

WARMQUELLE GREEN SCHEME IRRIGATION PROJECT

ENVIRONMENTAL MANAGEMENT PLAN

FEBRUARY 2021



PREPARED BY



&



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**ENVIRONMENTAL MANAGEMENT PLAN
WARMQUELLE/KHOWARIB IRRIGATION
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1 INTRODUCTION

The Environmental Investment Fund (employer) wishes to revive the Warmquelle Green Scheme Irrigation Projects in the Kunene Region on behalf of the Ministry of Agriculture, Water and Land Reform through a Design, Build, Operate and Transfer (DBOT) procurement process.

The work entails the DBOT of Warmquelle Green Scheme Irrigation Project in order to increase crop production as well as post-harvest life of crops.

Aloe Agri-technologies (Pty) Ltd, Outrun Consultants and Five Star Consortium were awarded the opportunity to implement the project and have prepared this Environmental Management Plan (EMP) in order to mitigate potential negative environmental impacts during the project's life cycle.

2 WARMQUELLE GREEN SCHEME STATUS QUO AND PLANNED ACTIVITIES

This section presents the current state of the Warmquelle Irrigation Green Schemes, Existing Infrastructure, Project Location and the Planned Activities.

2.1 Warmquelle

Table 1: Warmquelle infrastructure status and respective planned activities.

Aspect / Infrastructure	Status	Planned Activity
Water Source	Ongongo Fountain is the main water source	Rehabilitation of the pipeline: cleaning the pipeline and sealing leaks
Abstraction	The abstraction point comprises of the pipeline connected to a heavily silted weir at the fountain	Desiltation of the weir
Water conveyance / transportation	Water is transported by a 6 km galvanized steel pipeline which has several leaks and suspected silt points along the length.	Replacing of conduits to prevent leaks, clearing sand from the pipes, building of concrete footings supporting the conduits.
Storage dam	Silted and broken boundary fence	Desiltation and fencing
Crop production area	Existing field area is clean and free of vegetation	Land clearing on the additional 5Ha

	except for the additional 5Ha covered by Acacia trees.	Installation of drip and micro-sprinkler irrigation systems Installation of 3500m ² green houses, 3000m ² net houses and 400m ² nursery
Electricity	On-grid electricity is available	No planned activities
Accommodation	There is no staff accommodation onsite.	There are plans to build a 3 bedroomed house for the manager and 4 staff quarters rooms for agricultural interns
Administration, Warehouse, Logistics and Equipment	Existing building is dilapidated and needs reconstruction	There are plans to construct a block to cater for offices, kitchen & canteen, cold storage facility and warehouse.
Hydrocarbon fuel (Diesel)	No fuel storage facility exists onsite	An above ground fuel storage tank (5000l) is planned.



Figure 1: Image 1 - Silted water abstraction weir at the source, Image 2 - Water leakages along the pipeline, Image 3 - Heavily silted water storage earth dam at Warmquelle. The pond is poorly

secured, is a hazard to children from the community and deaths from drowning have been witnessed in the past Source: Own images taken during field visit.

3 DESCRIPTION OF THE ENVIRONMENT AND PROJECT LOCATION

3.1 Location

The project is planned for Warmquelle area located in Seisfontein, a settlement in the Seisfontein Constituency in Kunene Region. It has a population of 7,358 inhabitants. The project is taking place in the Kunene Region of Namibia, sub-Saharan Africa's driest country rocked with persistent droughts and erratic rains over the past decades. Kunene Region is the country's most drought affected regions.

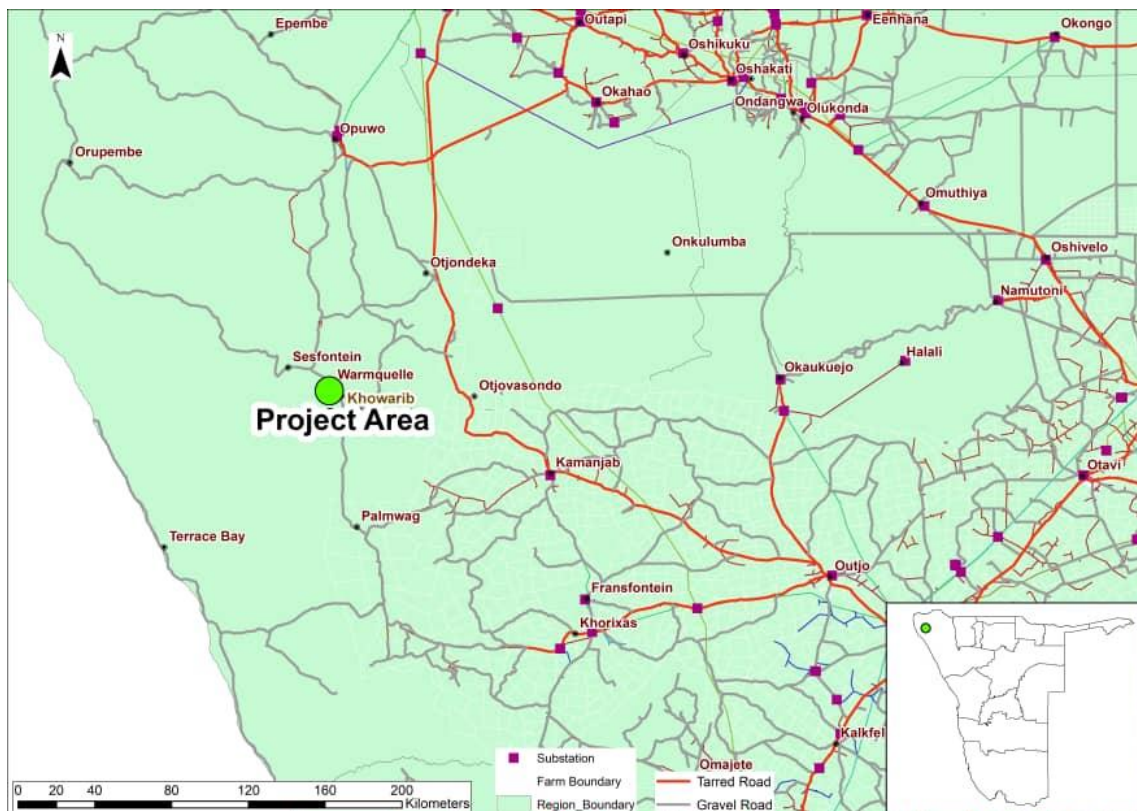


Figure 2: The location of the project area, Warmquelle, in relation to major towns in Namibia. Source: Own map.

3.2 Soils of the project area

The soils of the project area comprise of a combination of regosols and unconsolidated sandy soils. These soils have a poor water holding capacity and requires frequent watering depending on the temperatures. They are characterized by low clay and organic matter content making them poor in nutrients / fertility.

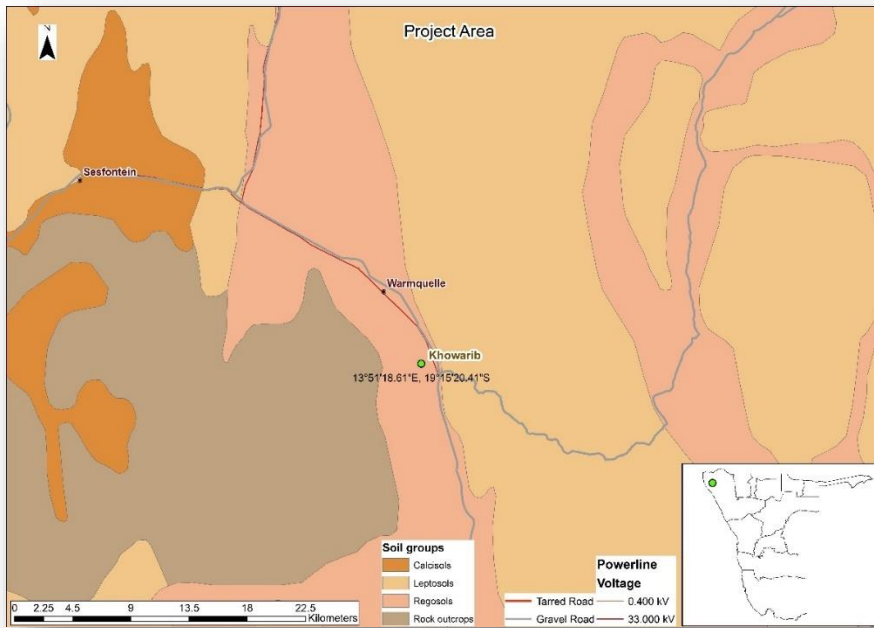


Figure 3: Regosols are the dominant soils of the project area. Source: Own map.

3.3 Rainfall, humidity, temperature and evapotranspiration

3.3.1 Rainfall

The median annual rainfall ranges from less than 50 mm to 250 mm in Namibia's hyper-arid southwest and coastline, and peak at 350 to 550 mm in the sub-humid northeast. Overall, about 22% of the country is classified as hyper-arid, 70% as arid, and less than 8% as dry sub-humid, (Mendelsohn, 2003). The potential evaporation is more than five times greater than average rainfall in the greater part of the country and lack of rainfall is regarded a key limitation to the country's development. This makes Namibia one of the world's most vulnerable countries with regard to climate change due to its extreme aridity and dependence on primary industry, combined with a limited adaptive capacity, (Brown, 2009). Approximately 70% of Namibia's population lives in rural areas. Farming is the dominant land use in Namibia, but it is characterized by low production and high risk due to arid conditions, infertile soils and generally poor land use practices. The project area is very arid and water is critical resource for both human beings and wildlife. It is very critical to embrace a combination of various technologies for water harvesting, efficient conveyance (zero losses) and efficient utilization on the agricultural enterprise to be established.

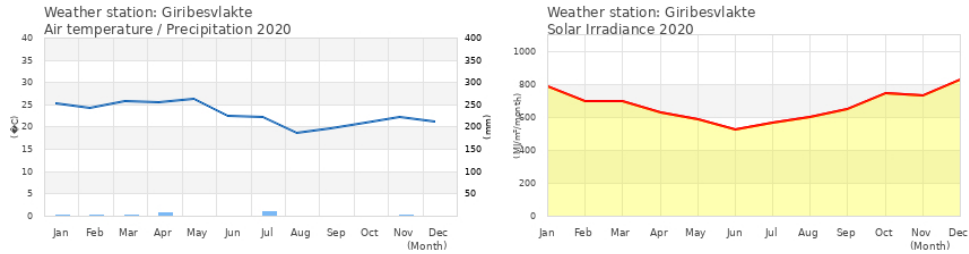


Figure 4: Average monthly temperature, precipitation and solar irradiance for the Warmquelle area. Source: SASSCAL Weathernet: http://www.sasscalweathernet.org/weatherstat_monthly_we.php.

3.3.2 Humidity

The air in the proposed project area is generally dry throughout the year with an average humidity of about 20%. This is too low than the tolerable humidity of 70 -80 % for fresh vegetable production. Optimum growing humidity is achievable under controlled cultivation systems using fogging systems which will be installed in both net houses and green houses.

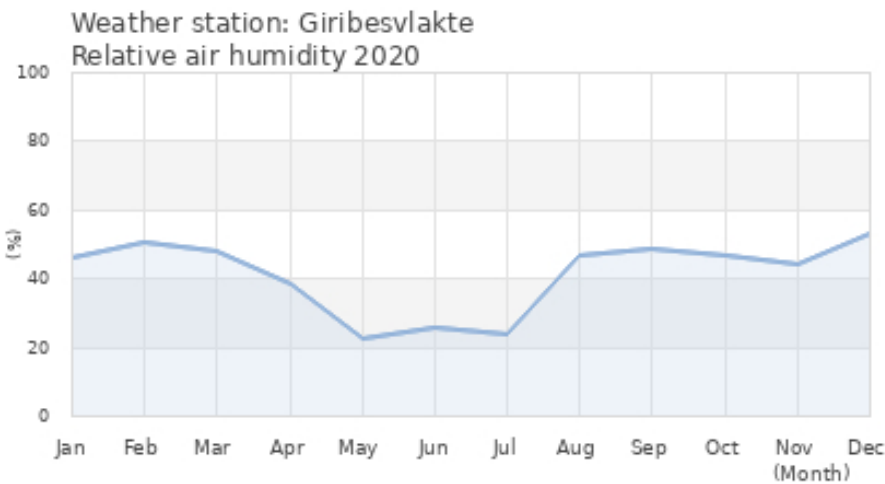


Figure 5: The project area's monthly average humidity. Source: SASSCAL Weathernet: http://www.sasscalweathernet.org/weatherstat_monthly_we.php.

3.3.3 Temperature

During the summer temperatures are very high and scorching, desiccating heat prevails. The average temperatures are normally between 29 and 35 °C and maximum temperatures of 43–46 °C are common. During the winter times of the year temperatures drop during the night due to the exceptional radiation loss under the clear skies. However, very rarely do temperatures drop far below freezing.

3.3.4 Demographics

According to national statistics census Kunene Region has a total population of 97 865 inhabitants who are distributed 68 % and 32 % in the rural areas and urban respectively. Of these 66 % are literate and the main source of income after salaries and wages being farming, 13 %. Kunene's population is characterized by widespread poverty with a value of 41% of households rated as poor and 11 % extremely poor during the 2011 census. The region has a dualistic economy: there are the well-developed formal businesses and commercial farming sectors (tourism enterprises and accommodation, supermarkets, shops, bakeries, butcheries) and the underdeveloped and extremely poorly resourced subsistence agriculture sector. The results show that in Kunene region, agriculture, forestry and fishing was the main industry (53.2%) of the work force. Hunger is already endemic among rural and poor populations in Kunene, worsened during prolonged drought conditions. Most depend on livestock-based products such as milk and meat in their diets, and especially the Ovahimba people who live locally, are extremely vulnerable to impacts of climate change. With few opportunities for employment and cash income, they already have difficulty purchasing food. Overall, there is limited economic opportunity for local people in the Kunene Region, other than from tourism. Under the Covid-19 pandemic, food insecurity will worsen and the number of people at risk from hunger will also increase.

3.4 Vulnerability to Food Insecurity

Warmquelle lies in the central highlands of the Kunene Basin and are amongst the most vulnerable areas to food insecurity in the country, due to different structural reasons including:

- Generalized poverty and few productive or domestic assets at household level;
- Few options for income diversification through income generating activities;
- Localized high population density, resulting in limited access to agricultural land;
- Impoverished soils, poor farming practices with few agricultural inputs; and
- High pressure on natural resources.

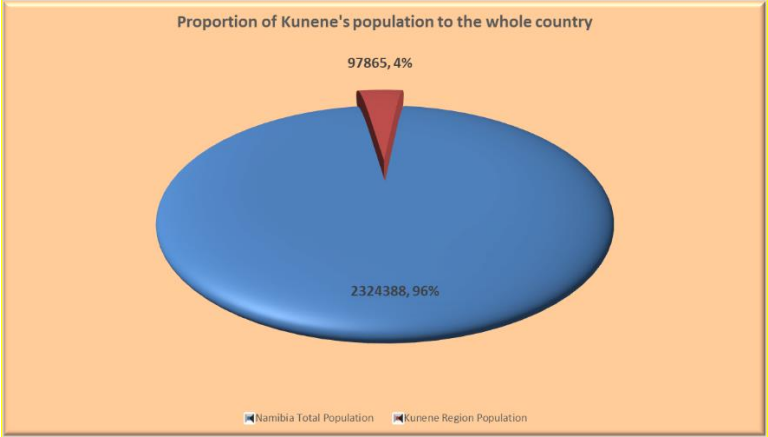


Figure 6: Kunene population and relative proportion to the country's total population.

4 ENVIRONMENTAL MANAGEMENT PLAN

Farming activities have a range of impacts on the environment, depending on the scale of operations and the types of activities to be undertaken. Potential environmental and socio-cultural impacts have been identified and practical realistic measures suggested, all in the vein of trying to minimize the level of environmental deterioration (See Tables 8.1 and 8.2). It should be noted that the responsibility for implementing all the suggested mitigation measures lies with the **Developer**. He will work hand in hand with all the Supervisors manning each area. The Supervisors will implement and monitor environmental aspects as much as they do their daily production activities.

Table 2: Environmental Management Plan

Project Phase	Impact	Positive \Negative	Impact source	Mitigation	Implementing agent
D E S I G N	Soil Erosion	Negative	Working on steep slopes due to poor positioning on the land.	Arrange / position infrastructure on flat land and avoid steep slopes	Developer, Design Consultant & Contractor
	Low water use efficiency	Negative	Poor choice of irrigation equipment, showers, cisterns and water tapes.	Chose high water efficient irrigation systems taking into consideration target crops to be grown and high evapotranspiration of the project site. Make use of low flow water tapes and showers etc.	Developer, Design Consultant & Contractor
	Low energy use efficiency	Negative	Poor orientation of panels and lack of poor choice of energy efficient technologies	Use solar on boreholes, booster pumps, geysers etc Ensure solar panels are oriented at the correct angle in relation to the solar azimuth.	Developer, Design Engineer & Contractor
	Night ambience	Negative	Low night ambience and poor signage increases accident risk. Poor lighting and dull colours on signs.	Avoid night operations onsite. Use bright colours. Use bright coloured signs that are visible in the night.	Design Engineer / Architects

Project Phase	Impact	Positive \ Negative	Impact source	Mitigation	Implementing agent
	Accessibility of fuel point	Negative	Poor accessibility increases accident risk. Poor design, poor signage and limited space	Make use of good signage and provide enough space for vehicles to move freely	Design Engineer / Architects
	Groundwater pollution	Negative	Sewage from accommodation and administration ablutions	Use conservancy tanks	Developer, Design Consultant & Contractor
C O N S T R U C T I O N	Soil Erosion	Negative	Clearing of land Eroded roads Poor tillage practice	Clearing of vegetation will be limited to previously cultivated sites only. Storm drains will be constructed along the road to minimise erosion Till across slope to minimise run-off in the field Use zero tillage practices / minimum tillage	Developer, Design Consultant & Contractor
	Danger of animals and humans from falling into foundations and water system trenches	Negative	Foundation and pipeline layout	Temporary fencing would be done on trenches as a safety measure for humans and animals.	Developer, Design Consultant & Contractor

Project Phase	Impact	Positive \ Negative	Impact source	Mitigation	Implementing agent
O P E R A T I O N A L	Ground water contamination (Both chemical and physical contamination)	Negative	Oil & fuel spillages Fuels Possible spillages of hazardous substances such as insecticides and herbicides	Workshop will be concretised to avoid contamination of groundwater Hazardous substances to be kept safe and secured with limited access to the workers on the site so as to reduce the chances of unauthorised and reckless spillages. For accidental spillages, the Farm Manager will ensure that the chemicals are neutralised. Surface runoff would be controlled to a holding storm water dam.	Developer, Design Consultant & Contractor
	Compaction of soils	Negative	Farming equipment	Use recommended conservation tillage equipment such as rippers so as to minimize soil disturbance. Restrict heavy moving equipment to access roads only.	Developer, Design Consultant & Contractor
	Solid waste	Negative	Packaging materials containing construction materials such as cement etc	Construct a pit dedicated for solid waste disposal	Developer, Design Consultant & Contractor
	Liquid waste	Negative	Waste water from washing, bathing, flushing etc.	Construct a conservation tank to allow flushing to the former.	Developer, Design Consultant & Contractor

Project Phase	Impact	Positive \ Negative	Impact source	Mitigation	Implementing agent
O P E R A T I O N A L	Salinisation	Negative	Loss of water from saline soils Watering crops using saline water.	Provide drainage including disposal of water to evaporation ponds.	Developer, Design Consultant & Contractor
	Alkalization	Negative	Accumulation of salts in the B horizon of the soil.	Maintain channels to prevent seepage, and reduce inefficiencies resulting from siltation and weeds. Allow for access to channels for maintenance in design.	Developer, Design Consultant & Contractor
	Soil acidification	Negative	Heavy leaching of cations due to over irrigation. Excessive use of ammonium based synthetic fertilizers.	Avoid excessive use of Nitrate fertilizers such as Ammonium Nitrate. Carry out soil analysis regularly and monitor changes in exchangeable AL ³⁺ .	Developer, Design Consultant & Contractor
	Water logging	Negative	Irrigation of crops during production	Set-up irrigation drainage systems.	Developer, Design Consultant & Contractor
	De-vegetation	Negative	Cutting of trees during construction and operation	Limit removal of vegetation to active areas only.	Developer, Design Consultant & Contractor

Project Phase	Impact	Positive \ Negative	Impact source	Mitigation	Implementing agent
	Soil contamination	Negative	Oil spillages Possible spillages of hazardous substances	Workshop will be concretised to avoid contamination of the soil. Hazardous substances to be kept safe and secured with limited access to the workers on the site so as to reduce the chances of unauthorised use and reckless spillages. For accidental spillages, the Farm Manager will ensure that the chemicals are neutralised.	Developer, Design Consultant & Contractor
O P E R A T I O N A L	Noise from machinery	Negative	Farming and land clearing	Use of well service machinery and also protect ears with ear plugs, etc.	Developer, Design Consultant & Contractor
	Effects of Dust on human health.	Negative	Dry tillage and vehicle movement in access road	Addition of the water to hold the dust Avoid tilling in dry soils Again, use of protective clothing such as dust masks would be mandatory.	Developer, Design Consultant & Contractor
	Depletion of ground water aquifers and / or fountains	Negative	Pumping water for irrigation	Control groundwater pumping, minimize over abstraction of the resource. Compliment groundwater abstraction using rain water harvesting technologies. Water demand should be managed with compliance to the conditions of the water extraction permit and according to the pumping tests done.	Developer, Design Consultant & Contractor

Project Phase	Impact	Positive \Negative	Impact source	Mitigation	Implementing agent
	Loss and modification of the soil profile.	Negative	Soil tillage during land preparation, mechanical weeding and moving equipment	Practice good farming methods, application of organic manure from decomposed plants to retain soil properties Minimize use of inorganic fertilizers. Apply cattle manure which can be bought from the local community.	Developer, Design Consultant & Contractor

Project Phase	Impact	Positive \ Negative	Impact source	Mitigation	Implementing agent
O P E R A T I O N A L	Employment creation	Positive	Labour for the irrigation scheme during construction and operation	Only locals will be considered for unskilled labour.	Developer, Design Consultant & Contractor
	Provision of infrastructure	Positive	Road construction Accommodation	The Proponent will use existing farm access. No staff quarters will be built except the farm manager's residence only.	Developer, Design Consultant & Contractor
	Negative social behaviour	Negative	Increased prostitution as a result of increased disposable income. Mixture of cultures	HIV/AIDS awareness sessions for the workers. Encourage the married to stay with their spouses. Have free condoms available at the farm. Recruit locals for all unskilled jobs, to reduce mixing of cultures.	Developer, Design Consultant & Contractor
	Improved standards of living	Positive	Increased availability of disposable income for the local	Recruit locals for all unskilled jobs	Developer, Design Consultant & Contractor
	Foreign currency generation	Positive	Sale of farm produce to international buyers especially Angola.	Increase production and even introduce green houses for to improve yields and shelf life of produce.	Developer, Design Consultant & Contractor
	Health problems	Negative	Effects of dust, noise and other activities	Provide appropriate safety clothing and equipment	Developer, Design

			<p>associated with farming on human health</p> <p>Outbreak of water borne diseases and COVID-19</p>	<p>Have regular medical examinations for those who work in sensitive area</p> <p>Maintain good hygiene at all times and provide good sanitary facilities.</p> <p>If there is an outbreak quickly notify the Ministry of Health & Social Services, quarantine the affected people and take them to the nearest clinic/hospital.</p>	<p>Consultant & Contractor</p>
	Injuries from accidents	Negative	<p>Accidents at the farm</p> <p>Fumigation and handling of hazardous chemicals</p>	<p>Implement safety measures at the farm including training, erecting warning signs at the farm.</p> <p>Train first aiders.</p> <p>Have well-equipped first aid kits on site.</p> <p>Ensure all chemicals are handled with protective clothing and during application workers are to adhere to the rules of how to fumigate or apply the pesticides.</p>	<p>Developer, Design Consultant & Contractor</p>

4.1 Guiding Notes Supporting the EMP

4.1.1 Tanks

Installation of above ground fuel storage tank and pipe work shall be undertaken in compliance with AS/NZ 1418.3-1997 Cranes, hoists and winches and AS/NZ 2550.1

4.1.2 General safety of public and employees

The work area should be cordoned off as a no-go area during construction and should be bund walled with a concrete floor and brick wall.

4.1.3 Managing fuel and oil spills

It is highly recommended to use leak proof concrete lining on all surfaces including the base supporting the above ground storage tank.

4.1.4 Detailed guidelines and conditions for managing loss of vegetation.

Irrigation impacts on vegetation were assessed and various mitigation measures presented in the EMP. The following guidelines were formulated to support the EMP with respect to managing and monitoring vegetation loss during establishment and operation of the proposed green scheme. The aspects and potential impacts of the proposed irrigation scheme that may affect flora and vegetation are:

- Disturbance and clearing land to make way for cultivation and the construction of infrastructure;
- Changes to the groundwater table, through groundwater level rises from seepage and modification of drainage; and
- Changes to surface hydrology.

Management of these aspects of irrigation and their potential impacts on flora and vegetation are described below.

- **GROUNDWATER LEVEL RISES**

Water logging and inundation of vegetation may occur as a result of groundwater level rises and modified surface water drainage. These areas, in effect become permanent to ephemeral wetlands and support wetland vegetation and other semi – aquatic species.

Groundwater levels may increase due to increased drainage into an area. Aquatic ponds for fisheries can be introduced.

The established list of protected species will be expanded and maintained and will include the different tolerances of these respective species and communities to changes in soil moisture regimes. This will assist in the development of consistent, focused and comprehensive monitoring systems.

Groundwater and vegetation monitoring sites should be established where ground and surface water issues may arise. Where vegetation is impacted by elevated water tables remedial actions should be evaluated and implemented where practical. Measures may include pumping and drainage earthworks.

Environmental Monitoring and Management Responsibility

Environmental management during establishment and operation of these green schemes lie with the Developer. In the event that Contractors are engaged, it remains the responsibility of the Developer to bind them contractually and ensure that the environmental obligations are met.

5 EMERGENCY PREPAREDNESS AND RESPONSE PLAN

It is prescribed that every project should have an emergency preparedness and response plan for the farming operations. This is a small operation and hence most of the items will be of a house-keeping nature and would need support from different governmental organizations and hotlines of key organizations (such as hospital, police, civil protection unit) shall be collected and put on a notice board for everyone to be familiar with and use them in case of emergency.

Table 3: Emergency Preparedness and Response Plan

Hazard	Causes	Early warning System	Effect	Intervention	By Who (Responsibility)
Fires	-Electrical shorts	-Alarms for accidents	Injuries and loss of life	-Create an emergency assembly point -Safety checks all around the buildings and equipment -Safety briefs before every shift -Clearly marked points with first aid kits -Clearly marked points for fire extinguishers and sand buckets	-Farm manager SHE Officer
Veld Fires	-Reckless disposal of cigarettes -Land Clearance -Absence of fire Guard -Poaching Fires	-Windy weather -Heavy rains – increases vegetation growth -Tall grass species	- Reduced grazing land and animal habitat - Destruction of some homesteads, animals	-Afforestation Awareness Campaign -Construction of fire guards -Train and set up firefighting teams -Warning systems in place -Clearly marked points for fire extinguishers and fire rubbers	-Farm Manager -SHE Officer
Deforestation	-Used as a source of firewood	-Wood demand -Siltation	-Low rainfall -Soil erosion	-A forestation awareness campaign - Use of alternative source of heat sources such as gas.	-SHE Officers

Hazard	Causes	Early warning System	Effect	Intervention	By Who (Responsibility)
		-Soil erosion -Electricity power cuts	- Shortage of fire wood -Increase wind flows through the area		
Road accident	-Driving under influence of alcohol -Un-serviced vehicles -Negligence	-Reports by either phone call or verbal	- Injury/ loss of life	-Driving safety awareness. -Discipline any negligence matters with heavy penalties such as fines. -No persons sitting on tractor mud guard. -Servicing of vehicles and vehicle inspections every morning.	Farm Manager
Outbreak cholera or typhoid	-Poor hygiene - Contamination of drinking water	-Reports and tests	-Illness and even loss of life	-Awareness campaigns on improved sanitation and hygiene. -Supply chlorine pills for water purification -Train people about the disease -Take affected people to the nearest clinic or hospital for treatment.	

Hazard	Causes	Early warning System	Effect	Intervention	By Who (Responsibility)
Snake bites	-Removal of habitat and clearing of vegetation	Shouting	Injury or loss of life	-Have snake venom antidote -Training on snake species identification and first aid on snake bites – <i>see tips on snake bites below</i> -have a stand by vehicle for such incidents	Construction supervisor, Farm Manager

IF YOU GET BITTEN - mambas & cobras

The most important thing is to try and identify the snake first **AND** keep calm...

These snakes' venom works by paralyzing the nervous system which means your respiratory muscles are affected, leading to lung failure.

TREATMENT

- apply a tourniquet above the bite which must be loosened every half hour so as not to restrict your blood flow completely
- 2 ampoules of polyvalent snake serum should be injected if available
- artificial respiration if necessary
- get to a hospital fast!

Venom in the eyes

- wash out thoroughly with lots of water
- if available, dilute one ampoule of polyvalent serum in the water

IF YOU GET BITTEN – boomslang & twig snake

The most important thing is to try and identify the snake first **AND** keep calm

These snakes' venom is haemotoxic and stops the blood from clotting and death will occur if left untreated. The venom is slow-acting, taking effect 2-4 hours after being bitten.

TREATMENT

- do not apply a tourniquet
- do not inject polyvalent snake serum
- get to a hospital as soon as possible!

Figure 11: Summary of first aids for snake bites for mambas, cobras, twig snakes (adapted from Safaribwana, 2007)

5.1 Monitoring Plan

It is mandatory for the proponent to submit a biannual report to the Environmental Commission. Monitoring provides the information for periodic review and improvement of the environmental management plan as necessary, ensuring that environmental protection is optimized at all stages of development through best practice. In this way undesirable environmental impacts will be detected early and remedied effectively. It will also demonstrate compliance with regulatory requirements. Environmental monitoring is directed to the following key environmental issues: -

- ◆ Develop improved practices and procedures for environmental protection
- ◆ Detect short- and long-term trends
- ◆ Recognize environmental changes and enable analysis of their causes
- ◆ Measure impacts
- ◆ Check the accuracy of predicted impacts
- ◆ Develop improved monitoring systems and
- ◆ Provide information on the impact of irrigation and farming activities

All data collected (whether by means of visual observations, instruments readings or chemical analyses) should be recorded in environmental log books.

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The rehabilitation and upgrading of the Warmquelle irrigation green schemes has potential negative environmental impacts. The study findings showed negative environmental impacts to the environment to varying degrees depending on the nature of the activity and impacts arising thereof. Management and corrective measures were formulated and implementation timelines proposed depending on the gravity of threat to human life and the environment.

The identified impacts, mitigation and monitoring activities, indicators, responsible parties and monitoring frequency are indicated in the EMP. The EMP should be implemented throughout the project lifecycle and an Environmental Management System formulated and implemented based on the study findings. Environmental monitoring and performance evaluations should be conducted and targets for environmental improvement set and monitored throughout the

project lifespan. It is also our determination that the findings should be incorporated earlier and sound SHE policies and supportive programmes implemented.

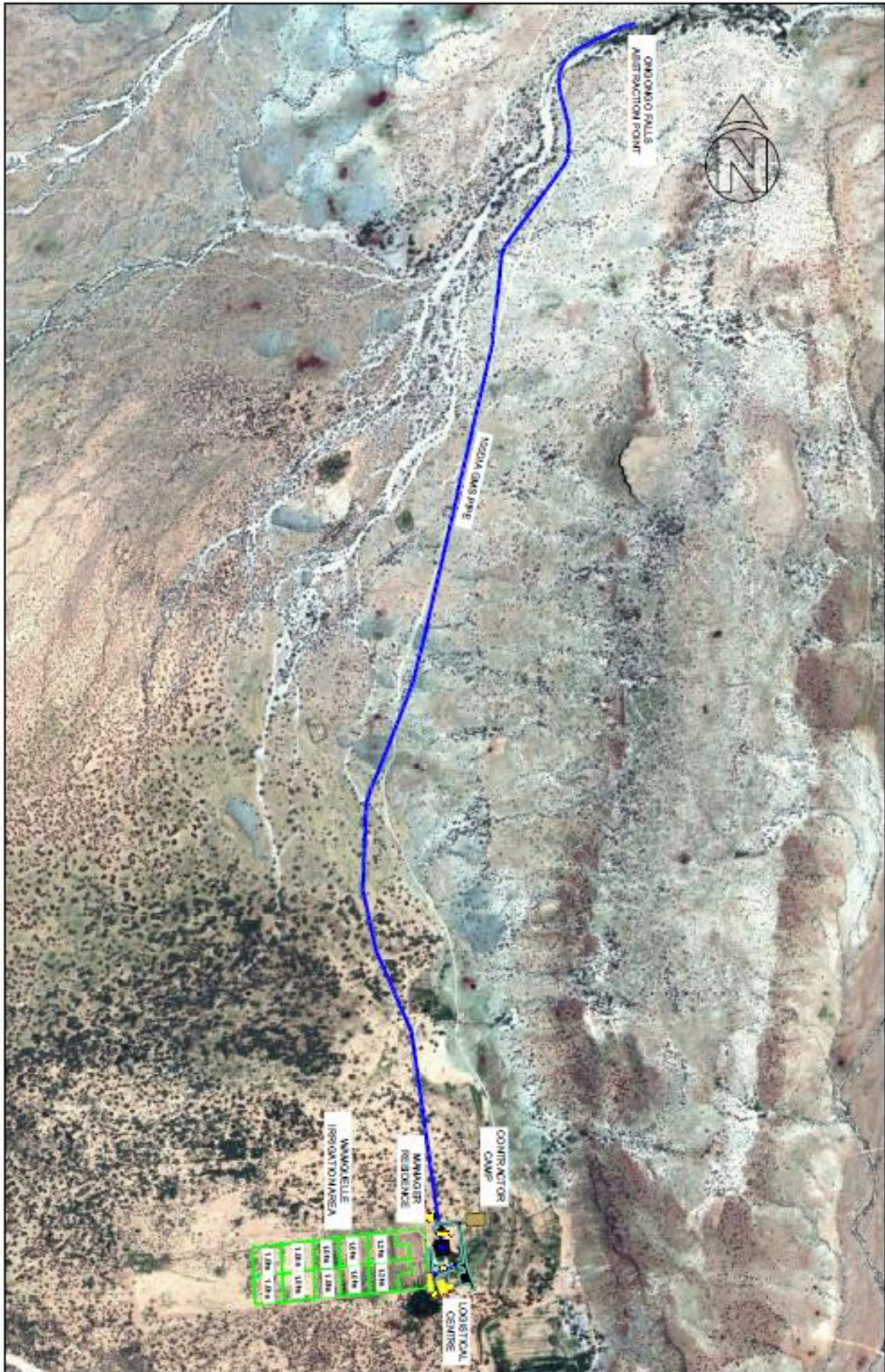
6.2 Recommendations

Recommendations were developed to guide the Developer on the key activities that should be done to effectively manage safety, health and environment:

- Give proper induction to the Contractor to avoid unwarranted environmental degradation.
- Develop SHE policies based on the study findings and use impacts evaluation to formulate the objectives.
- Develop and implement Environmental Management Systems.
- Develop an occupational health and safety plan
- Adhere to the environmental management obligations
- Obtain other relevant permits:
 - Permit to remove protected trees on a portion of the project site.
 - Water abstraction;
 - Access roads etc.

Provide relevant training to capacitate the workers with knowledge and skills to manage safety, health and the environment.

7 ANNEXURES: PROJECT SITE PLANS AND DESIGNS





ANNEXURE C1

SEWER/WATER LEGEND

- 110 DIA uPVC PIPE
- 25 DIA HDPE CLASS 4 DOMESTIC WATER LINE
- M 25 DIA DIAMETER KENT WATERMETER

Project WARMQUELLE/KHOWARIB IRRIGATION		Drawing Name WARMQUELLE SEWER LAYOUT		Date 15/01/2021
Client ENVIRONMENT INVESTMENT FUND OF NAMIBIA P. O. BOX 38157, AUAS VALLEY, WINDHOEK, NAMIBIA Phone: +264 61 431 7780 Email address: Contact person:	Project Managers DUNAMS CONSULTING ENGINEERS 8065 SCHWEITZER STREET, WINDHOEK WEST, WINDHOEK, NAMIBIA Phone: +264 61 238 911 Email: Contact person: A. Ushona	Contractor FIVE STAR INVESTMENT CC. ERF NO. 474, LONDON STREET WINDHOEK, NAMIBIA Phone: +264 811 622 042 Email: fivestar.invest@yahoo.com Contact person: L. Makutana	Agricultural Consultant ALOE AGRICULTURE TECHNOLOGIES (PTY) LTD. ERF NO. 919 NANCHAB ST, GIBESHA, BOX 20143, WINDHOEK, NAMIBIA Phone: 264 813 230 188 Email: info@aloesagritech.com Contact person: K. Shilolo	Consultants OUTRUN CONSULTANTS CC. NO. 10 WOERMANNBROCK BLDG, INDEPENDENCE AVENUE BOX 7622, KHOMASDAL WINDHOEK, NAMIBIA Phone: 264 61 2883 57 Email: Contact person: J. T. Makutifi
				Scale NTS
				Dwg No.
				Revision
				Design/Drawn: JAT

8 ANNEXURES: SOIL AND WATER QUALITY TEST RESULTS



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TEST REPORT

To: **Aloe Agriculture Technologies (Pty) Ltd**
Windhoek

Date received: **17-Dec-20**
Date analysed: **18-30-Dec-20**
Date reported: **4-Jan-21**

Attn: Mr J. Mukutiri
e-mail: **makkconsult@gmail.com**

Your Reference: **QU-5343**
Lab Reference: **I210124**

Type of Test:	pH (H ₂ O) 2:5	Conductivity 2:5	Total Nitrogen Mod. Kjeldahl method	Organic carbon Walkey Black	Organic matter calculated	Phosphorus extractable	Sodium	Potassium	Magnesium	Calcium
Method details:	electrometric	electrometric	ISO 11261:1995 (E)	% m/m C	factor = 1.724	Ohlsen	1M ammonium acetate (pH 7.0) followed by ICP-OES			
Units:		mS/m	mg N/kg		% m/m OM	mg P /kg	mg Na/kg	mg K/kg	mg Mg/kg	mg Ca/kg
Lab No.										
1 Khowarib Plot repeat	8.6	9.4	253	0.1	0.2	7	12	134	128	1426
2 Warm Quelle plot repeat	8.0	112.4	1780	2.0	3.5	58	107	1449	1010	4537

Type of Test:	Particle Size Analysis			Textural class
Method details:	Sand (2mm - 53 µm)	pipette method		
Units:	%	Silt (53-2 µm) %	Clay (<2 µm) %	
Lab No.				
1 Khowarib Plot	94.2	3.6	2.2	sand
	95.5	2.7	1.8	sand
2 Warm Quelle plot	12.0	69.2	18.8	silt loam
	15.1	73.9	11.0	silt loam

Extractable/exchangeable calcium and magnesium
Since calcium and magnesium carbonates dissolve to a large extent in ammonium acetate at pH 7.0; the concentrations of these cations are over-estimated in calcareous soils

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TEST REPORT

To: **Aloe Agriculture Technologies (Pty) Ltd.**
 Windhoek

Date received: 17/Dec/20
 Date analysed: 19 December - 23 December 2020
 Date reported: 11/Jan/21

Attn: Mr Josiah Mukutiti
 e-mail: makkconsult@gmail.com

Client Reference no.: verbal
 Quotation no.: OU-5343
 Lab Reference: I210124
 Enquiries: Ms Manuela Mayer

Parameter	Value	Units	me	Low	Medium	High	Very High
Sample details water sample							
Location of sampling point	Ongongo fountain						
Description of sampling point	-						
Date of sampling	2020/12/16						
Test item number	I210124/1						
				Salinity/Chloride/RSC Hazard			
pH	7.3				Acceptable pH range: 6.5-8.4		
Electrical Conductivity	73.1	mS/m		<25	25-75	75-225	>225
P-Alkalinity as CaCO ₃	0	mg/l					
Total Alkalinity as CaCO ₃	355	mg/l					
Bicarbonate as HCO ₃ ⁻	433	mg/l	7.10				
Carbonate as CO ₃ ²⁻	0	mg/l	0				
Total Hardness as CaCO ₃	404	mg/l					
Chloride as Cl	19	mg/l		0-105	105-140	140-350	>350
Fluoride as F	0.1	mg/l					
Sulphate as SO ₄ ²⁻	8	mg/l					
Nitrate as N	4.1	mg/l					
Sodium as Na	10	mg/l	0.44				
Potassium as K	1.9	mg/l					
Magnesium as Mg	55	mg/l	4.53				
Calcium as Ca	71	mg/l	3.54				
Manganese as Mn	<0.01	mg/l					
Iron as Fe	0.03	mg/l					
Copper as Cu	0.01	mg/l					
Zinc as Zn	0.02	mg/l					
Boron as B	0.02	mg/l		0.3-1.0	1.0-2.0	2.0-4.0	>4.0
Molybdenum as Mo	<0.01	mg/l					
Quality Indices:							
Electrical Conductivity	0.73	mS/cm					
HCO ₃ ⁻ :Ca	2.00	me/l					
Modified calcium value	1.26	me/l					
Adj. Sodium Adsorption Ratio	0.36	me/l					
Residual Sodium Carbonate	-0.97	me/l		<1.25	1.25-2.50	>2.50	
Magnesium Ratio	56.1	me/l			Acceptable ratio: <50		
Stability pH, at 25°C	7.07						
Ryznar Index	6.84	stable		<6.5= scaling, >7.5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	0.10	no corrosive properties		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			


 M. Mayer
 Section Head: Water Quality