 m.

The borehole was not constructed with casing; thus, it was determined that the pump testing would be conducted using the existing site equipment, not with Impulse's pump testing rig. This was due to the risk of borehole collapse during the installation of the testing equipment which is a wider diameter than the existing equipment and may have contacted the sidewalls of the borehole. The risk of borehole collapse would potentially result in the loss of equipment, loss of the borehole and subsequently the loss of water supply to the property until a new borehole could be installed.

Two (2) constant discharge rate tests were completed at the borehole, namely:

- Aquifer Test 01: A 1-hour constant discharge rate test where the existing pump was run at full capacity (i.e. 0.5 l/s); and
- Aquifer Test 02: A 4-hour constant discharge rate test where the existing pump was run at 0.3 l/s.

Following each of the tests a recovery test was completed to allow water levels to rebound to initial conditions. It must be noted that the second recovery test was not completed due to the borehole being needed for use at the site agricultural activities. However, the trend of recovery was the same as the previous test and the full recovery test was not required. The pumping test details are summarised in

Table *5.1* and discussed below.

Table 5.1: Aquifer Testing Summary

Aquifer Test	Static Water Level (m bgl)	Duration (min)	Pump Rate (l/s)	Available Drawdown (m)	Final Drawdown (m)	Recovery Duration (min)	Recovery (%)
Aquifer Test 01	11.85	51	0.5	21.15	20.55	90	99.8%
Aquifer Test 02	11.9	249	0.3	21.1	17.35	21	63.7%

5.1. Aquifer Test 01

The first aquifer test was conducted on 8th June 2017 using the existing pump equipment at the site, which was installed to a depth of 33 m bgl. The static water level for the test was 11.85 m bgl and the available drawdown was 21.15 m. The test was conducted for 51 minutes at a constant rate of 0.5 l/s (i.e. 1.8 m^3/hour), at 51 minutes the water level reached the pump inlet. The final drawdown for the test was 20.55 m. The borehole was allowed to recover following the pump test and reached 99.8% recovery after 90 minutes. The pumping test graph is shown in Figure 5.1 and the raw aquifer test data is shown in Appendix C.

The results of the pumping test were interpreted using the Cooper-Jacob straight-line fitting method and the Theis residual drawdown methods to determine the aquifer properties at the borehole. Transmissivity values varied between 0.15 and 1.7 m^2/day, as presented in

Table *5.2*, with an average transmissivity of 0.62 m^2/day. The sustainable borehole yield was determined using the FC-method and was determined to be 0.1 l/s for a 20-hour pumping cycle, or 0.2 l/s for an 8-hour pumping cycle, as shown in

Table *5.2*.

Table 5.2: Aquifer Test 01 Results Summary

Aquifer Test	Cooper-Jacob			Theis Recovery		Average (m2/d)	Sustainable Yield			
	Early Time (m^2/d)	Mid-Time (m^2/d)	Late Time (m^2/d)	Early Time (m^2/d)	Mid-Time (m^2/d)		24-hour pumping (l/s)	24-hour pumping (l/cycle)	8-hour pumping (l/s)	8-hour pumping (l/cycle)
Aquifer Test 01	1.667	0.47	0.2	0.1598	0.5806	0.62	0.1	7 200	0.2	5 760

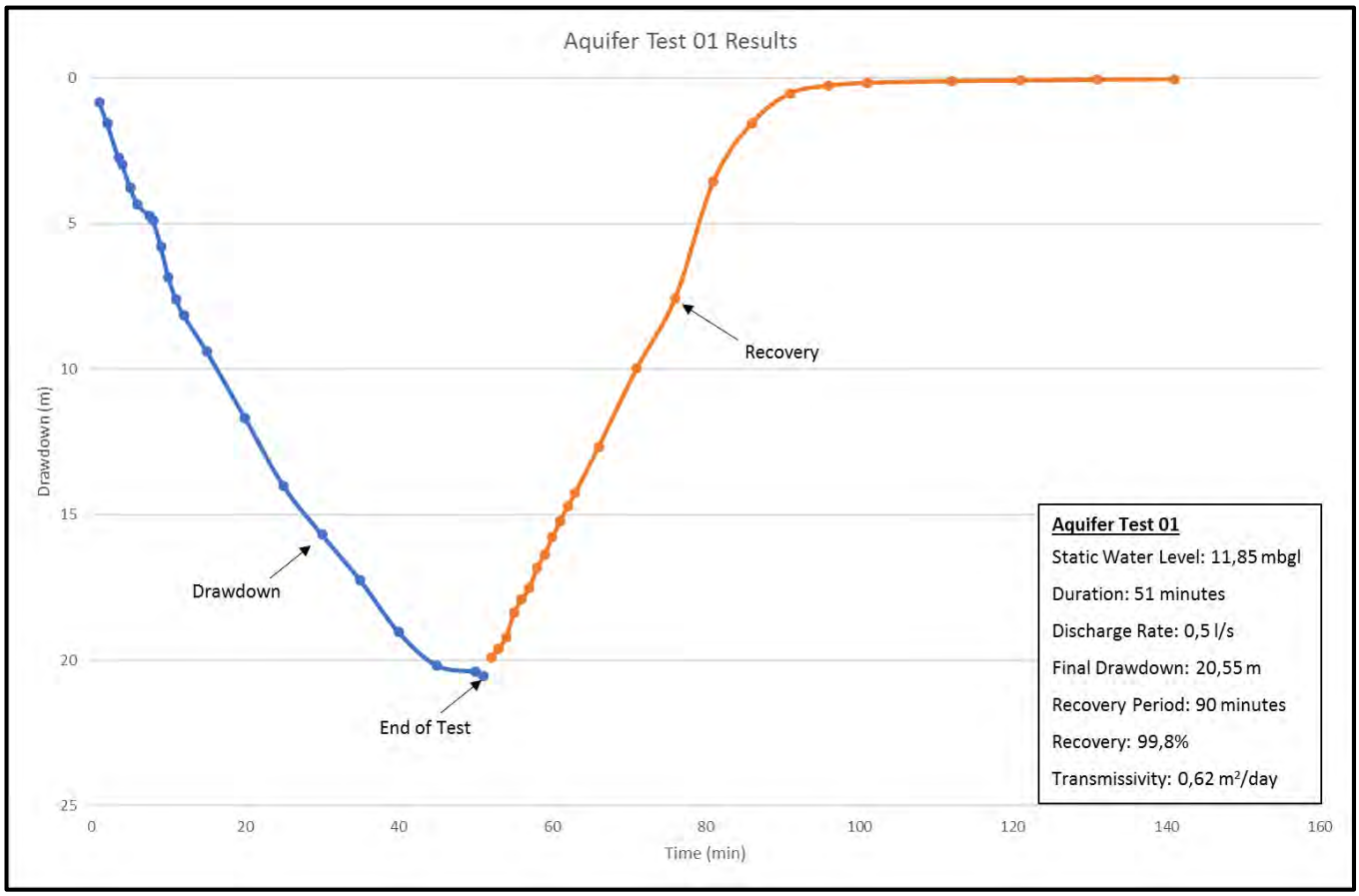


Figure 5.1: Aquifer Test 01 Results Graph

5.2. Aquifer Test 02

The second aquifer test was conducted on 8th June 2017 using the existing pump equipment at the site, which was installed to a depth of 33 m bgl. A ball valve was installed at the pump outlet to control the flow rate from the borehole. The static water level for the test was 11.9 m bgl and the available drawdown was 21.1 m. The test was conducted for 249 minutes at a constant rate of 0.3 l/s (i.e. 1.1 m³/hour). The final drawdown for the test was 17.35 m. The borehole was allowed to recover following the pump test and reached 63.7% recovery after 21 minutes, where recovery was stopped due to Mr Kgomo requiring the use of the borehole pump. The pumping test graph is shown in Figure 5.2 and the raw aquifer test data is shown in Appendix C.

The results of the pumping test were interpreted using the Cooper-Jacob straight-line fitting method and the Theis residual drawdown methods to determine the aquifer properties at the borehole. Transmissivity values varied between 0.2 and 4.9 m²/day, as presented in Table 5.3, with an average transmissivity of 1.56 m²/day. The sustainable borehole yield was determined using the FC-method and was determined to be 0.1 l/s for a 20-hour pumping cycle, or 0.2 l/s for an 8-hour pumping cycle, as shown in Table 5.3.

Table 5.3: Aquifer Test 02 Summary

Aquifer Test	Cooper-Jacob			Theis Recovery		Average (m2/d)	Sustainable Yield			
	Early Time (m2/d)	Mid-Time (m2/d)	Late Time (m2/d)	Early Time (m2/d)	Mid-Time (m2/d)		24-hour pumping (l/s)	24-hour pumping (l/cycle)	8-hour pumping (l/s)	8-hour pumping (l/cycle)
Aquifer Test 02	4.9	1.78	0.33	0.24	0.57	1.56	0.1	7 200	0.2	5 760

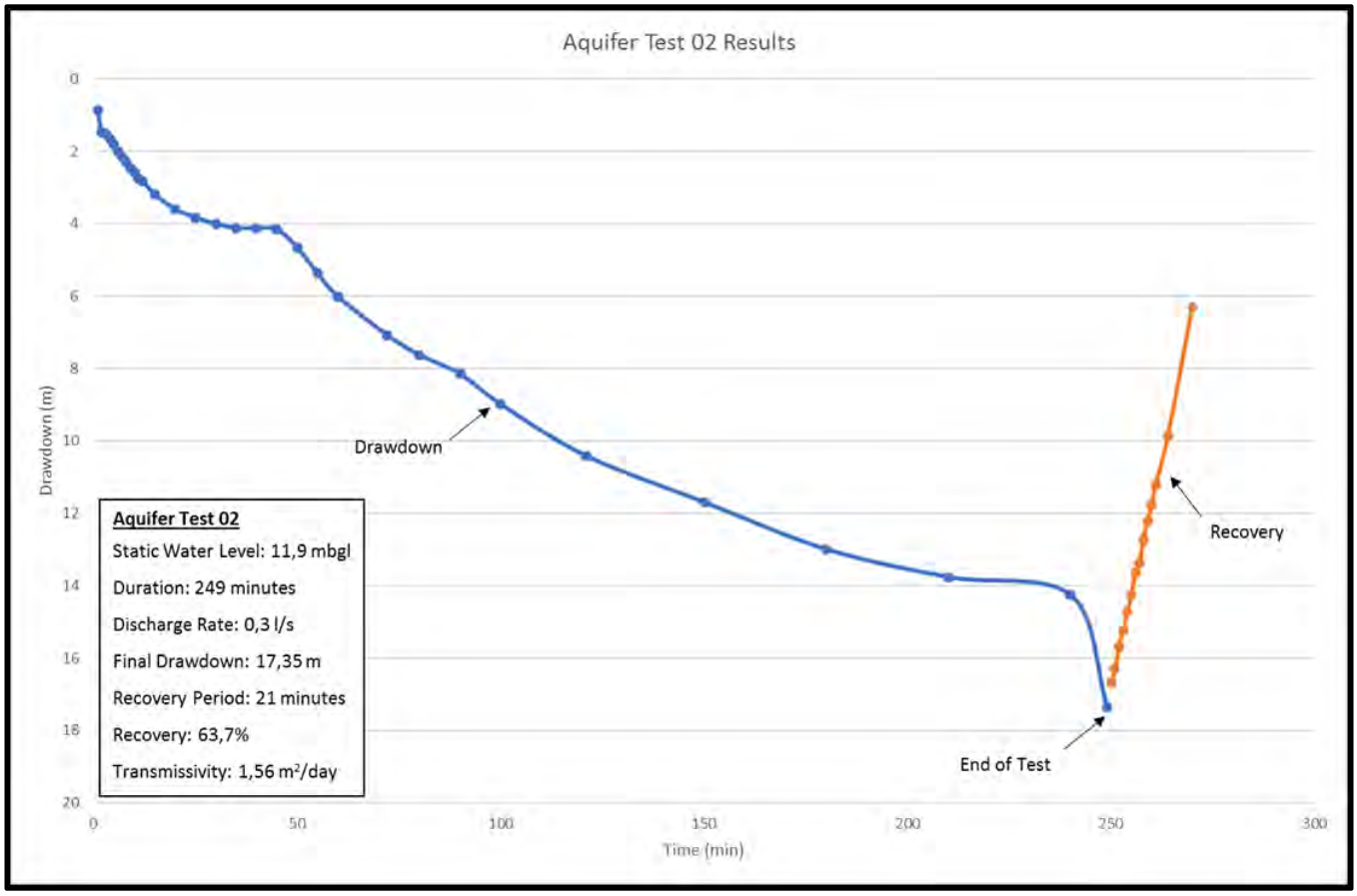


Figure 5.2: Aquifer Test 02 Results Graph

5.3. Borehole Pump Equipment Sizing

The aquifer testing data was interpreted using the FC Method and the sustainable yield determined to be 0.2 l/s (0.7 m³/hour) for 8 hours per cycle, where the borehole is allowed to recover for 2 hours after each pumping cycle.

Based on discussions with the client, the discharge point for the borehole water was set as the existing Jojo tank located 20 m from the borehole and elevated by 5 m above ground level.

The pump selection was made using a total head of 48.1 m, which was comprised of the following factors:

- A dynamic water level of 31 m;
- Static head of 10 m (i.e. the topographic elevation change from the borehole outlet to the base of the water storage tank);
- A pressure head of 5 m;
- Pipe friction losses of 2.1 m, where the pipeline is:
    - 20 m in length (an average, worst case length);
    - 32 mm OD Class 6 HDPE pipe; and
    - Friction loss of 0.1 m/100 m of pipeline.

A detailed schematic, with the calculation parameters, is shown in Figure 5.3.

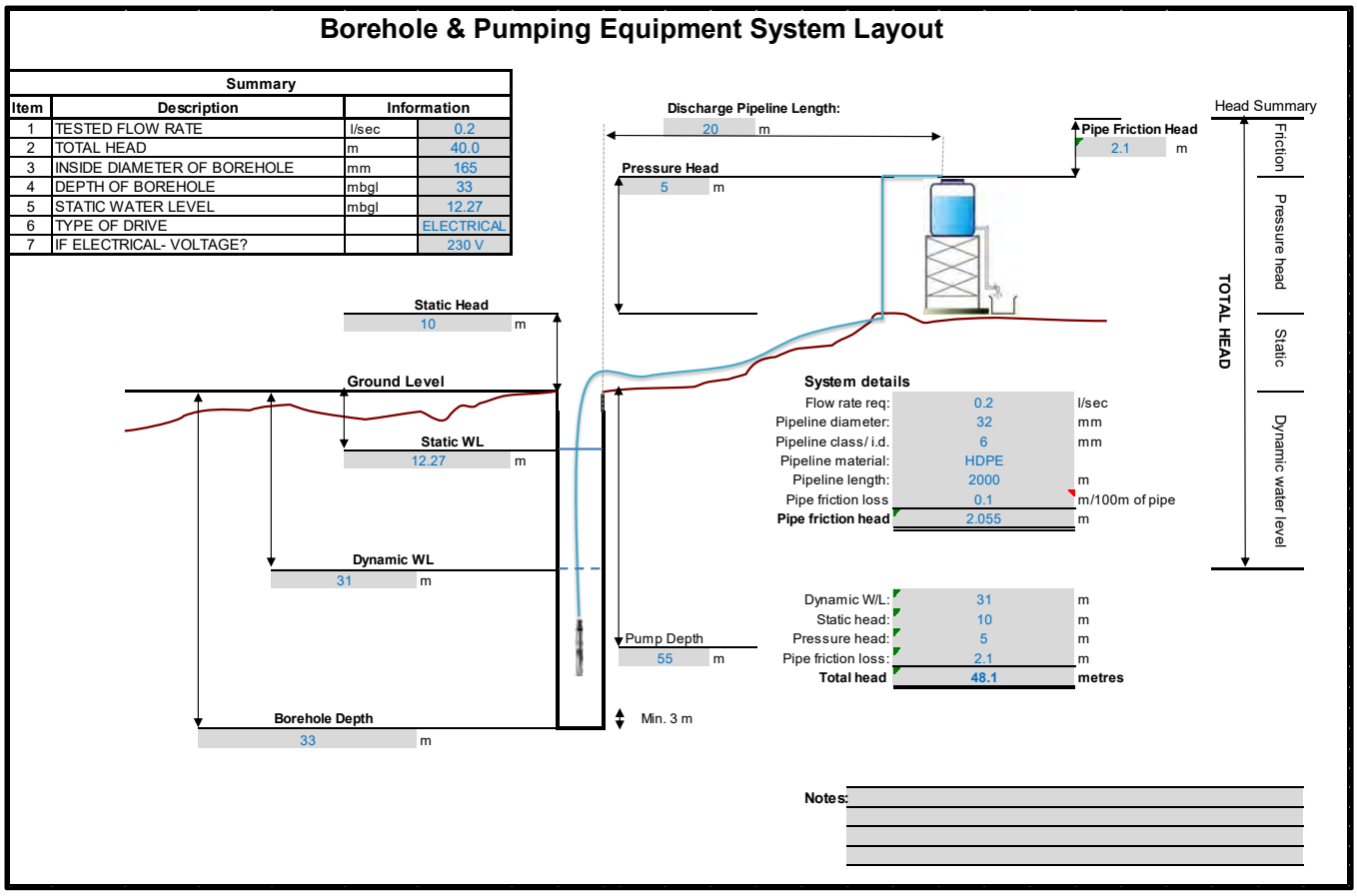


Figure 5.3: Pump Selection Parameters

6. GROUNDWATER RESERVE DETERMINATION

The production borehole at the site is intended to act as water supply point for the proposed site activities, thus a water use license application will be compiled and submitted to the Department of Water & Sanitation (DWS) for approval. A desktop level groundwater reserve determination for the site was completed to form part of the water use license application.

Please note that the groundwater reserve determination was completed using literature values and should be considered a high level, first order assessment of the site conditions. Further information would be required to complete a detailed assessment of the site.

6.1. Resource Units

6.1.1. Delineation

The resource unit for the site borehole was determined using groundwater flow barriers, which were determined by generating sub-catchment areas based on the site topographic data. The proposed production borehole, KBH01, is situated well within the unit of analysis boundary, as shown in Figure 6.2.

6.1.2. Conceptual Flow Model

The site is underlain predominantly by the Ecca Group, with no regional geological structures mapped within the site area, however, two (2) major trends were identified for regional geological structures, namely north-south and west-east striking trends. A north-south trending structure is located at the Apies River (~2.5 km east) and a west-east trending structure is situated ~3.5 km south of the site.

The rock formations of Ecca Group are classified as “intergranular and fractured aquifers”. Groundwater occurrences within “Intergranular and Fractured aquifers” are mainly concentrated within the weathered zones and/or geological structures.

Except for the aquifer testing conducted at the site, limited aquifer parameter information is available within the immediate vicinity. However, based on the GRDM Dataset (DWS, 2012) the average recharge to groundwater for the quaternary catchment is between 1 and 3% of MAP and the borehole yields for the area are typically within the range of 0.1 to 0.5 l/s (NGA, 2017), with higher yields intersected locally at large structural zones (between 2 and 10 l/s).

A total of seventy-three (73) hydrogeological boreholes with water strike information were found in the National Groundwater Archive (NGA). Based on the water strike frequency with depth, as shown in Figure 4.1the site is likely to be underlain by two, interconnected hydrogeological units. Namely:

- A shallow, weathered unit between 5 and 20 m below surface. The production potential is likely to be low due to low storage capacity and is potentially only water-bearing during the rainy season; and
- A deeper, fractured-rock unit between 40 and 80 m below surface, with localized occurrences up to 125 m. Blow yields recorded in the deeper unit vary between 0.1 and 5 l/s, with the expected transmissivity values ranging between 1 and 10 m^2/day and storage coefficient between $4e^{-5}$ and $6e^{-5}$.

Water level information near to the site was limited, however seventy (70) boreholes were identified in the National Groundwater Archive (NGA) within the A23F quaternary catchment. Water levels varied between 1and 60 m below ground level (bgl), with an average water level of 15 m bgl. The water levels showed a good correlation with topography (95%), suggesting that groundwater flow takes place under semi-confined conditions. Based on the groundwater contour map the general flow direction at the site is from south to north.

6.2. Resource Unit Hydrogeology

6.2.1. Recharge

Effective groundwater recharge is the percentage of rainfall which successfully enters the groundwater system. The remainder of the rainfall is either surface runoff, evapotranspiration or soil moisture. The effective recharge to the groundwater system is dependent on a number of environmental conditions, including geology, soils, surface run-off and stream morphology, as well as the effective storage in the aquifer.

The recharge for the site area was determined using two methods, namely extraction of values from the DWS dataset and the chloride mass balance (CMB) method. The values for recharge as per the GRDM dataset (DWS, 2012) were between 1 and 2% of MAP.

In the CMB method the recharge rate is determined using chloride as a natural tracer in the following equation:

$$R = \frac{P.Clp + D}{Clw}$$

Where: R is recharge to groundwater (mm/a)

P is precipitation (mm/a)

Cl_p is chloride in rain (mg/l)

D is the dry chloride deposition (mm/m^2/a)

Cl_w is chloride in groundwater (mg/l)

Van Tonder & Bean (2003) list the following assumptions and limitations which must be considered when applying the chloride mass balance method:

- Chloride is conserved in the aquifer system and does not partake in chemical reactions;
- Chloride concentrations in the study area rain and the rainfall per annum remain relatively constant;
- All chloride is derived from rainfall; and
- Borehole water samples were taken near to surface, as samples taken at depth will contain greater diluted chloride concentrations that will skew recharge calculation results.

For the site, it was assumed that dry deposition was 10% of the chloride in rainfall value, which was taken as 1 mg/l. Based on the water quality data available for borehole at the site the chloride in groundwater is 160.8 mg/l. Thus, the effective recharge for the site according to the CMB method is 3.7 mm/a which is 0.6% of MAP.

The recharge values from both methods are similar, however the CMB method recharge value of 0.6% MAP was chosen to be representative for the site and was considered realistic and conservative. The applicable groundwater recharge for the site was calculated as 45 510 m^3/a, i.e. 0.045 Mm^3/a.

6.2.2. Basic Human Need for the Resource Unit

The basic human needs are defined in the Water Services Act (Act No. 108 of 1997) as 25 l per person per day. The basic human need for the resource unit is calculated by multiplying the number of people in the catchment by 25 l/day.

According to the GRDM software program v 2.3.0.0 (DWS, 2012) the population for the quaternary catchment A23F was 361 907. The number of people per square kilometre was determined as 640, suggesting the population of the unit of analysis is 7903 people, which was adjusted to 3000 people as the unit of analysis is predominantly farms and small holdings, thus the population density would be lower.

Based on these figures the daily basic human need was 75 000 l/day, with an annual demand of 0.03 Mm^3/a. The majority of users will get their water from main lines or surface water bodies, thus it was assumed only 50% of basic human need would be obtained from groundwater (i.e. 0.015 Mm^3/a).

6.2.3. Groundwater Contribution to Surface Water Bodies

Baseflow is the water which travels through the lower region of the unsaturated zone into rivers and other surface water bodies; this contributes to maintaining flow in rivers during dry seasons. Other contributions include delayed interflow and direct groundwater discharge into the river.

For the catchment A23F the GRDM (DWS, 2012) figure for baseflow is 0.84 Mm^3/a. However, no rivers are present within the unit of analysis. Thus, the groundwater contribution to surface water bodies was assumed to be 0 Mm^3/a.

6.2.4. Current Groundwater Use

The majority of the communities received their water from either the nearby rivers or the main water lines. The current groundwater use for the quaternary catchment (according to the GRDM database (DWS, 2012)) was 52.3 l/s, which translated to 0.1 l/s per square kilometre. Thus, the current groundwater use for the unit of analysis was taken as 1.1 l/s, which was adjusted to 0.7 l/s as the unit of analysis is predominantly farms and small holdings, thus the population density would be lower.

The current groundwater use for the unit of analysis was 0.02 Mm^3/a, which was used for the reserve calculation.

6.2.5. Groundwater Quality

Please refer to Section 4.1.3 for the site groundwater quality.

6.2.6. Planned Future Groundwater Use

The borehole installed at the site, KBH01, is planned for use as a water production borehole at an abstraction rate of 0.7 m^3/hour for 8 hours per cycle, with two (2) cycles per day. Thus, the total future groundwater use at the site would be 4 100 m^3/a (0.0041 Mm^3/a).

6.3. RDM Assessment

6.3.1. Classification

6.3.1.1. Methodology

In order to classify the resource unit, the baseline conditions, current status and future management were reviewed, with both water quality and quantity aspects taken into consideration. The methodologies proposed by both Xu *et al.* (2003) and Colvin *et al.* (2004) were taken into account.

The present ecological status of the resource unit will be described based on the Reserve Category and Water Resource Classification, as shown in Figure 6.1.

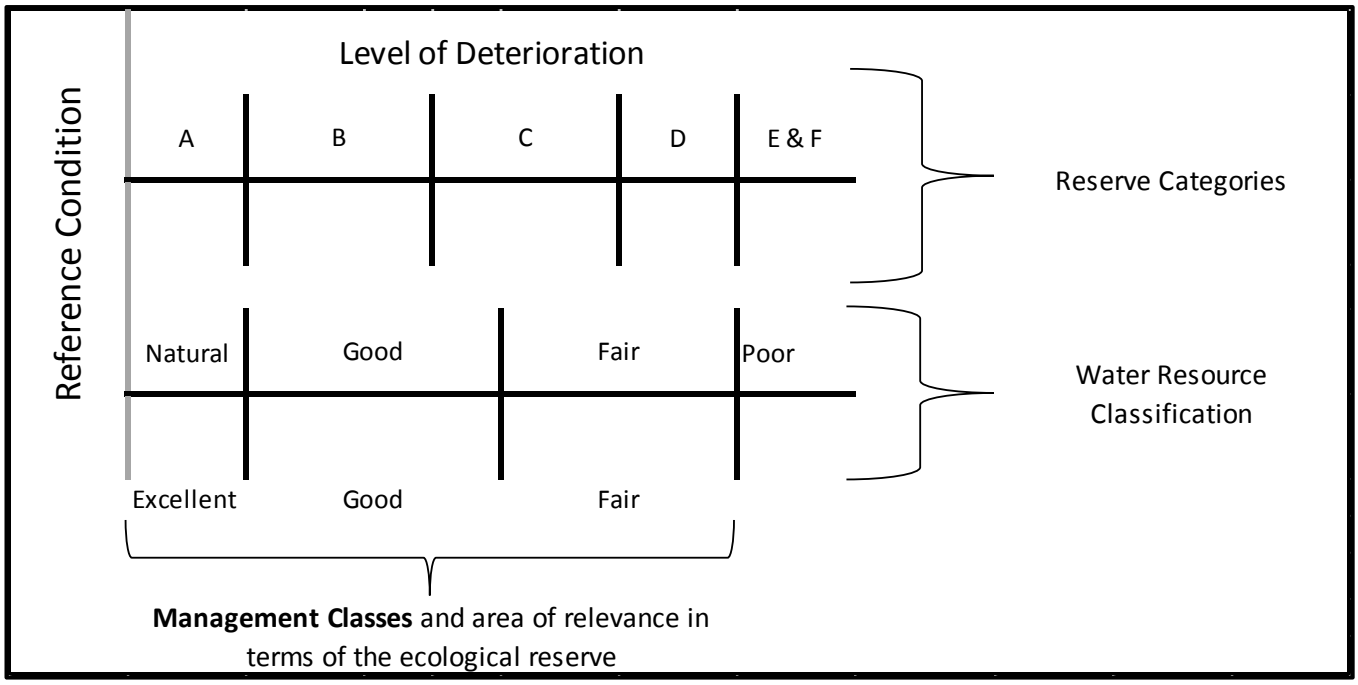


Figure 6.1: Relationship between Classification Systems (after Parsons & Wentzel, 2007)

6.3.1.2. Water Quantity

In order to define the status of a groundwater resource unit the sustainable use, observed ecological impacts or water stress can be evaluated. Limited information is available regarding ecological impacts from groundwater abstraction, thus the

classification process was done using the water stress concept. The National Water Act addresses the concept of water stress, however does not define it (Riemann & Blake, 2010). To quantitatively define water stress within a resource unit the modified stress index can be applied, where the volume of groundwater abstracted from the groundwater unit is divided by the difference between recharge to the unit and baseflow (Riemann & Blake, 2010) as shown in the equation below:

$$Stress\ Index = \frac{Groundwater\ Abstraction}{Recharge - Baseflow}$$

The present status category was then assigned as per Table 6.1, based on the parameters presented in Table 6.2. The resource unit's current groundwater abstraction is 0.04 Mm^3/a and recharge was 0.07 Mm^3/a. The stress index was calculated as 0.44 and fell within category C (moderately stressed).

Table 6.1: Stress Level Determination of a Groundwater Resource Unit (Parsons & Wentzel, 2007)

Present Status Category	Description	Stress Index
A	Unstressed or Low Levels of Stress	<0.05
B		0.05-0.20
C	Moderate Levels of Stress	0.20-0.50
D		0.50-0.75
E	Stressed	0.75-0.95
F	Critically Stressed	>0.95

Table 6.2: Present Status Category for Resource Unit

Resource Unit	Water Quantity				
	Recharge (Mm^3/a)	Baseflow (Mm^3/a)	GW-Use (Mm^3/a)	Stress Index	Class
Blue-Green Site	0.045	0	0.02	0.44	C

6.3.1.3. Water Quality

The water quality was categorized in terms of the level of existing contamination observed (if any) and the expected contamination expected due to land use and vulnerability, as presented in Table 6.3. The site is generally characterised by flat topography, with minor agricultural activities, thus the aquifer vulnerability is expected to be low and the impact of the current land use also low.

Table 6.3: Present Status Category based on vulnerability and land use impact (after Parsons & Wentzel, 2007)

	VULNERABILITY			
EXPECTED LAND USE IMPACT		Low	Medium	High
	Low Impact	A	B	B
	Moderate Impact	B	C	D
	High Impact	C	D	E

The majority of the parameters were within the SAWQG guideline values for agriculture: aquaculture, with the exception of:

- Alkalinity, Total Hardness and Iron (as Fe), which exceeded the guideline values.

The cause of the elevated parameters is most likely due to natural water-rock interactions at the site.

The present ecological status (PES) for water quality was assigned based on the observed data, as well as the expected contamination from the proposed site activities, as shown in Table 6.4.

Table 6.4: Present Ecological Status for Water Quality based on Current and Expected Contamination, Land Use and Vulnerability

	Contamination PES	Expected Impact	Vulnerability	PES	Final PES
Current Conditions	A	Low	Low	A	A
Expected Conditions	A	Low	Low	A	A

6.3.1.4. Combined Classification

The water quantity and water quality were combined to determine the present status category for the resource unit, as shown in Table 6.5. In order to conservatively describe the combined status of the water resource the worst status, where applicable, was considered.

Riemann & Blake (2010) state the proposed principles for assigning the desired ecological status for the resource units are:

- Deterioration of water quality needs to be avoided and the current PES must be maintained or improved upon;
- Protected areas (e.g. nature reserves) require a B class in water quality to ensure sustainability of protected ecology;

- Resource units containing the headwaters of the main rivers and aquifers require a B class in water quality to protect water resources further downstream;
- Resource units with mainly commercial agriculture and forestry require a C class in water quality to ensure sufficient water quality for irrigation. However, a D class can be accepted for water quantity, provided that this does not have a negative impact on downstream resource units;
- Resource units that mainly comprise rural villages and small towns, that are partly or fully dependent on groundwater for stockwatering, small hold agriculture and domestic use, require at least a C class in both water quantity and water quality to protect the livelihood of the rural population;

Based on these principles the resource unit's desired ecological status was proposed, as in Table 6.5. These are proposed and require verification during the Water Resource Classification process.

Table 6.5: PES and Desired Ecological Status of the Resource Unit

Resource Unit	Present Ecological Status			Desired Status	
	Quantity	Quality	Combined	Quantity	Quality
Blue-Green Site	C	A	C	D	A

1.1.1. Reserve Determination

The groundwater component of the reserve can be defined as the part of the overall groundwater resource that sustains both basic human needs and aquatic ecosystems. The components required for the reserve determination and their relevant sections within this report as summarised as follows:

- Aquifer Classification (Section 6.1.2)
- Basic Human Need for the Resource Unit (Section 6.2.2)
- Groundwater Users (Section 6.2.4)
- Water Quality (Section 6.2.5)
- Future Groundwater Use (Section 6.2.6)
- Ecological Flow Requirements (Baseflow) (Section 6.2.3)

The components of the reserve are summarised in Table 6.6. Based on the difference between the recharge to the resource unit (Section 6.2.1) and the reserve, the total allocable groundwater in the resource unit is 0.01 Mm^3/a. This is more than the required volume of 0.0041 Mm^3/a as required for the site.

Table 6.6: RDM Assessment for the Blue-Green Site Resource Unit

Resource Unit	Classification				Resource Evaluation			Reserve Components		Allocable Groundwater
	Present		Proposed		Recharge	Baseflow	GW-Use	BHN	EWR	
	Quantity	Quality	Quantity	Quality	Mm^3/a	Mm^3/a	Mm^3/a	Mm^3/a	Mm^3/a	Mm^3/a
Blue-Green Site	C	A	C	A	0.045	0	0.02	0.015	0	0.01

The groundwater allocation should be accommodated by concise license conditions and managed as per the site management plan proposed in Section 7.

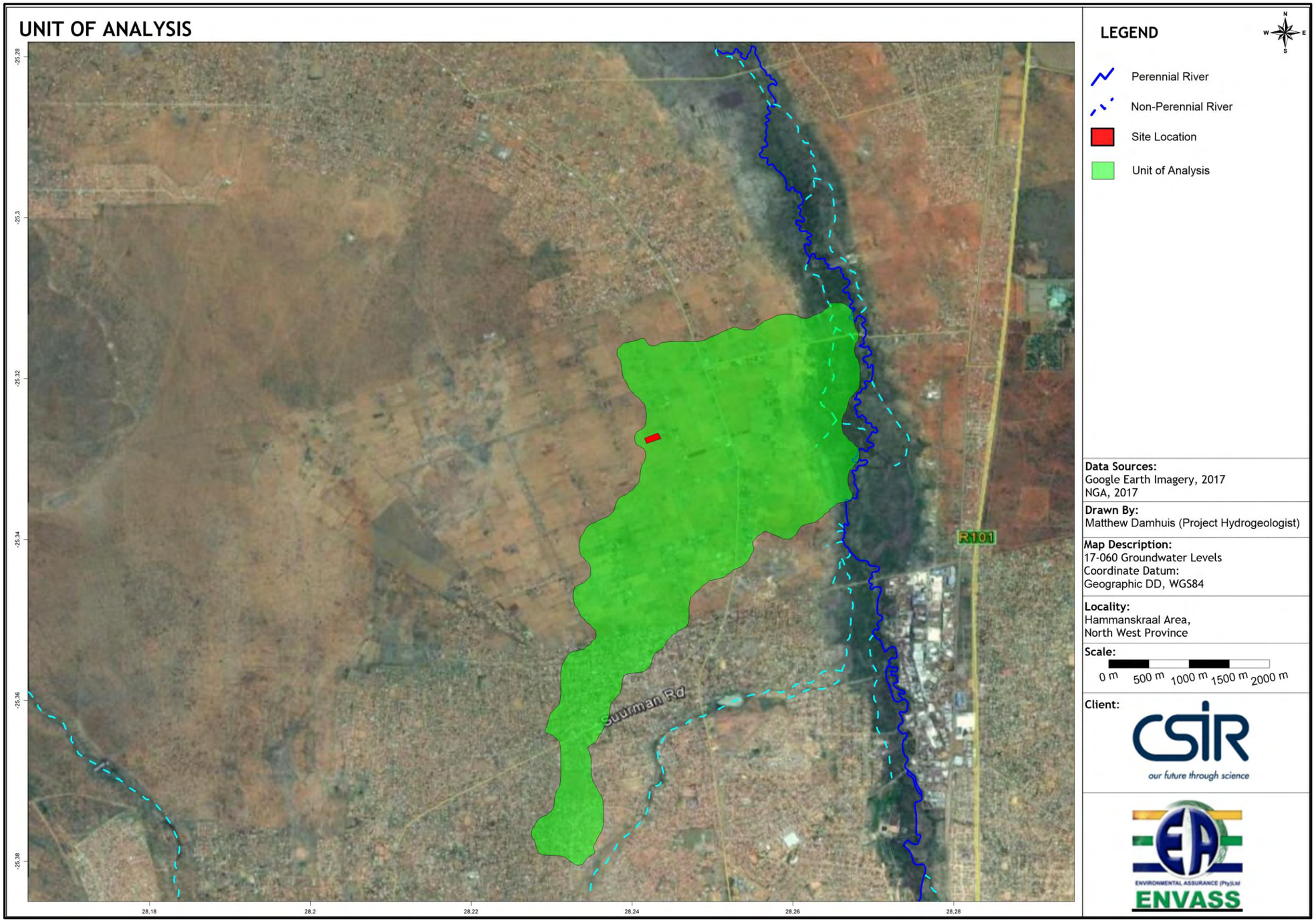


Figure 6.2: Unit of Analysis

7. SITE GROUNDWATER MANAGEMENT PLAN

The groundwater management plan (GWMP) was constructed for the site, taking into account the available hydrogeological information available. The GWMP is discussed in the following sections:

- Objectives;
- General Approach;
- Abstraction Borehole Management Recommendations; and
- Water Management Controls (incl. embedded controls and mitigation measures).

7.1. Objectives

The application of best practice guidelines should be employed at the site to manage, prevent and minimize the impact of abstraction on the surrounding groundwater environment while allowing the site water demands to be met. The following will form part of the embedded water management procedures:

- Maintenance of an effective response mechanism to deal with issues, including unexpected events and complaints; and
- Insurance of sufficient water supply during the project lifespan.

7.2. General Approach

The key principles to the GWMP approach are as follows:

- Minimize and manage the loss of the water resource while ensuring sufficient water supply; and
- Measure, monitor, evaluate and update management measures continuously through the life of project.

7.3. Abstraction Borehole Management Recommendations

Impulse recommends the following pumping schedule for suitable use, as presented in Table 7.1. A summary of the pumping schedule is provided below:

- Pumping Cycle: The borehole (KBH01) must be pumped at 0.2 l/sec (720 l/hr) for 8 hours, then allow for 2 hours of groundwater recovery.
- This pumping cycle can be repeated twice within a 24-hr period.
- A total water volume of 11 520 l/day (11.52 m^3/day) could be abstracted by following the recommended pumping schedule,
- All the abstracted water must be reticulated into three (1) 5 000 litre water storage tank onsite. The water storage tank must be kept full at all times and this can be achieved by means of installing Float Switches into the water storage tank to “top-up” the tank when the water level drops.

Table 7.1: Recommended Pumping Schedule

Cycle	Pump Rate		Pumping Time		Abstraction Volume per 1 Cycle		No. of Cycle within 24hr	Total Volume Abstraction Per 24 hr Period		
Period	l /sec	l /hour	min	hr.	(l / 1 cycle)	(m^3 / 1 cycle)	No.	l / day	m^3/day	m^3/hr.
Pumping	0.2	720	480	8	5760	5.76	2	11520	11.52	0.72
Recovery	0	0	120	2	0	0	2	-	-	-

7.4. Water Management Controls

The water management controls recommended for the construction and operational phases of the project operations is summarized in Table 7.2.

The water management controls address the borehole abstraction management systems for the site and their maintenance, as well as water quality management at the site in order to comply with local standards.

Table 7.2: Groundwater Management Plan

Issue/Component	Objective	Control Measure	Construction	Operational	Embedded	Mitigation	Unexpected Event
General Management Controls							
Training and Awareness	Comply with Relevant Standards and Legislation	Make all interested and affected parties aware of: water conservation/water demand management water pollution avoidance and minimization measures reporting procedure and registry of incidents	×	×	×	×	
		Train all residentss to reduce water consumption	×	×	×	×	
		Make one (1) individual person at a management level responsible for the management of the overall site water balance. Train departmental heads in the managing of water balance, water pollution and water conservation within their sectors.	×	×	×	×	
		Arrangements shall be implemented to support water resources, aquatic environments, ecosystem services and conservation research efforts carried out by local, regional and national research groups in order to further knowledge and understanding of such attributes in the areas of operation		×	×	×	
		Mechanisms shall be created and implemented to provide information and raise awareness among employees and other stakeholders to enhance knowledge and understanding of water resources, aquatic environments and conservation issues.	×	×	×	×	×
Site Water Management							
Water Use	Minimise and manage the loss in water resource	Groundwater should only be abstracted according to the pumping cycle as presented in this report		×	×	×	
	Groundwater Monitoring	Implement a groundwater monitoring program, which includes:					
		Groundwater levels and quality	×	×	×	×	×
		Water quality across the site	×	×	×	×	×
		Abstraction Volumes	×	×	×	×	×
	Maintain reticulation infrastructure	Backup pumps		×	×	×	×
		Pump maintenance and supply spares		×	×	×	×
		Flow and level monitoring		×	×	×	×
		Variable speed drives could allow flexibility in terms of operating where the groundwater inflows could be variable		×	×	×	×
		Continuous inspection of the reticulation system		×	×	×	×

7.4.1. Groundwater Monitoring Program

The groundwater monitoring network design should comply with the risk based source-pathway-receptor principle. A groundwater-monitoring network should contain monitoring positions which can assess the groundwater status at certain areas. Both the impact on water quality and water quantity should be catered for in the monitoring system. The boreholes in the network should cover the following:

- Contaminant sources;
- Sensitive receptors and
- Potential dewatering extent from groundwater abstraction (if any).

Furthermore, monitoring of the background water quality and levels is also required. Groundwater monitoring should be conducted to assess the following:

- Groundwater quality trends; and
- Groundwater Levels.

Groundwater Monitoring should be undertaken to SABS and DWA requirement according to the schedule presented in Table 7.3 below at borehole KBH01

This network complies with the above-mentioned criteria. It is envisaged that the frequency of monitoring remains on a quarterly basis, however indicator analyses are proposed during January and July. This is done in order to save costs.

Table 7.3: Groundwater Monitoring Programme

Monitoring Position	Sampling Interval	Analysis	Water Quality Standards
All Phases of Project			
All monitoring boreholes	Monthly: measuring the depth of groundwater levels	N/A	N/A
All monitoring boreholes	Quarterly: sampling for water quality analysis	- Full analysis in April and October - Abbreviated Analysis in January and July - Groundwater Levels	- South African Water Quality Guidelines: Domestic Use, livestock watering - SANS241:2015 Drinking Water Standards - Water Use License/EMP

			requirements (if applicable)
Rainfall	Daily at the Site	N/A	N/A

7.4.2. Monitoring Parameters

The identification of the monitoring parameters is crucial and depends on the chemistry of possible pollution sources (if any). They comprise a set of physical and/or chemical parameters (e.g. groundwater levels and predetermined organic and inorganic chemical constituents).

Once a pollution indicator has been identified it can be used as a substitute to full analysis and therefore save costs. The use of pollution indicators should be validated on a regular basis in the different sample position. The parameters should be revised after each sampling event; some metals may be added to the analyses during the operational phase, especially if the pH decreases.

7.4.2.1. Full Analysis

- Physical Parameters:
  - Groundwater Levels
- Chemical Parameters:
  - Field Measurements: pH; EC; Temperature
  - Laboratory Analyses: Anions and Cations (Ca, Mg, Na, K, NO_3, NH_4, Cl, SO_4, F, Fe, Mn, Al, Cr and Alkalinity); other parameters (pH, EC, TDS). An ICP metal scan should also be included.

7.4.2.2. Abbreviated Analysis

- Physical Parameters:
  - Groundwater Levels
- Chemical Parameters:
  - Field Parameters: pH, EC, TDS
  - Laboratory Analyses: Major Anions and Cations (Ca, Mg, Na, K, Fe, Mn, Cl, NO_3, SO_4) and EC.

Laboratory analysis techniques will comply with SABS guidelines. The groundwater monitoring database will be updated on a monthly basis as information becomes available. The database should be used to analyse the information and evaluate trends noted.

An annual compliance report should be compiled and submitted to the authorities for evaluation and comment. This report should be submitted annually for all phases of the project (i.e. construction and operational).

The site management must develop a monitoring response protocol. This protocol will describe procedures in the event that groundwater monitoring information indicates that action is required.

8. IMPACT ASSESSMENT

Typically, a site life cycle is comprised of four (4) distinct phases, each with their own unique environmental risks and impacts. The four phases of a typical project, in sequential order, are as follows:

- Feasibility Phase: baseline investigations are completed to determine the overall economic feasibility of the project and the processes to be used during operations. In terms of this type of project there are no environmental impacts for the feasibility phase;
- Construction Phase: involves the construction of necessary site infrastructure, such as access roads, power supply lines, site buildings (e.g. fish dams), processing plants (if necessary) and product storage facilities;
- Production Phase: fish would be produced at the site, processed and transported off-site for sale into the market. During the operational phase there would be potential, localised aquifer dewatering if borehole abstraction is not managed correctly; and
- Closure Phase: where operations at the site cease and rehabilitation of the site is conducted and water levels potentially affected by dewatering begin to rebound.

8.1. Construction Phase Impacts

During the construction phase at the site, the fish cultivation tanks would be constructed, as well as processing facilities and product storage facilities. The impacts on groundwater during construction would be limited due to the scale of the site operations.

Should groundwater be used to supply the construction activities (e.g. drinking water or dust suppression), localized dewatering could occur at the borehole. This would be a low impact both before and after management measures are put in place due to the localized extent of dewatering and the short duration of the impact. Borehole abstraction (if any) should be managed effectively and borehole water levels and abstraction volumes from the borehole should be recorded at least weekly.

Hydrocarbon spills from construction vehicles and/or fuel storage areas could result in localised groundwater contamination, which is a medium impact on the receiving environment. In order to manage these impacts all staff and supervisors at workshops, yellow metal laydown areas and fuel storage areas should be trained in hydrocarbon spill response and each of these areas should be equipped with the appropriate spill response kits and any contaminated soil must be disposed of correctly at a suitable location. Should these management measures be put in place the impact on the receiving environment would be reduced to a low impact.

During construction, it is likely that domestic waste would be generated by contractors and the site staff, which may result in groundwater contamination if not disposed of correctly. The domestic waste would have a low impact on the receiving environment, however it should be disposed of at a suitable landfill site only and good housekeeping practices should be implemented and maintained at the site.

The impact ratings for the construction phase are shown in Table 8.1.

Table 8.1: Construction Phase Impacts

Description of Activity	Impact Description	M	S	D	P	R
Groundwater Quantity						
Groundwater Dewatering	Without Mitigation/Management Measures					
	If groundwater is used for supply then localized dewatering could occur	4	2	2	3	24
	With Mitigation/Management Measures					
	Borehole abstraction should be sufficiently managed and water levels monitored at the abstraction well	4	2	2	3	24
Groundwater Quality						
Hydrocarbon Spills	Without Mitigation/Management Measures					
	Hydrocarbon spills from construction vehicles and fuel storage areas may contaminate the groundwater resource locally	8	2	3	4	52
	With Mitigation/Management Measures					
	Staff at workshop areas, yellow metal laydown zones and fuel storage areas should be sufficiently trained in hydrocarbon spill response. Each area where hydrocarbons are stored or likely to spill should be equipped with sufficient spill response kits and personnel, contaminated soil should be disposed of correctly at a suitable location	4	2	3	2	18

Waste Generation	Without Mitigation/Management Measures					
	During construction domestic waste will be generated by contractors and staff	2	2	3	4	28
	With Mitigation/Management Measures					
	Domestic waste should be disposed of at a dedicated, suitable landfill site	2	2	3	2	14

8.2. Operational Phase Impacts

During the operational phase of the site, groundwater would be abstracted from the on-site borehole (KBH01) and used in the aquaculture tanks for fish production. The production of fish at the site would result in product wastewater from the aquaculture tanks, as well as runoff water from the cleaning and processing activities.

The impacts on the receiving groundwater environment due to borehole abstraction (if managed correctly) are low, with the drawdown cone of the borehole expected to be limited to 50 m (i.e. remaining within the site boundaries). Due to the limited extent of the drawdown cone at the site it is unlikely that any groundwater users would be significantly impacted on during operations. However, should any users be impacted on the mine would need to supply, at their own cost, an equivalent quantity of water to these impacted parties. No mitigation is possible for the impact due to abstraction, however groundwater levels at the abstraction borehole should be monitored and discharge from the processing and wastewater operations should be disposed of in a safe manner.

Table 8.2: Operational Phase Impacts

Description of Activity	Impact Description	M	S	D	P	R
Groundwater Quantity						
Dewatering	Without Mitigation/Management Measures					
	Groundwater depletion may take place at the abstraction borehole if not managed correctly	2	1	4	4	28
	With Mitigation/Management Measures					
	No mitigation possible. Although unlikely to occur, should any local groundwater user's resource be impacted on by operations at the site the affected party should be provided with an alternative water source at the operator's cost. Groundwater levels should be monitored regularly and should any negative trends in groundwater levels be observed suitable mitigation should be implemented. Discharge water from the processing operations should be disposed of in a safe manner, should the water become contaminated over time it should either be stored in dedicated PCD's for reuse at the processing plant or treated prior to discharging into the environment.	2	1	4	4	28

8.3. Closure Phase Impacts

During closure at the site all production, processing and waste disposal facilities would be broken down and removed from the site. The abstraction from the site borehole would be ceased and groundwater levels would recover to normal conditions. No environmental impacts on the receiving groundwater environment were identified.

9. CONCLUSIONS & RECOMMENDATION

Impulse Water Holdings (Pty) Ltd ('Impulse') was contracted by Environmental Assurance (Pty) Ltd ('Envass') on behalf of the CSIR ('the client') to complete a water yield and water quality assessment at a farm portion located at Boplaas West, Hammanskraal, North West Province ('the site'). The site is located on a sub-portion of Plot 413 in Boplaas West, within the Moretele Municipality in Bonjala District, North West Province and is accessible via a dirt road. Currently the land is occupied by Mr T J Kgomo and is utilised for minor cash crops and subsistence farming.

The site is undergoing evaluation due to a grant application received by the client for the installation and operation of an aquaculture facility on a portion of the site. The objective of the project was to determine the sustainable yield of the borehole at the site, as well as the borehole water quality, and complete a basic geohydrological assessment at the site.

Due to accessibility challenges at the site, no additional water levels were obtained at the site area. However, seventy-five (75) water levels were available from NGA data for the site area. The water level of the on-site borehole was measured at 11.85 m bgl and the average water levels for the region varied between 1 and 60 m bgl, with an average water level of 15 m bgl. Groundwater levels showed a good correlation (95%) with topographic elevations at the site, suggesting flow takes place under semi-confined conditions. The general groundwater flow direction at the site was from north to south.

A water quality sample was taken at the site borehole following aquifer testing and submitted to a SANAS-accredited laboratory for analysis. The chemistry results were compared to the DWS (1996) South African Water Quality Guidelines, Volume 6: Agricultural Water Use: Aquaculture and DWS (1996). The majority of parameters were compliant with the SAWQG guideline values, with the exception of total hardness, alkalinity and iron (as Fe). These elevated parameters are likely to be caused by natural rock-water interactions at the site. It is recommended that a water softener unit is installed at the site to treat the water prior to use for production purposes. Although no guideline values are in place for E.Coli and Faecal coliforms, it must be noted that these parameters were detected at the borehole. It is recommended that an in-line UV treatment unit is placed between the borehole and end use tank to prevent any issues with fish production.

Currently there is one (1) borehole at the site (KBH01), which is equipped and is currently used for water supply to the household and irrigation water for the site agricultural activities. The borehole was originally installed to a depth of 150 m (Mr Kgomo, 2017), but has since collapsed to a depth of 33 m. The borehole was not constructed with casing; thus, it was determined that the pump testing would be conducted using the existing site equipment, not with Impulse's pump testing rig. This was due to the risk of borehole collapse during the installation of the testing equipment which is a wider diameter than the existing equipment and may have contacted the sidewalls of the borehole. The risk of borehole collapse would potentially result in the loss of equipment, loss of the borehole and subsequently the loss of water supply to the property until a new borehole could be installed.

Two (2) constant discharge rate tests were completed at the borehole, the aquifer testing data was interpreted using the FC Method and the sustainable yield determined to be 0.2 l/s (0.7 m^3/hour) for 8 hours per cycle, where the borehole is allowed to recover for 2 hours after each pumping cycle.

The production borehole at the site is intended to act as water supply point for the proposed site activities, thus a water use license application will be compiled and submitted to the Department of Water & Sanitation (DWS) for approval. A desktop level groundwater reserve determination for the site was completed to form part of the water use license application.

The groundwater component of the reserve can be defined as the part of the overall groundwater resource that sustains both basic human needs and aquatic ecosystems. Based on the difference between the recharge to the resource unit and the reserve, the total allocable groundwater in the resource unit is 0.01 Mm^3/a. This is more than the required volume of 0.0041 Mm^3/a as required for the site.

A hydrogeological impact assessment was completed for the site for the construction, operational and closure phases.

During the construction phase at the site, the fish cultivation tanks would be constructed, as well as processing facilities and product storage facilities. The impacts on groundwater during construction would be limited due to the scale of the site operations. Should groundwater be used to supply the construction activities (e.g. drinking water or dust suppression), localized dewatering could occur at the borehole. This would be a low impact both before and after management measures are put in place due to the localized extent of dewatering and the short duration of the impact. Borehole abstraction (if any) should be managed effectively and borehole water levels and abstraction volumes from the borehole should be recorded at least weekly.

Hydrocarbon spills from construction vehicles and/or fuel storage areas could result in localised groundwater contamination, which is a medium impact on the receiving environment. In order to manage these impacts all staff and supervisors at workshops, yellow metal laydown areas and fuel storage areas should be trained in hydrocarbon spill response and each of these areas should be equipped with the appropriate spill response kits and any contaminated soil must be disposed of correctly at a suitable location. Should these management measures be put in place the impact on the receiving environment would be reduced to a low impact.

During construction, it is likely that domestic waste would be generated by contractors and the site staff, which may result in groundwater contamination if not disposed of correctly. The domestic waste would have a low impact on the receiving environment, however it should be disposed of at a suitable landfill site only and good housekeeping practices should be implemented and maintained at the site.

During the operational phase of the site, groundwater would be abstracted from the on-site borehole (KBH01) and used in the aquaculture tanks for fish production. The production of fish at the site would result in product wastewater from the aquaculture tanks, as well as runoff water from the cleaning and processing activities.

The impacts on the receiving groundwater environment due to borehole abstraction (if managed correctly) are low, with the drawdown cone of the borehole expected to be limited to 50 m (i.e. remaining within the site boundaries). Due to the limited extent of the drawdown cone at the site it is unlikely that any groundwater users would be significantly impacted on during operations. However, should any users be impacted on the mine would need to supply, at their own cost, an equivalent quantity of water to these impacted parties. No mitigation is possible for the impact due to abstraction, however groundwater levels at

the abstraction borehole should be monitored and discharge from the processing and wastewater operations should be disposed of in a safe manner.

During closure at the site all production, processing and waste disposal facilities would be broken down and removed from the site. The abstraction from the site borehole would be ceased and groundwater levels would recover to normal conditions. No environmental impacts on the receiving groundwater environment were identified.

Based on the conclusions reached during the project, the following is recommended for the site:

- The borehole yield is most likely to be significantly lower than the original yield (when the borehole was 150 m deep), thus it is recommended that the borehole is redrilled/rehabilitated to its original depth and undergoes further aquifer testing to determine the sustainable yield. The borehole should be constructed using a combination of slotted and solid uPVC casing and have gravel pack installed in the annulus between the casing and borehole wall. This would prevent any further collapse of the borehole;
- Should the rehabilitation of the borehole to 150 m not be feasible, it is recommended that uPVC casing (both solid and slotted) be installed at the existing borehole (at 33 m depth) to prevent further borehole collapse. This will ensure sustainability of the borehole for site operations and prevent loss of equipment;
- It is recommended that a new borehole pump is installed at the site, as per recommendations in Section 35. , and an automated control system with timers and float level switches installed to ensure the recommended pump cycles are strictly adhered to. The system should also include a flow meter to monitor abstraction volumes and preferably have an electronic diver installed with telemetry to monitor groundwater levels at the site; and
- The water quality at the site was generally compliant with the SAWQG guidelines, however it is recommended that an appropriate water treatment plant is installed at the borehole to soften the water and remove excess iron prior to use. It is also recommended that a UV treatment unit is installed to remove microbiological parameters from the water prior to use.

We hope that this report has met your expectations and requirements for the project. Should any additional information be required please do not hesitate to contact us.

10. REFERENCES

Department of Water & Sanitation, 2012. *GRDM Software Dataset*.

Parsons, R. and Wentzel, J., 2007. Groundwater Resource Directed Measures Manual. Department of Water Affairs and Forestry, Pretoria.

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Appendix A – Methodologies

Desktop Review

A detailed desktop study was conducted for the site, during which all the available public domain information as well as all previous consultant reports for the site were reviewed. In addition to the data review, aerial and satellite imagery interpretation was conducted to identify and map any potential geological structures at the site. The data and information consisted of, but was not limited to, the following:

- 1:50 000 Topographic maps;
- 1:250 000 Geological Map Series of South African;
- 1:500 000 Hydrogeological Map Series of South African;
- National Groundwater Archive (NGA) datasets;
- Department of Water and Sanitation (DWS) water quality datasets;
- The Groundwater Resource Assessment Phase 2 (GRAII) Database; and
- Aerial and Satellite Imagery (Google Earth, ESRI's Online World and Latsat Imagery).

Hydrocensus Investigation

A hydrocensus investigation was planned to be completed within the immediate vicinity of the site, in order to identify the existing groundwater users and any additional groundwater points (e.g. boreholes, springs, etc.). Impulse was advised against contacting the neighbors by the on-site resident, Mr Kgomo.

Aquifer Testing

The production borehole (KBH01) underwent aquifer testing comprised of the following tests:

- A one (1) hour constant discharge rate test using the existing equipment at full capacity and the water level response measured and recorded;
- A four (4) hour constant discharge test, where water is removed from the borehole at a fixed rate, half of the full pump potential, and the water level response measured and recorded; and
- A recovery test where the water level recovery following the constant discharge tests is measured until the water level is 95% of the original water level, or twelve (12) hours have passed.

The results of the aquifer testing were interpreted in order to determine aquifer characteristics such as transmissivity and sustainable borehole yields. One (1) water sample was taken at the borehole and submitted to a SANAS-accredited laboratory for analysis, the results of which will be compared to the SANS241:2015 drinking water quality standards.

Groundwater Reserve Determination

During the project, a groundwater reserve determination (GRD) was completed for the site, using the desktop data available for the region, as well as field investigation results. The groundwater reserve determination used the Groundwater Reserve Directed Measures (GRDM) methodology as approved by the Department of Water and Sanitation (DWS).

Groundwater Impact Assessment

The results of the numerical modelling scenarios were used to conduct a high level hydrogeological impact assessment for the site, including the construction, operational and closure phases of life of mine (LOM). The impacts on both groundwater quantity and quality were quantified based on the magnitude (M), duration (D), scale (S) and probability of occurrence (P), following which mitigation measures were proposed and the risk re-evaluated to take mitigation and management measures into account.

The overall risk rating (R) was calculated using the equation: R = (M + S + D) * P, where the scale of the input parameters and risk categories are shown in **Error! Reference source not found.** tables below.

Risk Ranking Parameters

Magnitude:=M	*Duration:=D*
10: Very high/don't know	5: Permanent
8: High	4: Long-term (ceases with the operational life)
6: Moderate	3: Medium-term (5-15 years)
4: Low	2: Short-term (0-5 years)
2: Minor	1: Immediate
0: Not applicable/none/negligible	0: Not applicable/none/negligible
Scale:=S	*Probability:=P*
5: International	5: Definite/don't know
4: National	4: Highly probable
3: Regional	3: Medium probability
2: Local	2: Low probability
1: Site only	1: Improbable
0: Not applicable/none/negligible	0: Not applicable/none/negligible

Risk Classification

Significance	*Environmental Significance Points*	*Colour Code*
Neutral	0	N
Low (negative)	<30	L
Medium (negative)	30 to 60	M
High (negative)	>60	H

Appendix B – Water Sample Laboratory Certificate

TEST REPORT

DATE OF REPORT	:	*14 June 2017*
REFERENCE NO	:	*CLS172159*
CLIENT ORDER NO	:	*KBH Samples*
CONTACT PERSON	:	*Adri Cowley*
CLIENT	:	*Environmental Assurance (Pty) Ltd*
CLIENT ADDRESS	:	*394 Tram Street* *New Muckleneuk* *0181*
CLIENT CONTACT PERSON	:	*Johan Nortje*
CLIENT TELEPHONE NO	:	*(012) 460 9768*
CLIENT FAX NO	:	*(27) 78 200 3546*
CLIENT e-MAIL ADDRESS	:	*johan@envass.co.za*
ANALYSIS REQUIRED	:	*Analysis of Water.*
TEST METHOD USED	:	*SANS 241-1&2:2015* *Edition 2.*

TEST RESULTS

Table 1 – Analysis of Water.

TEST ITEM DESCRIPTION	*TEST ITEM CONDITION*	*DATE RECEIVED*	*DATE OF ANALYSIS*
Water	*Sealed in bottles. Received at ambient temperature.*	*9/06/2017*	*10/06/2017*

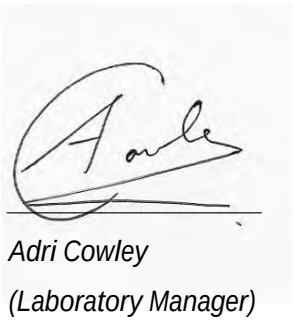
RESULTS:

Analysis	*Limit of Detection*	*KBH 01*
pH at 25°C		*7.79*
Electrical Conductivity at 25 °C (mS/m)		*107.40*
Total Dissolved Solids (mg/l)	*1*	*782*
Total Alkalinity as $CaCO_3$ (mg/l)	*0.1*	*230.75*
Total Hardness as $CaCO_3$ (mg/l)		*301*
Ammonia as N (mg/l)	*0.010*	*0.13*
Fluoride (mg/l)	*0.037*	*<0.037*
Chloride (mg/l)	*0.037*	*160.80*
Nitrate as N (mg/l)	*0.070*	*10.96*
Ortho-Phosphate (mg/l)	*0.065*	*<0.065*
Sulphate (mg/l)	*0.053*	*47.40*
Ag (mg/l)	*0.001*	*<0.001*
Al (mg/l)	*0.003*	*<0.003*
B (mg/l)	*0.001*	*<0.001*
Ba (mg/l)	*0.001*	*0.132*
Be (mg/l)	*0.001*	*<0.001*
Bi (mg/l)	*0.001*	*<0.001*
Ca (mg/l)	*0.009*	*77.397*
Cd (mg/l)	*0.001*	*<0.001*
Cr (mg/l)	*0.001*	*<0.001*
Cu (mg/l)	*0.001*	*<0.001*
Fe (mg/l)	*0.004*	*0.020*
Ga (mg/l)	*0.001*	*<0.001*

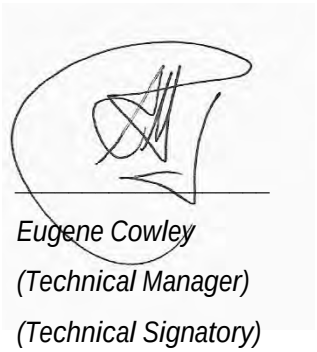
K (mg/l)	*0.007*	*13.940*
Li (mg/l)	*0.001*	*<0.001*
Mg (mg/l)	*0.001*	*26.169*
Mn (mg/l)	*0.001*	*0.027*
Mo (mg/l)	*0.001*	*<0.001*
Na (mg/l)	*0.009*	*63.801*
Ni (mg/l)	*0.001*	*<0.001*
Analysis	*Limit of Detection*	*KBH 01*
Pb (mg/l)	*0.001*	*0.004*
Rb (mg/l)	*0.001*	*<0.001*
Sr (mg/l)	*0.001*	*<0.001*
Te (mg/l)	*0.001*	*0.376*
Tl (mg/l)	*0.001*	*<0.001*
V (mg/l)	*0.001*	*<0.001*
Zn (mg/l)	*0.001*	*0.003*
Faecal Coliforms (CFU/100 ml)		*143*
e-coli (CFU/100ml)		*118*

Specific Test Conditions	*Samples stored at 5 °C prior to analysis.*
Deviations	*None.*

WORK APPROVED BY:



Adri Cowley
(Laboratory Manager)
(Technical Signatory)



Eugene Cowley
(Technical Manager)
(Technical Signatory)

14/06/2017
Date

This report relates to the specific sample(s) tested as identified herein, it does not imply Chemtech Laboratory Services approval of the quality and/or performance of the item(s) in question and the test results do not apply to any similar item that has not been tested.

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Results express in ppm, ppb, mg/m^3 or μg/m^3 were calculated using data supplied by the client.

Appendix C – Aquifer Test Results

Static Water Level (m bc):	12.27		Borehole ID:	KBH01	Aquifer Test 01			
Collar (m):	0.42		Date:	08/06/2017				
Drawdown					Recovery			
Time (min)	Water Level (mbc)	Water Level (mbgl)	Drawdown (m)	Yield (l/s)	Time (min)	Water Level (mbc)	Water Level (mbgl)	Recovery (m)
1	13.12	12.7	0.85	0.66	1	32.19	31.77	19.92
2	13.82	13.4	1.55		2	31.87	31.45	19.6
3.5	15.02	14.6	2.75	0.64	3	31.47	31.05	19.2
4	15.26	14.84	2.99	0.64	4	30.64	30.22	18.37
5	16.03	15.61	3.76		5	30.2	29.78	17.93
6	16.62	16.2	4.35	0.64	6	29.8	29.38	17.53
7.5	17	16.58	4.73		7	29.1	28.68	16.83
8	17.16	16.74	4.89		8	28.64	28.22	16.37
9	18.05	17.63	5.78		9	28.05	27.63	15.78
10	19.12	18.7	6.85	0.61	10	27.51	27.09	15.24
11	19.87	19.45	7.6		11	26.98	26.56	14.71
12	20.43	20.01	8.16		12	26.52	26.1	14.25
15	21.67	21.25	9.4	0.57	15	24.95	24.53	12.68
20	23.95	23.53	11.68		20	22.25	21.83	9.98
25	26.28	25.86	14.01	0.54	25	19.84	19.42	7.57
30	27.95	27.53	15.68	0.51	30	15.82	15.4	3.55
35	29.52	29.1	17.25	0.5	35	13.82	13.4	1.55

40	31.3	30.88	19.03	0.47		40	12.8	12.38	0.53
45	32.45	32.03	20.18			45	12.54	12.12	0.27
50	32.66	32.24	20.39	0.31		50	12.44	12.02	0.17
51	32.82	32.4	20.55	0.31		61	12.38	11.96	0.11
						70	12.36	11.94	0.09
						80	12.33	11.91	0.06
						90	12.31	11.89	0.04

Static Water Level (m bc):		12.32		Borehole ID:	KBH01	Aquifer Test 02			
Collar (m):		0.42		Date:	08/06/2017				
Drawdown						Recovery			
Time (min)	Water Level (mbc)	Water Level (mbgl)	Drawdown (m)	Yield (l/s)		Time (min)	Water Level (mbc)	Water Level (mbgl)	Recovery (m)
1	13.19	12.77	0.86			1	29.01	28.59	16.68
2	13.79	13.37	1.46	0.66		2	28.63	28.21	16.3
3	13.84	13.42	1.51	0.34		3	28.02	27.6	15.69
4	14	13.58	1.67			4	27.56	27.14	15.23
5	14.14	13.72	1.81			5	27.06	26.64	14.73
6	14.33	13.91	2	0.34		6	26.6	26.18	14.27
7	14.49	14.07	2.16			7	25.96	25.54	13.63
8	14.63	14.21	2.3			8	25.69	25.27	13.36
9	14.79	14.37	2.46			9	25.06	24.64	12.73
10	14.9	14.48	2.57			10	24.55	24.13	12.22
11	15.07	14.65	2.74			11	24.1	23.68	11.77
12	15.15	14.73	2.82	0.34		12	23.55	23.13	11.22
15	15.52	15.1	3.19	0.33		15	22.2	21.78	9.87
20	15.93	15.51	3.6	0.33		21	18.63	18.21	6.3
25	16.16	15.74	3.83						
30	16.34	15.92	4.01	0.33					

35	16.45	16.03	4.12						
40	16.46	16.04	4.13	0.32					
45	16.49	16.07	4.16	0.32					
50	16.99	16.57	4.66	0.32					
55	17.7	17.28	5.37	0.32					
60	18.34	17.92	6.01						
72	19.4	18.98	7.07	0.31					
80	19.96	19.54	7.63	0.32					
90	20.48	20.06	8.15						
100	21.32	20.9	8.99	0.32					
121	22.75	22.33	10.42	0.31					
150	24.03	23.61	11.7	0.31					
180	25.33	24.91	13						
210	26.1	25.68	13.77	0.31					
240	26.6	26.18	14.27	0.29					
249	29.68	29.26	17.35	0.54					

Palaeontological desktop study of an aquaponics farm project on the Farm Boschplaats 91 near Hammanskraal, Bojanala District, North West Province.

Report prepared by Paleo Field Services, PO Box 38806 Langenhovenpark 9330.

12 June 2017

Summary

The proposed new aquaponics facility is located on moderately fossiliferous Ecca sediments of the Hammanskraal Formation, that are capped by geologically recent and palaeontologically insignificant residual soil overburden. Considering the scale and overall impact of the development, it is extremely unlikely that any fossils will be found in within the proposed (± 0.5 ha) area. The proposed development may proceed as far as the palaeontological heritage is concerned and a phase 2 impact study is not necessary, provided that all excavation activities are restricted to within the boundaries of the development footprint. If, however, any fossils are discovered within fresh sedimentary bedrock during the construction phase of the development, a professional palaeontologist must be called in immediately to confirm and record the finds. In the meantime, ex situ remains must be wrapped in paper towels or heavy duty tin foil and stored in a safe place. The material should not be washed or cleaned in any way. In situ material must be kept in place and protected from further damage by covering it with light but rigid object like a box, bucket or metal sheet until further confirmation by the palaeontologist.

Introduction

The report is a preliminary assessment of potential palaeontological impact with regard to development of a new Tilapia aquaponics farm project to be constructed on a part of Portion 2 of the Farm Boschplaats 91 situated within the rural settlement of Bosplaas in the Moretele Local Municipality in the Bojanala Platinum District Municipality within the North West Province (1:50 000 scale topographic map 2528AC Shoshanguve, **Fig. 1**). It is found approximately 60km to the north of Pretoria and just to the north of the town Hammanskraal. The **study area measures approximately 1.5ha** in size and the **development will occupy**

approximately one third of the small holding situated approximately 2km to the west of the R101 tar road and the Apies River (**Fig. 2** & **3).**

Site centroid coordinates:

25°19'38.15"S 28°14'33.75"E

Methodology

The assessment was carried out in accordance with National Heritage Resources Act 25 of 1999 with the aim to assess the potential impact on palaeontological heritage resources that may result from the proposed development. The palaeontological significance of the affected areas were evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature.

Assumptions and Limitations

The assessment provided within this report is based upon a desktop study without the benefit of a site visit. As such, the presentation of geological units present within the study area is derived from 1:1 Ma and 1:250 000 geological maps that may vary in their accuracy. It is also assumed, for the sake of prudence, that fossil remains are always uniformly distributed in fossil-bearing rock units, although in reality their distribution may vary significantly.

Geology

The geology around Hammanskraal is represented by Permian Ecca Group sediments (Karoo Supergroup) to the north (Pe) and Proterozoic granites of the Lebowa Granite Suite to the south (Johnson *et al.* 2006) (**Fig. 4**). The Ecca Group equivalent in the Springbok Flats Basin is the Hammanskraal Formation, divided into an Upper Ecca Stage (UES) and Middle Ecca Stage (MES) (Visser & Van der Merwe 1959). The lower portion of the UES is comprised of grit, sandstone, sandy shale and carbonaceous shales which are possibly comparable to the Vryheid Formation of the Main Karoo Basin. The MES grades into the upper portion of this formation and is comprised of grey sandy shale, shaley sandstone with cross-bedding and minor layers of white sandstone and poorly bedded grey shale. This sequence can possibly be correlated to the Volkrust Formation of the Main Karoo Basin. A coal zone, consisting of interbedded black shale and coal occurs in local basins at the top of the formation.

Palaeontology

Surface exposures are poor, but Glossopterid flora has been recorded within the Hammanskraal Formation especially in the coal zone at top of the succession, and mostly from borehole cores. Coal deposit outcrop is generally very poor (Johnson et al. 2006) and there are no outcrops in the vicinity of the town of Hammanskraal. Ancient human skeletal and associated Florisian faunal remains discovered at Tuinplaats (Springbok Flats) have been discovered in geologically recent calcareous soils (Quaternary overburden) at a depth of ± 1.0 m (Pike *et al.* 2004). There is currently no record of Quaternary fossil sites within the immediate vicinity of the study area.

Impact Statement and Recommendation

The desktop investigation indicate that the proposed development footprint is located on potentially fossiliferous Ecca sediments of the Hammanskraal Formation that are capped by geologically recent and palaeontologically insignificant residual soil overburden (**Fig. 5**). Considering the scale of the development, it is extremely unlikely that any fossils will be found in within the proposed (± 0.5 ha) area. As far as the palaeontological heritage is concerned, the proposed development may proceed. A phase 2 impact study is not necessary, provided that all excavation activities are restricted to within the boundaries of the development footprint.

If, however, any fossils are discovered within fresh sedimentary bedrock during the construction phase of the development, a professional palaeontologist must be called in immediately to confirm and record the finds. In the meantime, ex situ remains must be wrapped in paper towels or heavy duty tin foil and stored in a safe place. The material should not be washed or cleaned in any way. In situ material must be kept in place and protected from further damage by covering it with light but rigid object like a box, bucket or metal sheet until further confirmation by the palaeontologist.

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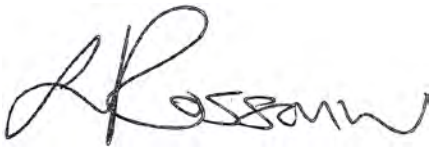
Visser, H. N., and Van Der Merwe, S. W., (1959), The Northeastern SBF Coal Field: Records of bore-holes 1 to 27 drilled for the Department of Mines. *Geological Survey, Bulletin* 31, pp 1-97.

DECLARATION OF INDEPENDENCE

I, Lloyd Rossouw, declare that I act as an independent specialist consultant. I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work as stipulated in the terms of reference. I have no interest in secondary or downstream developments as a result of the authorization of this project and have no conflicting interests in the undertaking of the activity.



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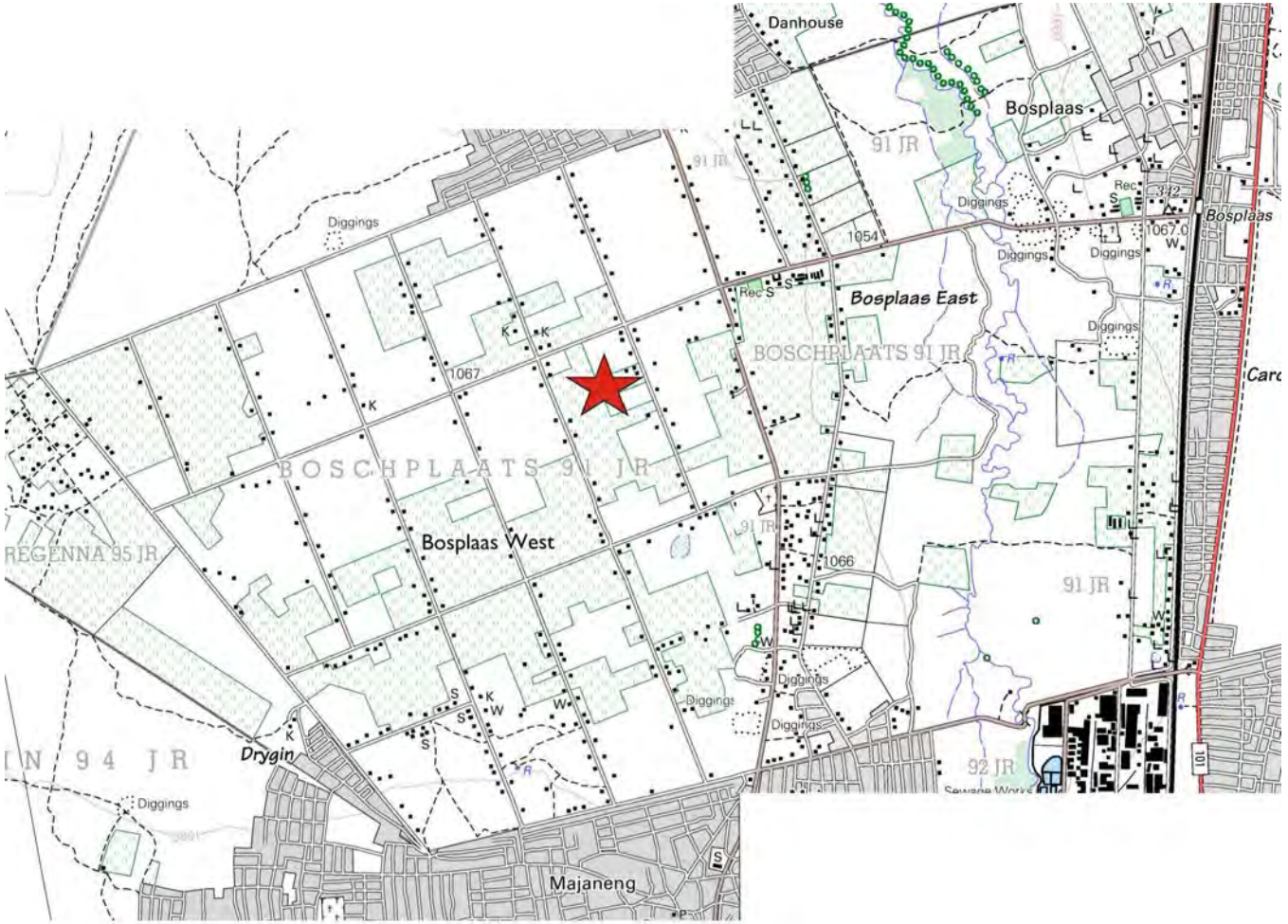

Figure 1. Map of the study area (portion of 1:50 000 scale topographic 2528AC Shoshanguve).

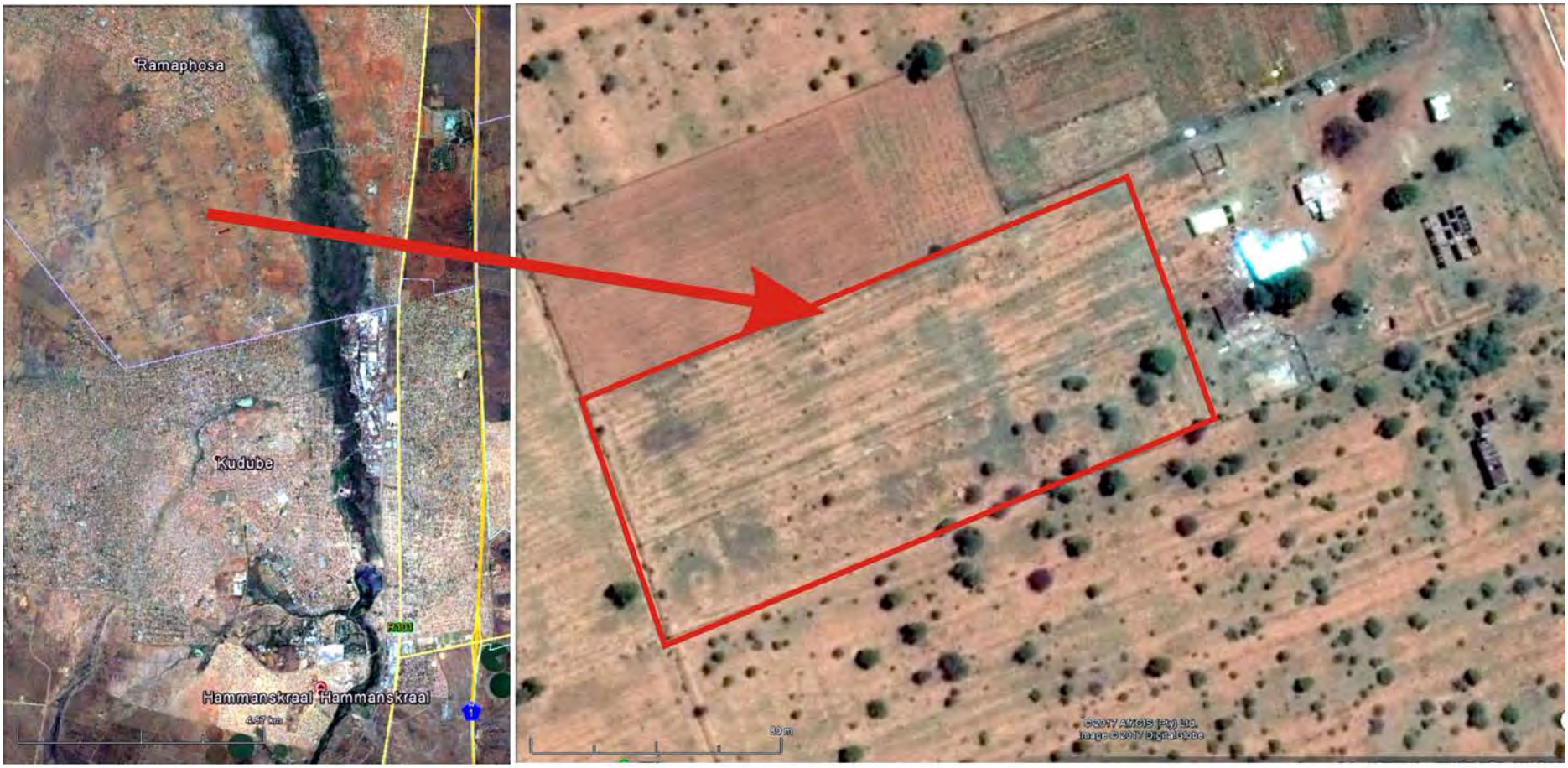

Figure 2. Aerial view of the study area.

Figure 3. General view of the site, looking east (top) and west (below).

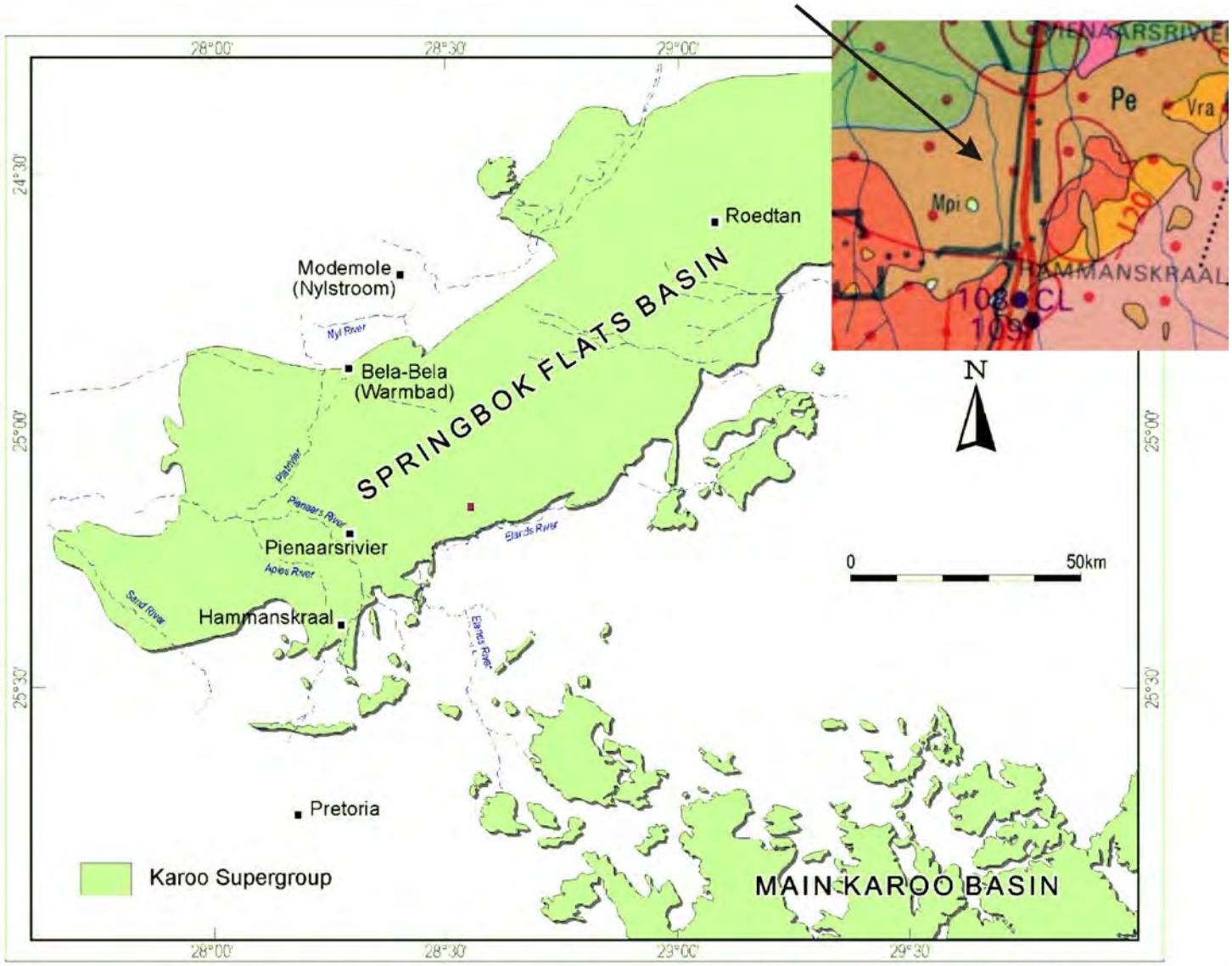

Figure 4. Distribution of the Ecca Group in the Springbok Flats Basin and northern part of the Main Karoo Basin (Nel 2012). Geological map of the Hammanskraal area (insert; 1: 1 000 000 scale geological map of RSA, 1997).

Figure 5. Well-developed residual soil overburden exposed immediately to the north of the study area.

HERITAGE IMPACT ASSESSMENT

(REQUIRED UNDER SECTION 38(8) OF THE NHRA (No. 25 OF 1999)

FOR THE PROPOSED BLUE-GREEN AQUACULTURE PTY LTD FARMING DEVELOPMENT, NORTH WEST PROVINCE

Type of development:

Aquaculture production facility

Client:

CSIR

Client info:

Karabo Mashabela

E – mail: KMashabela1@csir.co.za

Developer: Pule Hlahane

HCAC - Heritage Consultants
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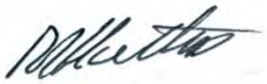
E-Mail: jaco.heritage@gmail.com

Report Author:
Mr. J. van der Walt

Project Reference:
HCAC Project number 2170602
Report date:
June 2017

APPROVAL PAGE

Project Name	**Blue-Green Aquaculture**
Report Title	Heritage Impact Assessment Blue-Green Aquaculture
Authority Reference Number	TBC
Report Status	Final Report
Applicant Name	Mr Pule Hlahane South African Farmers Association

	Name	**Signature**	**Qualifications and Certifications**	**Date**
Document Compilation	Jaco van der Walt		MA Archaeology ASAPA #159	June 2017
	Marko Hutten		BA Hons Archaeology	June 2017

DOCUMENT PROGRESS

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Amendments on Document

Date	Report Reference Number	Description of Amendment

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The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and HCAC reserves the right to modify aspects of the report including the recommendations if and when new information becomes available from ongoing research or further work in this field, or pertaining to this investigation.

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REPORT OUTLINE

Appendix 6 of the GNR 326 EIA Regulations published on 7 April 2017 provides the requirements for specialist reports undertaken as part of the environmental authorisation process. In line with this, Table 1 provides an overview of Appendix 6 together with information on how these requirements have been met.

Table 1. Specialist Report Requirements.

Requirement from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of - (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Section a Section 12
(b) Declaration that the specialist is independent in a form as may be specified by the competent authority	*Declaration of Independence*
(c) Indication of the scope of, and the purpose for which, the report was prepared	Section 1
(cA)an indication of the quality and age of base data used for the specialist report	Section 3.4 and 7.1.
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	9
(d) Duration, Date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3.4
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 8 and 9
(g) Identification of any areas to be avoided, including buffers	Section 9
(h) Map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 8
(I) Description of any assumptions made and any uncertainties or gaps in knowledge	Section 3.7
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity **including identified alternatives on the environment** or activities;	Section 9
(k) Mitigation measures for inclusion in the EMPr	Section 9 and 10
(I) Conditions for inclusion in the environmental authorisation	Section 9 and 10
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 9 and 10
(n) Reasoned opinion - (i) as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 10.2
(o) Description of any consultation process that was undertaken during the course of preparing the specialist report	Section 6
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Refer to BA report
(q) Any other information requested by the competent authority	Section 10

Executive Summary

An application for an Environmental Authorisation (EA) will be made by the Council for Scientific & Industrial Research (CSIR) on behalf of Mr Pule Hlahane, (Project Applicant) to the North West Department of Rural Environment and Agricultural Development (READ for the proposed Mozambican Tilapia Aquaculture project extending an area of approximately two hectares on Plot 413 Bosplaas West' north of Hammanskraal, in the Moretele Municipality in the Bojanala District North West Province.

HCAC was appointed to conduct a Heritage Impact Assessment of the proposed project to determine the presence of cultural heritage sites and the impact of the proposed development on these non-renewable resources. The study area was assessed both on desktop level and by a field survey. The field survey was conducted as a non-intrusive pedestrian survey to cover the extent of the development footprint.

No archaeological sites or material was recorded during the survey and an independent paleontological desktop study (Rossouw 2017) found that the study area is located on moderately fossiliferous Ecca sediments of the Hammanskraal Formation, that are capped by geologically recent and palaeontologically insignificant residual soil overburden. Therefore no further mitigation prior to construction is recommended in terms of Section 35 for the proposed development to proceed. In terms of the built environment of the area (Section 34), no standing structures older than 60 years occur within the study area. In terms of Section 36 of the Act no burial sites were recorded. If any graves are located in future they should ideally be preserved *in-situ* or alternatively relocated according to existing legislation. No public monuments are located within or close to the study area. During the public participation process conducted for the project no heritage concerns were raised.

Due to the lack of significant heritage resources in the study area the impact of the proposed project on heritage resources is considered low and it is recommended that the proposed project can commence on the condition that the following recommendations are implemented as part of the EMPr and based on approval from SAHRA:

- Implementation of a chance find procedure.

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Declaration of Independence

Specialist Name	Jaco van der Walt
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2014 Environmental Impact Assessment (EIA) Regulations, that I: • I act as the independent specialist in this application; • I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant; • I declare that there are no circumstances that may compromise my objectivity in performing such work; • I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity; • I will comply with the Act, Regulations and all other applicable legislation; • I have no, and will not engage in, conflicting interests in the undertaking of the activity; • I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; • All the particulars furnished by me in this form are true and correct; and • I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.
Signature	
Date	12/06/2017

a) Expertise of the specialist

Jaco van der Walt has been practising as a CRM archaeologist for 15 years. He obtained an MA degree in Archaeology from the University of the Witwatersrand focussing on the Iron Age in 2012 and is a PhD candidate at the University of Johannesburg focussing on Stone Age Archaeology with specific interest in the Middle Stone Age (MSA) and Later Stone Age (LSA). Jaco is an accredited member of ASAPA (#159) and have conducted more than 500 impact assessments in Limpopo, Mpumalanga, North West, Free State, Gauteng, KZN as well as he Northern and Eastern Cape Provinces in South Africa.

Jaco has worked on various international projects in Zimbabwe, Botswana, Mozambique, Lesotho, DRC Zambia and Tanzania. Through this he has a sound understanding of the IFC Performance Standard requirements, with specific reference to Performance Standard 8 – Cultural Heritage.

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ABBREVIATIONS

AIA: Archaeological Impact Assessment
ASAPA: Association of South African Professional Archaeologists
BGG Burial Ground and Graves
BIA: Basic Impact Assessment
CFPs: Chance Find Procedures
CMP: Conservation Management Plan
CRR: Comments and Response Report
CRM: Cultural Resource Management
DEA: Department of Environmental Affairs
EA: Environmental Authorisation
EAP: Environmental Assessment Practitioner
ECO: Environmental Control Officer
EIA: Environmental Impact Assessment*
EIA: Early Iron Age*
EIA Practitioner: Environmental Impact Assessment Practitioner
EMP: Environmental Management Programme
ESA: Early Stone Age
ESIA: Environmental and Social Impact Assessment
GIS Geographical Information System
GPS: Global Positioning System
GRP Grave Relocation Plan
HIA: Heritage Impact Assessment
LIA: Late Iron Age
LSA: Late Stone Age
MEC: Member of the Executive Council
MIA: Middle Iron Age
MPRDA: Mineral and Petroleum Resources Development Act
MSA: Middle Stone Age
NEMA National Environmental Management Act, 1998 (Act No. 107 of 1998)
NHRA National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NID Notification of Intent to Develop
NoK Next-of-Kin
PRHA: Provincial Heritage Resource Agency
SADC: Southern African Development Community
SAHRA: South African Heritage Resources Agency

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations and must be read and interpreted in the context it is used.*

GLOSSARY

Archaeological site (remains of human activity over 100 years old)
Early Stone Age (~ 2.6 million to 250 000 years ago)
Middle Stone Age (~ 250 000 to 40-25 000 years ago)
Later Stone Age (~ 40-25 000, to recently, 100 years ago)
The Iron Age (~ AD 400 to 1840)
Historic (~ AD 1840 to 1950)
Historic building (over 60 years old)

1 Introduction and Terms of Reference:

Heritage Contracts and Archaeological Consulting CC (**HCAC)** has been contracted by the CSIR to conduct a heritage impact assessment of the proposed infrastructure for a Mozambican Tilapia Aquaculture project on Plot 413 in Bosplaas West, North West Province. The report forms part of the Basic Assessment Report (BAR) and Environmental Management Programme Report (EMPR) for the aquaculture production facility.

The aim of the study is to survey the proposed development footprint to identify cultural heritage sites, document, and assess their importance within local, provincial and national context. It serves to assess the impact of the proposed project on non-renewable heritage resources, and to submit appropriate recommendations with regard to the responsible cultural resources management measures that might be required to assist the developer in managing the discovered heritage resources in a responsible manner. It is also conducted to protect, preserve, and develop such resources within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999). The report outlines the approach and methodology utilized before and during the survey, which includes: Phase 1, review of relevant literature; Phase 2, the physical surveying of the area on foot and by vehicle; Phase 3, reporting the outcome of the study.

During the survey, no heritage sites were identified. General site conditions and features on sites were recorded by means of photographs, GPS locations, and site descriptions. Possible impacts were identified and mitigation measures are proposed in the following report. SAHRA as a commenting authority under section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) require all environmental documents, complied in support of an Environmental Authorisation application as defined by NEMA EIA Regs section 40 (1) and (2), to be submitted to SAHRA. As such the Basic Assessment report and its appendices must be submitted to the case as well as the EMPr, once it's completed by the Environmental Assessment Practitioner (EAP).

1.1 Terms of Reference

Field study

Conduct a field study to: (a) locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest; b) record GPS points of sites/areas identified as significant areas; c) determine the levels of significance of the various types of heritage resources affected by the proposed development.

Reporting

Report on the identification of anticipated and cumulative impacts the operational units of the proposed project activity may have on the identified heritage resources for all 3 phases of the project; i.e., construction, operation and decommissioning phases. Consider alternatives, should any significant sites be impacted adversely by the proposed project. Ensure that all studies and results comply with the relevant legislation, SAHRA minimum standards and the code of ethics and guidelines of ASAPA.

To assist the developer in managing the discovered heritage resources in a responsible manner, and to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999).

Table 2: Project Description

Size of farm and portions	Approximately two hectares on Plot 413 Bosplaas West' north of Hammanskraal (Figure 1 -3)
Magisterial District	Moretele Municipality in the Bojanala District North West Province.
1: 50 000 map sheet number	2528AC
Central co-ordinate of the development	25° 19' 38.8015" S 28° 14' 33.6515" E

Table 3: Infrastructure and project activities

Type of development	Aquaculture production facility
Project size	2 ha
Project Components	The size of each 20 deep water culture tanks is (7.5m x 30m) and Green house (15m x 30m) with the capacity to breed 200 tons pa Mozambique tilapia (*Oreochromis mossambicus*).

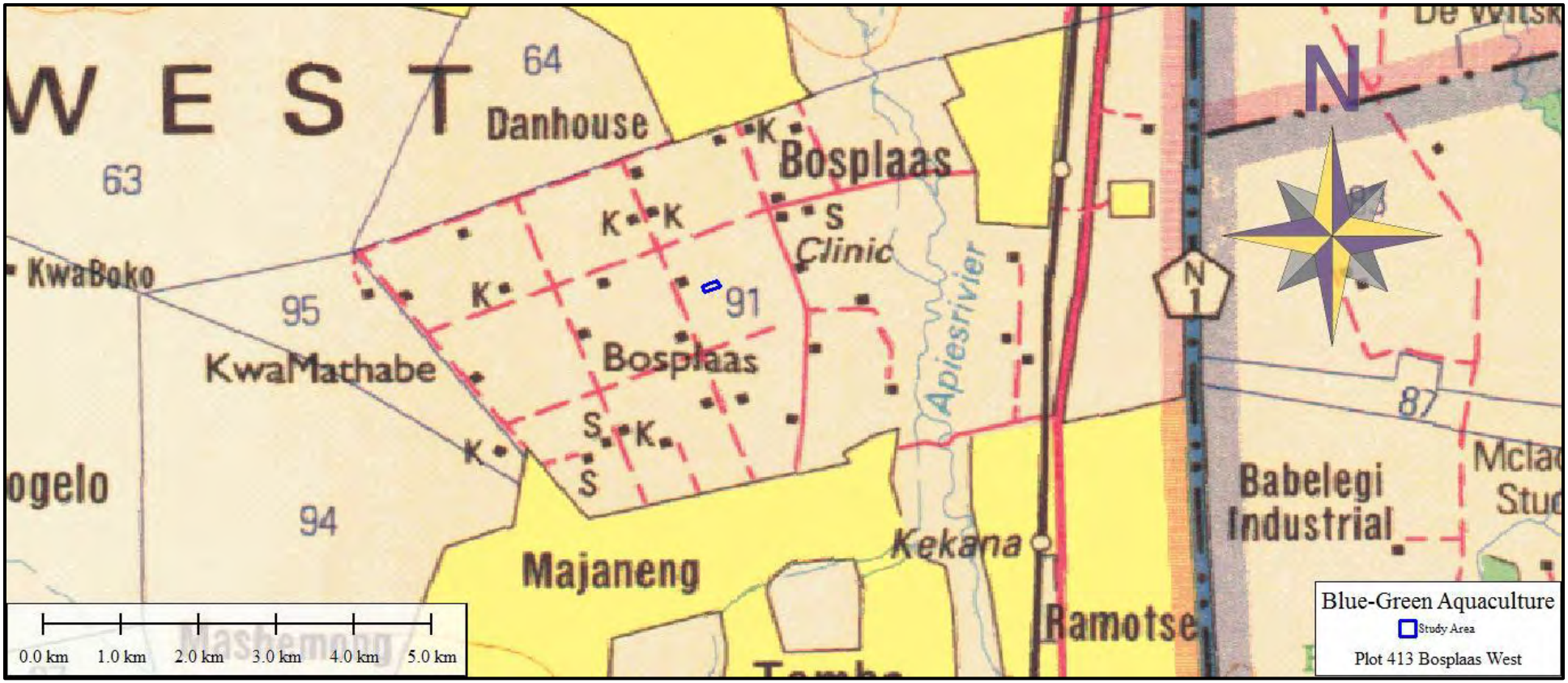

Figure 1. Provincial locality map (1: 250 000 topographical map)

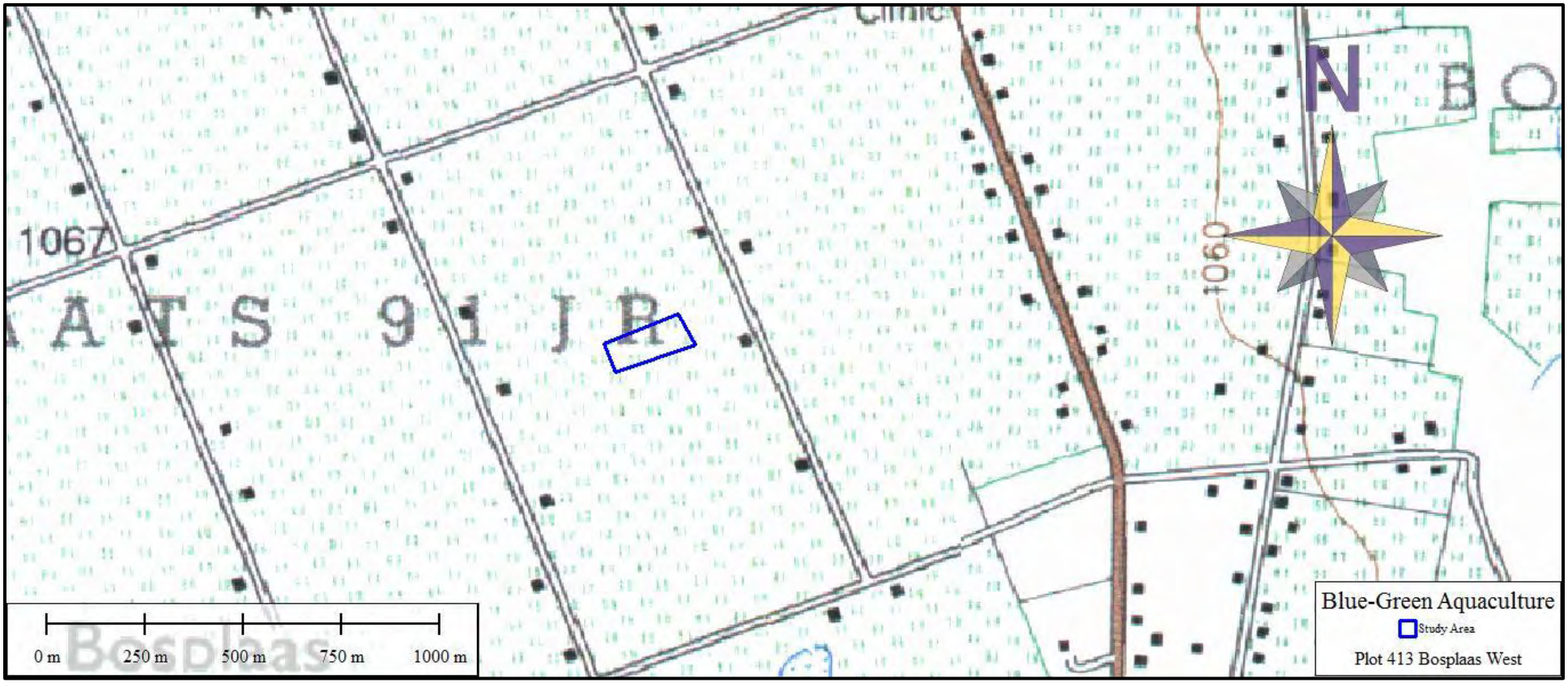

Figure 2: Regional locality map (1:50 000 topographical map).

Figure 3. Satellite image indicating the study area in blue (Google Earth 2016).

2 Legislative Requirements

The HIA, as a specialist sub-section of the EIA, is required under the following legislation:

- National Heritage Resources Act (NHRA), Act No. 25 of 1999)
- National Environmental Management Act (NEMA), Act No. 107 of 1998 - Section 23(2)(b)
- Mineral and Petroleum Resources Development Act (MPRDA), Act No. 28 of 2002 - Section 39(3)(b)(iii)

A Phase 1 HIA is a pre-requisite for development in South Africa as prescribed by SAHRA and stipulated by legislation. The overall purpose of heritage specialist input is to:

- Identify any heritage resources, which may be affected;
- Assess the nature and degree of significance of such resources;
- Establish heritage informants/constraints to guide the development process through establishing thresholds of impact significance;
- Assess the negative and positive impact of the development on these resources; and
- Make recommendations for the appropriate heritage management of these impacts.

The HIA should be submitted, as part of the impact assessment report or EMPr, to the PHRA if established in the province or to SAHRA. SAHRA will ultimately be responsible for the professional evaluation of Phase 1 AIA reports upon which review comments will be issued. 'Best practice' requires Phase 1 AIA reports and additional development information, as per the impact assessment report and/or EMPr, to be submitted in duplicate to SAHRA after completion of the study. SAHRA accepts Phase 1 AIA reports authored by professional archaeologists, accredited with ASAPA or with a proven ability to do archaeological work.

Minimum accreditation requirements include an Honours degree in archaeology or related discipline and 3 years post-university CRM experience (field supervisor level). Minimum standards for reports, site documentation and descriptions are set by ASAPA in collaboration with SAHRA. ASAPA is based in South Africa, representing professional archaeology in the SADC region. ASAPA is primarily involved in the overseeing of ethical practice and standards regarding the archaeological profession. Membership is based on proposal and secondment by other professional members.

Phase 1 AIA's are primarily concerned with the location and identification of heritage sites situated within a proposed development area. Identified sites should be assessed according to their significance. Relevant conservation or Phase 2 mitigation recommendations should be made. Recommendations are subject to evaluation by SAHRA.

Conservation or Phase 2 mitigation recommendations, as approved by SAHRA, are to be used as guidelines in the developer's decision making process.

Phase 2 archaeological projects are primarily based on salvage/mitigation excavations preceding development destruction or impact on a site. Phase 2 excavations can only be conducted with a permit, issued by SAHRA to the appointed archaeologist. Permit conditions are prescribed by SAHRA and includes (as minimum requirements) reporting back strategies to SAHRA and deposition of excavated material at an accredited repository.

In the event of a site conservation option being preferred by the developer, a site management plan, prepared by a professional archaeologist and approved by SAHRA, will suffice as minimum requirement.

After mitigation of a site, a destruction permit must be applied for with SAHRA by the applicant before development may proceed.

Human remains older than 60 years are protected by the National Heritage Resources Act, with reference to Section 36. Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act), as well as the Human Tissues Act (Act 65 of 1983), and are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36[5]) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in this age category, located inside a formal cemetery administrated by a local authority, require the same authorisation as set out for graves younger than 60 years, in addition to SAHRA authorisation. If the grave is not situated inside a formal cemetery, but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws, set by the cemetery authority, must be adhered to.

Human remains that are less than 60 years old are protected under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance No. 7 of 1925), as well as the Human Tissues Act (Act 65 of 1983), and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning; or in some cases, the MEC for Housing and Welfare. Authorisation for exhumation and reinternment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. To handle and transport human remains, the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

3 METHODOLOGY

3.1 Literature Review

A brief survey of available literature was conducted to extract data and information on the area in question to provide general heritage context into which the development would be set. This literature search included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS).

3.2 Genealogical Society and Google Earth Monuments

Google Earth and 1:50 000 maps of the area were utilised to identify possible places where sites of heritage significance might be located; these locations were marked and visited during the field work phase. The database of the Genealogical Society was consulted to collect data on any known graves in the area.

3.3 Public Consultation and Stakeholder Engagement:

Stakeholder engagement is a key component of any BAR process, it involves stakeholders interested in, or affected by the proposed development. Stakeholders are provided with an opportunity to raise issues of concern (for the purposes of this report only heritage related issues will be included). The aim of the public consultation process was to capture and address any issues raised by community members and other stakeholders during key stakeholder and public meetings. The process involved:

- Placement of advertisements (20 June 2017) and site notices (15 May 2017)
- Stakeholder notification (through the dissemination of information and meeting invitations);
- Stakeholder meetings undertaken with I&APs;
- Authority Consultation
- The compilation of a Basic Assessment Report (BAR).

3.4 Site Investigation

Conduct a field study to: a) systematically survey the proposed project area to locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest; b) record GPS points of sites/areas identified as significant areas; c) determine the levels of significance of the various types of heritage resources recorded in the project area.

Table 4: Site Investigation Details

	Site Investigation
Date	6 June 2017
Season	Winter –vegetation in the study area is low with good archaeological visibility. The impact area was sufficiently covered (Figure 4) to adequately record the presence of heritage resources.

Figure 4: Track logs of the survey in black.

3.5 Site Significance and Field Rating

Section 3 of the NHRA distinguishes nine criteria for places and objects to qualify as 'part of the national estate' if they have cultural significance or other special value. These criteria are:

- Its importance in/to the community, or pattern of South Africa's history;
- Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa;
- Sites of significance relating to the history of slavery in South Africa.

The presence and distribution of heritage resources define a 'heritage landscape'. In this landscape, every site is relevant. In addition, because heritage resources are non-renewable, heritage surveys need to investigate an entire project area, or a representative sample, depending on the nature of the project. In the case of the proposed project the local extent of its impact necessitates a representative sample and only the footprint of the areas demarcated for development were surveyed. In all initial investigations, however, the specialists are responsible only for the identification of resources visible on the surface. This section describes the evaluation criteria used for determining the significance of archaeological and heritage sites. The following criteria were used to establish site significance with cognisance of Section 3 of the NHRA:

- The unique nature of a site;
- The integrity of the archaeological/cultural heritage deposits;
- The wider historic, archaeological and geographic context of the site;
- The location of the site in relation to other similar sites or features;
- The depth of the archaeological deposit (when it can be determined/is known);
- The preservation condition of the sites; and
- Potential to answer present research questions.

In addition to this criteria field ratings prescribed by SAHRA (2006), and acknowledged by ASAPA for the SADC region, were used for the purpose of this report. The recommendations for each site should be read in conjunction with section 10 of this report.

FIELD RATING	*GRADE*	*SIGNIFICANCE*	*RECOMMENDED MITIGATION*
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP.A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

3.6 Impact Assessment Methodology

The criteria below are used to establish the impact rating on sites:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0-1 years), assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years), assigned a score of 2;
  - medium-term (5-15 years), assigned a score of 3;
  - long term (> 15 years), assigned a score of 4; or
  - permanent, assigned a score of 5;
  - The **magnitude**, quantified on a scale from 0-10 where; 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
  - The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5 where; 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
  - The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
  - the **status**, which will be described as either positive, negative or neutral.
  - the degree to which the impact can be reversed.
  - the degree to which the impact may cause irreplaceable loss of resources.
  - the *degree* to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e., where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e., where the impact must have an influence on the decision process to develop in the area).

3.7 Limitations and Constraints of the study

The authors acknowledge that the brief literature review is not exhaustive on the literature of the area. Due to the subsurface nature of archaeological artefacts, the possibility exists that some features or artefacts may not have been discovered/recorded during the survey and the possible occurrence of unmarked graves and other cultural material cannot be excluded. Similarly, the depth of the deposit of heritage sites cannot be accurately determined due its subsurface nature. This report only deals with the footprint area of the proposed development and consisted of non-intrusive surface surveys. This study did not assess the impact on medicinal plants and intangible heritage as it is assumed that these components would have been highlighted through the public consultation process if relevant. It is possible that new information could come to light in future, which might change the results of this Impact Assessment.

4 Description of Socio Economic Environmental

The 2012 Integrated Development Plan highlighted the following Socio-Economic information in the Bojanala District Municipality, the population of the Bojanala Platinum District is estimated to be 1 323 921. This is approximately 38 % of the total population of the North-West Province. The majority of the area can be classified as rural with very low densities that makes the provision of basic services very difficult and expensive. The area has an unemployment rate of 14.6%.

5 Description of the Physical Environment:

The study area measures approximately 1.5ha in size and the development will occupy approximately one third of the small holding it will be situated on. The small holding forms part of the rural settlement of Bosplaas and is situated approximately 2km to the west of the R101 tar road and the Apies River.

The small holding is fenced off and the study area is situated within the south-western parts of the property. This part of the property was previously ploughed and planted and is damaged and disturbed to a large extent. Disused irrigation pipes and other irrigation equipment are still scattered across these old fields. It is also covered with grass and other pioneer vegetation, but for the rest it is clear of large trees and dense bush. A ploughed and planted field is situated next to and on the northern and north-eastern side of the proposed development area. It is also bordered to the south and west by small holdings with similar use and occupation. The vegetation and landscape is described by Mucina and Rutherford (*The Vegetation of South Africa, Lesotho and Swaziland*, South African National Biodiversity Institute, Kirstenbosch, August 2006) as Springbokvlakte Thornveld.

Figure 5. General site conditions – agricultural activities to the north.

Figure 6. Remains of previous agricultural activities.

Figure 7. General site conditions – southern fence

Figure 8. General site conditions – view from the west

6 Results of Public Consultation and Stakeholder Engagement:

Adjacent landowners and the public at large were informed of the proposed activity as part of the BA process. Site notices and advertisements notifying interested and affected parties were placed at strategic points and in local newspapers as part of the process.

7 Literature / Background Study:

7.1 Literature Review

The following CRM reports were conducted in the greater area and were consulted for this report:

Author	Year	Project	Findings
Kusel, U.	2013	Cultural Heritage Resources Impact Assessment For The Construction Of A Proposed Pedestrian Pathway And Cycle Path At Hammanskraal Gauteng Province	No heritage sites were identified.
Beater, J.	2015	R101 To Moretele Local Municipality South Bulk Water Supply System	Graves
Van Schalkwyk, J.	2015	Basic Cultural Heritage Assessment for The Construction of A Number Of Proposed New Electricity Substations And Distribution Power Lines In The Moretele Local Municipality, North West Province	Graves.

7.1.1 Genealogical Society and Google Earth Monuments

No known grave sites are indicated close to the study area.

7.2 General History of the area

7.2.1 Archaeology of the area

7.2.1.1 The Stone Age

South Africa has a long and complex Stone Age sequence of more than 2 million years. The broad sequence includes the Later Stone Age, the Middle Stone Age and the Earlier Stone Age. Each of these phases contain sub-phases or industrial complexes, and within these we can expect regional variation regarding characteristics and time ranges. The three main phases can be divided as follows;

∗ Later Stone Age; associated with Khoi and San societies and their immediate predecessors. Recently to ~30 thousand years ago

∗ Middle Stone Age; associated with Homo sapiens and archaic modern humans. 30-300 thousand years ago.

∗ Earlier Stone Age; associated with early Homo groups such as Homo habilis and Homo erectus. 400 000-> 2 million years ago.

Stone Age sites are usually associated with stone artefacts found scattered on the surface or as part of deposits in caves and rock shelters. No previously recorded Stone Age sites are on record for the study area. No significant Stone Age sites are expected for the study area. The nearest heritage site is Tswaing Meteorite Crater to the west of Hammanskraal. The salt lake in the crater has been visited by Middle and Stone Age people.

7.2.1.2 The Iron Age

The Iron Age as a whole represents the spread of Bantu speaking people and includes both the pre-Historic and Historic periods. It can be divided into three distinct periods:

- The Early Iron Age: Most of the first millennium AD.
- The Middle Iron Age: 10th to 13th centuries AD
- The Late Iron Age: 14th century to colonial period.

The Iron Age is characterised by the ability of these early people to manipulate and work Iron ore into implements that assisted them in creating a favourable environment to make a better living.

There is also an early Tswana stonewalled site near the rim of the Tswaing crater. Salt was collected over hundreds of years in the Crater Lake by filtering, boiling and evaporating lake water during AD 1200 – 1830.. The largest concentration of Iron Age sites occurs just north of Pretoria on the Swartkoppies granite hills. Thousands of Late Iron Age Tswana sites are found all along this mountain range (Mason 1962)

These settlements are complex in that aggregated settlements are common, the outer wall sometimes includes scallops to mark back courtyards, there are more small stock kraals, and straight walls separate households in the residential zone. These sites dates to the 18th and 19th centuries and was built by people in the Fokeng cluster. In this area, the Klipriviersberg walling would have ended at about AD 1823, when Mzilikazi entered the area (Rasmussen 1978). This settlement type may have lasted longer in other areas because of the positive interaction between Fokeng and Mzilikazi.

7.3 Historical Information

J. S. Bergh's historical atlas of the four northern provinces of South Africa is a very useful source for the writing of local and regional histories. Interestingly, it seems that the study area is located in the vicinity of an Early Stone Age Terrain, known as the Wonderboompoort. (Bergh 1999: 4) This area was also important to Iron Age communities, the study area was located within an area where many Late Iron Age terrains were found (Bergh 1999: 7)

The Difaqane (Sotho), or Mfekane ("the crushing" in Nguni) was a time of bloody upheavals in Natal and on the Highveld, which occurred around the early 1820's until the late 1830's. (Bergh 1999: 109-115) It came about in response to heightened competition for land and trade, and caused population groups like gun-carrying Griquas and Shaka's Zulus to attack other tribes. (Bergh 1999: 14; 116-119) At the beginning of the nineteenth century, the predominant black tribe in the area north of Pretoria was the Manala-Ndebele. The Kgatla were also present to the north of where Pretoria is located today. It seems that, in 1832, Shaka's Zulu tribe passed by the south of Pretoria from the southeast in a westerly direction. This was in order to attack Mzilikazi's Ndebele. This group also went on raids in various other areas in order to expand their area of influence. (Bergh 1999: 11)

During the time of the Difaqane, a northwards migration of white settlers from the Cape was also taking place. Some travellers, missionaries and adventurers had gone on expeditions to the northern areas in South Africa, some already as early as the 1720's. The Scottish travellers Robert Scoon and William McLuckie passed through, or close by the area where the study area was located in 1829. In the same year, Robert Moffat and James Archbell also travelled through this area. (Bergh 1999: 12) In the mid 1830's, several travellers made their way from the Pretoria area into the inland. These included the travellers Robert Scoon, Dr. Andrew Smith and Captain William Cornwallis Harris. (Bergh 1999: 13)

It was however only by the late 1820's that a mass-movement of Dutch speaking people in the Cape Colony started advancing into the northern areas. This was due to feelings of mounting dissatisfaction caused by economical and other circumstances in the Cape. This movement later became known as the Great Trek. This migration resulted in a massive increase in the extent of that proportion of modern South Africa dominated by people of European descent. (Ross 2002: 39)

Pretoria was founded in 1855 and became the capital of South Africa, then known as the Zuid-Afrikaanse Republiek (ZAR), in 1860. By 1900, Pretoria was a thriving Transvaal town, with shaded streets, well-kept gardens and a lively economy. In mid-1899, the Pretoria district had a white population of 21 000 men and 19 000 women, while the black, coloured and Indian population totalled 38 618. (Theron 1984: 1-3)

Between 1939 and 1940, farm boundaries were drawn up in an area that includes the present-day Pretoria. (Bergh 1999: 15)

7.3.1 Anglo-Boer War

The Anglo-Boer War was the greatest conflict that had taken place in South Africa up to date, and also affected the Pretoria district. The white concentration camp located closest to this farm, was situated a small distance to the northeast of Pretoria. Another white and a black concentration camp are located to the southwest of Pretoria, in the Irene area. One battle took place at Silkaatsnek, to the northwest of Pretoria, some distance from the farm. Here, General De la Rey's Boer troops defeated the British army on 11 July 1900. (Bergh 1999: 54, 250) The Boer side however generally lost ground against the British as the war continued, and in June 1900 the Boer military leaders decided that Pretoria would have to be surrendered to the British forces. This decision was inevitable if the war was to be continued. The town was very susceptible to a siege, and its defence would have gravely endangered the lives of its inhabitants. More importantly, the defence of the town would involve such a great number of Boers that the capture of these men would have surely meant the end of the war. Pretoria was therefore occupied by British forces on Tuesday 5 June 1900. (Theron 1984: 273-279)

7.3.2 Cultural Landscape

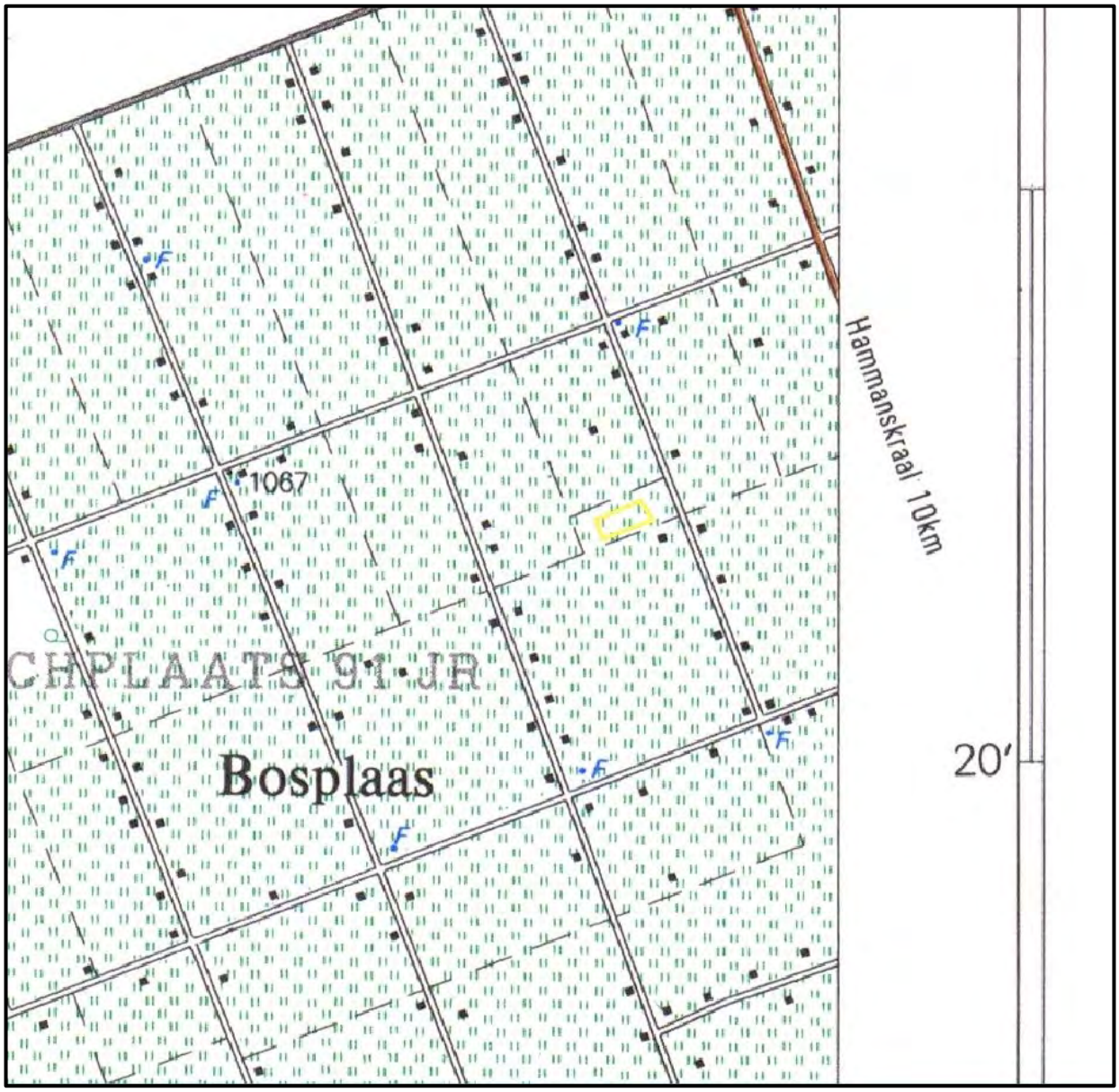

Figure 9. 1984 Topographical map of the site under investigation. The approximate study area is indicated with a yellow border. The site was located on the farm Boschplaats 91 JR and the property was used as cultivated lands. A building is visible just to the south of the site. (Topographical Map 1984)

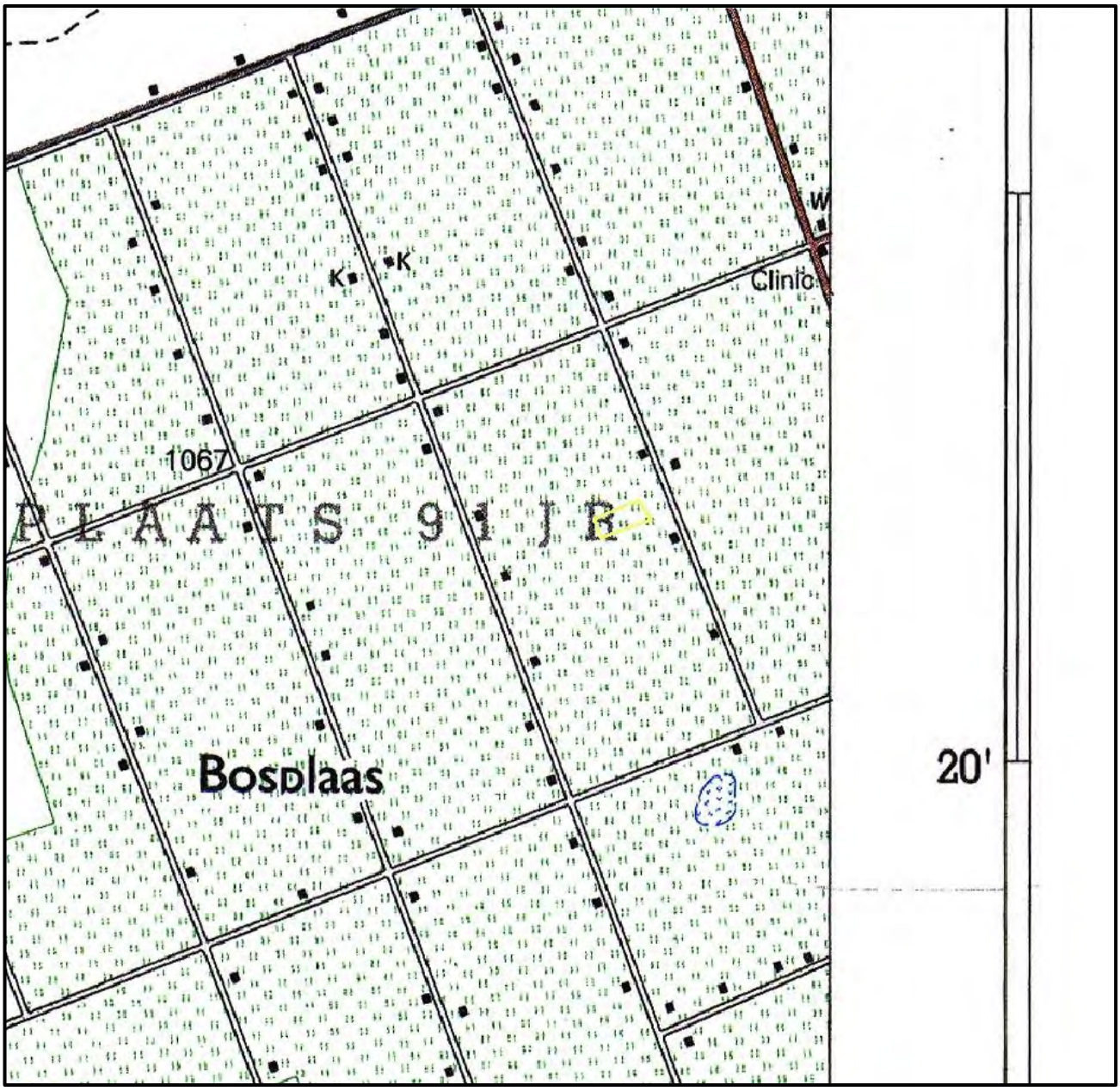

Figure 10. 1995 Topographical map of the site under investigation. The approximate study area is indicated with a yellow border. The property was still used as cultivated lands. (Topographical Map 1995)

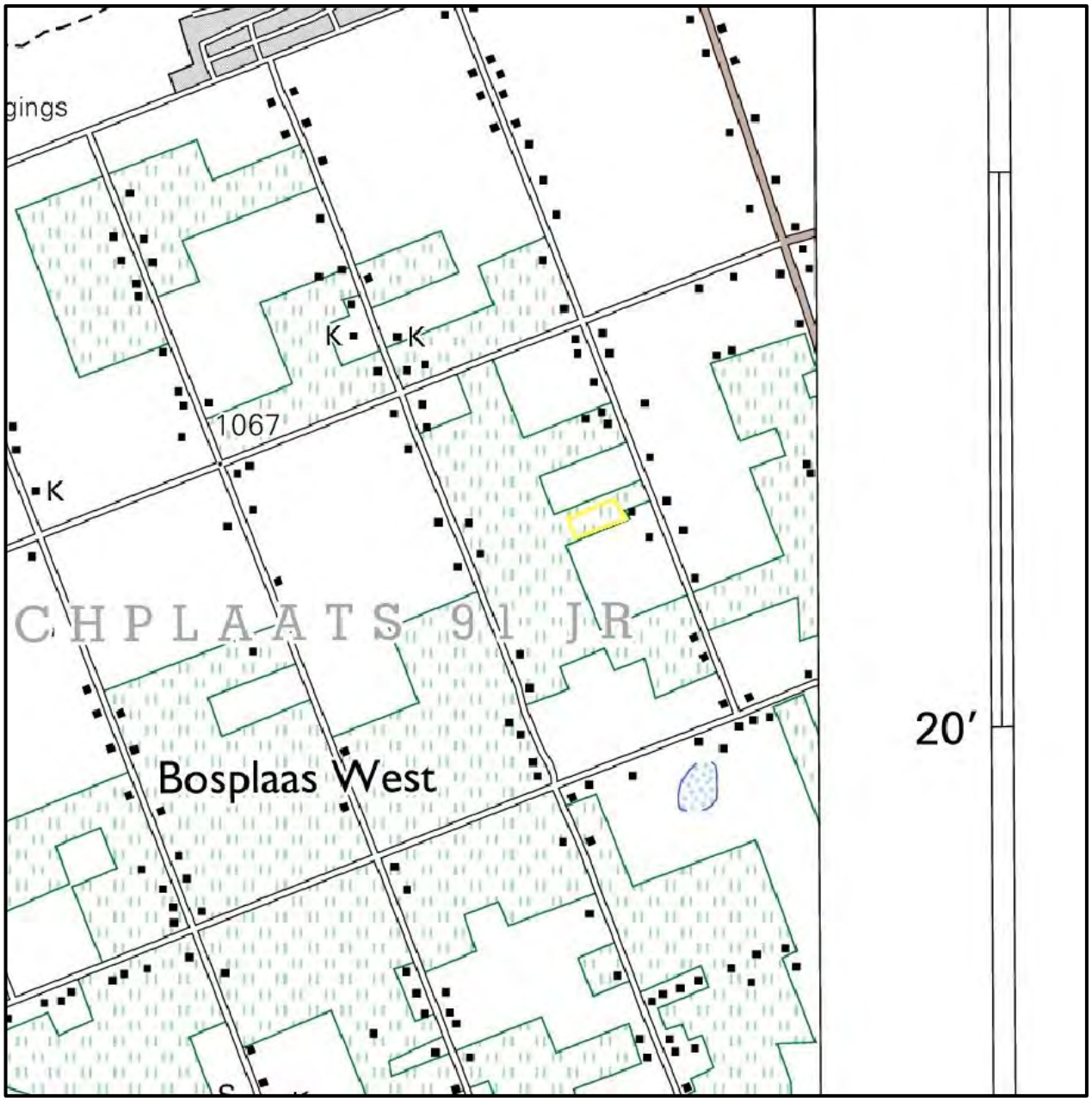

Figure 11. 2001 Topographical map of the site under investigation. The approximate study area is indicated with a yellow border. The study area was still used as cultivated lands. Some sections of the farm were no longer planted. A building can be seen directly to the east of the site under investigation. (Topographical Map 2001)

8 Findings of the Survey

It is important to note that only the development footprint was surveyed. This part of the property was previously ploughed and planted and is damaged and disturbed to a large extent and is marked by knee high grass cover (Figure 12 – 13). This would have impacted on all surface indications of heritage features.

The property belongs to Mr. Kgomo, who was not available during the investigations, but his wife was present at the time. The Kgomo family resides on the property and occupies several buildings on the eastern extent of the small holding. Ms. Kgomo mentioned that she was not aware of any heritage sites or features such as graves within the study area and the property. This was confirmed during the survey and no sites or finds of any heritage value or significance was identified as described below.

Figure 12. General site conditions – view from the west

Figure 13. General Site conditions – View of the homestead

8.1 Built Environment (Section 34 of the NHRA)

No standing structures older than 60 years occur in the study area.

8.2 Archaeological resources (Section 35 of the NHRA)

No archaeological sites or material was recorded during the survey. Therefore, no further mitigation prior to construction is recommended in terms of the archaeological component of Section 35 of the NHRA for the proposed development to proceed.

8.3 Burial Grounds and Graves (Section 36 of the NHRA)

In terms of Section 36 of the Act no burial sites were recorded. If any graves are located in future they should ideally be preserved *in-situ* or alternatively relocated according to existing legislation.

8.4 Cultural Landscapes, Intangible and Living Heritage.

Long term impact on the cultural landscape is considered to be negligible as the proposed development conforms to the rural character and previous agricultural use of the site. Visual impacts to scenic routes and sense of place are also considered to be low due to the extensive developments in the area.

8.5 Palaeontological Resources (Section 35 of the NHRA)

An independent study was conducted for this aspect. The study (Rossouw 2017) concluded:
"The proposed new aquaponics facility is located on moderately fossiliferous Ecca sediments of the Hammanskraal Formation, that are capped by geologically recent and palaeontologically insignificant residual soil overburden. Considering the scale and overall impact of the development, it is extremely unlikely that any fossils will be found in within the proposed (± 0.5 ha) area. The proposed development may proceed as far as the palaeontological heritage is concerned and a phase 2 impact study is not necessary, provided that all excavation activities are restricted to within the boundaries of the development footprint. If, however, any fossils are discovered within fresh sedimentary bedrock during the construction phase of the development, a professional palaeontologist must be called in immediately to confirm and record the finds. In the meantime, ex situ remains must be wrapped in paper towels or heavy duty tin foil and stored in a safe place. The material should not be washed or cleaned in any way. In situ material must be kept in place and protected from further damage by covering it with light but rigid object like a box, bucket or metal sheet until further confirmation by the palaeontologist." Kindly refer to the full report (Rossouw 2017).

8.6 Battlefields and Concentration Camps

A white concentration camp was situated a small distance to the northeast of Pretoria. Another white and a black concentration camp are located to the southwest of Pretoria, in the Irene area. One battle took place at Silkaatsnek, to the northwest of Pretoria, some distance from the farm. Here, General De la Rey's Boer troops defeated the British army on 11 July 1900. (Bergh 1999: 54, 250) The Boer side however generally lost ground against the British as the war continued, and in June 1900 the Boer military leaders decided that Pretoria would have to be surrendered to the British forces. This decision was inevitable if the war was to be continued. The town was very susceptible to a siege, and its defence would have gravely endangered the lives of its inhabitants. More importantly, the defence of the town would involve such a great number of Boers that the capture of these men would have surely meant the end of the war. Pretoria was therefore occupied by British forces on Tuesday 5 June 1900. (Theron 1984: 273-279).

8.7 Potential Impact

The chances of impacting unknown archaeological sites in the study area is considered to be negligible. Any direct impacts that did occur would be during the construction phase only and would be of very low significance. Cumulative impacts occur from the combination of effects of various impacts on heritage resources. The importance of identifying and assessing cumulative impacts is that the whole is greater than the sum of its parts. In the case of the development, it will, with the recommended mitigation measures and management actions, not impact any heritage resources directly. However, this and other projects in the area could have an indirect impact on the heritage landscape. The lack of any heritage resources in the immediate area minimises additional impact on the landscape.

8.7.1 Pre-Construction phase:

It is assumed that the pre-construction phase involves the removal of topsoil and vegetation as well as the establishment of infrastructure needed for the construction phase. These activities can have a negative and irreversible impact on heritage sites. Impacts include destruction or partial destruction of non-renewable heritage resources.

8.7.2 Construction Phase

During this phase, the impacts and effects are similar in nature but more extensive than the pre-construction phase. These activities can have a negative and irreversible impact on heritage sites. Impacts include destruction or partial destruction of non-renewable heritage resources.

8.7.3 Operation Phase:

No impact is envisaged for the recorded heritage resources during this phase.

Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.		
	Without mitigation	**With mitigation (Preservation/ excavation of site)**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (2)	Low (2)
Probability	Not probable (2)	Not probable (2)
Significance	**16 (Low)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	No resources were recorded	No resources were recorded.
Can impacts be mitigated?	Yes, a chance find procedure should be implemented.	Yes
Mitigation: Due to the lack of apparent significant archaeological resources no further mitigation is required prior to construction.		
Cumulative impacts: A Chance Find Procedure should be implemented for the project should any sites be identified during the construction process.		
Residual Impacts:		

If sites are destroyed this results in the depletion of archaeological record of the area. However, if sites are recorded and preserved or mitigated this adds to the record of the area.

9 Recommendations and conclusion

No archaeological sites or material were recorded during the survey and an independent paleontological desktop study (Rossouw 2017) found that the study area is located on moderately fossiliferous Ecca sediments of the Hammanskraal Formation, that are capped by geologically recent and paleontologically insignificant residual soil overburden. Therefore no further mitigation prior to construction is recommended in terms of Section 35 for the proposed development to proceed. However some construction phase management actions are recommended below with reference to the palaeontological component.

All excavation activities are restricted to within the boundaries of the development footprint.
If, however, any fossils are discovered within fresh sedimentary bedrock during the construction phase of the development, a professional palaeontologist must be called in immediately to confirm and record the finds. In the meantime, ex situ remains must be wrapped in paper towels or heavy-duty tin foil and stored in a safe place. The material should not be washed or cleaned in any way. In situ material must be kept in place and protected from further damage by covering it with light but rigid object like a box, bucket or metal sheet until further confirmation by the palaeontologist

In terms of the built environment of the area (Section 34), no standing structures older than 60 years occur within the study area. In terms of Section 36 of the Act no burial sites were recorded. If any graves are located in future they should ideally be preserved *in-situ* or alternatively relocated according to existing legislation. No public monuments are located within or close to the study area. Long term impact on the cultural landscape is considered to be negligible as the proposed development conforms to the rural character and previous agricultural use of the site. During the public participation process conducted for the project no heritage concerns was raised.

Due to the lack of significant heritage resources in the study area the impact of the proposed project on heritage resources is considered low and it is recommended that the proposed project can commence on the condition that the following chance find procedure are implemented as part of the EMPr and based on approval from SAHRA

9.1 Chance Find Procedures

The possibility of the occurrence of subsurface finds cannot be excluded. Therefore, if during construction any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped and a qualified archaeologist must be contacted for an assessment of the find and therefor chance find procedures should be put in place as part of the EMP. A short summary of chance find procedures is discussed below.

This procedure applies to the developer's permanent employees, its subsidiaries, contractors and subcontractors, and service providers. The aim of this procedure is to establish monitoring and reporting procedures to ensure compliance with this policy and its associated procedures. Construction crews must be properly inducted to ensure they are fully aware of the procedures regarding chance finds as discussed below.

- If during the pre-construction phase, construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager.
- It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find, and confirm the extent of the work stoppage in that area.
- The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.

10 References

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Theron, B. M. 1984. The social history of Pretoria during the first phase of the Anglo-Boer War: October 1899 - June 1900. MA Thesis, Pretoria: University of South Africa.

Maps

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11 Appendices:

Curriculum Vitae of Specialist

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Archaeologist

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Education:

Particulars of degrees/diplomas and/or other qualifications:

Name of University or Institution:		University of Pretoria
Degree obtained	**:**	BA Heritage Tourism & Archaeology
Year of graduation	**:**	2001
Name of University or Institution:		University of the Witwatersrand
Degree obtained	**:**	BA Hons Archaeology
Year of graduation	**:**	2002
Name of University or Institution	**:**	University of the Witwatersrand
Degree Obtained	**:**	MA (Archaeology)
Year of Graduation	:	2012
Name of University or Institution	**:**	University of Johannesburg
Degree	**:**	PhD
Year	:	Currently Enrolled

EMPLOYMENT HISTORY:

2011 – Present:	**Owner – HCAC (Heritage Contracts and Archaeological Consulting CC)**.
2007 – 2010 :	**CRM Archaeologist,** Managed the Heritage Contracts Unit at the University of the Witwatersrand.
2005 - 2007:	**CRM Archaeologist**, Director of Matakoma Heritage Consultants
2004:	**Technical Assistant**, Department of Anatomy University of Pretoria
2003:	**Archaeologist**, Mapungubwe World Heritage Site
2001 - 2002:	**CRM Archaeologists,** For R & R Cultural Resource Consultants, Polokwane
2000:	**Museum Assistant**, Fort Klapperkop.

Countries of work experience include:

Republic of South Africa, Botswana, Zimbabwe, Mozambique, Tanzania, The Democratic Republic of the Congo, Lesotho and Zambia.

SELECTED PROJECTS INCLUDE:

Archaeological Impact Assessments (Phase 1)

Heritage Impact Assessment Proposed Discharge Of Treated Mine Water Via The Wonderfontein Spruit Receiving Water Body Specialist as part of team conducting an Archaeological Assessment for the Mmamabula mining project and power supply, Botswana

Archaeological Impact Assessment Mmamethlake Landfill

Archaeological Impact Assessment Libangeni Landfill

Linear Developments

Archaeological Impact Assessment Link Northern Waterline Project At The Suikerbosrand Nature Reserve

Archaeological Impact Assessment Medupi – Spitskop Power Line,

Archaeological Impact Assessment Nelspruit Road Development

Renewable Energy developments

Archaeological Impact Assessment Karoshoek Solar Project

Grave Relocation Projects

Relocation of graves and site monitoring at Chloorkop as well as permit application and liaison with local authorities and social processes with local stakeholders, Gauteng Province.

Relocation of the grave of Rifle Man Maritz as well as permit application and liaison with local authorities and social processes with local stakeholders, Ndumo, Kwa Zulu Natal.

Relocation of the Magolwane graves for the office of the premier, Kwa Zulu Natal

Relocation of the OSuthu Royal Graves office of the premier, Kwa Zulu Natal

Phase 2 Mitigation Projects

Field Director for the Archaeological Mitigation For Booysendal Platinum Mine, Steelpoort, Limpopo Province. Principle investigator Prof. T. Huffman

Monitoring of heritage sites affected by the ARUP Transnet Multipurpose Pipeline under directorship of Gavin Anderson.

Field Director for the Phase 2 mapping of a late Iron Age site located on the farm Kameelbult, Zeerust, North West Province. Under directorship of Prof T. Huffman.

Field Director for the Phase 2 surface sampling of Stone Age sites effected by the Medupi – Spitskop Power Line, Limpopo Province

Heritage management projects

Platreef Mitigation project – mitigation of heritage sites and compilation of conservation management plan.

MEMBERSHIP OF PROFESSIONAL ASSOCIATIONS:

- Association of Southern African Professional Archaeologists. Member number 159

  Accreditation:
  - Field Director Iron Age Archaeology
  - Field Supervisor Colonial Period Archaeology, Stone Age Archaeology and Grave Relocation
- Accredited CRM Archaeologist with SAHRA
- Accredited CRM Archaeologist with AMAFA
- Co-opted council member for the CRM Section of the Association of Southern African Association Professional Archaeologists (2011 – 2012)

PUBLICATIONS AND PRESENTATIONS

- A Culture Historical Interpretation, Aimed at Site Visitors, of the Exposed Eastern Profile of K8 on the Southern terrace at Mapungubwe.
  - J van der Walt, A Meyer, WC Nienaber
  - Poster presented at Faculty day, Faculty of Medicine University of Pretoria 2003
- 'n Reddingsondersoek na Anglo-Boereoorlog-ammunisie, gevind by Ifafi, Noordwes-Provinsie. South-African Journal for Cultural History 16(1) June 2002, with A. van Vollenhoven as co-writer.
- Fieldwork Report: Mapungubwe Stabilization Project.
  - WC Nienaber, M Hutten, S Gaigher, J van der Walt
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2004
- A War Uncovered: Human Remains from Thabantšho Hill (South Africa), 10 May 1864.
  - M. Steyn, WS Boshoff, WC Nienaber, J van der Walt
  - Paper read at the 12th Congress of the Pan-African Archaeological Association for Prehistory and Related Studies 2005
- Field Report on the mitigation measures conducted on the farm Bokfontein, Brits, North West Province .
  - J van der Walt, P Birkholtz, W. Fourie
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2007
- Field report on the mitigation measures employed at Early Farmer sites threatened by development in the Greater Sekhukhune area, Limpopo Province. J van der Walt
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2008
- Ceramic analysis of an Early Iron Age Site with vitrified dung, Limpopo Province South Africa.
  - J van der Walt. Poster presented at SAFA, Frankfurt Germany 2008

- Bantu Speaker Rock Engravings in the Schoemanskloof Valley, Lydenburg District, Mpumalanga (*In Prep)*
    - J van der Walt and J.P Celliers
- Sterkspruit: Micro-layout of late Iron Age stone walling, Lydenburg, Mpumalanga. W. Fourie and J van der Walt. A Poster presented at the Southern African Association of Archaeologists Biennial Conference 2011
- Detailed mapping of LIA stone-walled settlements' in Lydenburg, Mpumalanga. J van der Walt and J.P Celliers
    - Paper read at the Southern African Association of Archaeologists Biennial Conference 2011
- Bantu-Speaker Rock engravings in the Schoemanskloof Valley, Lydenburg District, Mpumalanga. J.P Celliers and J van der Walt
    - Paper read at the Southern African Association of Archaeologists Biennial Conference 2011
- Pleistocene hominin land use on the western trans-Vaal Highveld ecoregion, South Africa, Jaco van der Walt.
    - J van der Walt. Poster presented at SAFA, Toulouse, France. Biennial Conference 2016

REFERENCES:

1. Prof Marlize Lombard Senior Lecturer, University of Johannesburg, South Africa
   E-mail: mlombard@uj.ac.za
2. Prof TN Huffman Department of Archaeology Tel: (011) 717 6040
   University of the Witwatersrand
3. Alex Schoeman University of the Witwatersrand
   E-mail:Alex.Schoeman@wits.ac.za

BASIC ASSESSMENT REPORT

Appendix H: Impact Assessment

CONTENTS

Appendix H: Impact Assessment

ENVIRONMENTAL IMPACT METHODOLOGY

INTRODUCTION

The Impact assessment must take account of the nature, scale and duration of effects on the environment, whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages from planning, through construction and operation to the decommissioning phase. Where necessary, the proposal for mitigation or optimisation of an impact is noted. A brief discussion of the impact and the rationale behind the assessment of its significance is provided in this Section. The EIA of the project activities is determined by identifying the environmental aspects and then undertaking an environmental risk assessment to determine the significant environmental aspects.

The environmental Impact Assessment is focussed on the following phases:

- Design and planning Phase
- Operational (cultivation and harvesting) Phase
- Restoration Phase

IMPACT ASSESSMENT METHODOLOGY

The following methodology has been provided by the CSIR to all specialists, for incorporation into specialist assessments:

METHODOLOGY OF IMPACT ASSESSMENT

According to the DEA IEM Series guideline on "Impact Significance" (2002), there are a number of quantitative and qualitative methods that can be used to identify the significance of impacts resulting from a development. The process of determining impact significance should ideally involve a process of determining the acceptability of a predicted impact to society. Making this process explicit and open to public comment and input would be an improvement of the EIA/BA process. The CSIR's approach to determining significance is generally as follows:

Use of expert opinion by the specialists ("professional judgement"), based on their experience, a site visit and analysis, and use of existing guidelines and strategic planning documents and conservation mapping (e.g. SANBI biodiversity databases);

Review of specialist assessment by all stakeholders including authorities such as nature conservation officials, as part of the report review process (i.e. if a nature conservation official disagreed with the significance rating, then we could negotiate the rating); and our approach is more a qualitative approach - we do not have a formal matrix calculation of significance as is sometimes done.

SPECIALIST CRITERIA FOR IMPACT ASSESSMENT

The following methodology has been provided by the CSIR to all specialists, for incorporation into specialist assessments:

Assessment of Potential Impacts

The assessment of impact significance is based on the following conventions:

Nature of Impact - this reviews the type of effect that a proposed activity will have on the environment and should include "what will be affected and how?"

Spatial Extent - this should indicate whether the impact will be:

- Site specific;

- Local (<2 km from site);
- Regional (within 30 km of site); or
- National.

Duration - The timeframe during which (lifetime of) the impact will be experienced:
- Temporary (less than 1 year);
- Short term (1 to 6 years);
- Medium term (6 to 15 years);
- Long term (the impact will cease after the operational life of the activity); or
- Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient).

Intensity - it should be established whether the impact is destructive or innocuous and should be described as either:
- High (severe alteration of natural systems, patterns or processes such that they temporarily or permanently cease);
- Medium (notable alteration of natural systems, patterns or processes; where the environment continues to function but in a modified manner); or
- Low (negligible or no alteration of natural systems, patterns or processes); can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making.

Probability - this considers the likelihood of the impact occurring and should be described as:
- Improbable (little or no chance of occurring);
- Probable (<50% chance of occurring);
- Highly probable (50 – 90% chance of occurring); or
- Definite (>90% chance of occurring).

Reversibility - this considers the degree to which the adverse environmental impacts are reversible or irreversible. For example, an impact will be described as low should the impact have little chance of being rectified to correct environmental impacts. On the other hand, an impact such as the nuisance factor caused by noise impacts from wind turbines can be considered to be highly reversible at the end of the project lifespan. The assessment of the reversibility of potential impacts is based on the following terms:

- High - impacts on the environment at the end of the operational life cycle are highly reversible;
- Moderate - impacts on the environment at the end of the operational life cycle are reasonably reversible;
- Low - impacts on the environment at the end of the operational life cycle are slightly reversible; or
- Non-reversible - impacts on the environment at the end of the operational life cycle are not reversible and are consequently permanent.

Irreplaceability - this reviews the extent to which an environmental resource is replaceable or irreplaceable. For example, if the proposed project will be undertaken on land that is already transformed and degraded, this will yield a low irreplaceability score; however, should a proposed development destroy unique wetland systems for example, these may be considered irreplaceable and thus be described as high. The assessment of the degree to which the impact causes irreplaceable loss of resources is based on the following terms:

- High irreplaceability of resources (this is the least favourable assessment for the environment);
- Moderate irreplaceability of resources;
- Low irreplaceability of resources; or
- Resources are replaceable (this is the most favourable assessment for the environment).

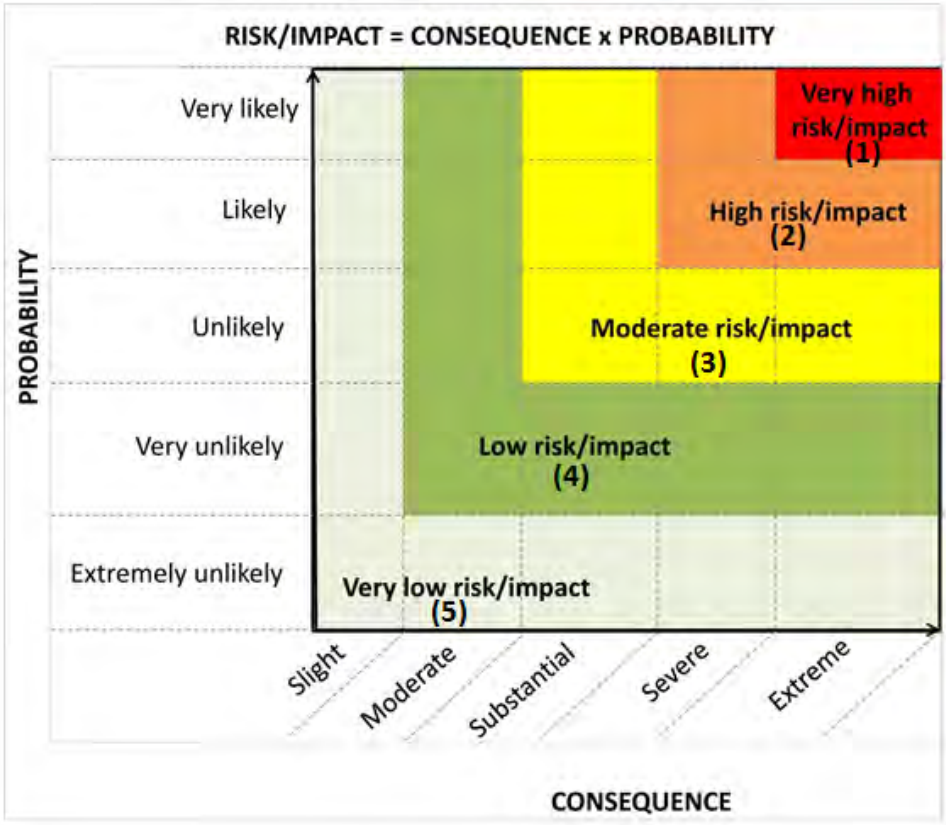

Figure 1: Guide to assessing risk/impact significance as a result of consequence and probability.

The status of the impacts and degree of confidence with respect to the assessment of the significance is stated as follows:

Status of the impact: A description as to whether the impact will be:
- Positive (environment overall benefits from impact);
- Negative (environment overall adversely affected); or
- Neutral (environment overall not affected).

Degree of confidence in predictions: The degree of confidence in the predictions, based on the availability of information and specialist knowledge. This should be assessed as:
- High;
- Medium; or
- Low.

Based on the above considerations, the specialist provides an overall evaluation of the significance of the potential impact, which should be described as follows:

- **Low to very low:** the impact may result in minor alterations of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated;
- **Medium:** the impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated; or
- **High:** Where it could have a "no-go" implication for the project unless mitigation or re-design is practically achievable.

Furthermore, the following must be considered:

- Impacts should be described both before and after the proposed mitigation and management measures have been implemented.
- All impacts should be evaluated for the construction, operation and decommissioning phases of the project, where relevant.
- The impact evaluation should take into consideration the cumulative effects associated with this and other facilities which are either developed or in the process of being developed in the region, if relevant.

Management Actions:

- Where negative impacts are identified, mitigatory measures will be identified to avoid or reduce negative impacts. Where no mitigatory measures are possible this will be stated.
- Where positive impacts are identified, augmentation measures will be identified to potentially enhance these.
- Quantifiable standards for measuring and monitoring mitigatory measures and enhancements will be set. This will include a programme for monitoring and reviewing the recommendations to ensure their ongoing effectiveness.

Monitoring:

Specialists should recommend monitoring requirements to assess the effectiveness of mitigation actions, indicating what actions are required, by whom, and the timing and frequency thereof.

Cumulative Impact:

Consideration is given to the extent of any accumulative impact that may occur due to the proposed development. Such impacts are evaluated with an assessment of similar developments already in the environment. Such impacts will be either positive or negative, and will be graded as being of negligible, low, medium or high impact.

Mitigation:

The objective of mitigation is to firstly avoid and minimise impacts where possible and where these cannot be completely avoided, to compensate for the negative impacts of the development on the receiving environment and to maximise re-vegetation and rehabilitation of disturbed areas. For each impact identified, appropriate mitigation measures to reduce or otherwise avoid the potentially negative impacts are suggested. All impacts are assessed without mitigation and with the mitigation measures as suggested.

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
Construction											
Direct Impacts	*Loss or degradation of the wetland*	Negative	Site specific	Temporary (<2 years)	Low	High reversibility	Moderate irreplaceability	Low probability (10-25% chance)	High	Low (Negative)	• No wetland where identified onsite
	Hydrological systems in the region	Negative	Local	Long term	Low	Moderate	Moderate	Very likely	High	Low Negative	• Footprint should be restricted to the proposed 4.4 hectares
	Ground water contamination	Negative	Local	Long term	Low	Moderate	Low irreplaceability	Very likely	High	Low	• Footprint should be restricted to the proposed 4.4 hectares • Identification of the monitoring parameters is crucial and depends on the chemistry of possible pollution sources • Laboratory analysis must be taken annually must comply with SABS guidelines
	Soil disturbance	Negative	Site specific	Long term (>15 years)	Low	Moderate	Low irreplaceability	Very likely	High	Medium (negative)	• Dust control measures should be implemented during construction • The denuded and disturbed areas on site should be landscaped and re-vegetated as soon as possible with indigenous plants
	Loss of terrestrial vegetation and faunal habitat Although the site is situated in the Springbokvlakte Thornveld Endangered	Negative	Site specific	Long term (>15 years)	Low	High reversibility	Low irreplaceability	Low probability (10-25% chance)	High	Low (Negative)	• Ensure that all infrastructure avoids all Very High and High sensitive areas • Indigenous trees and shrubs should be established in the

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
	vegetation type and Vulnerable Threatened Ecosystem, construction of the Aquaponics facility will result in destruction of an already transformed habitat. Of concern is that a number of trees could be lost, which provide habitat for roosting and nesting birds including owls and potentially small raptors.										place of alien species • Clearly demarcate or fence in the construction site. Relocate CI plant and animal specimens from the construction footprint, with advice from an appropriate specialist. • Commence (and preferably complete) construction during winter, when the risk of disturbing growing plants should be least.
	Loss of CI or medicinal flora	Negative	Site specific	Temporary (<2 years)	Low	Moderate reversibility	Moderate irreplaceability	Low probability (10-25% chance)	Medium	Low (Negative)	• Obtain permits to remove CI species • Transplant CI and medicinally important floral specimens from the infrastructure footprint to suitable locations in the surrounding area. • Obtain guidance from a suitably qualified vegetation specialist or horticulturist regarding the collection, propagation/storage and transplantation of plants.
	Loss of CI fauna	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Moderate irreplaceability	Low probability (10-25% chance)	Medium	Low (Negative)	• Appoint an appropriate specialist to relocate CI fauna from vegetation, termitaria and soil that is removed from

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											the infrastructure footprint. • Commence (and preferably complete) construction during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least. • Check open trenches for trapped animals (e.g. hedgehogs, reptiles and frogs), and relocate trapped animals with advice from an appropriate specialist. • Prohibit disturbance and persecution (e.g. poaching) of fauna, and introduction of pets and other alien fauna (apart from the production of fish). • Provide notices and training to inform workers about dangerous animals (e.g. venomous snakes and scorpions) and prohibited activities (e.g. poaching) • Walk fence lines to remove snares.
	Introduction and proliferation of alien species	Negative	Site specific	Temporary (<2 years)	Low	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	High	Low (Negative)	• Carefully regulate / limit access by vehicles and materials to the construction site. Demarcate or fence in the construction area. • Prohibit the introduction of

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											domestic animals such as dogs and cats. • Remove any woody alien species that germinate. • Plant only locally indigenous flora if landscaping needs to be done • Keep construction activities neat and tidy. When complete, remove all sand piles and landscape all uneven ground while re-establishing a good topsoil layer • Remove Category species using mechanical methods, and minimize soil disturbance as far as possible.
	Increased dust and erosion	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Low (Negative)	• Limit vehicles, people and materials to the construction site. • Commence (and preferably complete) construction during winter, when the risk of erosion should be least. • Revegetate denude areas with locally indigenous flora a.s.a.p. • Implement erosion protection measures on site. Measures could include bunding around soil stockpiles, and vegetation of areas not to be developed. • Implement effective and environmentally-friendly dust control measures, such as

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											mulching or periodic wetting.
	Sensory disturbance of fauna	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Highly probable (50-90% chance)	Medium	Low (Negative)	• Commence (and preferably complete) construction during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least. • Minimize noise to limit its impact on calling and other sensitive fauna (e.g. frogs and Secretary bird). • Limit construction activities to day time hours • Minimize or eliminate security and construction lighting, to reduce the disturbance of nocturnal fauna.
	Destruction of palaeontological material	Negative	Site specific	Permanent	Medium	Probable	Low	Low	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
	Destruction of archaeological artefacts	Negative	Site specific	Permanent	Medium-low	Definite	Very low	Low	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Negative	Site specific	Permanent	Medium-low	Probable	Very low	Low	High	Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Emissions from dust generation and construction vehicles	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Ensure that cleared (excavated) areas and unpaved surfaces are sprayed with water (obtained from an approved source) to minimise dust generation. • Approved soil stabilisers may be utilised to limit dust

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											generation. • Ensure that construction vehicles travelling on unpaved roads do not exceed a speed limit of 40 km/hour. • Limit vehicles, people and materials to the construction site • Adequate dust control strategies should be applied to minimise dust deposition, for example: Periodic spraying of water on the entrance road when necessary
	Potential spillage of by spillage or discharge of construction waste water	Negative	Site specific	Long term	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Low (Negative)	• Ensure that adequate containment structures are provided for the storage of construction materials on site. • Ensure the adequate removal and disposal of construction waste and material
	Potential Pollution of the surrounding water and ground as a result of generation of building rubble and waste scrap material	Negative	Site specific	Short term	Low	High reversibility	Low irreplaceability	Very low probability	High	High (Negative)	• Ensure that adequate containment structures are provided for the storage of construction materials on site. • Ensure the adequate removal and disposal of construction waste and material
	Opportunities for employment and skills development	Positive	Site specific	Long term	Low	Moderate	N/A	Very likely	High	Medium (Positive)	• Enhance the use of local labour and local skills as far as reasonably possible.

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											• Where the required skills do not occur locally, and where appropriate and applicable, ensure that relevant local individuals are trained. • Ensure that an equitable percentage allocation is provided for local labour employment as well as specify the use of small-to-medium enterprises and training specifications in the Contractors contract. • Ensure that goods and services are sourced from the local and regional economy as far as reasonably possible.
	Potential visual impacts as the result of construction activities	Negative	Site specific	Short term	Low	High reversibility	N/A	Very low probability	High	Low (Negative)	• No specific mitigation measures are required other than standard construction site housekeeping and dust suppression. These are included below: • The contractor(s) should maintain good housekeeping on site to avoid litter and minimise waste. • Litter and rubble should be timeously removed from the construction site and disposed at a licenced waste disposal facility.

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											• The project developer should demarcate construction boundaries and minimise areas of surface disturbance. • Appropriate plans should be in place to minimise fire hazards and dust generation. • Night lighting of the construction site should be minimised within requirements of safety and efficiency.
	Potential noise impact as the result of the use of construction equipment	Negative	Local	Long term	Low	High reversibility	Low irreplaceability	Very low probability	High	Medium (Negative)	• Limit construction activities to day time hours
	Potential impact on the safety of construction workers and Health injuries to construction personnel as a result of construction work	Negative	Site specific	Short term	Low	High reversibility	Low irreplaceability	Very low probability	High	Medium (Negative)	• Ensure that a skilled and competent Contractor is appointed during the construction phase. The Contractor must be evaluated during the tender/appointment process in terms of safety standards. • The Contractor must ensure that all construction personnel are provided with adequate PPE for use where appropriate. • The Contractor must undertake a Construction Phase Risk Assessment. • A Construction Site Manager or Safety Supervisor should be

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											appointed, in conjunction with the project manager, to monitor all safety aspects during the construction phase. This could be the same person that is assigned to co-ordinate the construction traffic.
	Traffic, congestion and potential for collisions	Negative	Site specific	Short term	Low	High reversibility	Low irreplaceability	Very low probability	High	Low (Negative)	• Ensure that roads are not closed during construction, which may restrict access for emergency services. • The Contractor must ensure that all construction personnel are provided with adequate PPE for use where appropriate
INDIRECT IMPACTS: • Loss of biodiversity • Some additional disturbance will inevitably occur in the direct surroundings of the site • Increased dust levels during construction might negatively affect the plant growth.											
CUMULATIVE IMPACTS: • Additional infrastructure development, for example, water pipelines, power lines and access roads and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.											
Direct Impacts	*Loss or degradation of the wetland*	Negative	Site specific	Temporary (<2 years)	Low	High reversibility	Moderate irreplaceability	Low probability (10-25% chance)	High	High (Negative)	• Design measures to effectively control vehicle access, vehicle speed, dust, storm water run-off, erosion and sedimentation on the road. • Implement the measures that were designed to control impacts on the road preferably during winter, when the risk of

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											erosion should be least.
	Loss of terrestrial vegetation and faunal habitat	Negative	Site specific	Temporary (<2 years)	Low	Moderate reversibility	Moderate irreplaceability	Very low probability	High	Medium (Negative)	• Ensure that all infrastructure avoids all Very High and High sensitive areas • Clearly demarcate or fence in the construction site. Relocate CI plant and animal specimens from the construction footprint, with advice from an appropriate specialist. • Commence (and preferably complete) construction during winter, when the risk of disturbing growing plants should be least.
	Loss of CI or medicinal flora	Negative	Site specific	Temporary (<2 years)	Low	Moderate reversibility	Moderate irreplaceability	Low probability (10-25% chance)	Medium	Medium (Negative)	• Obtain permits to remove CI species • Transplant CI and medicinally important floral specimens from the infrastructure footprint to suitable locations in the surrounding area. • Obtain guidance from a suitably qualified vegetation specialist or horticulturist regarding the collection, propagation/storage and transplantation of plants.
	Introduction and proliferation of alien species	Negative	Site specific	Short term (2-5 years)	Medium-low	High reversibility	Low irreplaceability	Low probability (10-25% chance)	Medium	High (Negative)	• Carefully regulate / limit access by vehicles and materials to the construction site. Demarcate or fence in the

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											construction area. • Prohibit the introduction of domestic animals such as dogs and cats. • Remove any woody alien species that germinate. • Plant only locally indigenous flora if landscaping needs to be done • Keep construction activities neat and tidy. When complete, remove all sand piles and landscape all uneven ground while re-establishing a good topsoil layer • Remove Category species using mechanical methods, and minimize soil disturbance as far as possible.
	Increased dust and erosion	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Limit vehicles, people and materials to the construction site. • Commence (and preferably complete) construction during winter, when the risk of erosion should be least. • Revegetate denude areas with locally indigenous flora a.s.a.p. • Implement erosion protection measures on site. Measures could include bunding around

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											soil stockpiles, and vegetation of areas not to be developed. • Implement effective and environmentally-friendly dust control measures, such as mulching or periodic wetting.
	Sensory disturbance of fauna	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Highly probable (50-90% chance)	Medium	Medium (Negative)	• Commence (and preferably complete) construction during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least. • Minimize noise to limit its impact on calling and other sensitive fauna (e.g. frogs and Secretarybird). • Limit construction activities to day time hours • Minimize or eliminate security and construction lighting, to reduce the disturbance of nocturnal fauna.
	Destruction of palaeontological material	Negative	Site-Specific	Permanent	Medium-low	Low	High	Probable (25-50% chance)	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution. •
	Destruction of archaeological artefacts	Negative	Site-Specific	Permanent	Medium-low	Low	High	Definite	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Negative	Site-specific	Permanent	Medium	Low	High	Probable (25-50% chance)		Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Emissions from dust generation and	Negative	Site specific	Short term (2-	Low	High reversibility	Low irreplaceability	Probable (25-50%	Medium	Medium (Negative)	• Ensure that cleared (excavated) areas and unpaved

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
	construction vehicles			5 years)				chance)			surfaces are sprayed with water (obtained from an approved source) to minimise dust generation. • Approved soil stabilisers may be utilised to limit dust generation. • Ensure that construction vehicles travelling on unpaved roads do not exceed a speed limit of 40 km/hour. • Limit vehicles, people and materials to the construction site • Adequate dust control strategies should be applied to minimise dust deposition, for example: Periodic spraying of water on the entrance road when necessary
	Potential Pollution of the surrounding water and ground water as a result of generation of building rubble and waste scrap material	Negative	Site specific	Short term	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	High (Negative)	• Ensure that adequate containment structures are provided for the storage of construction materials on site. • Ensure the adequate removal and disposal of construction waste and material
	Opportunities for employment and skills development	Positive	Local	Long term	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Positive)	• Enhance the use of local labour and local skills as far as reasonably possible. • Where the required skills do

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											not occur locally, and where appropriate and applicable, ensure that relevant local individuals are trained. • Ensure that an equitable percentage allocation is provided for local labour employment as well as specify the use of small-to-medium enterprises and training specifications in the Contractors contract. • Ensure that goods and services are sourced from the local and regional economy as far as reasonably possible.
	Potential visual impacts as the result of construction activities	Negative	Local	Long term	Low	High reversibility	Low irreplaceability	Probable (15-50% chance)	High	Low (Negative)	• No specific mitigation measures are required other than standard construction site housekeeping and dust suppression. These are included below: • The contractor(s) should maintain good housekeeping on site to avoid litter and minimise waste. • Litter and rubble should be timeously removed from the construction site and disposed at a licenced waste disposal facility. • The project developer should

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											demarcate construction boundaries and minimise areas of surface disturbance. • Appropriate plans should be in place to minimise fire hazards and dust generation. • Night lighting of the construction site should be minimised within requirements of safety and efficiency.
	Potential noise impact as the result of the use of construction equipment	Negative	Long term	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Negative)	• Limit construction activities to day time hours
	Potential impact on the safety of construction workers and Health injuries to construction personnel as a result of construction work	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Negative)	• Ensure that a skilled and competent Contractor is appointed during the construction phase. The Contractor must be evaluated during the tender/appointment process in terms of safety standards. • The Contractor must ensure that all construction personnel are provided with adequate PPE for use where appropriate. • The Contractor must undertake a Construction Phase Risk Assessment. • A Construction Site Manager or Safety Supervisor should be appointed, in conjunction with

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											the project manager, to monitor all safety aspects during the construction phase. This could be the same person that is assigned to co-ordinate the construction traffic.
Operational Phase											
	Loss or degradation of wetland	Negative	Local	Long term (>15 years	Medium	Moderate reversibility	Moderate irreplaceability	Probable (< 90% chance)	High	High (Negative)	• Monitor and maintain the road impact control measures to ensure that they remain effective
	Environmental contamination	Negative	Local	Long term (>15 years	Medium	Moderate reversibility	Moderate irreplaceability	Probable (< 90% chance)	Medium	Medium (Negative)	• Ensure that the facility is designed in accordance with international best practice norms, and with advice from an appropriate specialist, to ensure that there is no environmental contamination from effluent, fodder, carcasses and other waste, and to ensure that there is also effective storm water management • Adhere to best practice waste disposal norms • Establish appropriate emergency procedures for accidental contamination of the surroundings. Waste recycling should be incorporated into the facility's

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											operations as far as possible. Designate a secured, access restricted, signposted room for the storage of potentially hazardous substances such as herbicides, pesticides dips and medications. All hazardous waste should be disposed of at an appropriate licensed facility for this. • Rehabilitate contaminated areas a.s.a.p. in accordance with advice from appropriate contamination and environmental specialists • Educate workers regarding the handling of hazardous substances and about waste management and emergency procedures with regular training and notices and talks.
	Poor / Inappropriate control of animal pests	Negative	Site specific	Long term (>15 years	Medium	Moderate reversibility	Moderate irreplaceability	Probable (25-50% chance)	Medium	High (Negative)	• Ensure that there is effective storm water drainage around the facility • Ensure that the facility is sufficiently ventilated to keep floors, bedding, and fodder as dry as possible. • Prevent and manage unwanted animal access to fodder. • Check that fan louvers (if installed) work properly, and

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											close fans completely when off. • Ensure that floors are sloped and slatted to facilitate drainage. • Screed concrete floors properly to seal all cracks and limit the pooling of effluent and water. • Effectively maintain and seal all pipes and reservoirs containing slurry, to prevent animals from accessing the effluent. • Clean floors regularly. • Clean up excess fodder regularly from under troughs and feed bins. • Keep areas surrounding the facility free of spilled manure and litter. • Remove all trash, and sources of feed and water for pests from the outside perimeter of the facilities. • Keep weeds and grass mowed to 5cm or less immediately around the facilities, to reduce the prevalence of insects. • Electrocution devices are available to kill flies, while other mechanical devices include traps, sticky tapes or

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											baited traps. • Control rodents through effective sanitation, rodent proofing and (as humane as possible) extermination. • Rodenticides are not advised. • Ensure that measures to control pests are tightly restricted to areas where these are problematic. Pest control measures should be taxon-specific. If necessary, advice should be sought from an appropriate specialist.
	Disease transmission	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Maintain appropriate pest control measures • Effectively maintain and seal all pipes and reservoirs containing slurry, to prevent animals from accessing the effluent.
	Altered burning	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Create safe storage on the premises for flammable materials. If artificial burning is considered necessary, establish and implement a fire management plan with emergency fire procedures. • Maintain an effective fire break between the facility and the surrounding natural environment.

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											• Educate workers about the fire plan and emergency procedures with regular training and notices
	Introduction and proliferation of alien species	Negative	Site specific	Temporary (<2 years)	Low	Moderate reversibility	Moderate reversibility	Probable (25-50% chance)	High	High (Negative)	• Carefully regulate / limit access by vehicles and materials to the site • Prohibit the introduction of domestic animals such as dogs and cats. • Plant only locally indigenous flora if landscaping needs to be done. • Employ best practices regarding tilling of soil and weed management • Minimize the accumulation or dispersal of excess fodder on site. • Remove Category species using mechanical methods, and minimize soil disturbance as far as possible. Alien debris could be donated to a local community
	Loss of CI or medicinal flora	Negative	Site specific	Temporary (<2 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Educate the personnel prior to operation, and with yearly refresher talks.
	Sensory disturbance of fauna	Negative	Site specific	Long term (>15 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• *Minimize essential lighting.* • Ensure that all outdoor lights are angled downwards and/or

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											fitted with hoods. • Avoid using metal halide, mercury or other bulbs that emit high UV (blue-white) light that is highly and usually fatally attractive to insects. • Use bulbs that emit warm, long wavelength (yellow-red) light, or use UV filters or glass housings on lamps to filter out UV. • *Minimize unavoidable noise* Conduct regular maintenance of machinery and ventilation systems / fans (if any).
	Destruction of palaeontological material	Negative	Site-Specific	Permanent	Medium-low	Low	High	Probable (25-50% chance)	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of archaeological	Negative	Site-Specific	Permanent	Medium-low	Low	High	Probable (25-50%	Medium	Very Low (Negative)	• If any archaeological material, palaeontological material or

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
	artefacts							chance)			human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Negative	Site specific	Permanent	Medium	Medium	High	Probable (25-50% chance)	High	Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Emissions into the atmosphere as a result of staff vehicles.	Negative	Site specific	Temporary (<2 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Negative)	• Efficient movement of traffic through the entrance and exit in order to reduce congestion and vehicle emissions. • Ensure that the facility is operated in such a manner whereby potential odours are minimised.
	Improved service delivery with regards	Negative	Site specific	Temporary (<2 years)	Low	High reversibility	Low irreplaceability	Probable (25-50%	High	Medium (Positive)	• Ensure that the proposed infrastructure is maintained

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
	Fish products							chance)			appropriately to ensure that all facilities and infrastructure operate within its design capacity to deliver as the market requires.
	Opportunities for employment and skills development	Positive	Local	Long term (>15 years)	High	High reversibility	Low irreplaceability	Probable (> 90% chance)	High	Medium (Positive)	• Enhance the use of local labour and local skills as far as reasonably possible. • Where the required skills do not occur locally, and where appropriate and applicable, ensure that relevant local individuals are trained. • Ensure that an equitable percentage allocation is provided for local labour employment as well as specify the use of small-to-medium enterprises and training specifications in the Contractors contract. • Ensure that goods and services are sourced from the local and regional economy as far as reasonably possible.
	Night lighting of the development on the nightscape of the surrounding landscape	Negative	Local	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (> 90% chance)	Medium	Medium (Negative)	• No specific mitigation measures are recommended as it is assumed that night lighting of the proposed storage facility will be planned in such a manner so as to minimize light pollution such as glare and

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											light spill (light trespass) by: • Using light fixtures that shield the light and focus illumination on the ground (or only where light is required). • Avoiding elevated lights within safety/security requirements. • Using minimum lamp wattage within safety/security requirements. • Where possible, using timer switches or motion detectors to control lighting in areas that are not occupied continuously (if permissible and in line with minimum security requirements). • Switching off lights when not in use in line with safety and security
	Potential noise impact from operations and road transport of products	Negative	Local	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• It is recommended that the drivers of the vehicles be discouraged from using air brakes at night. • Limit the effects of noise associated disturbances from operational activities on sensitive fauna such as owls and medium-large mammals (especially carnivores), potentially occurring hedgehogs and large terrestrial

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											birds such as Korhaans and Secretary birds.
	Minor accidents to the public and moderate accidents to operational staff	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• An Emergency Plan should be compiled in order to deal with potential spillages and fires. Records of practices should be kept on site. • Scheduled inspections should be implemented by operating personnel in order to assure and verify the integrity of hoses, piping and storage lagoon. • Portable fire extinguishers and fire water hydrants (i.e. appropriate fire-fighting equipment) should be provided at the facility as required.
	Atmospheric pollution due to fumes, smoke from fires	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Portable fire extinguishers and fire water hydrants (i.e. appropriate fire-fighting equipment) should be provided at the terminal as required. Mobile fire-fighting equipment should be provided at the berths as a safety precaution during the vessel offloading process. It should be noted that the products planned to be stored at the terminal have high flash points and low volatility. As a result, fires are

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											unlikely, unsustainable, and can be extinguished with basic fire water and portable fire extinguishers.
Decommission											
Direct Impacts	*Loss or degradation of the wetland*	Negative	Local	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	High (Negative)	• Monitor and maintain the road impact control measures to ensure that they remain effective
	Introduction and proliferation of alien species	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	High (Negative)	• Remove Category species using mechanical methods, and minimize soil disturbance as far as possible.
	Increased dust and erosion	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Negative)	• Limit vehicles to the construction site • Commence (and preferably complete) decommissioning during winter, when the risk of erosion should be least. • Revegetate denude areas with locally indigenous flora a.s.a.p. • Implement erosion protection measures on site to reduce erosion and sedimentation of the local drainage system. Measures could include bunding around soil stockpiles, and vegetation of areas not to be developed. • Implement effective and

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											environmentally-friendly dust control measures, such as mulching or periodic wetting of the entrance road.
	Sensory disturbance of fauna	Negative	Site specific	Temporary (<2 years)	Low	High reversibility	Low irreplaceability	Low probability (10-25% chance)	Medium	Low (Negative)	• Commence (and preferably complete) demolition / rehabilitation during winter, when the risk of disturbing active (including breeding and migratory) animals, should be least. • Minimize noise to limit its impact on sensitive fauna. • Limit demolition activities to day time hours • Minimize or eliminate security and other lighting, to reduce the disturbance of nocturnal fauna.
	Destruction of palaeontological material	Negative	Site-Specific	Permanent	Medium-low	Low	High	Probable (25-50% chance)	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											curation in an approved institution.
	Destruction of archaeological artefacts	Negative	Site-Specific	Permanent	Medium-low	Low	High	Probable (25-50% chance)	High	Very Low (Negative)	• If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an appropriate specialist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
	Destruction of graves	Negative	Site-Specific	Permanent	Medium-low	Low	High	Probable (25-50% chance)	High	Low (Negative)	• The two graveyards should be fenced off clearly and pointed out to all construction workers and other staff on site to ensure that impacts to them are avoided; • No construction work should occur within 10 m of any of the graves;
	Discharge of contaminated stormwater into the surrounding environment	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• The appointed Contractor should compile a Method Statement for Stormwater Management during the decommissioning phase. • Provide secure storage for oil,

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											chemicals and other waste materials to prevent contamination of stormwater runoff.
	Emissions from decommissioning vehicles and generation of dust	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	Medium	Medium (Negative)	• Ensure that cleared (excavated) areas and unpaved surfaces are sprayed with water (obtained from an approved source) to minimise dust generation. • Approved soil stabilisers may be utilised to limit dust generation. • Ensure that decommissioning vehicles travelling on unpaved roads do not exceed a speed limit of 40 km/hour.
	Noise generation from demolition activities	Negative	Local	Long term	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Negative)	• A method statement, including detailed procedures, must be drawn up prior to any decommissioning of existing tanks. • Decommissioning personnel must wear proper hearing protection, which should be specified as part of the Decommissioning Phase Risk Assessment carried out by the Contractor. • The Contractor must ensure that all decommissioning personnel are provided with

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											adequate PPE, where appropriate.
	Pollution of the surrounding environment as a result of the handling, temporary storage and disposal of solid waste	Negative	Site specific	Short term (2-5 years)	Low	High reversibility	Low irreplaceability	Probable (25-50% chance)	High	Medium (Negative)	• General waste (i.e. building rubble, demolition waste, discarded concrete, bricks, tiles, wood, glass, plastic, metal, excavated material, packaging material, paper and domestic waste etc.) and hazardous waste (i.e. empty tins, paint and paint cleaning liquids, oils, fuel spillages and chemicals etc.) generated during the decommissioning phase should be stored temporarily on site in suitable (and correctly labelled) waste collection bins and skips (or similar). Waste collection bins and skips should be covered with suitable material, where appropriate. • Should the on-site storage of general waste and hazardous waste exceed 100 m^3 and 80 m^3 respectively, then the National Norms and Standards for the Storage of Waste (published on 29 November 2013 under GN 926) must be adhered to • Ensure that general waste and hazardous waste generated are

Activity	Impact summary	Status	Extent	Duration	Intensity	Reversibility	Irreplaceability	Probability	Confidence	Significance after mitigation	Proposed mitigation
											removed from the site on a regular basis and disposed of at an appropriate, licensed waste disposal facility by an approved waste management Contractor. Waste disposal slips or waybills should be kept on file for auditing purposes as proof of disposal. • Ensure that sufficient general waste disposal bins are provided for all personnel throughout the site. These bins must be emptied on a regular basis. • Appropriately time demolition / rehabilitation activities to minimise sensory disturbance to fauna.

DIRECT IMPACTS:

- None of the impacts mentioned above will occur.
- If the proposed project does not proceed, increased income and economic spin-off activities will not be realised.
- Approximately 11 new permanent jobs will not be created during the operational phase.
- If the proposed project does not proceed, the industries that rely on the supply of fish products could experience hindered economic growth potential.

INDIRECT IMPACTS:
There are no indirect impacts during the construction phase for the No-go Option.

CUMULATIVE IMPACTS:
There are no cumulative impacts during the construction phase for the No-go Option

BASIC ASSESSMENT REPORT

Appendix I: Public Participation

CONTENTS

Appendix I.1a: Proof of placement of relevant advertisements and notices

Notice of release of Draft Basic Assessment for comment for the proposed Tilapia aquaponics farm project, Bosplaas West North of Hammanskraal, in the Moretele Municipality in Bojanala District North West Province.

CSIR EMS Reference No: CSIR/02100/EMS/IR/2017/15674/A

Notice is hereby given of a Basic Assessment (BA) process being undertaken on behalf of Blue-Green Aquaculture (Pty) Ltd (the Project Applicant) for the proposed Aquaponics facility, comprising 2 ha on portion 413 Thaba Ya Batho in the Moretele local municipality, North West. The proposed project will be located on a portion of land owned by Mr T J Kgomo. The GPS coordinates at the centre point of the site are: 28.243569E, -25. 32748424S.

In terms of the NEMA EIA Regulations published in Government Notice Regulation (GNR) 327, 324 on 7 April 2017 Government Gazette Number 40772, a BA process is required as the project triggers listed activities 6, 8 and 27 of GN.R327 as well as activities 12 and 13 of GN.R 324.

The Council for Scientific and Industrial Research (CSIR) is managing the BA process on behalf of the applicant as part of the Special Needs and Skills Development Programme commissioned by the national Department of Environmental Affairs (DEA).

You are invited to register as an Interested and/or Affected Party (I&AP) and/ or to provide any written comments on the BA process by 16 October 2017. To obtain further information on the project and/or to register as an I&AP, please provide your full name, full postal address, phone numbers, email address and state your interest and/or concern to: **Ms. Karabo Mashabela, CSIR, PO Box 320, Stellenbosch 7599, Phone: (021) 888 2482, Fax: (021) 888 2693 or Email: kmashabela1@csir.co.za**

Appendix I.1b: Proof of Site Notice placed at the entrance gate in Plot 413 Bosplaas west (25°19' 37" South 28°14' 34" East – GPS Coordinates)


Blue-Green Aquaculture (Pty) Ltd
Tilapia Facility Project Site (North West)
NOTICE OF A BASIC ASSESSMENT (BA) PROCESS
CSIR
Blue-Green Aquaculture (Pty) Ltd
Projeke ya dihlaphi (North West)
KITSISO YA TIRELO YA BASIC ASSESSMENT (BA)

Blue-Green Aquaculture (Pty) Ltd
Projeke ya dihlaphi (North West)

KITSISO YA TIRELO YA BASIC ASSESSMENT (BA)

Le itsisiwe gore, go ya ka melao ya Tlhatlhobo ya Tikologo (EIA), ka fa tlase ga molawana-tsamaiso 41(1) le molawana-tsamaiso 41(4), e e gatisitsweng ka Gazeteng ya Mmuso ya nomoro 40772 wa 7 April, ya Molao wa Lekgotla la Taolo ya Tikologo, 1998 (Molao 107 wa 1998), gore **Blue-Green Aquaculture (Pty) Ltd**, e batla go simolola kgwebo ya go rua thlaphi kwa tshimong 413 ko Bosplass west North West.

(CSIR Reference Number: CSIR/02100/EMS/IR/2017/15674/A

Lekgotla la Dipatlisiso tsa Saense le Indasteri (Council for Scientific & Industrial Research -CSIR), le le ikemetseng ka di tlhatlhobo tsa tikologo, le tlo laola tsaimaiso ya tlhatlhobo ya tikologo ya projekte. Projekte e tla kwadisiwa le the North West Department of Rural, Environment and Agricultural Development (READ). Tlhatlhobo ya tikologo e tlhokagala gonne e tsositse ditiro tse di latelang tsa Kitsiso ya Melao wa Mmuso(GNR) 327 le 32 ya 7 April 2017:

Kitsiso ya Mmuso	**Nomoro ya Tiro**
GNR 327, 7 April 2017	6 (i)
GNR 327, 7 April 2017	27
GNR 327, 7 April 2017	8
GNR 324, 7 April 2017	12 (a)(ii)
GNR 324, 7 April 2017	13 (a) (ii)

Go fitlhela dikitsiso tse di amanang le projekte le tsamaiso ya tlhatlhobo ya tikologo, ikwadise jaaka mokgatlhegi le moamegi wa projekte. Ikopantshe le:

Project Manager
Ms. Karabo Mashabela
PO Box 320, Stellenbosch, 7599
Tel: 021 888 2482
Fax: 021 888 2693
Email: kmashabela1@csir.co.za

Setshwantsho 1: Mmepe o o bontshang lefelo la projekte

Blue-Green Aquaculture (Pty) Ltd
Tilapia Facility Project Site (North West)

NOTICE OF A BASIC ASSESSMENT (BA) PROCESS

Notice is hereby given, in terms of the Environmental Impact Assessment (EIA) Regulations, under sub-regulation 41(1) and sub-regulation 41(4), published in Government Gazette No 40772 of 7 April 2017, of the National Environmental Management Act, 1998 (Act No 107 of 1998), that the **Blue-Green Aquaculture (Pty) Ltd**, proposes the construction of an aquaculture facility on plot 413 in Bosplaas West, North West.

(CSIR Reference Number: CSIR/02100/EMS/IR/2017/15674/A

The Council for Scientific and Industrial Research (CSIR), as the independent Environmental Assessment Practitioner, will manage the required Basic Assessment process for the proposed project. The project will be registered with the North West Department of Rural, Environment and Agricultural Development (READ). The need for a Basic Assessment is triggered by the following activity listed in Government Notice Regulations (GNR) 327 and 324 of 7 April 2017:

Government Notice	Listed Activity Number
GNR 327, 7 April 2017	6 (i)
GNR 327, 7 April 2017	27
GNR 327, 7 April 2017	8
GNR 324, 7 April 2017	12 (a)(ii)
GNR 324, 7 April 2017	13 (a) (ii)

To obtain further information with regards to the project and Basic Assessment process, or to register as Interested and Affected Party (I&AP), please contact the Project Manager below, and quote the CSIR Reference Number: **CSIR/CAS/EMS/IR/2015/0015/A)**

Figure 1: Locality Map depicting the location of the Proposed Project

Project Manager
Ms. Karabo Mashabela
PO Box 320, Stellenbosch, 7599
Tel: 021 888 2482
Fax: 021 888 2693
Email: kmashabela1@csir.co.za

Appendix I.2a: Letter to I&APs to notify them of the initiation of the Basic Assessment Process

CSIR Environmental Management Services
PO Box 320
Stellenbosch
7599
South Africa
Tel: +27 21 888 2482
Fax: +27 21 888 2693
Email: kmashabela1@csir.co.za

15 May 2017

Dear Interested and Affected Party

THE PROPOSED DEVELOPMENT OF TILAPIA AQUAPONICS FARM PROJECT, BOSPLAAS WEST IN NORTH OF HAMMANSKRAAL, IN THE MORETELE MUNICIPALITY IN BOJANALA DISTRICT NORTH WEST PROVINCE (CSIR REFERENCE NO: NO:CSIR/02100/EMS/IR/2017/15674/A).

The National Department of Environmental Affairs (DEA) and the Council for Scientific and Industrial Research (CSIR) have initiated the Special Needs and Skills Development Programme, whereby small-medium micro-enterprises and community trusts who are lacking financial means are provided with *pro-bono* environmental services. The project is being assessed in terms of the Government Notice Regulations (GNR) 324, 325 and 327of 7 April 2017 of the National Environmental Management Act (Act 107 of 1998) published in Government Gazette 38282 on 7 April 2017.

Blue-Green Aquaculture (Pty) Ltd has been identified as an eligible client for this service and is proposing to develop an aquaponics facility on Portion 413 of the Farm Bosplass west. The need for a Basic Assessment process is required by the inclusion of the activities listed within GNR 327: Activity 6,8 & 27 and GNR 324: Activity 12(a)(ii) and 13(a)(ii). The CSIR, as the independent Environmental Assessment Practitioner (EAP), will be managing the Basic Assessment and public consultation processes for this proposed development.

Please find enclosed, a Background Information Document (BID) that will assist in your further understanding of the project as well as a Registration and Comment form. A 30 days commenting period has been allocated for the review and the provision of comments to the EAP, as well as for registering as an Interested and Affected Party that will be kept informed of the project for the remainder of the EIA process. Please submit your comments before or on **15 June 2017**.

Should you have any project related queries, please feel free to contact the undersigned

Yours sincerely,

Ms. Karabo Mashabela (Project Manager)

Contact: **Ms. Karabo Mashabela**
Postal address: PO Box 320, Stellenbosch, 7599, South Africa
Tel: 021 888 2482
Fax: 021 888 2473
E-mail: kmashabela1@csir.co.za
Website: http://www.csir.co.za/ems/specialneeds/

Appendix I.2b: Proof of Notification of release of BID

Name & Signature of person responsible for post: F. Hendrik 15/05/2017

35 items –**Registered Post** (Blue-Green (Pty) Ltd BA 15 May 2017) Karabo Mashabela 021 888 2482

EMS 0136 / RUN / 02100 / 021SE

Grasslands Society of South Africa Feyni Du Toit P.O. Box 41, Hilton 3245	Department of Environmental Affairs- National Mmatlala Rabothata Private Bag X447 Pretoria 0002	Vincent Maseko P O Box 60382 Karen Park 0118
Department of Agriculture, Forestry and Fisheries Mashudu Marubini Private Bag X138 Pretoria 0001	Tharina Boshoff Private Bag X2039 Mmabatho 2739	Steven Muklola Private Bag X2039 Mmabatho 2739
Malefyane Mosadi Private Bag X2039 Mmabatho 2736"	Rhuleni Mathebula Private Bag X2039 Mmabatho 2735"	Moretele Local Municipality Amogelang Sefara Private Bag X367, Makapanstad, North West 0404
Moretele Local Municipality Municipal Manager Private Bag X367, Makapanstad, North West, 0404	Bojanala Platinum District Municipality Goitsimosimo Tau P O Box 1993, Rustenburg,0300	Community Chairman Mr Ngema Private Bag X1031 Bethanie, 0270
Jan Maseko Private Bag X1031 Bethanie 0270	Mathews Mlangeni Private Bag X1031 Bethanie, 0270	David Maseko Private Bag X1031 Bethanie, 0270

Central Region, (Molopo, Ditsobotla, Lehurutshe, Madikwe). Private Bag X106, Mafikeng 2735	Extension Officers, P.O.Box 24, Rustenburg 0300.	Extension Officers, P.O.Box 112, Vryburg 8600
Boysee Masango Private Bag X1031 Bethanie, 0270	Joshua Mlangeni Private Bag X1031 Bethanie, 0270	Edwin Lelaka Private Bag X1031 Bethanie, 0270
Senza Ngozo Private Bag X1031 Bethanie, 0270	Alfred Ngobese Private Bag X1031 Bethanie, 0270	Madoda Maseko Private Bag X1031 Bethanie, 0270
Sbongseni Mlangeni Private Bag X1031 Bethanie, 0270	Mndeni Ngozo Private Bag X1031 Bethanie, 0270	South African National Parks (SANParks) Dr. Howard Hendriks PO Box 787, Pretoria 0001
Bongane Radebe Private Bag X1031 Bethanie, 0270	Ntomfuthi Mlangeni Private Bag X1031 Bethanie, 0270	Caiphus Ngozo Private Bag X1031 Bethanie, 0270
Ward Councillor ~~Mr Mosetlhe~~ Private Bag x367 ~~P O Box 1962~~ Makapans la D ~~Hammanskraal~~ 0404 ~~0400~~	North West Provincial Heritage Resources Authority Mr Mosiane Mothlabane Private Bag X90 Mmabatho 2735	AgriLand Anneliza Collett Private Bag X120, Pretoria 0001

Council for Geoscience Dr Stewart Foya Private Bag X 112, Pretoria 0001	South African Heritage Resources Agency (SAHRA) Marie South PO Box 4637, Cape Town 8000	Mr Pule Hlahane 8277 Nkoane Road, Motse-Thabong, Welkom, 9460

Appendix I.3: Comments received following the release of the Background Information Document

The table below lists all the comments received from Interested and Affected Parties (I&APs) following the release of the Background Information Document for comment regarding the proposed aquaponics farm of 2 ha on Bosplaas West. Copies of the correspondence are included in the Basic Assessment Report.

ISSUES RAISED	COMMENTATOR	DATE	RESPONSE
The Department will like to be offered an opportunity to comment on the formal application in terms of the Subdivision of Agricultural Land Act (SALA), Act 70 of 1970. The application should include: Copy of Deed of property, Motivation letter, Clear Locality Map and Sketch Plan. Area of concern is the loss of agricultural land.	Mabule R Land use advisor	29/05/2017	Thank you very much for the respond duly noted will submit land ownership concern form sighed by the owner, Locality map and the, stench plan. What kind of a motivational letter will your department need?

Appendix I.3: Comments received following the release of the Background Information Document

Appendix I.3a: Comments from SAHRA

Aquaponics Farm

Our Ref:

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 11025

Date: Friday May 26, 2017
Page No: 1

Interim Comment

In terms of Section 38(2) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Mr Pule Hlahane
South African Farmers Association

The Blue-Green Aquaculture PTY Ltd is a small scale commercial farming enterprise that was established in 2013 and is proposing to establish an aquaculture production facility. Blue-Green Aquaculture has leased land, i.e Plot 413 in Bosplaas West, from Mr T J Kgomo for the establishment of an aquaculture production farm. The lease agreement includes the utilisation of a borehole with the capacity to store 10 000 L of water.

Thank you for notifying SAHRA of the proposed aquaculture production facility on Plot 413 in Bosplaas West, north of Hammanskraal, Moretele Municipality, North West Province.

In terms of the National Heritage Resources Act, No 25 of 1999 (NHRA), heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resources authority. This means that before such sites are disturbed by development it is incumbent on the developer to ensure that a **Heritage Impact Assessment** (HIA) is done as per section 38(1), 38(3) and 38(8) of the NHRA. This must include the archaeological component (Phase 1) and any other applicable heritage components. The HIA must be conducted as part of the Environmental Application Process in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA) and the NEMA 2014 Environmental Impact Assessment (EIA) Regulations.

The quickest process to follow for the archaeological component would be to contract a specialist (see www.asapa.org.za) to provide a Phase 1 Archaeological Impact Assessment Report. The Phase 1 Impact Assessment Report will identify the archaeological sites and assess their significance. It should also make recommendations (as indicated in section 38) about the process to be followed. For example, there may need to be a mitigation phase (Phase 2) where the specialist will collect or excavate material and date the site. At the end of the process the heritage authority may give permission for destruction of the sites. If the property is very small or disturbed and there is no significant site the specialist may choose to send a letter to the heritage authority to indicate that there is no necessity for any further assessment.

The proposed development area is located within an area of High Palaeontological Sensitivity. A Palaeontological Desk Top study must be undertaken to assess whether or not the development will impact

Aquaponics Farm

Our Ref:

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 11025

Date: Friday May 26, 2017
Page No: 2

upon palaeontological resources - or at least a letter of exemption from a Palaeontologist is needed to indicate that this is unnecessary (see www.palaeontologicalsociety.co.za for qualified paleontologists).

Any other heritage resources that may be impacted such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or viewscapes must also be assessed.

All environmental reports and appendices produced as part of the EA process must be submitted for review so that an informed comment may be issued.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Natasha Higgitt
Heritage Officer
South African Heritage Resources Agency

John Gribble
Manager: Maritime and Underwater Cultural Heritage Unit / Acting Manager: Archaeology, Palaeontology and Meteorites Unit
South African Heritage Resources Agency

ADMIN:

Aquaponics Farm

Our Ref:

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 11025

Date: Friday May 26, 2017
Page No: 3

Direct URL to case: http://www.sahra.org.za/node/398287

Appendix I.3b: Comments from Department of Agriculture Forestry and Fisheries

Karabo Mashabela 29/05/2017 11:41 AM
RE: Register I&APs_Disclosure of interest_ENGLISH
MabuleR@DAFF.gov.za

Good day Mabule

Thank you very much for the respond duly noted will submit land ownership concern torm sighed by the owner, Locallty map and the, stench plan. What kind of a motivational letter will your department need?

Regards
Karabo

>>> MabuleR <MabuleR@daff.gov.za> 29/05/2017 11:23 >>>
The Department will like to be offered an opportunity to comment on the formal application in terms of the Subdivision of Agricultural Land Act (SALA), Act 70 of 1970. The application should include: Copy of Deed of property, Motivation letter, Clear Locality Map and Sketch Plan. Area of concern is the loss of agricultural land.

Hope you will find the above to be in order

Kind Regards

From: Karabo Mashabela [KMashabela1@csir.co.za]
Sent: Monday, May 29, 2017 10:29 AM
To: MabuleR
Subject: Register I&APs_Disclosure of interest_ENGLISH

Good day

Please see the attached document

Kind regards
Karabo Mashabela
CSIR: EAP


Mail From: Karabo Mashabela

File Edit View Actions Tools Window Help Retain

Close Reply Reply All Forward

Mail | Properties | Discussion Thread

Karabo Mashabela 29/05/2017 12:06 PM

RE: Register I&APs_Disclosure of interest_ENGLISH

To: MabuleR@DAFF.gov.za

Thank you we will provide you with all the information

Kind regards
Karabo Mashabela

>>> MabuleR <MabuleR@daff.gov.za> 29/05/2017 12:02 >>>

Why the proposal (needs and desirability)


Mail From: Karabo Mashabela

File Edit View Actions Tools Window Help Retain

Close Reply Reply All Forward

Mail | Properties | Discussion Thread

Karabo Mashabela 31/05/2017 09:59 AM

Re: PLOT 413

to: NtanganedzeniMA

Good day Ntanga

Thank you for the respond duly noted.

Kind regards
Karabo Mashabela

>>> NtanganedzeniMA <NtanganedzeniMA@dalrrd.gov.za> 30/05/2017 13:43 >>>

Good day

May you please find the attached. The last acknowledgement I send it to you is wrong reference number.

Regards
Ntanga

agriculture,
forestry & fisheries
Department:
Agriculture, forestry & fisheries
REPUBLIC OF SOUTH AFRICA

Directorate Land Use and Soil Management, Private Bag x120, Pretoria, 0001
Delpen Building, c/o Annie Botha & Union Streets, Riviera

From: Director: Land Use and Soil Management
Tel: (012) 319 7678 **Fax:** (012) 329 5938 **e-mail:** agriland@nda.agric.za

CSIR
P.O. BOX 320
STELLENBOSCH
7599

2017-05-30

Dear Sir/Madam

This serves as a notice of receipt and confirms that your application has been captured in our electronic AgriLand tracking and management system. It is strongly recommended that you use the on-line AgriLand application facility in future.

Detail of your application as captured:

Type: EIA
Your reference number:
Property Description: ***PLOT 413***
Dated: 15 MAY 2017

Please use the following reference number in all enquiries:

AgriLand reference number: 2017_05_0208
Enquiries can be made to the above postal, fax or e-mail address.

Yours sincerely,

N.V. MAUMELA
pp DIRECTOR: LAND USE AND SOIL MANAGEMENT

Online application available at: http://www.agis.agric.za/agriland

Appendix I.3c: Proof of Water use application

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Limpopo-NW CMA, 285 Francis Baard Street, Pretoria
Private Bag X995, Pretoria, 0001. Tel (012) 392 1300. www.dwa.gov.za

Enquiries: Khuthadzo Mulaudzi
Email: mulaudzik@dws.gov.za

Tel: 012 392-1363
Fax: 012 392-1408
Ref No.:16/2/7/A235/P26

8277 Nkoane Road
Motse-Thabong
Welkom
9459

Attention: Mr L P Hlahane

LIMPOPO WATER MANAGEMENT AREA: APPLICATION FOR WATER USE AUTHORISATION IN TERMS OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998): SECTION 21 (a): TAKING OF WATER FROM GROUNDWATER FOR AGRICULTURE-AQUACULTURE: PLOT 413 BOSPLAAS WEST HAMMANSKRAAL

This serves to confirm that the Department of Water and Sanitation has received your water use licence application for authorisation- taking of water Section 21(a) from groundwater. Please note that the Department can at this stage not yet confirm that water use authorisation will be granted.

Should you have any enquiry, do not hesitate to contact this office at above mentioned contact details. The Department will assist should you require additional information with respect to your application.

Yours Sincerely

AD MAUMELA
ACTING CHIEF EXECUTIVE OFFICER: LIMPOPO-NW CMA

DATE: 23/03/2017

Page 1 of 1

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Limpopo-North West Proto CMA, 285 Francis Baard Street, Pretoria, Private Bag X995, Pretoria, 0001
Tel (012) 3921300, Fax: 012 392 2998, www.dwa.gov.z
Enquiries: K Mulaudzi
Email: mulaudzik@dws.gov.za
Tel: 012 392-1363
Fax: 012 392-1408
Ref no: 16/2/7/A29

Mr L P Hlahane
Blue Green Aquaculture
8277 Nkoane Road
Motse-Thabong
Welkom
9459

Attention: Mr Hlahane

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT 1998 (ACT NO. 36 OF 1998); SECTION 21 (a): TAKING OF WATER FROM GROUNDWATER FOR AGRICULTURE-AQUACULTURE: PLOT 413 BOSPLAAS WEST HAMMANSKRAAL.

Please refer to your request of 23 May 2017 to register to use water in terms of General Authorisation no. 538 dated 02/09/2016 for taking of water from Apies River for irrigation in the quaternary catchment A23E.

Water use(s): Section 21(a): Taking water from a water resource

Summary of water use activity:

Property Description	Name of Water resource	Quartenary Catchment	Purpose	Volume (m^3/a)	Co-ordinates
Plot 413 Bosplaas West Hammanskraal	Groundwater	A23E	Agriculture: Aquaculture	265	25, 32691° S, 28, 28442° E

The department has evaluated the submitted documents and confirms that the intended water uses fall within the ambit of the General Authorisation. You may therefore continue with the water uses as authorised in terms of Section 22(1)(a)(iii) of the National Water Act, 1998. You are reminded to adhere to the conditions stipulated in the said General Authorisation.

Please be informed that your water uses have been registered for the purpose of capturing the water uses in the Department's records and billing purposes. Find attached with this letter the relevant General Authorisation and registration certificate for ease of reference.

Please note that if you don't comply with the conditions of the General Authorisation your water use will be considered as unlawful.

Yours sincerely

***pp* ACTING CHIEF EXECUTIVE OFFICER: LIMPOPO-NORTH WEST PROTO CMA**
A.D. MAUMELA

DATE: 25/5/2017

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

National Register of Water Use Registration Record 26072516

Water Use Registration Record 26072516 is issued in terms of the regulations requiring that a Water Use be registered, promulgated under Section 26(1)(c) of the National Water Act(Act 36 of 1998) to:

Applicant

Applicant Type:	INDIVIDUAL
Name:	MR LP HLAHANE
ID Number:	8101255460089
Gender	MALE
Population Group	BLACK
Postal Address:	PLOT 413 CYNTHIA RD BOSPLAAS WEST HAMMANSKRAAL 0400
VAT Registration Number:	

Water Management Area

Name:	LIMPOPO

Register Status

Status:	ACTIVE

Register No. 26072516 | 2017/07/07 12:04:56 PM | Print Seq. No. 1 | Page 1 of 4

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

National Register of Water Use Registration Record 26072516

Water Use Registration Record 26072516 is issued in terms of the regulations requiring that a Water Use be registered, promulgated under Section 26(1)(c) of the National Water Act(Act 36 of 1998) to:

...Continued from Page 1

Water Uses

See attached Annexure(s)

Water Use No.	Water Use	Volume	Volume Start Date	Volume End Date
1	21(a)	250 CUBIC METRES PER YEAR	2017/07/01	

CE: WRM

Office: North West Office
Regional Office: Limpopo Region

DEPARTMENT VAN WATER EN SANITASIE
PROVINSIAAL HOOF / PROVINCIAL HEAD
NORTH WEST REGION
2017 -07- 07
PRIVAATSAK / PRIVATE BAG X995
PRETORIA 0001
DEPARTMENT OF WATER AND SANITATION

Date stamp of issuing office

DISCLAIMER :
This Registration Record:
1 is not an acknowledgement of an entitlement to the registered water use;
2 may NOT be used to create the impression that it is proof of a water use entitlement. By virtue of section 22(1) of the National Water Act, the only documents that may be used as proof of a water use entitlement, are:
2.1 a licence;
2.2 an official document stating the extent of existing lawful water use pursuant to sections 33 or 35 of the National Water Act;
2.3 a general authorisation as published in the Gazette; or
2.4 Schedule 1 of the National Water Act.
Notes:
- If an entitlement for the specific water use referred to in this Registration Record has been confirmed by the Department, it may be indicated as such in this Registration Record.
- If the responsible authority has dispensed with the requirement for a licence for a specific water use, no water use entitlement is needed for that use under the National Water Act.
3 is issued without alterations or erasures and is invalid if it contains alterations not in conformity with the Department's official copy; and in substitution of any Registration Record the Department may have previously issued and the information is valid as at the date of issue.

Register No. 26072516 2017/07/07 12:04:57 PM Print Seq. No. 1 Page 2 of 4

National Register of Water Use Registration Record 26072516

Taking water from a water resource in terms of Section 21(a) of the National Water Act

Water Use Identification

Register Number:	26072516
Water Use Number:	1
Water Use Start Date:	2017/07/01
Water Use Status Date:	2017/07/07
Water Use Status:	REGISTERED

Lawfulness Authentication

Finding:	LAWFUL
Finding Date:	2017/05/25
Finding Reason:	GENERAL AUTHORISATION
Finding Confirmed:	YES
General Authorisation:	Gov. Gazette 40243, Notice 538, 2 September 2016
Legal Section:	Section 21(a) of the National Water Act (Act no. 36 of 1998)
GA Applicable From Date:	2017/03/01
GA Applicable To Date:	2037/03/31

Water Use Details

Water Use Sector(s)(i.e. Purpose(s) of Water Use):	AGRICULTURE: AQUACULTURE	
Source Type:	BOREHOLE	
Water Resource Name:	BOREHOLE	
Point of Abstraction:	**Latitude** 25.32691° south	**Longitude** 28.28442° east
Datum Type:	WGS-84	
Quaternary Drainage Region:	A23F	

Registered Volumes

Start Date	End Date	Registered Volume (m³)	Time Interval
2017/07/01		250	PER YEAR

Property Where Water Use Occurs

Property Name:	PLOT 413 CYNTHIA RD
Property Number:	413
Portion of Property:	0
SG Cadastral Code:	T0JR00000000041300000
Deeds Office:	PRETORIA
Registration Division:	JR
Registration Division Province:	GAUTENG
Surveyor General Office:	PRETORIA

WUN/Property Relationship Details

Relationship Start Date	Relationship End Date
2017/07/01	

Register No. 26072516 WUN 1 | 2017/07/07 12:04:57 PM | Print Seq. No. 1 | Page 3 of 4

National Register of Water Use Registration Record 26072516

Taking water from a water resource in terms of Section 21(a) of the National Water Act

Water Use Identification

Register Number:	26072516
Water Use Number:	1
Water Use Start Date:	2017/07/01
Water Use Status Date:	2017/07/07
Water Use Status:	REGISTERED

DISCLAIMER :
This Registration Record:

1 is not an acknowledgement of an entitlement to the registered water use;
2 may NOT be used to create the impression that it is proof of a water use entitlement. By virtue of section 22(1) of the National Water Act, the only documents that may be used as proof of a water use entitlement, are:
2.1 a licence;
2.2 an official document stating the extent of existing lawful water use pursuant to sections 33 or 35 of the National Water Act;
2.3 a general authorisation as published in the Gazette; or
2.4 Schedule 1 of the National Water Act.
Notes:
- If an entitlement for the specific water use referred to in this Registration Record has been confirmed by the Department, it may be indicated as such in this Registration Record.
- If the responsible authority has dispensed with the requirement for a licence for a specific water use, no water use entitlement is needed for that use under the National Water Act.

3 is issued without alterations or erasures and is invalid if it contains alterations not in conformity with the Department's official copy; and in substitution of any Registration Record the Department may have previously issued and the information is valid as at the date of issue.

Register No. 26072516 WUN 1 | 2017/07/07 12:04:57 PM | Print Seq. No. 1 | Page 4 of 4

Appendix I.4: Proof of Notification of release of Draft report

CSIR Specialist Services
PO Box 320
Stellenbosch
7599
South Africa
Tel: +27 21 888 2482
Fax: +27 21 888 2693
Email: kmashabela1@csir.co.za

14 September 2017

Dear Interested and/or Affected Party,

NOTICE OF RELEASE OF DRAFT BASIC ASSESSMENT REPORT FOR A 30-DAY REVIEW PERIOD

BASIC ASSESSMENT FOR THE PROPOSED TILAPIA AQUAPONICS FARM PROJECT, PLOT 413 BOSPLAAS WEST IN NORTH OF HAMMANSKRAAL, IN THE MORETELE MUNICIPALITY IN BOJANALA DISTRICT NORTH WEST.

CSIR REPORT NUMBER CSIR/02100/EMS/IR/2017/15674/A

The National Department of Environmental Affairs (DEA) have initiated the Special Needs and Skills Development Programme and have appointed the Council for Scientific and Industrial Research (CSIR) to manage the Programme on their behalf. The Programme is assisting small-medium micro-enterprises and community trusts who are lacking financial means are provided with *pro-bono* environmental services to decrease the burden of the cost associated with starting a business. Blue Green (Pty) Ltd has been identified as an eligible client for this service and is proposing to develop of an Aquaculture facility on Portion 413 of the Bosplaas west, North West.

In terms of Government Notice Regulations GNR 324, 325, 326 and 327 on the 7 April 2017 of the National Environmental Management Act (Act 107 of 1998) published in Government Gazette 40772, Environmental Authorisation from the Competent Authority, in this case the North West Department of Rural Environment and Agricultural Development (READ), is required prior to the undertaking of any activity triggered within GNR 324, 325, 326 and 327. The CSIR, as the independent Environmental Assessment Practitioner (EAP), will be managing the Basic Assessment and Public Participation Process for this proposed project.

In line with the Environmental Impact Assessment requirements of 7 April 2017, Interested and Affected Parties (I&APs) are hereby notified of the release of the Draft BA Report for a 30-day review period, which will extend from **15 September 2017 to 16 October 2017**. Please submit any review comments on the Draft BAR by **16 October 2017** to the CSIR Project Manager via email or post at the contact details above.

The next step in the BA Process will entail compiling the Final BA Report and including all comments received from I&APs during the 30-day review period of the Draft BA Report. Once finalised, the Final BA Report will be submitted to the READ for decision making. As a registered I&AP on the project database, you will be notified in writing of the submission of the Final BA Report, as well as the outcome of the decision making process.

Should you have any queries or require additional information please do not hesitate to contact the undersigned using the contact details provided.

Sincerely,

Ms. Karabo Mashabela (Project Manager)
CSIR (Environmental Management Services)
Kmashabela1@csir.co.za
021 8882482

Appendix I.5: A list of registered interested and affected parties

Company/organization	Name	Postal
NATIONAL, PROVINCIAL AND LOCAL		
Department of Environmental Affairs- National	Mmatlala Rabothata	Fedsure Building, Private Bag X447, 315 Pretorius Street, Pretoria, 0002
Department of Environmental Affairs- National	Sibusisiwe Hlela	Fedsure Building, Private Bag X447, 315 Pretorius Street,Pretoria 0002
Department of Environmental Affairs- National	Takalani Nemarude	Fedsure Building, Private Bag X447, 315 Pretorius Street, Pretoria 0002
Department of Rural Development and Land Reform	Bonginkosi Zulu	Fedsure Building, Private Bag X447, 315 Pretorius Street, Pretoria 0002
Department of Agriculture, Forestry and Fisheries	Mashudu Marubini	Private Bag X138, Pretoria, 0001
National Department of Mineral Resources	Kgauta Mokoena	Private Bag X59, Arcadia 0007
National Department of Water Affairs	Ms Ndileka K mohapi	Private Bag X313,Pretoria, 0001
National Department of Water Affairs	Namisha Muthraparsad	Private Bag X313,Pretoria, 0001
NW READ	Rhuleni Mathebula	Private Bag X2039,Mmabatho,2739
NW READ	Malefyane Mosadi	Private Bag X2039,Mmabatho,2739
Moretele Local Municipality	Amogelang Sefara	Private Bag X367, Makapanstad, North West, 0404
Moretele Local Municipality	Municipal Manager	Private Bag X367, Makapanstad, North West, 0404
Bojanala Platinum District Municipality	Goitsimosimo Tau	P O Box 1993, Rustenburg,0300

Company/organization	Name	Postal
LANDOWNERS & NEIGHBOURS		
Community Chairman- Plot 260 Jonathan	Mr Ngema	Private Bag X1031 Bethanie, 0270
Neighbouring Landowner- Plot 521 Bosplaas	PP Mahlangu	Private Bag X1031 Bethanie, 0271
Neighbouring Landowner- Plot 471 Bosplaas	Nelson	Private Bag X1031 Bethanie, 0272
Neighbouring Landowner- Plot 410 Bosplaas	Elias	Private Bag X1031 Bethanie, 0273
Neighbouring Landowner- Plot 414 Bosplaas	Dumisani	Private Bag X1031 Bethanie, 0274
Neighbouring Landowner- Plot 413 Bosplaas	Tshiaison j	Private Bag X1031 Bethanie, 0275
OTHER		
North West Parks & Tourism Board	Andrew Mvundle	
NW Parks Board Bird Sanctuary	Sampie van der Merwe	
South African National Parks (SANParks)	Dr. Howard Hendriks	PO Box 787, Pretoria, 0001
Council for Geoscience	Dr Stewart Foya	Private Bag x112, Pretoria 0001
South African Heritage Resources Agency (SAHRA)	Marie South	PO Box 4637, Cape Town, 8000
Endangered Wildlife Trust (EWT)	Stephanie Aken	
AgriLand	Anneliza Collett	Private Bag X120, Pretoria 0001
Client	Pule Hlahane	Private Bag X1031 Bethanie, 0270
Department of Agriculture Forestry and Fisheries	Thembi N	Private Bag X120, Pretoria, 001
Leads 2 Business	Carmen Barends	

Appendix I.6: Copies of any correspondence and minutes

Blue-Green
Aquaculture (PTY) LTD

Invitation to Public participation meeting about fish farm in Plot 413

When: Strictly between 10AM until 11AM, on Saturday 9th of Sep

Where: Bosplaas Resource Centre

Come and hear about the new development

Blue-Green Aquaculture

Blue-Green Aquaculture (PTY) LTD 2013/080629/07

Blue-Green Aquaculture

CSIR

DEPARTMENT OF ENVIRONMENTAL AFFAIRS
SPECIAL NEEDS AND SKILLS DEVELOPMENT PROGRAMME
PUBLIC MEETING–09 September 2017
Attendance Register

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Physical Address/ Postal Address (plot number)	Name and Surname	Email	Telephone/Cell	Signature
Plot 519	C. Radebe	lizanaradesongmail Com	082 808358	[signature]

CSIR

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Page 1 of 4

Blue-Green Aquaculture

Blue-Green Aquaculture (PTY) LTD
2013/080629/07

Address: 6277 Nkoane Road
Motse-Thabong,
Welkom, 9463
Postal: PO Box 1345,
Welkom, 9460

Website: www.blue-green.co.za
Email: info@blue-green.co.za

Wednesday, 13th of September

Public Participation Meeting (9th of September) Report back

1. Background

On the 6th of September, a CSIR Environmental Services representative requested that Mr Hlahane of Blue-Green Aquaculture call and hosts a Public participation meeting (PPM) with the Bosplaas community on the 9th of September. The Public participation meeting is part of the Basic Assessment Report compiled by CSIR. It should be noted that Mr Hlahane objected to the short notice with regards to informing the community. However, Mr Hlahane was able to secure a venue and call a meeting with the deputy Chair of the Community Authority (CA), Mr Mkhomazi, and the local Ward Councillor, Ms. Mahlangu on the Thursday the 7th of September.

Present at the meeting of the 7th of September was the executive of the CA and Councillor Mahlangu. The executive committee and the Councillor were scathing of the short notice but pledged to inform the members of the community. Mr Mahlangu informed Mr Hlahane that even with door-to-door invitation and seven days' notice; only between 10-20 members of the 300 Bosplaas households ever attend their meeting; therefore Mr Hlahane should not expect many people to attend.

2. Venue

The Bosplaas Resource Centre was used as the venue for the PPM. The Venue is central to the major activities in and around Bosplaas; as the Local Clinic, Councillor's Office, Post Office, and Community Authority's office, Petrol Station and Small Business Resource Office are all within 200m of each other. Mr Hlahane put up 17 posters within this area and at two schools near the Resource Centre (pictures taken are sent as attachments).

3. Meeting

The venue was booked for an ANC branch general meeting (BGM) from 11:00 am and therefore the PPM had to be from 10:00 am until 11:00 am. Mr Hlahane was banking on the ANC BGM in order to remedy the short notice in informing the community. At the 10:00 am Mr Kgomo was the only community member present. At 10:30 a group of people arrived and claimed that they would not sign the register (nor have their pictures taken) as they did not see the need for the whole environmental process. Further probing led to the answer "there already fish in the Appies/Tshwane River and if freshwater fish escaped from the farm, the fish would be returning home". After pleading with the people that arrived, one Bosplaas resident signed the register.

4. Conclusion

The members of the CA would like to see the project becoming a reality, as they would like to learn from Blue-Green Aquaculture and establish their own fish farms. The Councillor agrees with the CA and would like to ensure that Blue-Green Aquaculture employs Bosplaas residents. The people that arrived at the meeting asked for jobs.

Jobs and food security are key drivers for the community and local leadership. An observation from engaging with communities on separate occasions, there was a level of frustration within the community with people coming to present ideas to them and nothing materialising. Blue-Green Aquaculture must put something on the ground if we need to mobilise the community.

Community Authority contact number:	Mr Mkhomazi	+27 71 497 7964
Ward Councillor contact number:	Ms. Mahlangu	+27 81 763 1664

Blue-Green Aquaculture

Appendix I.7: Proof of meeting notification

Bosplaas Clinic

Post office entrance gate

Post office door

Small business resource centre

Outside resource centre

Basic Assessment for the proposed tilapia aquaponics project, on plot 413 of the farm Bosplaas West, north of the town of Hammanskraal, in the Moretele Municipality in Bojanala District, North West Province

Appendix J:
Environmental Management Programme (EMPr)

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1 Purpose of the Environmental Management Programme

This Environmental Management Programme (EMPr) is prepared as part of the requirements of the Environmental Impact Assessment (EIA) Regulations (December 2017, as amended) promulgated under the National Environmental Management Act (NEMA) (Act 107 of 1998, as amended). The purpose of this Environmental Management Programme (EMPr) is to ensure "good environmental practice" by taking a holistic approach to the management and mitigation of environmental impacts during the construction, operation and decommissioning phase of the proposed Aquaponics facility. This EMPr therefore sets out the methods by which proper environmental controls are to be implemented by the Aquaponics's management. The Draft EMPr is submitted to the North West Department of Rural, Environment and Agricultural Development as part of the Application for Environmental Authorisation.

This EMPr is considered to be a "live" document that can be updated as new information becomes available during the construction and operational phases, if applicable, of the proposed development. The EMPr is based largely on the findings and recommendations of the BA process. Mitigation measures are carried over from the Basic Assessment Report into the EMPr, except where they are not applicable, and additional measures added where necessary.

The EMPr identifies the following:

- Construction and Operation activities that will impact on the environment;
- Specifications with which the aquaponics project's management shall comply in order to protect the environment from the identified impacts; and
- Actions that shall be taken in the event of non-compliance.

This EMPr incorporates management plans for the design, construction, operation and decommissioning phases of the project, which consist of the following components:

- **Impact**: The potential positive or negative impact of the development that needs to be enhanced, mitigated or eliminated.
- **Objectives**: The objectives necessary in order to meet the goal; these take into account the findings of the specialist studies.
- **Mitigation/Management Actions**: The actions needed to achieve the objectives, taking into consideration factors such as responsibility, methods, frequency, resources required and prioritisation.
- **Monitoring**: The key monitoring actions required to check whether the objectives are being achieved, taking into consideration responsibility, frequency, methods and reporting.

This EMPr specifies the management actions necessary to ensure minimal environmental impacts, as well as procedures for monitoring these impacts associated with the proposed activity. In terms of legal compliance, this EMPr is designed to satisfy Appendix 4 of Government Notice Regulation 326 of 7 April 2017, as presented in Table 1 below.

This EMPr also intended to ensure that the principles of Environmental Management specified in the National Environmental Management Act are promoted during the different phases of the proposed development of aquaponics facility.

Table 1. Compliance with Appendix 4 of Government Notice Regulation 326 of 7 April 2017 and Section 24N of the National Environmental Management Act 107 of 1998.

Requirements according to Appendix 4 of GNR 326 of 7 April 2017	Section
(1) An EMPr must comply with section 24N of the Act and include- a) details of - (i) the EAP who prepared the EMPr; and (ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	Section 1.3 Appendix I
b) a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	Section 3
c) a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers;	Section 3, Figures 1 and 2
d) a description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including-	Section 4
(i) planning and design;	Section 4
(ii) pre-construction activities;	Section 4
(iii) construction activities;	Section 4
(iv) rehabilitation of the environment after construction and where applicable post closure; and	Section 4
(v) where relevant, operation activities;	Section 4
e) a description and identification of impact management outcomes required for the aspects contemplated in paragraph (d);	Section 4
f) a description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable, include actions to – i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;	Section 4
ii) comply with any prescribed environmental management standards or practices;	Section 4
iii) comply with any applicable provisions of the Act regarding closure, where applicable; and	N/A
iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;	N/A
g) the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 4
h) frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 4
i) an indication of the persons who will be responsible for the implementation of the impact management actions;	Section 4
j) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	Section 4
k) the mechanism for monitoring compliance with the impact management actions	Section 4

Requirements according to Appendix 4 of GNR 326 of 7 April 2017	Section
contemplated in paragraph (f);	
l) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 4
m) an environmental awareness plan describing the manner in which- (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	Section 4
n) any specific information that may be required by the competent authority.	N/A

1.2 Environmental Assessment Practitioner

The Environmental Assessment Practitioners (EAPs) who prepared this EMPr are from the Environmental Management Services (EMS) group of the Council for Scientific and Industrial Research (CSIR). The CSIR is amongst the largest multi-disciplinary research and development organizations in Africa, which undertakes applied research and development for implementation across the continent, as well as providing consulting services to industry, government and international agencies. It is one of the leading organisations in South Africa contributing to the development and implementation of environmental assessment and management methodologies and sustainability science.

This EMPr is prepared by the following EAPs at CSIR:

Karabo Mashabela – Karabo holds a MSc degree in Environmental Sciences. She has two years of experience in the environmental management field working on the Aquaculture SEA in the CSIR. Karabo is currently one of the project managers of the Special Needs and Skills Development Programme of the CSIR (for aquaculture projects).

Minnelise Levendal – Minnelise is a Senior EAP in the EMS group of the CSIR and holds a Master's degree in Biological Science (Botany) from the Stellenbosch University. She is a registered Pr.Sci.Nat and has 16 years of experience in Environmental Management (which includes ten years working as an EAP). Before she joined the CSIR she was employed at the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) for five years where she assessed EIAs, BAs and EMPs. Minnelise is currently managing various EIAs for wind and solar renewable energy projects in South Africa. She was the CSIR project manager for the 100 MW Ubuntu Wind Energy Facility near Jeffreys Bay (Environmental Authorisation granted in June 2012), as well as the 50 MW Banna Ba Pifhu Wind Energy Facility proposed by WKN Windcurrent near Humansdorp in the Eastern Cape (Environmental Authorisation granted in July 2014). She was the project manager of ten BAs for wind monitoring masts in South Africa as part of the National Wind Atlas Project of the Department of Energy. Environmental Authorisation from the DEA for all the ten masts was obtained in 2010.

Paul Lochner - Paul Lochner is an environmental assessment practitioner at the CSIR in Stellenbosch, with over 25 years of experience in a wide range of environmental assessment and management studies. His particular experience is in the renewable energy, oil and gas, wetland management, and industrial and

port development sectors. He has been closely involvement in the research and application of Strategic Environmental Assessment in South Africa, and also has a wide range of experience in Environmental Impact Assessment and Environmental Management Plans. He holds a degree in Civil Engineering and a Masters in Environmental Science, both from the University of Cape Town. In July 2003, he was certified as an Environmental Assessment Practitioner by the Interim Certification Board for Environmental Assessment Practitioners of South Africa. He has authored several guidelines for government, such as being lead author on the *Guideline for Environmental Management Plans* published by Western Cape government in 2005 and still currently applicable in the Western Cape.

The CVs for these EAPs are contained in Appendix K of the BAR Report.

2. ROLES AND RESPONSIBILITIES

For the purposes of this EMPr, the following roles and responsibilities have been identified:

- Farm Manager (acting on behalf of the project developer, Blue-Green Aquaculture);
- The Contractor(s); and
- Environmental Control Officer.

2.1 Farm Manager

The Farm Manager is designated as overall responsible on behalf of Blue-Green Aquaculture (Pty) Ltd to oversee the construction, operational and decommissioning aspects of this tilapia aquaponics project and to make sure that the EMPr is implemented and the conditions of Environmental Authorisation are adhered to throughout the project lifecycle. He/she will also be responsible for rehabilitation of disturbed areas during construction. The Farm Manager will have a team supporting him/her in this role.

Note that in the *Initial Planning and Design phase* of the project, the Farm Manager may not have been appointed and therefore the EMPr makes direct mention of Blue-Green Aquaculture as being responsible for actions in this phase.

2.2 The Contractor(s)

The Contractors are the persons or companies appointed to undertake construction or decommissioning of this aquaponics project. The Contractor(s) will be responsible for the overall construction and decommissioning activities on site and compliance with all conditions of authorization as well as drafting the Method Statements that are required as part of the EMPr in order to protect environmental resources, minimise pollution and to rehabilitate disturbed areas and its implementation thereof.

2.3 Environmental Control Officer (ECO)

The Environmental Control Officer will be part of the project staff and will advise the Contractor on all environmental matters relating to the works, in terms of this EMPr. The Environmental Control Officer will also be responsible for monitoring construction activities on site to also ensure that all the recommendations of the EMPr are adhered to during construction phase. He/she will also be responsible for the implementation of the EMPr on site during the operations phase. The ECO can be an internal staff member of the Contractor assigned to the project. Given the phased development of this tilapia farming project, the ECO may simultaneously be overseeing the construction and operations phases of the project.

3. PROJECT DESCRIPTION

In South Africa, the aquaculture industry is still in its developmental stage in comparison to the global aquaculture community, however, it has the potential to grow and contribute towards job creation, food security, economic development and export opportunities. Blue-Green Aquaculture (Pty) Ltd is a small scale commercial fish farming enterprise that was established in 2013 and it is proposing to establish an aquaculture production facility for tilapia. Blue-Green Aquaculture has leased two hectares of land, i.e. Plot 413 in Bosplaas West, from Mr T J Kgomo for the establishment of an aquaculture production farm. The lease agreement includes the utilisation of a borehole on the farm Bosplaas West that is located north of Hammanskraal, in the Moretele Municipality in the Bojanala District of the North West Province. The regional locality of the site is shown in Figure 1.

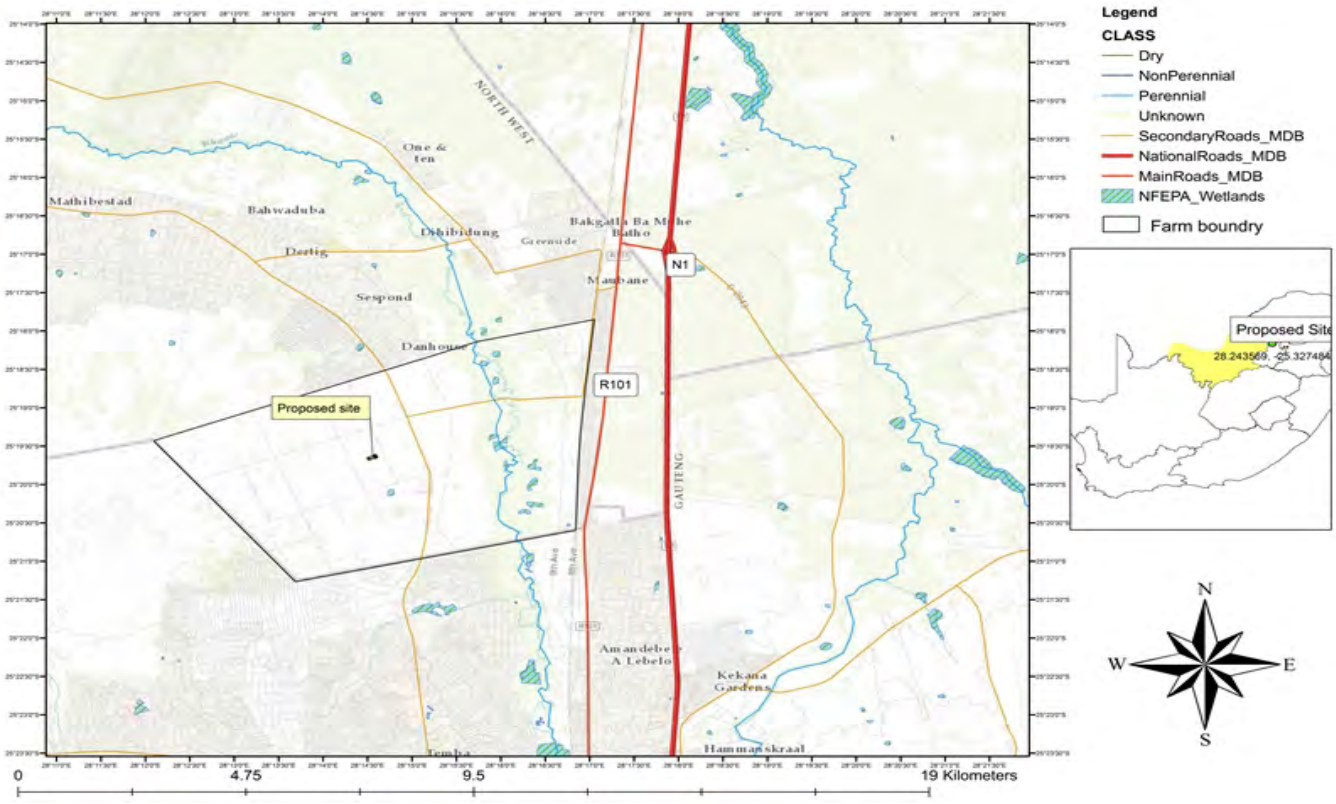

Figure 1: Regional locality of the proposed aquaculture facility

Blue-Green Aquaculture's production plan is set to increase production with three different phases over a period of five to ten years. The first phase will be the aquaponics with 20 metric tons of production (i.e. 20 000 kg) of Mozambique tilapia fish together with approximately 20 tonnes of lettuce; in the second phase the aquaculture increases to 100 tons of production of Mozambique tilapia fish together with approximately 20 tonnes of lettuce; and in the third phase on the fish production increases to 200 tons of tilapia together with approximately 20 tonnes of lettuce.

The water requirement for this project will be approximately 250 m^3 per annum for phase one for production of 20 tons of tilapia, increasing to 500 m^3 per annum for phase two of 100 tons of fish production, and lastly for phase three will be approximately 1500m^3 per annum for 200 tons of fish production. A water use licence general authorisation for phase one was obtained from the Department of Water Affairs in 07 July 2017 (Appendix I.3c). For phase two and three, the water use licence was logged with the Department of Water and Sanitation in 10 July 2017. Blue-Green Aquaculture Pty Ltd aims to produce approximately 20 tonnes of vegetables (lettuce from all phases). The vegetables will be produced annually from the waste water generated by the fish.

The greenhouse facility will have 18 deep water culture tanks (7.5m x 30m) for growing lettuce hydroponically; and the aquaculture component will include 10 tanks with the capacity to rear up to 200 metric tons per annum of Mozambique tilapia as production increases over 10 years through to phase three. The facility consists of a fish packing house, fish hatchery and a fish processing facility. During phase one, the project will transport live fish to a nearby fish processing facility. During phase two and three, Blue-Green aquaculture will develop their own fish processing facility to clean and freeze fish. The facility will process the waste to fish meal or sell it to Non Profit Organizations.

Mozambique tilapia (*Oreochromis mossambicus*), commonly known as blue kurper is native to southern Africa and is a popular fish species for aquaculture. It naturally occurs in coastal regions and the lower reaches of rivers in southern Africa and it generally prefers slow moving water bodies such as lagoons, rivers and impoundments, but can also colonise faster-flowing rivers and streams.

The area of the farm is 4.4 hectares and the planned footprint of the aquaponics project is approximately 2 hectares.

The construction phase is expected to give rise to approximately 6-12 new jobs; and the operations phase is planned to provide new jobs.

3.1 Technology choice and water management

The enterprise will start as an aquaponics facility (i.e. system of aquaculture in which the waste produced by farmed fish or other aquatic creatures supplies the nutrients for plants grown hydroponically, which in turn purify the water) and later it will be separated into an aquaculture farm and a hydroponics farm (where hydroponics is the process of growing plants in sand, gravel, or liquid, with added nutrients but without soil). Water will be sourced from the existing borehole on site and the effluent will be used to grow vegetables (i.e. lettuce) hydroponically. The technology to be employed on the farm is a recirculating aquaculture system (RAS) linked to hydroponic growbeds. Figure 2 is a simplified overview of the technology employed in an aquaponics system. The fish are grown in the fish rearing tanks (caption 1) and then the fish waste (faeces and uneaten food) flows into the settling tank (caption 2), where the process of biofiltration results in the conversion of toxic ammonia into plant friendly nitrates (caption 3) before the nitrate rich water is fed to the plants (caption 4). In the Deep Water Culture (DWC) beds (caption 5), the plants grow and take up the nitrates and other micronutrients thereby cleaning the

water (caption 6). The last step (caption 7) is the collection of clean water before being pumped back to the fish tanks.

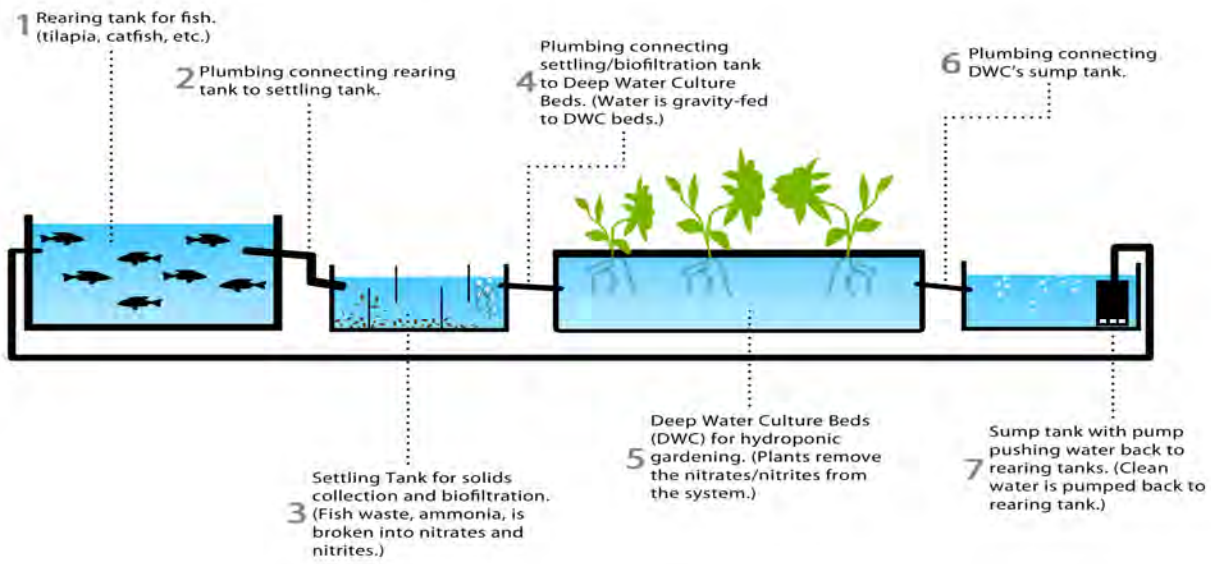

Figure 2: Overview of aquaponics technology being applied for this project

3.2 Proposed project components and layout

The main project components and the proposed layout plan for the full three phases of the project up to 200 000 kg per annum fish production is shown in Figure 2 and described below. The proposed infrastructure of the aquaponics facility will entail the following:

- Pure water tank with 5000 litres of water supply
- 10 fish rearing tanks, consisting of:
  - Five 5000 litre fish rearing tanks of 2700 mm diameter
  - Five 2500 litre fish rearing tanks of 2200 mm diameter
- 3 fish houses (30m length x 10m breadth):
  - Hatchery
  - Processing fish house
  - Packing of fish
- 9 greenhouses (30m length x 15m breadth), containing 18 deep water culture tanks for growing lettuce (each tank is 7.5m breadth x 30m length)
- Four clarifier tanks that are used to remove solid particulates or suspended solids from liquid for clarification and (or) thickening
- Sump that also serves as a reservoir
- Workers facilities (kitchen, toilet etc) (80m length x 40m breadth)
- Existing borehole and water storage dam.

On the layout plan for the aquaculture facility (Figure 3), the water from the fish tanks moves via gravity to the setting tanks (clarifiers) for the first step in removing solid waste. Water is further filtered and the conversion of toxic ammonia into nitrates and nitrites (plant food). The nitrate/nitrite rich food is fed to the plants in the greenhouses. The plants clean the water for the fish. The clean water is stored in the pure tank. The lettuce is grown in hydroponic tanks (Deep Water Culture beds) in the greenhouses.

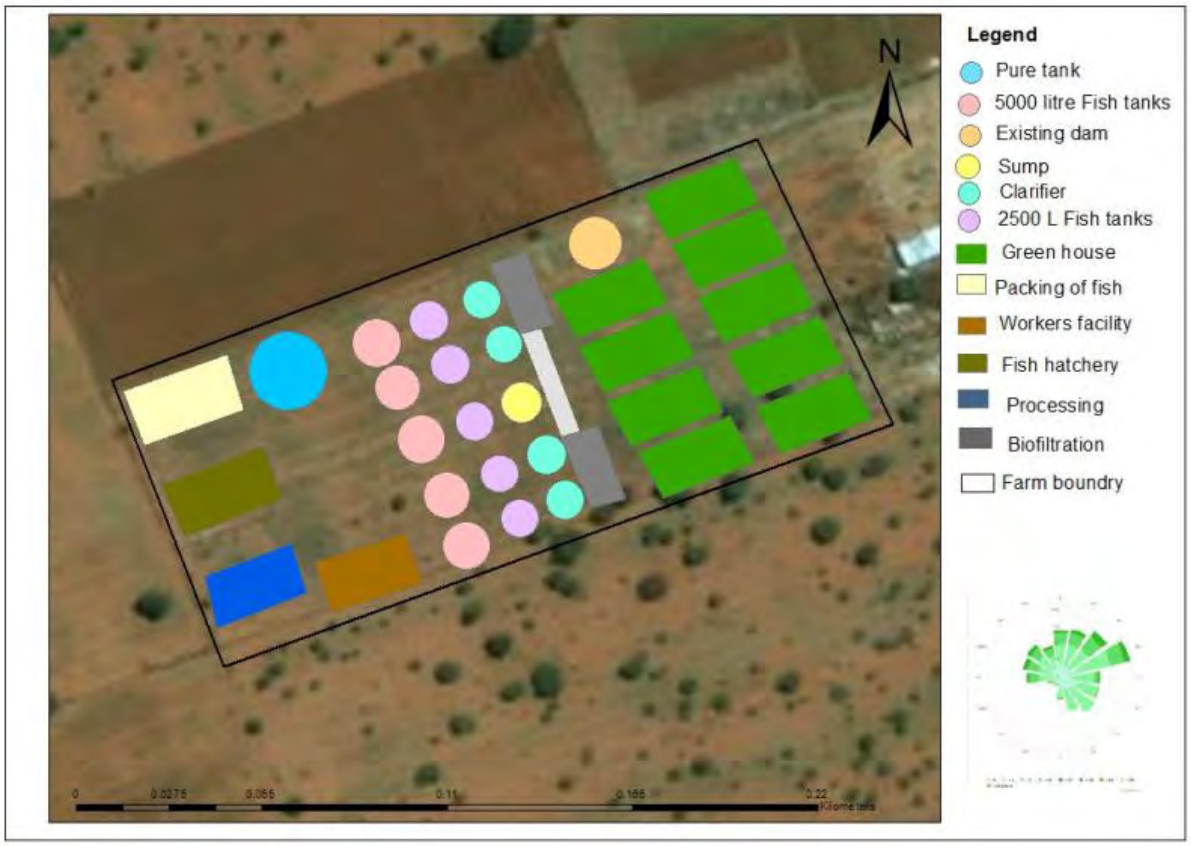

Figure 3: Layout plan for the proposed aquaculture facility

3.3 Identification of "no go" areas and avoidance of sensitive areas and buffers

There are no specific "no go" areas on the site that need to be avoided, based on environmental sensitivities or other factors. This was confirmed in the BA Report that included specialist studies on Ecology by Ekotrust, on hydrogeology by Impulse Water (Pty) Ltd and Environmental Assurance (Pty) Ltd, and on heritage by Heritage Contracts and Archaeological Consulting CC. The sensitivity mapping in the BA Report also reviewed the SANBI BGIS database and the National Freshwater Ecosystem Priority Areas (NFEPA) database and confirmed that there are no sensitivities on site from these databases that need to be avoided, including the requirement of 500m buffers around wetlands and rivers, as shown in Figure 4.

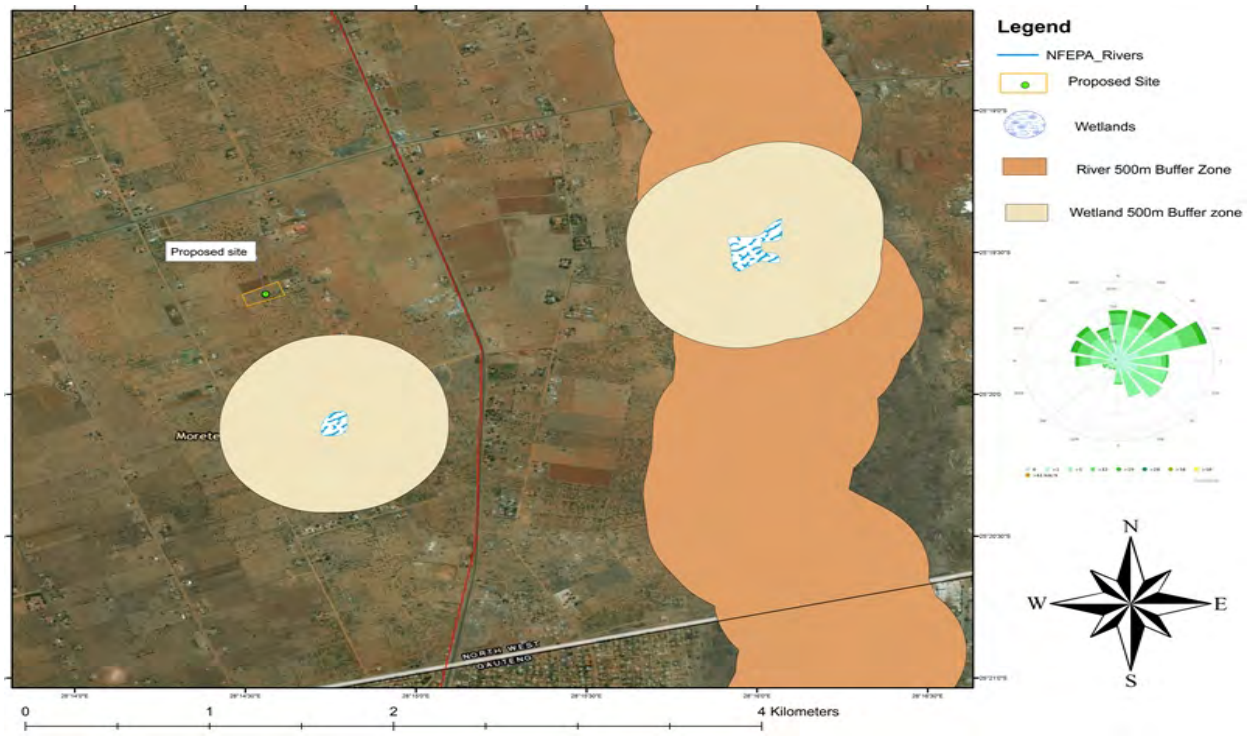

Figure 4: Layout of the proposed development with sensitivities

3.4 Technical operational management aspects of this project

Additional information on key technical operational management aspects is included in the EMPr. These are:

- Site groundwater management plan to ensure sustainable water supply to the project from the borehole on site and avoid unnecessary loss of water (refer to section 4.2)
- Aquaculture day-to-day water quality management plan, with reference to the South African Water Quality Guidelines for Agricultural Use (below).

Water quality is the most important aspect of the day-to-day management of the aquaculture facility and requires constant monitoring. Dissolved oxygen (DO) is one of the most important parameters in fish farming in cold water, where there is much more oxygen available for the fish to consume than in warm water. Thus farming fish in warm water, as for tilapia, requires even more intense oxygen monitoring and control than farming in cold water.

Table 2. Physical and chemical water quality parameters in an aquaculture recirculation system

Parameter	Formula	Unit	Normal	Unfavourable level
Temperature		oC	Depending on species	
Oxygen	O2	%	70-100	< 40 and > 250
Nitrogen	N2	% saturation	80-100	> 101
Carbon dioxide	CO2	mg/L	10-15	> 15
pH			6.5-7.5	< 6.2 and > 8.0
Phosphorus	PO43-	mg/L	1-20	
Nitrate	NO3-	mg/L	100-200	>300
Nitrite	NO2-	mg/L	0-0.5	> 0.5
Ammonia	NH3	mg/L	< 0.01 (pH influence)	> 0.025
Ammonium	NH4+	mg/L	0-2.5 (pH influence)	> 2.5
Suspended solids	SS	mg/L	25	> 100
Calcium	Ca++	mg/L	5-50	
Alkalinity		Mmol/L	1-5	< 1

Table 3. Water quality analysis results for Blue-Green Aquaculture

South African Water Quality Guidelines Agricultural Use:			
Paramater	Unit	Target Quality Range Volume 6 : Aquaculture	KBH01
pH at 25 C	pH	6.5 - 9.0	7.79
Alkalinity	mg CaCO3/l	20 - 100	230.75
Aluminium as Al	mg/l	< 0.03	BDL
Arsenic	mg/l	0 - 0.05	NA
Cadmium as Cd	Mg/l	Water Hadness (mg/CaCO3/l) 180 = 1.8 mg/l	BDL
Cloride as Cl	mg/l	600	160.8
Chromium as Cr	mg/l	< 20	BDL
Copper as Cu	mg/l	< 0.005	BDL
Iron as Fe	mg/l	< 0.01	0.02
Lead as Pb	mg/l	< 0.01	0.004
Manganese as Mn	mg/l	< 0.1	0.027
Nitrate (NO3) as N	mg/l	< 300	10.96
Nitrite (NO2) as N	mg/l	0 - 0.05	NA
Phenols (C6H5OH)	mg/l	< 1.0	NA
Phosphorus as Orthophosphate	mg/l	0.1	BDL
Selenium (Se(VI))	mg/l	< 0.3	NA
Sulphide	mg/l	< 0.001	NA
Total Hardness	mg CaCO3/l	20 - 100	301
Beryllium as Be	mg/l	NS	BDL
Boron as B	mg/l	NS	BDL
Fluoride as F	mg/l	NS	BDL
Lithium as Li	mg/l	NS	BDL
Molybdenum as Mo	mg/l	NS	BDL
Nickel	mg/l	NS	BDL
Sodium as Na	mg/l	NS	63.801
Electrical Conductivity	mS/m	Turbid Water Species < 20 000	107.4
Vanadium as V	mg/l	NS	BDL

The majority of the parameters for the project are within the SAWQG guideline values for agriculture (aquaculture) with the exception of Alkalinity, Total Hardness and Iron (as Fe), which exceeded the guideline values table above

4. ENVIRONMENTAL MANAGEMENT PROGRAMME, INCLUDING MANAGEMENT OBJECTIVES, MANAGEMENT OUTCOMES, MANAGEMENT ACTIONS AND MONITORING

The EMPr is provided for the following phases of the project:

- Design and planning phase
- Construction phase
- Operational phase
- Decommissioning phase.

4.1 Management objectives and actions for the Design and Planning Phase

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
1	Ensure the footprint of the aquaponics project is limited to the allocated 2 hectares (the total farm area is 4.4 ha). This will avoid impacts on any flora and flora of conservation importance or of medicinal value.	Detailed site design to ensure that the project footprint is restricted to the proposed 2 hectares.	Review of final project plan when ready for submission to Local Authorities for local planning approval. This plan must include designated areas for specific activities, such as storage of topsoil, general waste, parking for vehicles, construction materials etc.	Check final project plan when ready for submission to Local Authorities	Blue-Green Aquaculture
2	Ensure the detailed design for waste-water management for the project prevents pollution of surrounding areas by avoiding any waste-water discharges and including design measures to manage potential spills.	Water balance plan and detailed design for waste-water to avoid discharges on site that could impact on surrounding land use.	Review of final project design when ready for submission to Local Authorities for local planning approval.	Once-off during design followed by regular control	Blue-Green Aquaculture
3	Design a detailed storm water management plan for the facility to prevent erosion and/or impact on surrounding areas.	The design of the stormwater management system must attenuate water on the farm and prevent erosion.	Use of swales or areas where water can soak-away, as part of the stormwater design for the project.	Once-off during design followed by regular control	Blue-Green Aquaculture
4	Minimise the risk of introduction and/or proliferation of alien plant and animal species on site, with the planned rehabilitation focused on indigenous plant species.	Prepare a site rehabilitation plan as part of the planning for the construction phase that includes establishment of indigenous vegetation.	Include the need for a site rehabilitation plan using indigenous vegetation as part of the construction tender documents to contractors, to ensure this is part of the construction phase planning.	Check site rehabilitation plan is included as Contractual requirement	Blue-Green Aquaculture
5	Contractors understand and plan for the Construction management actions, in order to meet the EMPr requirements.	Project developer conveys the construction management requirements to the Contractors	Ensure that Contractors incorporate the Construction management actions into their project proposals and contracts, such as the designation of areas for specific activities, good house-keeping requirements, waste recycling, pest management, etc.	Check contract documents with Contractors	Blue-Green Aquaculture
6	ECO appointed to oversee Construction phase	Appoint an ECO	Advertise for and source a suitably qualified ECO, including preparation of a monthly site monitoring checklist to be used by the ECO.	Appointment of ECO to be finalised before start of Construction	Blue-Green Aquaculture

4.2 Management objectives and actions for the Construction Phase

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
1	Ensure the footprint of the aquaponics project is limited to the allocated 2 hectares (the total farm area is 4.4 ha). This will avoid impacts on any flora and flora of conservation importance or of medicinal value. This also avoids heritage impacts such as grave, as there are no graves on the project site.	Demarcate 2 ha construction area and ensure that vehicle access is limited to this zone.	Demarcate the site using hazard tape and clearly specify the access route for vehicles.	Start of construction	Farm Manager
2	Activities are limited to designated areas to avoid environmental risks.	Designate areas on site for specified activities.	Designate areas on site for specified activities, such as storage of topsoil, temporary storage and sorting of general waste, parking for vehicles, storage of construction materials, washing of vehicles, etc.	Start of construction	Farm Manager

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
3	Good house-keeping applied on site during construction	Good house-keeping actions are specified for all Contractors on site	Good house-keeping actions are specified for all Contractors on site, such as keeping construction activities neat and tidy, vehicles and machinery to be properly serviced to reduce noise and atmospheric emissions, waste skips to be clearly labelled, contractors to wear adequate Personal Protective Equipment (PPE), pest management, etc.	Monthly, using the site monitoring checklist	ECO
4	Avoid pollution of the surrounding environment as a result of the handling, temporary storage and disposal of general solid waste. (No hazardous waste storage has been identified as part of the construction phase).	Reduce risk of soil and groundwater contamination as a result of incorrect storage, handling and disposal of general waste.	• General waste and hazardous waste should be stored temporarily on site in suitable (and correctly labelled) waste collection bins and skips (or similar). Waste collection bins and skips should be covered with suitable material, where appropriate. • Should the on-site storage of general waste and hazardous waste exceed 100 m^3 and 80 m^3 respectively, then the National Norms and Standards for the Storage of Waste (published on 29 November 2013 under Government Notice 926) must be adhered to. • Ensure that the construction site is kept clean at all times and that construction personnel are made aware of correct waste disposal methods. • Ensure that sufficient general waste disposal bins are provided for all construction personnel throughout the site. These bins must be emptied on a regular basis. • No solid waste may be burned on site. • The Contractor should provide adequate waste skips (or similar) on site and the Construction Contract should specify that the Contractor must be responsible for the correct disposal of the contents of the waste skips. • All construction waste (including rubble) should be frequently removed from site and correctly disposed using a licensed municipal landfill site • Establish appropriate emergency procedures for accidental contamination of the surroundings. Waste recycling should be incorporated into the facility's operations as far as possible.	Monthly, using the site monitoring checklist	ECO
5	Avoid pollution caused by spillage or discharge of construction waste water into the surrounding environment and/or via stormwater from the site.	Prevent the spillage of waste water from construction through management of stormwater, sewage, chemicals, oils, liquid wastes etc.	• Contractor(s) to submit a Method Statement for Stormwater Management during the construction phase before commencing construction activities. • Provide secure storage for oil, chemicals and other waste materials in order to prevent contamination	Monthly, using the site monitoring checklist	ECO

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
			of stormwater runoff. • Regular inspections of stormwater infrastructure should be undertaken to ensure that it is kept clear of all debris and weeds.		
6	Rehabilitation of the sites makes use of indigenous vegetation and top soil from the site, to enhance retention of natural seed-bank in the soil and minimise the risk of introducing alien plants.	Implement the rehabilitation plan for the construction phase.	Topsoil from excavations is to be stockpiled on site and used in subsequent rehabilitation, and may also contain an indigenous seed bank. Rehabilitation and planting to use indigenous and water-wise species.	Monthly, using the site monitoring checklist	ECO
7	Minimise erosion impacts from stormwater run-off	Divert and impede surface water flows from areas with construction activities	Contractor(s) to submit a Method Statement for Stormwater Management during the construction phase before commencing construction activities that includes actions to manage stormwater on site, such as diversion and impediment of flow.	Monthly, using the site monitoring checklist	ECO
8	Minimise dust impact from construction vehicles, especially during winter when the soil is dry.	Apply dust abatement measures	Use dust abatement measures such as spraying water on the road (if sufficient water is available), or adding mulch to soil, or use of soil-binding sprays or applications. Construction vehicles travelling on unpaved roads to not exceed a speed of 40 km/hour.	Monthly, using the site monitoring checklist	ECO
9	Minimise the visual impact of the construction phase on surrounding residents and on local fauna	Apply standard visual impact mitigation for construction projects	Apply standard visual impact mitigation for construction projects, such as limiting construction activities to day time hours, minimising security and construction lighting, minimise dust impacts from vehicles, etc.	Monthly, using the site monitoring checklist	ECO
10	Prevent disturbance to and damage to heritage artefacts, should any be found on site during construction.	Prevent damage and destruction to fossils, artefacts and materials of heritage significance.	The construction workers must be briefed on the potential uncovering of heritage features and what actions are then required. If artefacts of heritage significance are discovered, the activities in that area must cease and the South African Heritage Resources Agency (SAHRA) must be immediately contacted.	Monthly, using the site monitoring checklist	ECO
11	Maximise the socio-economic benefits from employment creation and skills development during the construction phase, which is expected to give rise to approximately 6-12 new jobs.	Maximise local employment and local business opportunities to promote and improve the local economy.	Enhance the use of local labour and local skills as far as reasonably possible. Where the required skills do not occur locally, and where appropriate and applicable, ensure that relevant local individuals are trained	Specify local requirements in tender documents and review during the construction phase	Farm Manager

4.3 Management objectives and actions for the Operations Phase

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
1	Abstraction of groundwater from the borehole on site is conducted sustainably and without unnecessary loss of water resources	Measure, monitor, evaluate and update management measures continuously through the life of project.	Impulse Water (Pty) Ltd, 2017, (in a specialist study for the BA Report) recommends the following pumping schedule for suitable use: • Pumping Cycle: The borehole (KBH01) must be pumped at 0.2 l/sec (720 l/hr) for 8 hours, then	Groundwater should only be abstracted according to the pumping cycle. Conduct quarterly monitoring of	Farm Manager

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
			allow for 2 hours of groundwater recovery. This pumping cycle can be repeated twice within a 24-hr period. • A total water volume of 11 520 l/day (11.52 m3/day) could be abstracted by following the recommended pumping schedule. • All the abstracted water must be reticulated into three (1) 5 000 litre water storage tank onsite. The water storage tank must be kept full at all times and this can be achieved by means of installing Float Switches into the water storage tank to "top-up" the tank when the water level drops.	groundwater levels and quality, including water quality across the site and abstraction volumes.	
2	Quality of groundwater abstracted is suitable for the project	Sampling and analysis of groundwater	• Groundwater to be analysed against the South African Water Quality Guidelines (for agriculture) and the SANS241:2015 Drinking Water Standards and the relevant Water Use license for the project. • Ensure that there are appropriate control measures in place for any contamination event.	Quarterly sampling for water quality analysis, with full analysis in April and October, and abbreviated analysis in January and July	Farm Manager
3	Responsible water demand management in order to avoid unnecessary waste of water	Prepare site water balance	One person at management level to be responsible for managing the overall site water balance and preparing an annual site water balance report.	Site water balance report to be prepared annually	Farm Manager
4	Waste water management is conducted effectively to avoid impacts on the fish as well as the receiving environment. The facility will process the waste to fish meal or sell it to Non Profitable Organizations.	Waste water management to be implemented as crucial to successful ongoing operations	• The higher the rate of recirculation the less new water will be used, and the less discharge water will need to be treated. • Waste recycling should be incorporated into the facility's operations as far as possible. • Designate a secured, access restricted, signposted room for the storage of potentially hazardous substances such as herbicides, pesticides and medications. All hazardous waste should be disposed of at an appropriate licensed facility for this • Educate workers regarding the handling of hazardous substances and about waste management and emergency procedures with regular training and notices and talks. • Establish appropriate emergency procedures for accidental contamination of the surroundings from waste-water spills.	Conduct daily water quality monitoring using the Operational phase monitoring checklist.	Farm Manager or ECO
5	Avoid impacts on biosecurity and transmission of diseases.	Prevent the attraction of pests and animals carrying infectious diseases and ensure the containment of disease outbreaks if the occur.	• Fish mortalities must be identified and removed immediately from tanks. • Workers must be effectively trained to handle sick and dead fish. • Emergency procedures that aim to address the	Use the Operational monitoring checklist. Conduct monthly for first two years of operation, and thereafter quarterly.	ECO

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
			potential for disease outbreaks must be developed and implemented where applicable • Eggs or fish stocked in the facility must be disease free and preferably from a certified disease free strain • Water used must be disease free or sterilised before going into the system • No visitors or stuff should enter the farm sick.		
6	Apply energy efficient means of water temperature regulation	Water heating technology may be needed in winter to warm the water for the tilapia.	Apply energy efficient means of water heating in winter, such as use of heat pumps or solar power.	Quarterly monitoring of energy efficiency and electricity usage.	Farm Manager
7	Apply effective pest control measures to minimise spread of pests and associated disease risks.	Prevent, detect and control pest infestations before they become a problem, through frequent and careful cleaning, monitoring and control.	• Ensure that there is effective storm water drainage around the facility • Ensure that the facility is sufficiently ventilated to keep floors and feedstock as dry as possible. • Clean floors regularly, removing any excess feed, excrement etc. • Remove all trash, and sources of feed and water for pests from the outside perimeter of the facilities. • Control rodents through effective sanitation. • Ensure that measures to control pests are tightly restricted to areas where these are problematic. Pest control measures should be taxon-specific. If necessary, advice should be sought from an appropriate specialist.	Quarterly using the Operational monitoring checklist.	Farm Manager
8	Maintain site using indigenous vegetation	Limit risk of alien vegetation spreading on site	Plant only locally indigenous flora if landscaping needs to be done	Throughout Operation	Farm Manager and ECO
9	Minimise the visual impact of the operations phase on surrounding residents and on local fauna	Apply standard visual impact mitigation for agricultural operations	• Apply standard visual impact mitigation for the operation of agricultural projects, such as minimising security and construction lighting, ensure that all outdoor lights are angled downwards and/or fitted with hoods, etc. • Where possible, using timer switches or motion detectors to control lighting in areas that are not occupied continuously (if permissible and in line with minimum security requirements). • Switching off lights when not in use in line with safety and security.	Monthly, using the site monitoring checklist	ECO
11	Maximise the socio-economic benefits from employment creation and skills development during the operations phase, which is	Maximise local employment and local business opportunities to promote and	Enhance the use of local labour and local skills as far as reasonably possible. Where the required skills do not occur	Annual review of employee profile and employment &	Farm Manager

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
	expected to give rise to approximately 24 jobs in phase 1, increasing to 74 permanent jobs and 46 seasonal jobs in phase 2, and ultimately 105 permanent jobs and 80 seasonal jobs in phase 3.	improve the local economy.	locally, and where appropriate and applicable, ensure that relevant local individuals are trained.	training opportunities provided to people from the local area.	

4.4 Management objectives and actions for the Decommissioning Phase

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
1	Conduct decommissioning in accordance with legislated requirements applicable at the time.	Identify applicable legal requirements	Identify applicable legal requirements for site clearing and clean-up at the time of decommissioning.	To be determined	Farm Manager
2	Prevent proliferation of alien invasive plant and animal species	By law, remove and dispose of Category 1b alien species on site. All Category 2 species that remain on site must require a permit.	Remove Category 1b alien species that may have appeared on site using mechanical methods and minimise soil disturbance as far as possible.	Conduct monthly during decommissioning using the Decommissioning checklist	ECO
3	Limit disturbances to surrounding residents and local fauna and flora from decommissioning activities	Minimise impacts of noise, dust and lightning.	Limit demolition activities to day time hours. Minimise vehicle activity and ensure vehicles are properly serviced. Apply effective dust management.	Conduct monthly during decommissioning using the Decommissioning checklist	ECO
4	Potential spillage of effluent to the surrounding environment (from portable sanitation facilities for decommissioning personnel).	Reduce the spillage of domestic effluent and the impact thereof on the environment.	Normal sewage management practises should be implemented. These include ensuring that portable sanitation facilities are regularly emptied and the resulting sewage is transported safely (by an appointed service provider) for correct disposal at an appropriate, licenced facility. Proof of disposal (in the form of waste disposal slips or waybills) should be retained on file for auditing purposes.	Conduct monthly during decommissioning using the Decommissioning checklist	ECO
5	Discharge of contaminated stormwater into the surrounding environment.	Reduce the contamination of stormwater.	The appointed Contractor should compile a Method Statement for Stormwater Management during the decommissioning phase.	Conduct monthly during decommissioning using the Decommissioning checklist	ECO

No.	Impact management objectives and outcomes	Management actions	Methodology to achieve the management actions	Monitoring method & frequency	Responsibility
6	Pollution of the surrounding environment as a result of the handling, temporary storage and disposal of solid waste.	Reduce soil and groundwater contamination as a result of incorrect storage, handling and disposal of general and hazardous waste.	• General waste (i.e. building rubble, demolition waste, discarded concrete, bricks, tiles, wood, glass, plastic, metal, excavated material, packaging material, paper and domestic waste etc.) and hazardous waste (i.e. empty tins, paint and paint cleaning liquids, oils, fuel spillages and chemicals etc.) generated during the decommissioning phase should be stored temporarily on site in suitable (and correctly labelled) waste collection bins and skips (or similar). Waste collection bins and skips should be covered with suitable material, where appropriate. • Ensure that general waste and hazardous waste generated are removed from the site on a regular basis and disposed of at an appropriate, licensed waste disposal facility by an approved waste management Contractor. Waste disposal slips or waybills should be kept on file for auditing purposes as proof of disposal. • Ensure that sufficient general waste disposal bins are provided for all personnel throughout the site. These bins must be emptied on a regular basis.	Conduct monthly during decommissioning using the Decommissioning checklist	ECO
7	Emissions from decommissioning vehicles and generation of dust as a result of earthworks and demolition.	Reduce dust emissions during decommissioning activities.	• Ensure that cleared (excavated) areas and unpaved surfaces are sprayed with water (obtained from an approved source) to minimise dust generation. • Approved soil stabilisers may be utilised to limit dust generation. • Ensure that decommissioning vehicles travelling on unpaved roads do not exceed a speed limit of 40 km/hour.	Conduct monthly during decommissioning using the Decommissioning checklist	ECO
8	Potential health injuries to workers during decommissioning, especially activities like demolition.	Prevent health effects such as on hearing impacts and respiratory illnesses on personnel.	Ensure that all decommissioning personnel are provided with adequate PPE for use where appropriate. Decommissioning personnel must wear proper hearing protection.	Check continuously during decommissioning	ECO

5. ENVIRONMENTAL EDUCATION AND AWARENESS PLAN

The environmental awareness training should be undertaken when necessary and it is the responsibility of the farm manager to ensure that every person who will be coming to site is educated about the general conduct. Furthermore a register must be signed as part of the monitoring process; this will serve as proof that workers were made aware of the sensitivities on site. A method statement will be compiled by the contractor prior to commencement of construction activities. The method statement will comply with all the recommendations that have been outlined in the EMPr of the project with aims to protect environmental resources, minimise pollution and to rehabilitate disturbed areas.

The Farm Manager will be responsible for implementing a programme that will raise environmental awareness for all construction workers. The environmental awareness training will be presented to all workers in other to promote a successful implementation of the EMPr. An Environmental Control Officer shall be appointed to assist the manager with effective implementation of the programme and to also ensure compliance with all conditions of authorisations received.

The Awareness training shall emphasise the importance of an EMPr in order to promote compliance. All the environmental impacts that are associated with the proposed development should be outlined together with the proposed mitigation measures.

During construction, the ECO must conduct awareness training with the Contractors that includes:

- the need to conserve water and makes all affected parties aware of the water conservation and water demand management practices on site, as well as water pollution avoidance and reporting procedures for incidents;
- briefing construction workers on the potential uncovering of heritage features, what these might look like, and what actions are then required.

6. ENVIRONMENTAL MONITORING, REPORTING AND AUDITING

The construction area must be inspected and the Environmental Control Officer must compile a report after each inspection. Should non-compliance be recorded, the construction activities must be ceased until remedial actions are taken to ensure compliance. The report must be submitted to the Farm manager who can then address any issues raised with the engineer and contractor. The reports will be kept as part of record keeping and will be sent to READ should they be requested.

The Environmental Control Officer will be responsible for monitoring of construction activities on site to also ensure that all the recommendations of the EMPr are adhere to during the construction phase of the programme. Monitoring of compliance with all the recommendations should be done regularly in order to protect the natural resources on site.

Written records should entail the method statement, the approved EMPr that consists of monitoring reports, a site incident register, relevant authorisations that have been obtained and records of any meeting and training held with the construction workers. The farm manager will also be responsible for post construction phase monitoring programme i.e. clearance of Invasive Alien Species on site, the removal of debris during flooding etc.

7. REFERENCES

Jacob Bregnballe. A Guide to Recirculation Aquaculture An introduction to the new environmentally friendly and highly productive closed fish farming systems. FAO 2015.

Recirculation Aquaculture by M.B. Timmons & J.M. Ebeling, NRAC Publication No. 01-007, Cayuga Aqua Ventures, USA, 2002, ISBN 978-0-9712646-2-5

The EMPr is also informed by the following specialist studies conducted as part of the Basic Assessment process.

Name	Company/organisation	Specialist topic
Noel Van Rooyen	EKOTRUST	Flora fauna and wetlands
David van der Merwe	Environmental Assurance (Pty) Ltd	Geohydrology study
Du Toit Wilken	Environmental Assurance (Pty) Ltd	Geohydrology study
Matthew Damhuis	Impulse water	Geohydrology study
Jaco Breytenbach	Impulse water	Geohydrology study
Jaco van der Walt	HCAC	Heritage impact assessment

BASIC ASSESSMENT REPORT

Appendix K:
Details of EAPs and expertise

CONTENTS

Appendix K: CVs of the Project Team

CSIR
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**Curriculum Vitae of Paul Lochner –
Technical Advisor and
Quality Assurance (EAPSA) Certified**

Name of firm	CSIR
Name of staff	Paul Lochner
Profession	Environmental Assessment and Management
Position in firm	Manager: CSIR Environmental Management Services
Years' experience	24 years
Nationality	South African

Biographical Sketch

Paul Lochner commenced work at CSIR in 1992, after completing a degree in Civil Engineering and a Masters in Environmental Science, both at the University of Cape Town. His initial work at CSIR focused on sediment dynamics and soft engineering applications in the coastal zone, in particular, beach and dune management. He conducted several shoreline erosion analyses and prepared coastal zone management plans for beaches. He also prepared wetland management plans.

As the market for environmental assessment work grew, he led Environmental Impact Assessments (EIAs), in particular for coastal resort developments and large-scale industrial developments located on the coast; and Environmental Management Plans (EMPs), in particular for wetlands, estuaries and coastal developments. He has also been involved in researching and applying higher-level approaches to environmental assessment and management, such as Strategic Environmental Assessment (SEA). In 1998-1999, he coordinated the SEA research programme within the CSIR, which led to him being a lead author of the Guideline Document for SEA in South Africa, published by CSIR and national Department of Environmental Affairs (DEA) in February 2000.

In 1999 and 2000, he was the project manager for the legal, institutional, policy, financial and socio-economic component of the Cape Action Plan for the Environment ("CAPE"), a large-scale multi-disciplinary study to ensure the sustainable conservation of the Cape Floral Kingdom. This was funded by the Global Environmental Fund (GEF) and prepared for WWF-South Africa. The study required extensive stakeholder interaction, in particular with government institutions, leading to the development of a Strategy and Action Plan for regional conservation.

In July 2003, he was certified as an Environmental Assessment Practitioner by the

Interim Certification Board for Environmental Assessment Practitioners of South Africa.

He has authored several guidelines for government. In 2004, he was lead author of the *Overview of IEM* document in the updated Integrated Environmental Management (IEM) Information Series published by national Department of Environmental Affairs and Tourism (DEAT). In 2005, he was part of the CSIR team that prepared the series entitled *Guidelines for involving specialists in EIA processes* for the Western Cape Department of Environmental Affairs and Development Planning (DEADP); and he authored the *Guideline for Environmental Management Plans* published by Western Cape government in 2005. In 2006-2007, he worked closely with the (then) Dept of Minerals and Energy (DME) of South Africa to prepare a Guideline for Scoping, Environmental Impact Assessment and Environmental Management Plans for mining in South Africa.

Over the past 20 years has been closely involved with several environmental studies for industrial and port-related projects in Coega Industrial Development Zone (IDZ), near Port Elizabeth. This included the SEA for the establishment of the Coega IDZ in 1996/7, an EIA and EMP for a proposed aluminium smelter in 2002/3, and assistance with environmental permit applications for air, water and waste. At the Coega IDZ and port, he has also conducted environmental assessments for port development, LNG storage and a combined cycle gas turbine power plant, manganese export, rail development, marine pipelines, and wind energy projects.

Since 2009, he has undertaken numerous EIAs for the renewable energy sector, in particular for wind and solar photovoltaic energy projects. In these EIAs, he has been project leader and integrated the specialist findings from a range of specialist disciplines.

He is currently project leader on two Strategic Environmental Assessments (SEAs) that are being undertaken for national DEA. These SEAs are to support the implementation of the Strategic Integrated Projects (SIPs) that are being promoted by the Presidential Infrastructure Coordinating Committee (PICC). The SEA for Wind and Solar Photovoltaic Energy for South Africa is being conducted over 2013-2014, and the SEA for electricity grid infrastructure commenced January 2014.

Since 2009, Paul has been the manager of the Environmental Management Services (EMS) group within CSIR. This group currently consists of approximately 20 environmental assessment practitioners and a group assistant, with offices in Stellenbosch and Durban. EMS focuses on conducting complex environmental studies in challenging environments, such as remote and data poor regions in Africa (e.g. Cameroon, Gabon, Angola, Namibia and Ethiopia). We also specialise in environmental studies for emerging and innovative technologies, drawing on research and applied scientific expertise within CSIR. Our role is to assist in ensuring the sustainability of projects in terms of environmental and social criteria, by providing a range of environmental services that extend across the project lifecycle, from the pre-feasibility stage through to feasibility, commissioning, operations and closure. We provide this service to government, international agencies, private sector and non-government organisations.

EMPLOYMENT TRACK RECORD

The following table presents a sample of the projects that Paul Lochner has been involved in to this date:

Completion Date	Project description	Role	Client
In progress	**SEA for Aquaculture** Development in South Africa (marine and freshwater)	Project leader	DEA and DAFF
In progress	**SEA for the Square Kilometre Array** radio-telescope in the Karoo, South Africa	Project leader	DEA and DST
2015-2017	**SEA for Shale Gas Development** in South Africa	Project co-leader	Dept of Environmental Affairs (DEA), DMR, DOE, DST, DWS
2015-2016	SEA for the development of **Electrical Grid Infrastructure** for South Africa	Project leader	DEA
2016-2017	EIA for the 75 MW x 12 **solar photovoltaic** energy projects near Dealesville, Free State	Project Leader	Mainstream Renewable Power SA
2014-2015	SEA of **planning** for the far south Cape Peninsula	Project Leader	City of Cape Town
2013-2015	EIA for the Ishwati Emoyeni 140 MW **wind energy project** and supporting electrical infrastructure near Murraysburg, Western Cape	Project Leader	Windlab
2013-2015	EIA for the Saldanha marine outfall **pipeline**	Project Leader	Frontier Saldanha Utilities
2012-2015	SEA for identification of **renewable energy zones** for wind and solar PV projects in South Africa	Project leader	DEA
2012-2013	**Environmental Screening Study for a desalination plant** for the City of Cape Town	Project leader	City of Cape Town & WorleyParsons
2012-2013	EIA for **LNG Import** to the Mossel Bay Gas-to-Liquid refinery (stopped end of Scoping)	Project leader	PetroSA
2012-2013	EIA for the **desalination plant** for the Saldanha area	Project leader	West Coast District Municipality & WorleyParsons
2012-2013	EIA for the **manganese export terminal** at the Port of Ngqura and Coega IDZ	Project leader	Transnet

Completion Date	Project description	Role	Client
2011 - 2012	EIA for the **100 MW solar photovoltaic** project proposed by Mainstream Renewable Power at Blocuso, near Keimoes in the Northern Cape	Project leader	Mainstream Renewable Power
2011 – 2012	EIA for the **100 MW solar photovoltaic** project proposed by Mainstream Renewable Power at Roode Kop Farm, near Douglas, in the Northern Cape	Project leader	Mainstream Renewable Power
2011 – 2012	EIA for the 75 MW **solar photovoltaic project** proposed by Solaire Direct at **GlenThorne**, near Bloemfontein in the Free State	Project leader	Solaire Direct
2011 – 2012	EIA for the 75 MW **solar photovoltaic project** proposed by SolaireDirect at **Valleydora**, near Springfontein in the Free State	Project leader	Solaire Direct
2010-2011	More than 10 Basic Assessments (BAs) for **solar photovoltaic projects** in the western cape, Northern Cape, Eastern Cape and Free State	Project leader	Various clients including Dutch, German, French and South African companies
2010/2011	**EIA for the Langerfontein** wind project near Darling, Western Cape.	Project leader	Mr Herman Oelsner, Khwe Khoa
2010/2011	**EIA for a 100 MW wind project at Zuurbron and a 50 MW wind project Broadlands** in the Eastern Cape	Project leader	WindCurrent SA (German-based company)
2010/2011	**EIA for the proposed 143 MW Biotherm wind energy project near Swellendam**, Western Cape, South Africa	Project leader	Biotherm South Africa (Pty) Ltd
2010/2011	**EIA for the proposed InnoWind wind energy projects near Swellendam, Heidelberg, Albertinia and Mossel Bay (totalling approx 210 MW),** Western Cape, South Africa	Project leader	InnoWind South Africa (Pty) Ltd
2009/2010	**EIA for the proposed Electrawinds wind energy facility** of 45-75 MW capacity in the Coega IDZ, Eastern Cape	Project leader	Electrawinds N.V. (Belgium)

Completion Date	Project description	Role	Client
2009/2010	**EIA for proposed 180 MW Jeffreys Bay wind energy project,** Eastern Cape	Project Leader and co-author	Mainstream Renewable Power South Africa
2009/2010	**Basic Assessment for the national wind Atlas for South Africa**	Project leader	SANERI and SA Wind Energy Programme, Dept of Energy
2009/2010	**EIA for the proposed Gecko soda plant,** Otjivalunda and Arandis, Namibia (cancelled)	Project leader	Gecko, Namibia
2009-2010	**EIA for the proposed desalination plant** at Swakopmund, Namibia	Project leader	NamWater, Namibia
2009	**EMP for the Operational Phase of the Berg River Dam**, Franschoek, South Africa	Project leader and report co-author	TCTA, South Africa
2009/2010 *(on hold)*	**EIA for the proposed crude oil refinery** at Coega, South Africa	Project leader and lead author	PetroSA, South Africa
2008	**Environmental Risk Review** for proposed LNG/CNG import to Mossel Bay, South Africa	Project leader and lead author	PetroSA, South Africa
2008	**Review of the Business Plan** for catchment management for the Berg Water Dam Project, Franschhoek, South Africa	Project reviewer and co-author	TCTA, South Africa
2007 – 2010	**EIA for proposed Jacobsbaai Tortoise Reserve eco-development**, Saldanha, Western Cape	Project Leader and co-author	Jacobsbaai Tortoise Reserve (Pty) Ltd
2007 – 2010	**Independent reviewer** for the EIA proposed Amanzi lifestyle development, Port Elizabeth	Independent reviewer appointed to advise EAP	Public Process Consultants and Pam Golding
2007 – 2008	**EIA for proposed 18 MW Kouga wind energy project,** Eastern Cape	Project Leader and co-author	Genesis Eco-Energy (Approved by DEDEA in March 2009)
2007	**Review of EIA for the proposed Hanglip Eco-Development**, Plettenberg Bay, Western Cape	Co-author of review of EIA, undertaken on behalf of DEADP	Dept of Environmental Affairs & Development Planning, Western Cape
2006-2007	**Scoping phase for the EIA for the proposed Coega LNG-to-Power Project** at the Port of Ngqura, Coega IDZ	Project Leader and co-author	Eskom and iGas
2006-2007	**Guideline** for Scoping, Environmental Impact	Project leader and co-author	Dept of Minerals and Energy (DME), South

Completion Date	Project description	Role	Client
	Assessment and Environmental Management Plans for mining in South Africa		Africa
2006	**Environmental Impact Assessment (EIA)** for the extension of the Port of Ngqura, Eastern Cape	Project Leader and co-author	Transnet
2006	**Integrating Sustainability Into Strategy: Handbook** (Version 1)	Project Leader and co-author	CSIR (STEP research report)
2005	**Technology Review** for the proposed aluminium smelter at Coega, South Africa	Project Leader and lead author	Alcan, Canada
2005	**Environmental and Social Impact Assessment (ESIA) report** for the proposed alumina refinery near Sosnogorsk, Komi Republic, Russia	Project manager and co-author	Komi Aluminium, Russia, IFC, EBRD
2005	**Guideline for Environmental Management Plans (EMPs)** for the Western Cape province, including conducting a training course for provincial government	Author	Dept of Environmental Affairs & Development Planning, Western Cape
2005	**Guideline for the review of specialist studies** undertaken as part of environmental assessments	Member of Steering Committee and project facilitator	Dept of Environmental Affairs & Development Planning, Western Cape
2004	**Review of Strategic Management Plan** for Table Mountain National Park (2001-2004)	Reviewer and co-author	South African National Parks
2004	**Strategic Needs Assessment Process** for mainstreaming sustainable development into business operations	Researcher and co-author	CSIR (internal research)
2004	**Environmental Monitoring Committees** booklet in the IEM Information Series for DEAT	Contributing author	Department of Environmental Affairs and Tourism (DEAT)
2004	**Overview of Integrated Environmental Management** (IEM) booklet in the IEM Information Series	Lead author and researcher	DEAT
2003	**Environmental Screening Study** for gas power station, South Africa	Project Manager and lead author	Eskom, iGas and Shell
2003	**Environmental Management**	Project Manager and lead author	Pechiney, France

Completion Date	Project description	Role	Client
	Programme (EMP) Framework for the proposed Coega Aluminium Smelter; and assistance with preparing permit and licence applications		
2003	**Environmental Management Plan** for the Operational Phase of the wetlands and canals at Century City, Cape Town	Project leader and lead author	Century City Property Owners' Association
2002	**Environmental Impact Assessment** for the proposed Pechiney aluminium smelter at Coega, South Africa	Project Manager and lead author	Pechiney, France
2002 - 2003	**Research project:** Ecological impact of large-scale groundwater abstraction on the Table Mountain Group aquifer	Project Manager	Water Research Commission
2002	**Environmental Management Plan** for the Eskom Wind Energy Demonstration Facility in the Western Cape	Co-author	Eskom
2001-2002	**Environmental Impact Assessment** for the Eskom Wind Energy Demonstration Facility in the Western Cape	Quality control & co-author	Eskom
2001	**Environmental Due Diligence** study of four strategic oil storage facilities in South Africa	Project manager and co-author	SFF Association
2000	**Cape Action Plan for the Environment**: a biodiversity Strategy and Action Plan for the Cape Floral Kingdom - legal, institutional, policy, financial and socio-economic component	Project manager and contributing writer	World Wide Fund for Nature (WWF): South Africa
1999	**Environmental Management Plan** for the establishment phase of the wetlands and canals at Century City, Cape Town	Project manager and lead author	Monex Development Company
1999	**Environmental Management Programme** for the Thesen Islands development, Knysna	Process design and Co-author	Chris Mulder Associates Inc; Thesen and Co.
1999	**Management Plan** for the coastal zone between the Eerste and Lourens River, False Bay, South Africa	Project manager and lead author	Heartland Properties and Somchem (a Division of Denel)

Completion Date	Project description	Role	Client
1998	**Environmental Assessment** of the Mozal Matola Terminal Development proposed for the Port of Matola, Maputo, Mozambique	Project manager and author.	*SNC-Lavalin-EMS*
1998	**Strategic Environmental Assessment (SEA)** for the Somchem industrial complex at Krantzkop, South Africa	Project manager and co-author	Somchem, a Division of Denel
1997	**Strategic Environmental Assessment (SEA)** for the proposed Industrial Development Zone and Harbour at Coega, Port Elizabeth, South Africa	SEA project manager and report writer	Coega IDZ Initiative Section 21 Company
1996	**Environmental Impact Assessment** of Development Scenarios for Thesen Island, Knysna, South Africa	Project manager and report writer	Thesen and Co.
1996	**Environmental Impact Assessment** of the Management Options for the Blouvlei wetlands, Cape Town	Project manager and report writer	Ilco Homes Ltd (now Monex Ltd)
1995	**Environmental Impact Assessment** for the Saldanha Steel Project, South Africa	Report writing and management of specialist studies	Saldanha Steel Project
1994	**Environmental Impact Assessment** for the upgrading of resort facilities on Frégate Island, Seychelles	Member of the project management team, co-author, process facilitator	Schneid Israelite and Partners
1994	**Environmental Impact Assessment** for exploration drilling in offshore Area 2815, Namibia	Project manager and co-author	Chevron Overseas (Namibia) Limited
1994	**Management Plan** for the Rietvlei Wetland Reserve, Cape Town	Project manager and lead author	Southern African Nature Foundation (now WWF-SA)
1993	**Beach management plan** for Stilbaai beachfront and dunes, South Africa	Project manager and lead author	Stilbaai Municipality
1993	**Beach and dune management plan for Sedgefield** for the beach east of the mouth of the Swartvlei estuary	Project manager and lead author	Nel and De Kock Planners, George
1993	**Coastal Stability analysis and beach management plan** for the	Project manager and lead author	Milnerton Municipality

Completion Date	Project description	Role	Client
	Table View coastline north of Blaauwberg Road, Cape Town		

EMPLOYMENT RECORD

- **1992 to present** Involved in coastal engineering studies; and various forms of environmental assessment and management studies. Council for Scientific and Industrial Research – Environmental Management Services (EMS) - Stellenbosch

QUALIFICATIONS/EDUCATION

- M. Phil. Environmental Science (University of Cape Town)
- B.Sc. Civil Engineering (awarded with Honours) (University of Cape Town)

LANGUAGE CAPABILITY

LANGUAGES	*Speaking*	*Reading*	*Writing*
English	Excellent	Excellent	Excellent
Afrikaans	Moderate	Moderate	Moderate

Minnelise Levendal (Project Leader, Reviewer)

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CURRICULUM VITAE OF MINNELISE LEVENDAL – PROJECT LEADER

Name of firm	CSIR
Name of staff	Minnelise Levendal
Profession	Environmental Assessment and Management
Position in firm	Project Manager
Years' experience	8 years
Nationality	South African
Languages	Afrikaans and English

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BIOSKETCH:

Minnelise joined the CSIR Environmental Management Services group (EMS) in 2008. She is focussing primarily on managing Environmental Impact Assessments (EIAs), Basic Assessments (BAs) and Environmental Screening studies for renewable energy projects including wind and solar projects. These include an EIA for a wind energy facility near Swellendam, Western Cape South Africa for BioTherm (Authorisation granted in September 2011) and a similar EIA for BioTherm in Laingsburg, Western Cape (in progress). She is also managing two wind farm EIAs and a solar Photovoltaic BA for WKN-Windcurrent SA in the Eastern Cape. Minnelise was the project manager for the Basic Assessment for the erection of ten wind monitoring masts at different sites in South Africa as part of the national wind atlas project of the Department of Energy in 2009 and 2010..She was also a member of the Project Implementation Team who managed the drafting of South Africa's Second National Communication under the United Nations Framework Convention on Climate Change. The national Department of Environmental Affairs appointed the South African Botanical Institute (SANBI) to undertake this project. SANBI subsequently appointed the CSIR to manage this project.

EDUCATION:

- M.Sc. (Botany) Stellenbosch University 1998
- B.Sc. (Hons.) (Botany) University of the Western Cape 1994
- B.Sc. (Education) University of the Western Cape 1993

MEMBERSHIPS:

- International Association for Impact Assessment (IAIA), Western Cape (member of their steering committee from 2001-2003)
- IUCN Commission on Education and Communication (CEC); World Conservation Learning Network (WCLN)
- American Association for the Advancement of Science (AAAS)
- Society of Conservation Biology (SCB)

EMPLOYMENT RECORD:

- **1995:** Peninsula Technicon. Lecturer in the Horticulture Department.
- **1996:** University of the Western Cape. Lecturer in the Botany Department.
- **1999:** University of Stellenbosch. Research assistant in the Botany Department (3 months)
- **1999:** Bengurion University (Israel). Research assistant (Working in the Arava valley, Negev – Israel; 2 months). Research undertaken was published (see first publication in publication list)
- **1999-2004:** Assistant Director at the Department of Environmental Affairs and Development Planning (DEA&DP). Work involved assessing Environmental Impact Assessments and Environmental Management Plans; promoting environmental management and sustainable development.
- **2004 to present:** Employed by the CSIR in Stellenbosch:
- September 2004 – May 2008: Biodiversity and Ecosystems Services Group (NRE)
- May 2008 to present: Environmental Management Services Group (EMS)

PROJECT EXPERIENCE RECORD:

The following table presents a list of projects undertaken at the CSIR as well as the role played in each project:

Completion Date	Project description	Role	Client
2011 *(in progress)*	EIA for the proposed Electrawinds Swartberg wind energy project near Moorreesburg in the Western Cape	Project Manager	Electrawinds
2010-2011 *(in progress)*	EIA for the proposed Ubuntu wind energy project, Eastern Cape	Project Manager	WKN Windkraft SA
2010-2011 *(in progress)*	EIA for the proposed Banna ba pifhu wind energy project, Eastern Cape	Project Manager	WKN Windkraft SA
2010-2011	BA for a powerline near Swellendam in the Western Cape	Project Manager	BioTherm Energy (Pty Ltd
2010-2011 *(Environmental Authorisation granted in September 2011)*	EIA for a proposed wind farm near Swellendam in the Western Cape	Project Manager	BioTherm Energy (Pty Ltd
2010 (complete)	Basic Assessment for the erection of two wind monitoring masts near Swellendam and Bredasdorp in the Western Cape	Project Manager	BioTherm Energy (Pty Ltd
2010 (complete)	Basic Assessment for the erection of two wind monitoring masts near Jeffrey's Bay in the Eastern Cape	Project Manager	Windcurrent (Pty Ltd
2009-2010	Basic Assessment Process for the proposed	Project	Department of Energy

Completion Date	Project description	Role	Client
((*Environmental Authorisations granted during 2010)*	erection of 10 wind monitoring masts in SA as part of the national wind atlas project	Manager	through SANERI; GEF
2010	South Africa's Second National Communication under the United Nations Framework Convention on Climate Change	Project Manager	SANBI
2009 *(Environmental Authorisation granted in 2009)*	Basic Assessment Report for a proposed boundary wall at the Port of Port Elizabeth, Eastern Cape	Project Manager	Transnet Ltd
2008	Developing an Invasive Alien Plant Strategy for the Wild Coast, Eastern Cape	Co-author	Eastern Cape Parks Board
2006-2008	Monitoring and Evaluation of aspects of Biodiversity	Project Leader	Internal project awarded through the Young Researchers Fund
2006	Integrated veldfire management in South Africa. An assessment of current conditions and future approaches.	Co- author	Working on Fire
2004-2005	Biodiversity Strategy and Action Plan Wild Coast, Eastern Cape, SA	Co-author	Wilderness Foundation
2005	Western Cape State of the Environment Report: Biodiversity section. (Year One).	Co- author and Project Manager	Department of Environmental Affairs and Development Planning

PUBLICATIONS:

Bowie, M. (néé Levendal) and Ward, D. (2004). Water status of the mistletoe *Plicosepalus acaciae* parasitic on isolated Negev Desert populations of *Acacia raddiana* differing in level of mortality. Journal of Arid Environments 56: 487-508.

Wand, S.J.E., Esler, K.J. and **Bowie, M.R** (2001). Seasonal photosynthetic temperature responses and changes in ^{13}C under varying temperature regimes in leaf-succulent and drought-deciduous shrubs from the Succulent Karoo, South Africa. South African Journal of Botany 67:235-243.

Bowie, M.R., Wand, S.J.E. and Esler, K.J. (2000). Seasonal gas exchange responses under three different temperature treatments in a leaf-succulent and a drought-deciduous shrub from the Succulent Karoo. South African Journal of Botany 66:118-123.

LANGUAGES

Language	***Speaking***	***Reading***	***Writing***
English	*Excellent*	*Excellent*	*Excellent*
Afrikaans	*Excellent*	*Excellent*	*Excellent*

Minnelise Levendal

July 2017

Karabo Mahabela (Project Manager)

CSIR
Jan Cilliers Street
PO Box 320 Stellenbosch 7600
South Africa

Phone: +27 21 888 2408
Fax: +27 21 888 2693
Email: kmashabela1@csir.co.za

CURRICULUM VITAE – Karabo Mashabela (Cand.Sci.Nat)

Position in Firm:	Environmental Assessment Practitioner (Intern)
Full Name:	Karabo Mashabela
Professional Registration:	Cand.Sci.Nat Environmental Sciences
Date of Birth:	11/12/1989
Nationality:	South African
Marital Status:	Single
Language Proficiency:	English, N Sotho, Swati, Ndebele, Zulu and Tsonga

BIOSKETCH:

Karabo holds a master's degree in Environmental Science and Geography from University of Limpopo Turfloop campus. Her undergraduate degree was a Bachelor of Science with majors in Environmental Science and GIS and remote sensing. She is currently working as an environmental assessment practitioner intern at the Council for Scientific and Industrial Research (CSIR). Karabo has been the co-author of a various special need and skills programme Basic Assessment. She assisted with the Umgeni water desalination plant and wind and solar SEA.
She is also a project officer for National Strategic environmental assessment for Aquaculture.

EMPLOYMENT TRACK RECORD:

The following table presents a list of projects that Karabo Mashabela has been involved in to this date:

Completion Date	Project description	Role	Client
In progress	**National Strategic environmental assessment for Aquaculture**	Project officer	National Department of Environmental Affairs and National Department of Agriculture Forestry and Fisheries
In progress	**Special Needs and Skills Development Programme (DEA-CSIR)**	Project Manager conducting Environmental services such as basic Assessments and	Various SMME's and Community Trusts

Completion Date	Project description	Role	Client
		Environmental Screening Studies.	
In progress	**Strategic Environmental Assessment (SEA)** Wind and solar	Project assistant	National Department of Environmental Affairs
In Progress	**EIA for Desalination plants on the KZN Tongaat.**	Project member- Public Participation Process, stakeholder engagement and project support.	Umgeni Water
In progress	**Intubayethu screening study Eastern Cape**	Project manager	DEA
In progress	**Basic Assesment for Blue-Green Aquaculture PTY Ltd**	Project manager	DEA
In progress	**Basic assessment for FishLab**	Project manager	DEA

EMPLOYMENT RECORD:

- **2016** Environmental Scientist and Assessment Practitioner (Intern) for National Strategic environmental assessment. Council for Scientific and Industrial Research – Consulting and Analytical Services (CAS) – Stellenbosch
- **2016** Environmental consultant **and contractor trainer Dwarsrivier Chrome Mine**
- **2011-2015** University of Limpopo Geography Department - GIS and Remote Sensing lab assistant, facilitating GIS practical's using Quantum GIS and ARC-GIS software.
- **2010** National greening in the 2010 national environmental volunteer project ambassador for the department during the FiFa world cup (LEDET) Limpopo Department of Economic Development, Environment and Tourism

QUALIFICATIONS/EDUCATION:

Qualification Obtained:	BSc (Environmental and Resource Studies)
Name of Institution:	University of Limpopo
Duration:	3 years (2009-2011)
Major Subjects Passed:	• Environmental Management and Planning, Impact Studies (EIA, SEA, SIA, Risk Assessment, etc) • Solid Waste Management, Water Treatment Processes and Technology, Natural Resource Ecology, Remote Sensing and Geographic Information System (GIS)
Qualification obtained:	BSc Honours (Geography and Environmental Sciences)
Name of Institution:	University of Limpopo (2012)
Major Subjects Passed:	• Elements of Environmental Management • (Environmental Law, Environmental Management • Systems (ISO 14001), EIA, SEA, SIA, IEM, Risk Assessment, • Project Management, Environmental Monitoring and Auditing) • GIS-Applications • Demography • Geography Research Methods
Honours Research Topic:	"Waste management strategies at Lebowakgomo Central Business Area"

Qualification obtained:	MSc Geography and Environmental Sciences (GIS and Remote Sensing)
Name of Institution:	University of Limpopo (2013-2015
Master of Science Research Topic:	Onsite greywater reuse as a water conservation Method: A case study of Lepelle-Nkumpi local Municipality, Limpopo province of South Africa
Masters results:	Completed

TRAINING, CONFERENCES AND PROFFESIONAL REGISTRATIONS:

- Media and Science Training Accreditation through Jive Media Africa (2016)
- IAIA WC Workshop for roles and responsibilities of an environmental control officer (2016)
- IAIAsa 2016 Annual National Conference Port Elizabeth (17-18 August 2016) Presented MSc study CSIR collaboration
- Project Management accreditation through the CSIRs Innovation, Leadership and Learning Academy Project Management Course (2016)
- Participated in the ACCESS Student Heritable planet workshop (2011)
- Registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP) (Reg #: 116164)
- Member of the IAIAsa (Membership no: 5322)

BASIC ASSESSMENT REPORT

Appendix L:
Any other information

CONTENTS

Appendix L: Any other information

read
Department:
Rural, Environment and Agricultural Development
North West Province & Government
REPUBLIC OF SOUTH AFRICA

2030 NDP

80 Church Street
Private Bag X 82298,
Rustenburg 0300
Republic of South Africa

ENVIRONMENTAL SERVICES
BIODIVERSITY MANAGEMENT

Tel: +27 (14) 592 7378
Fax: +27(14) 592 7249
E-mail:

Mr Pule Hlahane
30 Bestiana
Lydiana
Pretoria

Operating of fish breeding and processing facility

With reference to your application for;

1. The translocation of O mossambicus and C gariepinus fertile eggs, fingerlings and or broodstock.
2. Operating a fish hatchery and fish nursery
3. Operating a tilapia and catfish nursery and fingerling grow out facility.
4. Operating a tilapia and catfish harvesting and processing facility,

the following refers to the matter.

The Department has no objection to the establishment of the tilapia aquaponics farm project on Plot 413, Bosplaats in the Bojanala district.

Permits for the translocation of fish and the operation of the facility can only be given once the structures are in place and have been inspected.

The environmental process runs independently from the biodiversity permitting process and as long as the listed environmental activities are not triggered biodiversity permits will be issued for the operation.

CW Hoogkamer
Control Biodiversity Officer
Environmental Management Inspector
Bojanala District

Appendix L.: Proof of release of Draft Basic Assessment Report

BACKGROUND INFORMATION DOCUMENT (BID)

Basic Assessment Process:

Tilapia aquaponics farm project, Bosplaas West in North of Hammanskraal, in the Moretele Municipality in Bojanala District North West Province

CSIR
our future through science

Mashabela Karabo

kmashabela1@csir.co.za

CSIR Ref
No:CSIR/02100/EMS/IR/2017/15674/A

INTRODUCTION OF THE PROPOSED PROJECT

The Blue-Green Aquaculture PTY Ltd is a small scale commercial farming enterprise that was established in 2013 and is proposing to establish an aquaculture production facility. Blue-Green Aquaculture has leased land, i.e Plot 413 in Bosplaas West, from Mr T J Kgomo for the establishment of an aquaculture production farm. The lease agreement includes the utilisation of a borehole. Bosplaas West is north of Hammanskraal, in the Moretele Municipality in Bojanala District North West Province, and the leased area of the farm (Plot 413) is approximately two hectares (figure 1). The BA Process plays an important role in promoting sustainable agriculture.

TECHNOLOGY CHOICE AND WATER MANAGEMENT

The enterprise will start as an aquaponics facility and later it will be separated into an aquaculture farm and a hydroponics farm. Water will be sourced from the existing borehole on site and the effluent will be used to irrigate the vegetable garden.The technology that will be employed on the farm is recirculating aquaculture systems (RAS) linked to hydroponic growbeds. Figure 2 is a simplified overview of the technology employed in an aquaponics system. The fish are stocked in the fish rearing tanks (caption 1 in figure 2) and then the fish waste (faeces and uneaten food) flows into the settling tank (caption 2), the process of biofiltration result in the conversion of toxic ammonia into plant friendly nitrates (caption 3) before the nitrate rich water is fed to the plants (caption 4). In the Deep Water Culture (DWC) beds (caption 5); the plants grow and take up the nitrates and other micronutrients thereby cleaning the water (caption 6). The last step (caption 7) is the collection of clean water before being pumped back to the fish tanks.

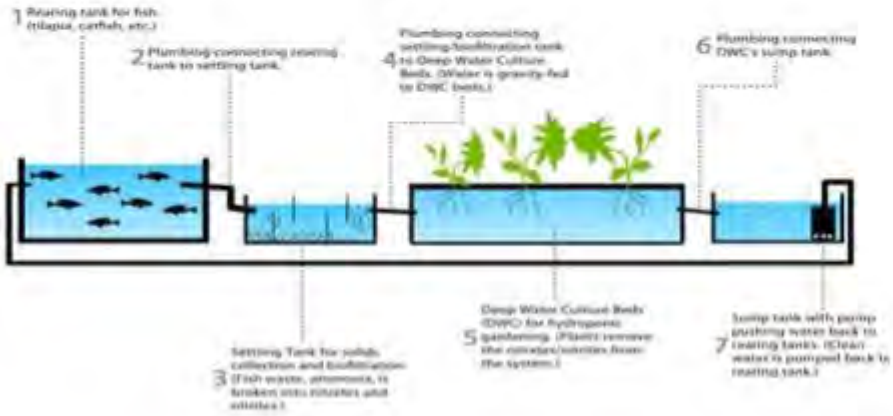


Figure 2: Simplistic overview of aquaponics technology.

PURPOSE OF THE BACKGROUND INFORMATION

The purpose of this document is to provide stakeholders with information, opportunity for registration as Interested and Affected Parties in the BA process. It is also to obtain their comments on the proposed Mozambican Tilapia Aquaculture project extending an area of approximately two hectares on Plot 413 Bosplaas West' north of Hammanskraal, in the Moretele Municipality in the Bojanala District North West Province.

An application for an Environmental Authorisation (EA) will be made by the Council for Scientific & Industrial Research (CSIR) on behalf of Mr Pule Hlahane, (Project Applicant) to the North West Department of Rural Environment and Agricultural Development (READ), in terms of the Environmental Impact Assessment (EIA) Regulations, 2017 published in Government Notice (GN) R325 7 April 2017. The application will be done in terms of activities listed in GN R.327 and 324 which require a Basic Assessment to obtain EA prior to development. The aim of the environmental assessment is to identify potential impacts associated with the development and to recommend methods to avoid or reduce adverse impacts and promote positive impacts.

If you would like to participate in the process, please complete the included registration form to register as an Interested and Affected Party. Please quote the reference number provided and send any concerns or comments to:

Ms. Karabo Mashabela
Email: kmashabela1@csir.co.za
Tel: 021-888-2482
Fax: 021-888-2693
Address: CSIR, PO Box 320, Stellenbosch, 7599
Website: http://www.csir.co.za/ems/specialmeets/

Kindly submit comments on or before the 15th of June 2017.

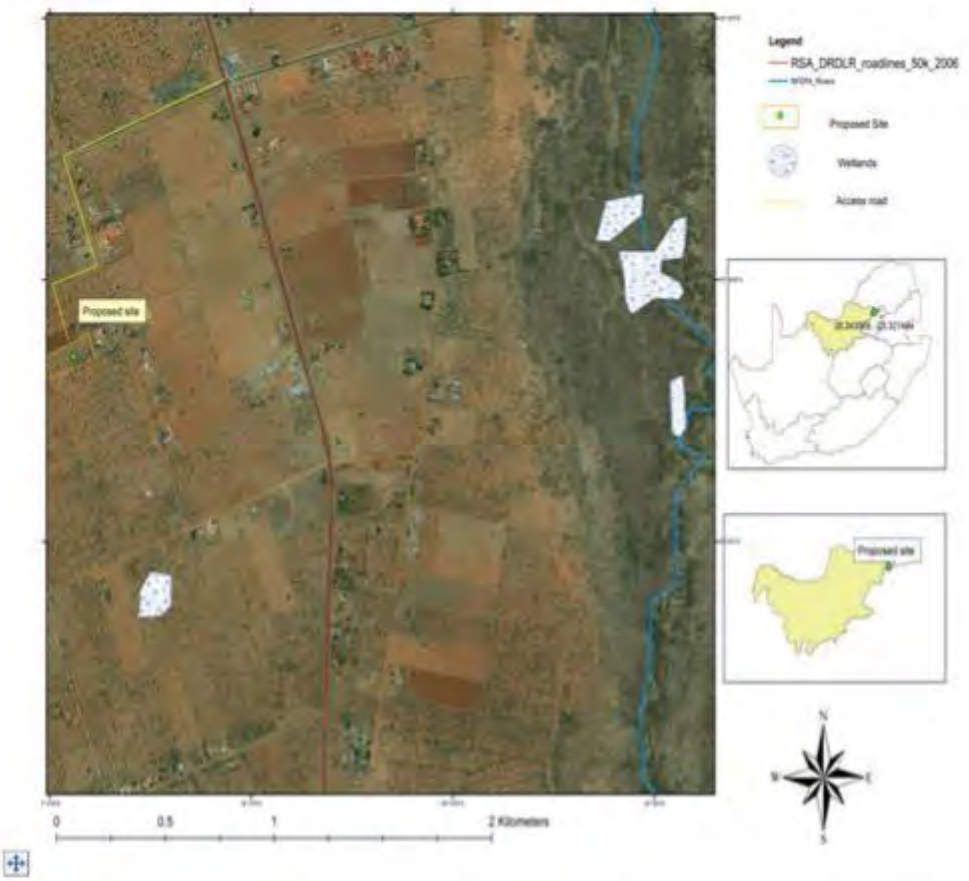


Figure 1: Project site for the proposed Blue Green Tilapia aquaponics farm project, Bosplaas West in North of Hammanskraal, in the Moretele Municipality in Bojanala District North West Province

SUMMARY OF THE ENVIRONMENTAL ASSESSMENT PROCESS

Table 1: Listed activities applicable to the project.

Relevant notice and Activity No(s):	Description of each listed activity as per the Government Notice:
GN. R 327, 7 April 2017 Activity 6	The development and related operation of facilities, infrastructure or structures for aquaculture of— (i) finfish, crustaceans, reptiles or amphibians, where such facility, infrastructure or structures will have a production output exceeding 20 000 kg per annum (wet weight);
GN. R 327, 7 April 2017 Activity 8	The development and related operation of hatcheries or agri-industrial facilities outside industrial complexes where the development footprint covers an area of 2 000 square metres or more.
GN. R 327, 7 April 2017 Activity 27	The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for— (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.
GN. R 324, 7 April 2017 Activity 12 (a) ii.	The clearance of an area of 300 square meters or more of indigenous vegetation except where such clearance is required for maintenance purposes undertaken in accordance with a maintenance management plan. ii. Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
GN. R 324, 7 April 2017 Activity 13 (a) ii.	The development and related operation of facilities of any size for any form of aquaculture. ii. A protected area including municipal or provincial nature reserves as contemplated by NEMPAA or other legislation;

The BA process that will be undertaken for this project is summarised in the following steps:

Step 1: Notify Authorities and potential Interested and affected parties (I&APs) (30 days) (current stage)

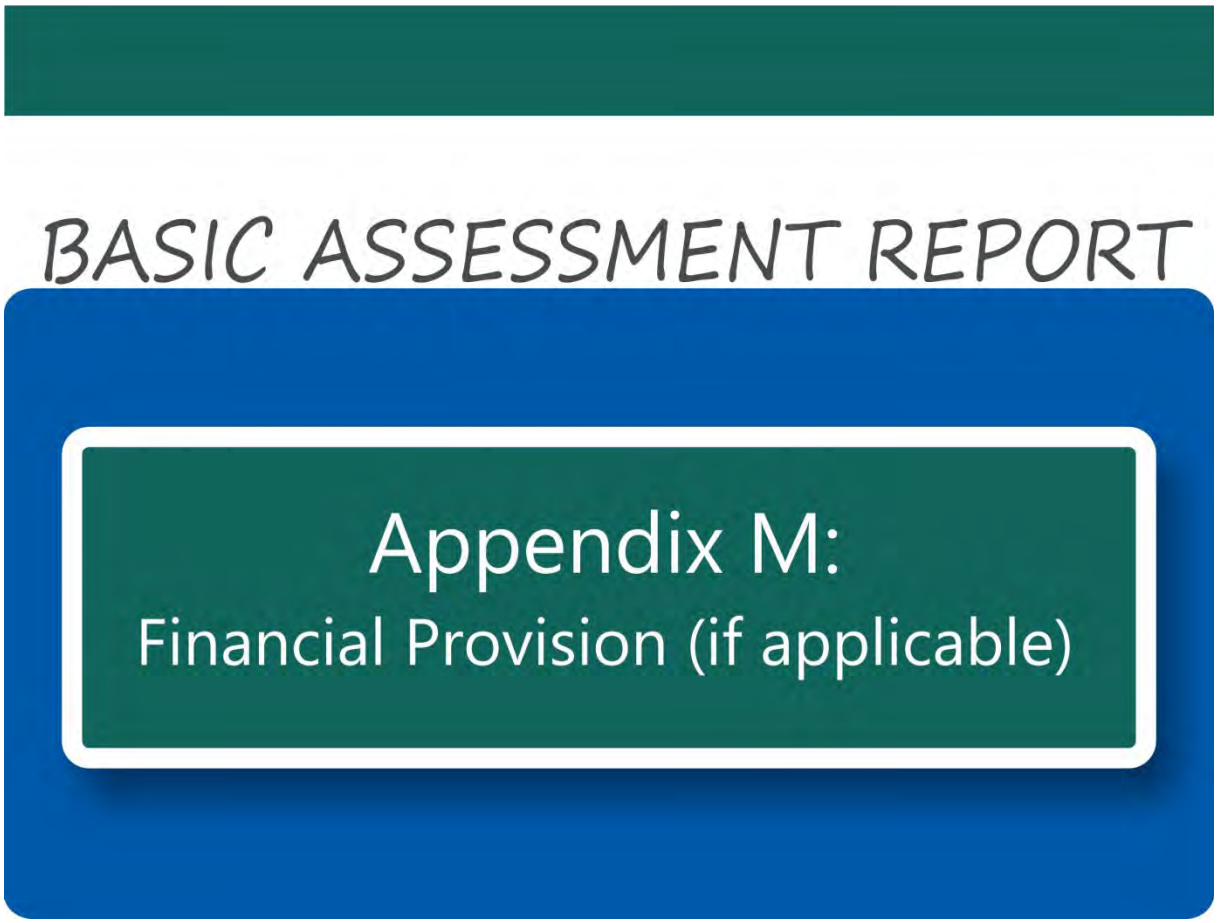
The first stage in the process entails notifying all potential I&APs of the proposed project, by sending out a Background Information Document (BID), and providing I&APs with an opportunity to register as an I&AP. I&APs are required to register their interest on the project database within 30 days (in order to be included from the outset of the BA process) and/or raise issues or concerns.

Step 2: Basic Assessment Report for Public Comment (30 days)

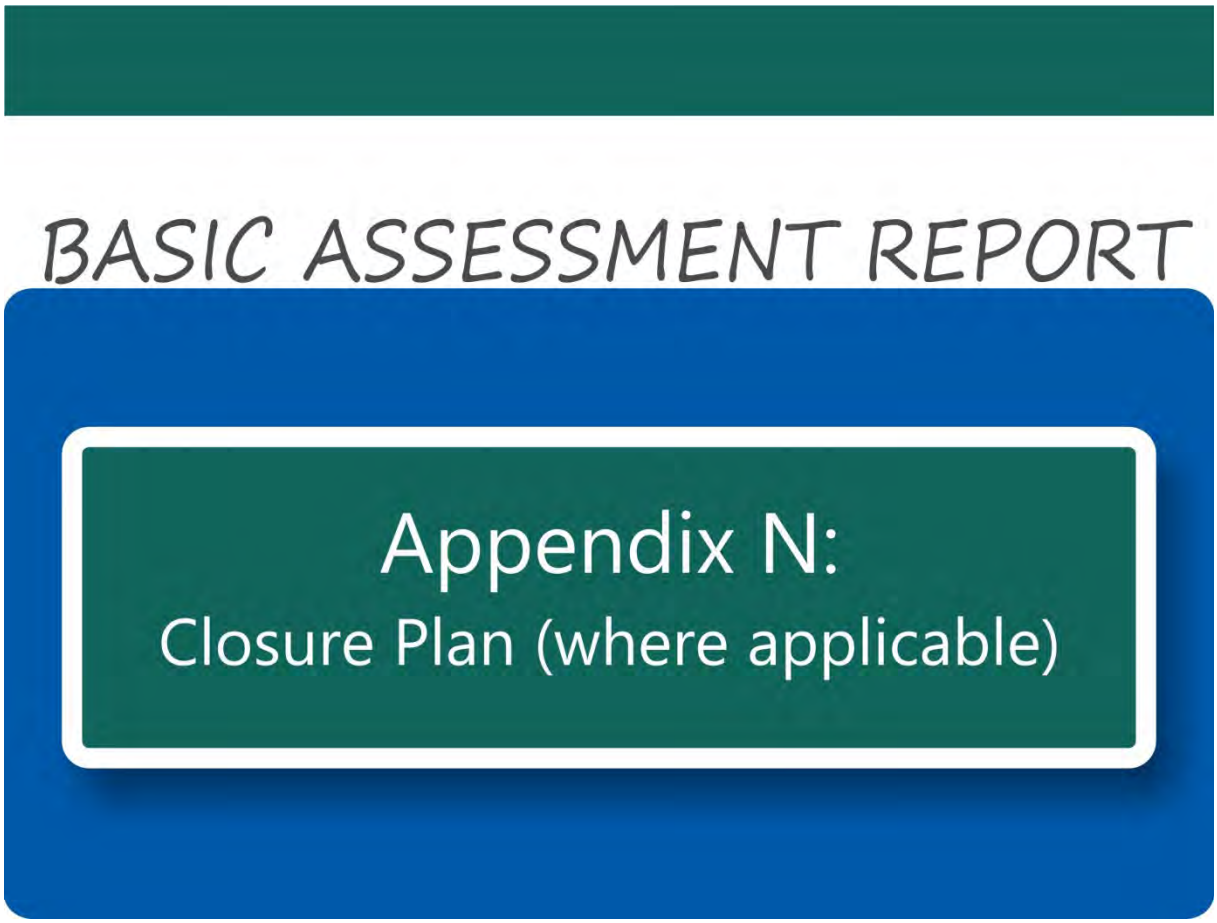
The BA process is undertaken in order to identify and assess potential environmental impacts, both positive and negative, that may be associated with the project. Mitigation and management measures will be identified to reduce potential negative impacts and will be included in the Environmental Management Programme (EMPr) for this project. The Basic Assessment Report will include comments received from all I&APs on this document and findings of the specialist study. All registered I&APs on the project database will be notified in writing of the 30 day comment period for the BAR.

Step 3: BAR to be submitted to DMR for decision-making

The BAR will be drafted and will be submitted to the North West Department of Rural Environment and Agricultural Development (READ), for decision-making. The comments and issues raised will be included in the BAR. All I&APs will be provided with written notification on whether the project has been granted or refused EA and about the appeal process.


BASIC ASSESSMENT REPORT
Appendix M:
Financial Provision (if applicable)

N/A



Closure Plan (where applicable) as described in Appendix 5 of EIA Regulations, 2014

Morgan DL, Gill HS, Maddern MG and Beatty SJ (2004).Distribution and impacts of introduced freshwater fishes in Western Australia. New Zealand Journal of Marine and Freshwater Research 38:511–523.

Russell DJ, Thuesen PA and Small FE (2010). Tilapia in Australia: Development of Management Strategies for the Control and Eradication of Feral Tilapia Populations in Australia. Pest Smart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, Australia.

Mabasa MP.,Petja BM. Agro-ecological zone based farm planning at Thaba Ya Batho small agricultural holdings: planning and production perspectives. *http://hdl.handle.net/10500/22139* date accessed 22 June 2017.

SANBI (2007). Draft Guideline regarding the Determination of Bioregions and the Preparation and Publication of Bioregional Plans. March 2007.mPrepared by the South African National Biodiversity Institute at the request of the Minister and Department of Environmental Affairs and Tourism

SANBI (2008). Threatened Ecosystems in South Africa: General Information. South African Biodiversity Institute, Pretoria.

Scholes, R.J. & Biggs, R (2005) A biodiversity intactness index. Nature 434, 45-49

Smith, R.J. (2004). Conservation Land-Use Zoning (CLUZ) software. Durrell Institute of Conservation and Ecology, Canterbury, UK., from http://www.mosaic-conservation.org/cluz date accessed 22 June 2017.