APP-004071 (ECC-01474)

IMPLEMENTATION OF AND COMPLIANCE WITH THE ENVIRONMENTAL MANAGEMENT PLAN FOR AN IRRIGATION PROJECT (ANNUAL CROP PRODUCTION) BY WAGNOU IRRIGATION CC ON FARM OKAMBEKERE NO. 662, OKORUKAMBE CONSTITUENCY, OMAHEKE REGION, NAMIBIA

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ABBREVIATIONS / ACRONYMS / SYMBOLS / UNITS

The following is a list of the abbreviations, acronyms, symbols, units, technical terms, and definitions used in this Report:

AIDS	Acquired Immunodeficiency Syndrome
DEA	Directorate of Environmental Affairs
DEAF	Directorate of Environmental Affairs and Forestry
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EAPAN	Environmental Assessment Professionals of Namibia
ECC	Environmental Clearance Certificate
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FAO	Food and Agriculture Organization of the United Nations
ha	hectare
HACCP	Hazard Analysis Critical Control Points
HIV	Human Immunodeficiency Virus
I&APs	Interested and Affected Parties
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IWM	Integrated Waste Management
km	kilometre
km/h	kilometre per hour
kV	kilo Volt
kVa	kilo-volt-ampere
m	metre
m^3	cubic metre
m^3/annum	cubic metre per annum
m^3/h	cubic metre per hour
mg/l	milligrammes per litre
mm	millimetre
MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MHSS	Ministry of Health and Social Services
MME	Ministry of Mines and Energy
MSDS	Material Safety Data Sheets
NamPower	Namibia Power Corporation (Proprietary) Limited
NCE	Namibia Chamber of Environment
PM	Particulate Matter
PMP	Pest Management Plan
PPE	Personal Protective Equipment
SA	South Africa
SHE	Safety, Health, Environment
STIs	Sexually Transmitted Infections
TB	Tuberculosis
UK	United Kingdom
UNAM	University of Namibia
WHO	World Health Organization

1 Introduction

1.1 Background

Farm Wagnou No. 691 is situated 100 kilometres (km) north of Gobabis, in the Okorukambe Constituency, Omaheke Region, Namibia.

"*Wagnou Boerdery*" is a Namibian, family-owned business, that operates a diversified agricultural establishment that takes pride in its quality products: cattle (Beefmaster, Belgian Blue, and Chianina Cattle); fodder (fodder sorghum and Blue Buffalo grass *Cenchrus ciliaris* are cut and baled; value is added by milling, mixing and user friendly bagging of milled feed mixes); and crops (maize and beans) (see http://wagnou.com/; LM Environmental Consulting, 2021).

The owners and manager of Farm Wagnou No. 691 registered Wagnou Irrigation CC/2012/0065 in 2020, and is leasing an area, 400 hectares (ha) in size, from Mr Frans Nel, the owner of Farm Okambekere No. 662, to conduct an Irrigation Project (annual crop production).

Farm Okambekere is located around 50 km north-west of Farm Wagnou, Okorukambe Constituency, Omaheke Region, Namibia. Access to the area can be attained via the T1402 Trunk Road (from Gobabis) and District Road D1628 (see Figures 1 and 2).

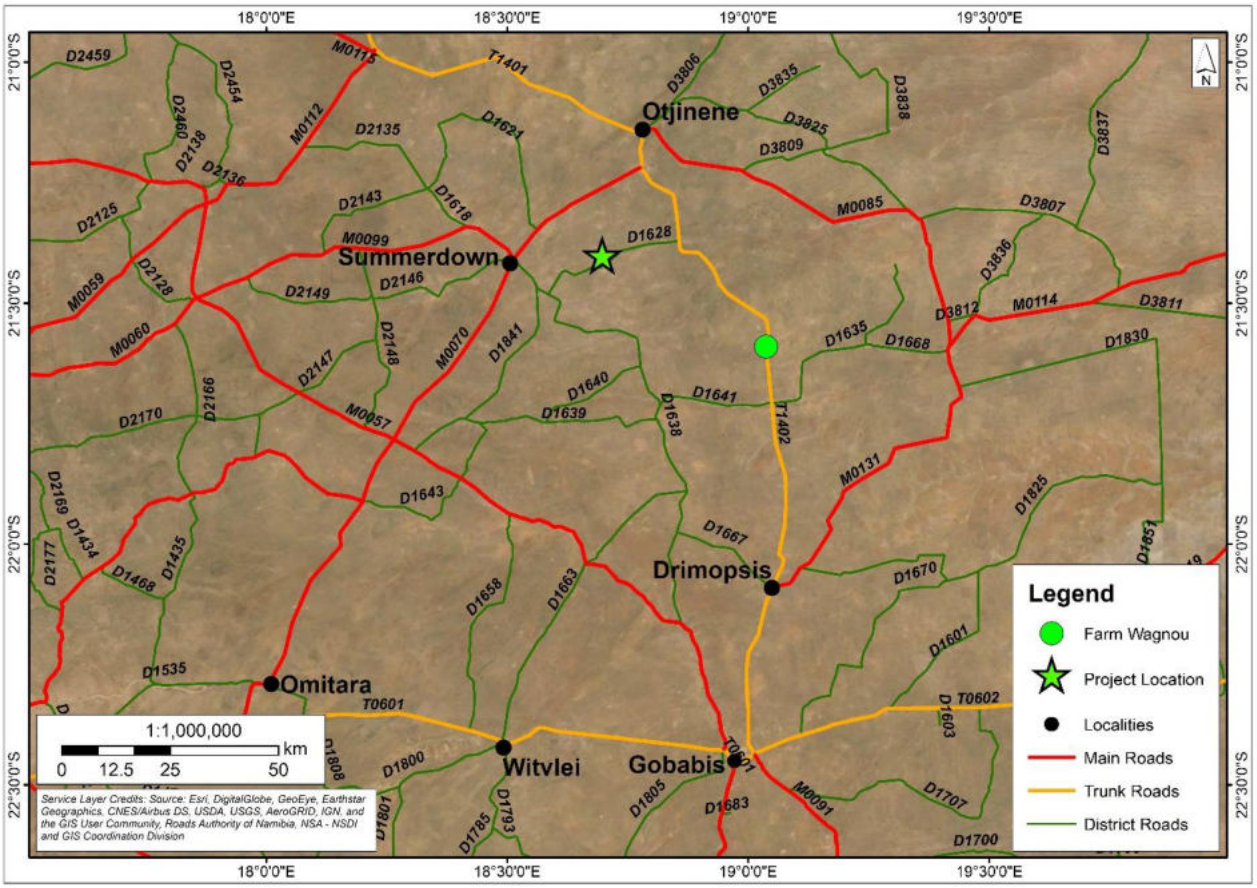

Figure 1: Map showing the location of Farms Wagnou No. 691 and Okambekere No. 662, Okurokambe Constituency, Omaheke Region, Namibia (*Source: Miss Maike Prickett, GIS Specialist, September 2020*).

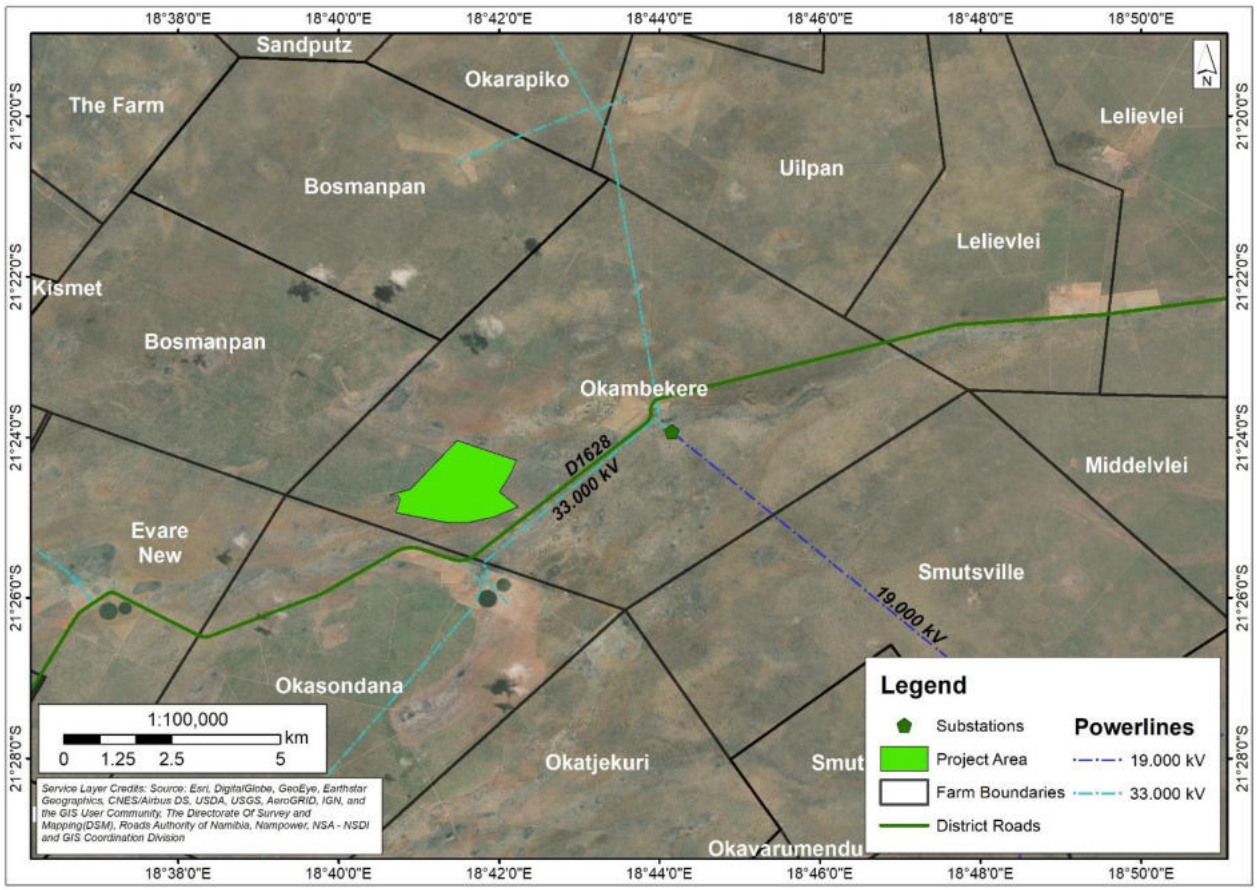

Figure 2: Map showing the location of the irrigation area on Farm Okambekere No. 662, Okurokambe Constituency, Omaheke Region, Namibia (*Source: Miss Maike Prickett, GIS Specialist, December 2020*).

On 24 September 2020, Wagnou Irrigation CC applied to the Executive Director, Ministry of Agriculture, Water and Land Reform (MAWLR) for an Environmental Clearance Certificate (ECC). The day before, 23 September 2020, the Application was registered online with the Ministry of Environment, Forestry and Tourism (MEFT). The relevant documents were submitted to the Executive Director, MAWLR (hard copy), and Environmental Commissioner, MEFT (hard copy, as well as electronically via http://www.eia.meft.gov.na/) on 21 December 2020.

On 24 February 2021, the Geohydrology Division, Directorate of Water Resource Management (DWRM), MAWLF submitted a letter/response sheet for interested and affected parties to the Directorate of Environmental Affairs (DEA) (now Directorate of Environmental Affairs and Forestry (DEAF)), MEFT. The letter was made available by MEFT to LM Environmental Consulting on 11 March 2021.

The *Hydrogeology Assessment Specialist Study* and the *Environmental Scoping, Impact Assessment and Management Plan Report for a Proposed Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia* were updated and a *Revised Environmental Scoping, Impact Assessment and Management Plan Report for a Proposed Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia* was submitted to the MEFT on 26 March 2021.

The Office of the Environmental Commissioner issued an ECC on 29 June 2021; the ECC is valid for three (3) years and expired on 29 June 2024.

1.2 Terms of Reference

LM Environmental Consulting was appointed by Wagnou Irrigation CC to prepare a report, illustrating the implementation of and compliance with the Environmental Management Plan (EMP) and to update the EMP (see LM Environmental Consulting, 2021), in aid of the application for the renewal of the Environmental Clearance Certificate (ECC) in June 2024 (see Table 1 for a list of the Environmental Reports submitted to the MAWLR and MEFT to date).

Table 1: List of the Environmental Reports submitted to the Ministries of Agriculture, Water and Land Reform and Environment, Forestry and Tourism since September 2020.

Application / Report	**Date of Submission**	**Status**
Environmental Scoping, Impact Assessment and Management Plan Report for a Proposed Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia	17 December 2020 (online: MEFT) 21 December 2020 (hard copies: MAWLR and MEFT)	The Geohydrology Division, Directorate of Water Resource Management (DWRM), Ministry of Agriculture, Water and Land Reform (MAWLR) submitted a letter/response sheet for interested and affected parties to the Directorate of Environmental Affairs (DEA), MEFT on 24 February 2021; the letter was made available by MEFT to LM Environmental Consulting on 11 March 2021
Revised Environmental Scoping, Impact Assessment and Management Plan Report for a Proposed Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia (LM Environmental Consulting, 2021)	26 March 2020 (online: MEFT)	An ECC was issued by the Office of the Environmental Commissioner on 29 June 2021
Bi-Annual Environmental Report for the Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia. July to December 2021 (Maartens, 2022a)	10 February 2022 (online and hard copy: MEFT)	No feedback was received from the Department of Environmental Affairs and Forestry (DEAF), MEFT
Bi-Annual Environmental Report for the Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia. January to June 2022 (Maartens, 2022b)	09 August 2022 (hard copy only; the online submission could not be done as the online portal collapsed)	No feedback was received from the DEAF, MEFT
Environmental Monitoring Report for the Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia. July to December 2022 (Maartens, 2023a)	06 February 2023 (hard copy only; all previous information was lost with the collapse of the online portal)	No feedback was received from the DEAF, MEFT
Environmental Monitoring Report for the Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia January to June 2023 (Maartens, 2023b)	08 August 2023 (hard copy only; all previous information was lost with the collapse of the online portal)	No feedback was received from the DEAF, MEFT
Environmental Monitoring Report for the Irrigation Project (Annual Crop Production) by Wagnou Irrigation CC on Farm Okambekere No. 662, Okorukambe Constituency, Omaheke Region, Namibia. July to December 2023 (Maartens, 2024)	19 January 2024 (hard copy only; all previous information was lost with the collapse of the online portal)	No feedback was received from the DEAF, MEFT

1.3 Environmental Assessment Practitioner

The author of this Report is Dr Lima Maartens who has more than 31 years' experience in natural resource management (*she gained her doctorate (Ph.D.) in Fisheries Science from Rhodes University, South Africa (SA) while working for the Namibian Ministry of Fisheries and Marine Resources (MFMR) in 2000*), lecturing (*University of Namibia (UNAM)*), environmental science and management (*De Beers Marine Namibia and the Canadian Forsys Metals Corp*), and consulting (*LM Environmental Consulting was established by Dr Maartens in October 2009*).

Sectors that she worked in as an Environmental Assessment Practitioner (EAP) include: exploration (including offshore oil and gas); mining and quarrying; renewable energy (solar and wind); tourism; manufacturing; agriculture; aqua- and mariculture; township, property (including medicine storage facilities) and waterfront developments, transport (rail and road), and infrastructure.

Dr Maartens is registered as a Lead Practitioner and Reviewer with the Environmental Assessment Professionals of Namibia (EAPAN) (she served on the Executive Committee during 2016/17), an Associate Member and Environmental Auditor with the Institute of Environmental Management and Assessment (IEMA) in the United Kingdom (UK), a Full Member of the Namibia Chamber of Environment (NCE), and a Member of the Namibia Scientific Society.

She has published five peer-reviewed scientific research articles (and three as co-author), six popular articles (and one as co-author), one book chapter (and one book chapter as co-author), 169 technical reports (LM Environmental Consulting), three technical reports (for De Beers Marine Namibia), and one conference paper.

2 Environmental Management Plan: Implementation and Compliance

2.1 Introduction

As part of the EMP performance review, the following actions were carried out:

- A site visit was undertaken to the area between 18 and 19 July 2024;
- The following information was made available by Mr Johan van der Merwe:
    - Consumer (Fuel) Installation Certificate, CI/2904/2024, Ministry of Mines and Energy (MME), 19 June 2024; and
    - Assessment of water quality and its subsequent effect on soils, Analytical Laboratory Services, March 2024.

2.2 Compliance: Environmental Management Plan

In order to illustrate compliance with the EMP (see Table 2), the following colour codes were applied:

	Compliance/Completed
	In Progress/Ongoing
	Non-compliance
	Not Applicable (N/A)
	Changes made to existing EMP

The EMP (see LM Environmental Consulting, 2021; also see International Finance Corporation (IFC), 2007a; b; and c; Pallett and Tarr, 2017; Cornell College of Agriculture and Life Sciences (CALS), 2020; Christelis *et al*., 2021; Mr Peter Cunningham, Environment and Wildlife Consulting Namibia, pers. comm.) is not a static document and the document should be updated as activities at the Irrigation Project progresses.

Table 2: Updated Environmental Management Plan for Wagnou Irrigation CC's activities i.e. Irrigation (Annual Crop Production), Farm Okambekere No. 662, Omaheke Region, Namibia.

Aspect	Impact	Mitigation	Compliance / Comments (2024)
Social and Environmental Performance			
Management and Monitoring	Social and Environmental Performance	Adhere to all Namibian Legislation, including Best Practice Guidelines, and the Agreement of Lease. Ensure that all aspects related to the Environmental Management Plan (EMP) are implemented.	Ongoing. The Agreement of Lease is valid until 31 July 2030 (see LM Environmental Consulting, 2021).
Consultation and Disclosure	Social and Environmental Performance	Maintain open and direct lines of communication with the Authorities and Interested and Affected Parties (I&APs) (e.g. representatives from the Ministry of Agriculture, Water and Land Reform (MAWLR), the Ministry of Environment, Forestry and Tourism (MEFT), Namibia Power Corporation (Proprietary) Limited (NamPower), etc.) with regards to environmental matters. Consult with I&APs throughout the project process and adequately incorporate I&APs' concerns.	Ongoing; see Maartens (2022a).
~~Grievance Mechanism~~	~~Social and Environmental Performance~~	~~Implement a grievance mechanism for receiving and resolving any concerns and grievances related to the project's social and environmental performance throughout the project life cycle.~~ ~~Inform all I&APs about the mechanism.~~ ~~Address concerns promptly and transparently and in a culturally appropriate manner.~~ ~~Keep a register of all concerns/issues received from I&APs, as well as the measures taken to address these.~~	No concerns or grievances related to the project's social and environmental performace have been received during the past three years (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Training, including awareness and inductions	Social and Environmental Performance	Train employees in matters related to the project's social and environmental performance and Namibia's regulatory requirements. Ensure adequate environmental awareness training for all personnel. Give environmental induction presentations to all personnel.	Environmental awareness training is given in the form of Toolbox Talks (see Maartens, 2022a; b; 2023a; b; 2024). Staff was given *ad hoc* training in the handling/operation of the implements and tractors (see Maartens 2023a); a new baler was purchased and five operators were trained in handling the new machine (see Maartens, 2024). One member of staff also received training on the newly acquired bale wrapper (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
Employment and procurement opportunities	Social and Environmental Performance	Source contracting companies/service providers/workers based on merit and expertise giving preference to local contractors/service providers/workers (from the local area, and then from the settlements of Otjinene and Drimiopsis) on condition that the local contractors/service providers/workers have the required experience and expertise. Ensure that contractors/service providers adhere to the Namibian Labour, Social Security, Health and Safety, and Affirmative Action laws. Source maximally from local resources to ensure maximum economic beneficiation of local businesses in terms of new business sales.	The staff is sourced from the local area first, then from the settlements of Otjinene and Drimiopsis (see LM Environmental Consulting, 2021), then from Gobabis, and finally from the Kavango and Ovamboland (see Maartens, 2022a; b; 2023a; b; 2024). Staff has also been sourced from Plessis Farm, a resettlement farm close by (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.). Contractors used include: the John Deere Agency; Michael Huppel from Hochveld – Combine Harvester; Agra; Cape Agri; Grootfontein Crop Care; and NamPower (readings and maintenance) (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Labour and Working Conditions	Social and Environmental Performance	Establish, maintain and improve the worker-management relationship. Base the employment relationship on equal opportunity and fair treatment and no discrimination to be allowed. Comply with Namibia's labour and employment laws. Promote safe and healthy working conditions and the protection and promotion of worker health. Document and communicate the Working Conditions and Terms of Employment. Respect Collective Agreements and the right of workers to organise and bargain collectively. Implement a Grievance Mechanism.	Ongoing Management has an ''open door'' policy (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Occupational and Community Health and Safety and Security	Social and Environmental Performance	Adhere to all Namibia's Health and Safety Regulations (Labour Act, 1992: Regulations Relating to the Health and Safety of Employees at Work).	
		Ensure that an **HIV/AIDS Policy and Programme** and **Health and Safety Plan** is in place.	
		A SHE (Safety, Health, Environment) Representative to be appointed once the staff complement reaches 20.	Wagnou Irrigation CC employs one (1) female and nine (9) male staff; additional workers are employed on an *ad hoc* basis. Between three (3) and four (4) male staff stay at the Project Site at any time (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Occupational Health and Safety Training to be provided to all employees.	In-house training is provided (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
		Ensure that qualified first aid can be provided at all times.	First aid can be provided at all times; Mr Willem Leask, Partner, Wagnou Irrigation CC is a qualified first aider, and First Aid Kits are available at the offices on Farms Wagnou No. 691 and Okambekere No. 662, as well as in all the vehicles. Staff that are ill, are either transported to one of the Clinics (e.g. to Epukiro), or otherwise taken to a private Doctor in Gobabis (see Maartens, 2022a; b; 2023a; b; 2024; Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
		Comply with all safety regulations re. electricity supply.	Mr Willem Leask, Partner, Wagnou Irrigation CC is a qualified electrician (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
		Ensure that employees are trained in the use of appropriate fire fighting equipment and ensure that such equipment is on hand at all times.	Compliant and ongoing; three water bowsers are available for use at the two (2) Farms (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
		Provide and ensure the active use of Personal Protective Equipment (PPE).	The staff is issued with and wear PPE (i.e. shoes, overalls, gloves, and hats (sun protection)) (herbicides and pesticides are sprayed from a cab tractor) (see Maartens, 2022a; b; 2023a; b; 2024).
		Make suitable arrangements, as far as practicable, for the maintenance of health, the prevention and overcoming of outbreaks of disease (e.g. Tuberculosis (TB)) and of adequate first aid services.	To date, there has been no staff member that contracted TB (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
		Prevent communicable disease (e.g. Sexually Transmitted Infections (STIs) such as HIV transmission): provide surveillance and active screening and treatment of employees; prevent illness among employees (through health awareness and education initiatives); ensure ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers; and promote immunization.	Once a year, representatives from the Ministry of Health and Social Services (MHSS) in Gobabis/the Clinic visit all the farm workers; basic examinations are carried out and awareness talks given (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
		Implement measures to protect the entire team (including contractors) against the SARS-CoV-2 Virus that causes COVID-19. Train employees in the COVID-19 regulations. Provide adequate handwashing and hand sanitizing facilities; maintain the required physical distance and wear a face mask if applicable. Stay up-to-	Measures were implemented to protect the entire team (including contractors) against the SARS-CoV-2 Virus that causes COVID-19 (see Maartens, 2022a; b; 2023a; b; 2024).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		date on current COVID-19-related regulations in the Region and Country.	
		Ensure that security arrangements are in place.	The Project area (400 ha) is game proof fenced, and there are locks on all the gates (and the transformers) (see Maartens, 2022a; b; 2023a; b; 2024).

a)


b)

Figure 3: Pictures showing: a) the sign board (with contact details); and b) the game proof fence (that was erected around the Project area) (*Source: L. Maartens, 18 July 2024*).

Soil Preparation / Construction of Transmission Lines (also see Annual Crop Production: General)			
~~Pre-bush Clearing~~	~~Disturbance/loss of fauna and flora~~	~~Confirm that there are no White-backed vulture *Gyps africanus* nests in the area to be debushed/irrigated; should such nests occur, then these should be avoided at all cost and the proposed Project layout be adapted to reflect this.~~ ~~Remove (e.g. capture) unique/sensitive fauna (e.g. tortoises, chameleons, etc.) before commencing with the bush clearing (and/or species serendipitously located during the bush clearing activities) and relocate these to an area outside the area to be cleared / in the immediate area.~~ ~~Remove unique/sensitive flora (e.g. all *Aloe* species such as *A. litoralis* and *A. zebrina*, etc.) before commencing with bush clearing and relocate these to an area outside the area to be cleared / in the immediate area but with similar geology.~~	No White-backed vulture *Gyps africanus* nests, unique/sensitive flora (e.g. all *Aloe* species), invasive alien species, or archaeological sites were observed in the area. The unique/sensitive fauna (e.g. tortoises and chameleons) were moved to neighbouring areas before (and during) the de-bushing exercise (see Maartens, 2022a). After the 2021 rainy season (and 2022 season, but fewer), bullfrogs and turtles were observed in water pools in the cleared area, as well as in the dam on Farm Okambekere No. 662 (see Maartens, 2022a; 2023b).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
Bush Clearing and Annual Crop Production	Disturbance/loss of fauna and flora and habitat alteration	Restrict all activities to previously demarcated areas; all other areas will be regarded as "no go" zones in order to minimise the impact on the surrounding land. No trespassing on adjoining properties is allowed and no fauna or vegetation is to be interfered with. Make use of existing access routes as far as possible. Avoid off-road and unnecessary nocturnal driving in the area (as it could result in the destruction of slow moving fauna, i.e. various reptiles and other nocturnal species) (and this would minimise the effect on the localised and potentially sensitive flora in the area). Implement and maintain (internal) track discipline with maximum speed limits (e.g. 20-25 kilometres per hour (km/h)) (this would result in fewer faunal road mortalities and associated dust pollution problems). Utilise field borders to provide wildlife corridors around the proposed irrigation area. Implement a policy of “no kill” with regards to fauna (e.g. poaching for meat (snares); the collection of veld foods (e.g. tortoises); the capture/killing of birds; the killing of snakes, etc.). No animal may be injured, fed, trapped, hunted or harmed in any way. Avoid the removal of and/or damage to any protected flora species as far as feasible. Educate/inform staff and contractors re dangerous (e.g. snakes) and protected species (e.g. tortoises) to avoid the consequences of killing and/or the illegal collection of such species. Educate/inform staff and contractors re the threat/consequences of fires, wood collection and/or the illegal collection of any plant species. Do not allow on-site fires for cooking (this could easily cause runaway veld fires affecting the local fauna, but also causing problems (e.g. loss of grazing and	No new roads and/or tracks have been made (see Maartens, 2022a; b; 2023a; b; 2024).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		domestic stock mortalities, etc.) for the neighbouring farmers). Implement a suitable and appropriate refuse removal policy (littering could result in certain animals (e.g. baboons, jackals, etc.) becoming accustomed to humans and the associated activity and result in typical human-wildlife conflict issues. Eradicate all invasive alien plant species.	Some alien *Opuntia* plants were observed; the plants are not regarded as invasive in the area (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Tansmission Lines			
~~Transmission lines and associated structures~~	~~Negative impact on avifauna~~	~~Monitor the power lines and associated structures (for possible bird collisions/electrocutions).~~ ~~Consider the use of standard bird flight diverters and/or vibration dampers, placed at the required intervals along the line, to make the line more visible to birds (if required).~~	The power lines and associated structures were monitored, and no bird collisions/electrocutions were found to have occurred (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
The following power connections were installed (see LM Environmental Consulting, 2021): i) a new overhead transmission line, 800 metres (m) in length, tapped off from the existing Namibia Power Corporation (Proprietary) Limited (NamPower) 33 kilo Volt (kV) transmission line, to the pump station (1 x 315 kilo-volt-ampere (kVa) transformer at the pump station with 2 x 75 kVa meter points; power is supplied to the pump station, pivots and pumps via underground cables); and ii) a new overhead transmission line, 940 m in length, tapped off from the existing NamPower 33 kV transmission line to abstraction/production borehole (BH) 12 (1 x 100 kVa transformer with 1 x 75 kVa meter point) and from there to the other abstraction/production boreholes via underground cables. One underground water pipeline links the boreholes and the reservoir (see Figure 4).			

Aspect	Impact	Mitigation	Compliance / Comments (2024)

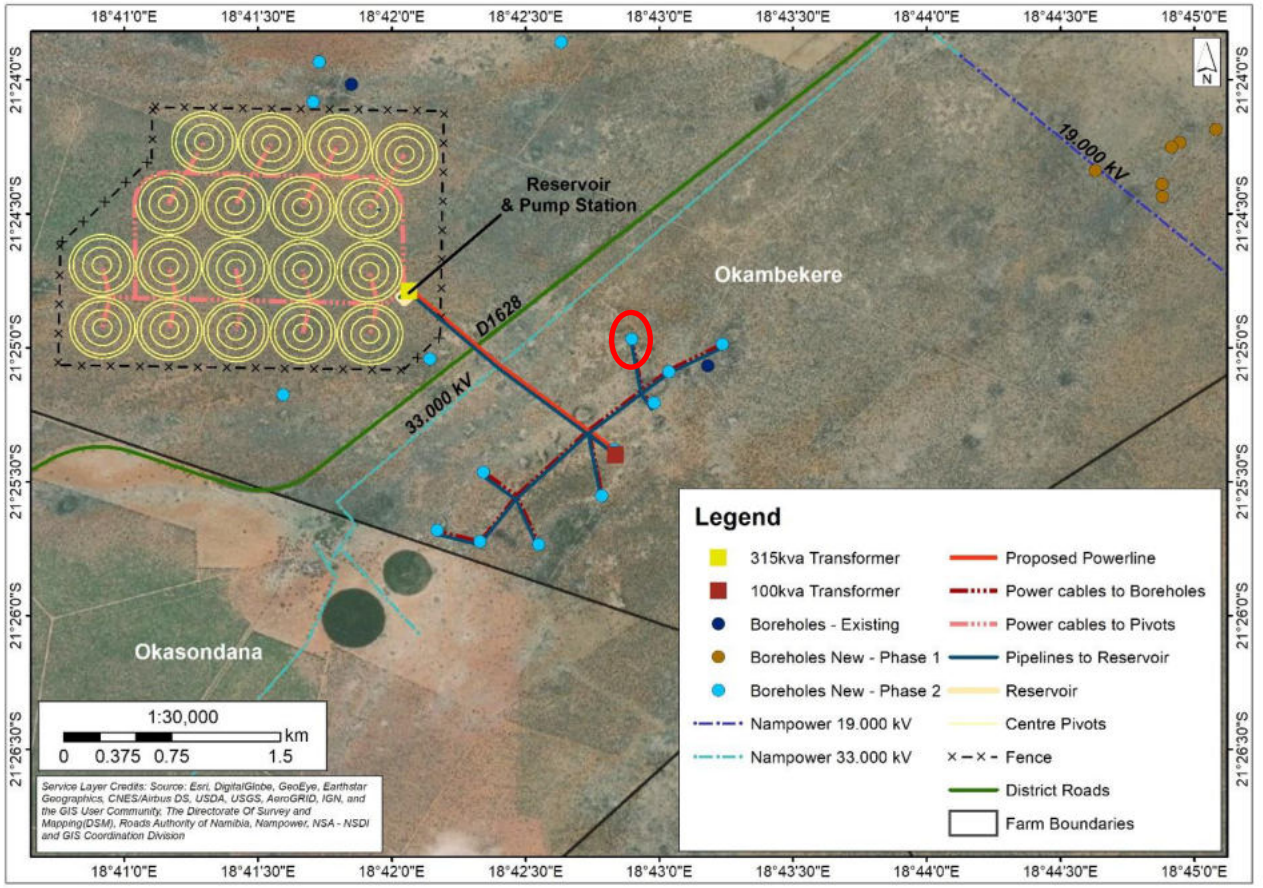

Figure 4: Map showing the water and power line routes on Farm Okambekere No. 662, Okurokambe Constituency, Omaheke Region, Namibia (*Source: Miss Maike Prickett, GIS Specialist, December 2020*).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
 a)  b)  c)  d) Figure 5: Pictures showing: a) one of the boreholes (see red oval in Figure 4); b) and c) the overhead transmission lines; and d) the pump station (*Source: L. Maartens, 18 July 2024*).			
Sowing/planting (also see Annual Crop Production: General)			
Seeds for Sowing	Loss of genetic resources and variability	Use certified crop seeds (seeds to not contain seeds from invasive alien species; seeds to comply with the information on the packaging regarding seed diameter and species). Obtain a permit from the MAWLR for any seeds to be imported.	Compliant and ongoing. The pesticides, fertilizers and all seeds are bought from licensed suppliers (e.g. Agra, Cape Agri, and Grootfontein Crop Care) (and that no permits thus need to be obtained by the Management of Farm Okambekere No. 662) (see Maartens, 2022a; b; 2023a; b; 2024).
Growing phase - Nutrient management (also see Annual Crop Production: General)			
Soil Management	Soil degradation and/or erosion	Practice **Integrated Nutrient Management (INM)** (to avoid nutrient depletion / accumulation).	Compliant and ongoing.

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Use vegetative barriers (crop residues or remains) to prevent wind and water erosion. Use appropriate machinery to avoid soil compaction. Use plant cover or intercrops and shelterbelts to reduce erosion from wind and heavy rain. *After harvesting the maize, a "cover crop mix" e.g. sunn hemp or radishes/turnips/lentils will be planted; after harvesting the wheat, legumes (peanuts or cowpeas), or radishes/turnips/lentils will be planted*. Increase the organic matter content in the soil to protect the soil from sun/rain/wind and to feed the biota in the soil (crop residues, compost and/or manure can be used, but consider the potential for the spreading of pests). Consider adding lime to the soil (this will compensate for acidification (due to acid deposition and fertilizers) and maintain stable pH levels). Assess the potential impacts of waste materials (e.g. manure and sludge) to soils and water resources prior to use for soil enhancement (the waste materials may contain harmful contaminants e.g. heavy metals, nitrogen, phosphorus and disease-causing agents).	Maize/peanuts/luzerne/cowpeas will be planted in summer and then oats/peas and luzerne in winter. Wheat will not be planted anymore. Sunn hemp/radish/turnip/lentils may be planted for soil health and cover (to prevent wind erosion). Lime was added to the soil once in the past three years. Chicken manure only is used (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Nutrient Management / Application of Fertlizers	Pollution of biophysical environment (surface and groundwater)	Balance nutrient application according to INM recommendations. Use crop rotation methods (to enable cultivation of leguminous plants with nitrogen fixation capabilities). Use plants to cover the soil, especially during a fallow period. Instead of burning, rather incorporate organic waste materials into soils. Conduct regular soil testing (to establish nutrient needs) in order to determine fertilizer application rates/correct doses.	Compliant and ongoing. Maize/peanuts/luzerne/cowpeas will be planted in summer and then oats/peas and luzerne in winter. Wheat will not be planted anymore. Sunn hemp/radish/turnip/lentils may be planted for soil health and cover (to prevent wind erosion). Organic waste is incorporated into the soil. Soil samples are sent to SGS in South Africa every three (3) years.

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Assess soil acidity (so that maximum uptake of phosphates can be achieved). Obtain a permit from the MAWLR for any *fertilizer* to be imported. Spills during transfer, mixing, and storage to be handled as per Hazardous Materials Management. Store fertilizers in their original packaging in a dedicated, locked area, with proper signage, and with access limited only to authorised personnel. Prepare a management plan covering the measures for containment, storage and ultimate destruction of obsolete fertilizers in accordance to the Food and Agriculture Organization (FAO) guidelines (and consistent with country commitments under the Stockholm, Rotterdam and Basel Conventions).	This is done every three (3 years) (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.). The pesticides, fertilizers and all seeds are bought from licensed suppliers (e.g. Agra, Cape Agri, and Grootfontein Crop Care) (and that no permits thus need to be obtained by the Management of Farm Okambekere No. 662) (see Maartens, 2022a; b; 2023a; b; 2024). Compliant (pers. obs., 18 July 2024). All fertilizers are used, i.e. there is no obsolete fertilizers (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Use of Manure	Odours / atmospheric emissions and Community health and safety	~~Store manure as far away from dwellings/homesteads as possible~~. ~~Cover the manure (if feasible) to reduce odors and atmospheric emissions~~. ~~Do not apply manure to the fields if the wind direction is toward nearby dwellings/homesteads~~.	Chicken manure only is used; it is obtained via 10 to 20 trucks from Namib Poultry each year and applied immediately (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Growing phase - Pest management (also see Annual Crop Production: General)			
Annual Crop Production – Attraction of e.g Baboon, Kudu, Porcupine, Warthog and Avifauna (Guinea fowl, Red-billed Quellea's, etc.)	Human-wildlife conflict	Game proof fence the proposed Project area; ~~at ground level, the fence should either be dug in and secured with rock/concrete, and/or electrified.~~ At no time / under any circumstances should snares ever be used. ~~Place perching poles throughout the Project area where raptors that prey on guinea fowl, red-billed quellea's, etc. (and rodents) could perch and assist in disturbing the birds~~. ~~Consider game bird hunting (within the season and with the necessary permits, etc.) in case of large numbers of guinea fowl be attracted to the Project area~~.	Compliant and ongoing. During the first season only were wax blocks put out for the mice (see Maartens, 2022a).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		~~At no time / under any circumstances should poisons ever be used~~.	
Pest Management / Application of Pesticides	Pollution of biophysical environment (surface and groundwater) and Occupational and community health and safety	Follow an **Integrated Pest Management (IPM)** strategy and prepare a **Pest Management Plan (PMP)**. Consider the following alternatives to using pesticides: rotate crops; ~~use pest-resistant crop varieties~~; use mechanical weed control ~~and/or thermal weeding~~; use beneficial organisms to perform the biological control of pests (e.g. insects, birds, mites, microbial agents); protect natural enemies of pests (i.e. provide favourable habitats to house pest predators); use animals to graze areas and manage plant coverage; ~~or use mechanical controls (i.e. traps, barriers, light and sound to kill/relocate/repel pests)~~. Obtain a permit from the MAWLR for any *Pest Control Product (Conventional and Biological)* to be imported. Maintain a pesticide logbook: e.g. field observations, ~~weather data~~, time and dosage of treatment, and effectiveness and apply pesticides based on these criteria. Ensure that only the minimum effective dose is applied. Avoid the use of pesticides that fall under the World Health Organization (WHO) Recommended Classification of Pesticides by Hazard Classes 1a and b, and by Hazard Class II. Also those that are listed in Annexes A and B of the Stockholm Convention (except under the conditions noted in the convention). Avoid using any pesticide on the FSC (Forest Stewardship Council) Lists of highly hazardous pesticides (2019). Only use pesticides that are manufactured under license, registered and approved by the appropriate authority and in accordance with the FAO's International Code of Conduct on the Distribution and Use of Pesticides. Only use pesticides that are labeled in accordance with international standards and norms. Select application technologies and practices designed to reduce unintentional drift or runoff (as per IPM program) and under controlled conditions.	Compliant and ongoing. See below. The data are logged by an external party (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.). The pesticides, fertilizers and all seeds are bought from licensed suppliers (e.g. Agra, Cape Agri, and Grootfontein Crop Care) (and that no permits thus need to be obtained by the Management of Farm Okambekere No. 662) (see Maartens, 2022a; b; 2023a; b; 2024). The pesticides are sprayed using a tractor (to reduce unintentional drift or runoff).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Pesticide application equipment to be maintained and calibrated in accordance with manufacturer's recommendations. Store pesticides in their original packaging in a dedicated, dry, cool, frost-free, well aerated, locked area, with proper signage, and with access limited only to authorised personnel. Also ensure that spill containment measures are in place. Ensure that the personnel applying pesticides are properly trained; mixing and transfer of pesticides to be done in ventilated and well-lit areas using containers designed/dedicated for the task. Contaminated containers to be handled and treated as hazardous waste (see Hazardous Materials Management). Personnel that apply pesticides should use the correct PPE. Purchase and store only the required amounts of pesticides.	Compliant (pers. obs., 18 July 2024). There are only two (2) store rooms (one for oil, tools and spares, and one for liquid fertilizers and pesticides) and no signs were put up.
Growing phase - Water Management			
(Cumulative) Use of Groundwater (in the Summerdown Area)	Decline in / depletion of natural resources (groundwater)	Regional and National Water Authorities to combine monitoring information and evaluate and manage the resource as a whole.	Regional and National Water Authorities to ensure that all irrigation farmers have the necessary permits and submit returns to the Department of Water Affairs (DWA), MAWLR.
Abstraction of Groundwater for Irrigation	Decreasing groundwater levels	Maximise the use of available precipitation (rain water).	Compliant and ongoing.
		Base the abstraction of water from any production borehole on the results and recommendations of controlled test pumping. That is, use the lower conservative pumping rate during Year 1. Evaluate the effect of pumping on the aquifer (overall water balance) at the end of Year 1. Make adjustments to the higher recommended yield if drawdown remains as per projection.	Quarterly returns are submitted to the DWA, MAWLR (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.). Regional and National Water Authorities to ensure that all irrigation farmers have the necessary permits and submit returns to the DWA, MAWLR. Regional and National Water Authorities to combine monitoring information and evaluate and manage the resource as a whole.
		Implement the proposed Groundwater Monitoring Programme (see Christelis et al., 2021; Annexure 7).	Compliant and ongoing.
		Monitor the rest water levels (*production and monitoring boreholes*) ~~*weekly*~~ *monthly* (before commencing with pumping).	The DWA, MAWLR issued a permit (No. 11593) for the abstraction of 750,000 m^3 of

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Monitor the pumping rates and total pumping volumes from each production borehole on a ~~*weekly*~~ *monthly* basis.	groundwater for irrigation purposes on Farm Okambekere No. 662 per annum on 31 August 2021. The permit expired on 31 August 2023 (see Maartens, 2022a; b; 2023a). An application for an extension was submitted in February 2023 (see Maartens, 2023b). The permit (No. 11529; 750,000 m^3) was issued on 30 June 2023 (validity 12 June 2023 to 11 June 2025) (see Maartens, 2023b; 2024). Rest water levels, pumping rates and total pumping volumes, are recorded monthly (as per the conditions to permit (No. 11529). Note: on 29 August 2023, the Water Resources Management Act 11 of 2013 was implemented; the Minister made Water Resources Management Regulations 2023. Clients will have 18 months to comply with the Water Resources Management Act and Regulations.
		Take corrective measures if there is a sharp drop is the rest water level. That is, a Critical Dynamic Water level was determined and the pumping water level should not exceed this. If the pumping water level goes below the critical level, pumping of the borehole should be stopped and the borehole examined to eliminate any localised cause of high drawdown. Following this, an assessment of the aquifer should be carried out utilising the collected monitoring data.	Quarterly returns are submitted to the DWA, MAWLR; to date, the pumping water level has not exceeded the Critical Dynamic Water (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Abstraction of Groundwater for Irrigation	Decline in water quality	*Implement the proposed Groundwater Monitoring Programme (see Christelis et al., 2021; Annexure 7).*	Compliant and ongoing.
		Sample three of the production and monitoring boreholes (WW205663, W205665, WW205669, WW205672, WW205673, EB1) for pesticide residue at the beginning of the irrigation scheme as baseline condition.	Note that these tests do not form part of Analytical Laboratory Services' irrigation water package (Me Helena P Daniel, Section Head: Water Quality, Analytical Laboratory Services, pers. comm., 24 July 2024).
		Conduct water quality monitoring of individual production *and monitoring* boreholes (to detect the presence of fertilizers, pesticides and their breakdown products) *three times per year (before planting, during the growth period, and after harvesting).*	Water quality monitoring was carried out during July 2022 (see Maartens, 2022b), August 2023 (see Maartens, 2024), and March 2024.

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Conduct additional sampling and analysis if contamination is suspected.	
Abstraction of Groundwater for Irrigation	Eventual infiltration of water to the Kalahari aquifer	*Implement the proposed Groundwater Monitoring Programme (see Christelis et al., 2021; Annexure 7).*	Compliant and ongoing.
		Establish a monitoring network at the commencement of the irrigation farm; monitoring boreholes should be located within the irrigated farm and in the down flow direction. Consider using boreholes *WW205658, WW205662, WW205663, WW205734, WW205735, and Existing Borehole (EB) 1* as monitoring boreholes. Conduct groundwater level monitoring in pumping and monitoring boreholes.	Compliant and ongoing.
		Evaluate impact on groundwater table and flow after two years of irrigated farming.	Quarterly returns are submitted to the DWA, MAWLR (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.). Regional and National Water Authorities to ensure that all irrigation farmers have the necessary permits and submit returns to the DWA, MAWLR. Regional and National Water Authorities to combine monitoring information and evaluate and manage the resource as a whole.
Excess Irrigation and Infiltration of Water Containing Fertilizers and Biocides	Contamination of soil and groundwater	Optimise the irrigation rate to minimise irrigation return flow.	Ongoing.
Excess Irrigation and Leaching of Accumulated Salts in the Soil due to Evaporation	Salinisation of soil and infiltration of high salinity water to the underlying aquifer	Optimise the irrigation rate (avoid over and under-irrigation) to minimise flooding and salt accumulation with evaporation.	Ongoing.
Irrigation Rate Management	Reduced pumping, fertilizer and biocide use and the subsequent (potential) contamination of groundwater, and costs	Implement irrigation water conservation measures (as applicable): Avoid midday irrigation (to reduce evaporation). Monitor soil moisture. Maintain a water management logbook (and record precipitation, ~~rainfall~~, ~~evaporation~~, time and amounts of	Compliant and ongoing. Irrigation takes place at night. Soil moisture is measured daily in summer and three (3) times per week in the winter by means of a (hand) soil drill.

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		water applied) (to understand the long-term trends in water use).	Details re the time, date and amounts of water applied is automatically recorded in real time (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Harvest (also see Annual Crop Production: General)			
Organic Dust and Inorganic Material (Thresing, Handling, Storage of Grain)	Occupational health and safety	Use local air extraction devices at dust-generating equipment (e.g. ~~tipping pits, elevators, open conveyors, hoppers~~, silos, ~~dryers, and scales~~). Threshing machines to be equipped with a cab and ventilator. Only store dry grain (to reduce microorganism growth).	Material is loaded from the harvester into a silo (see photo on the front page), and from there to the lorries using a farm auger (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Food Safety	Community health and safety	Food handling/processing to be performed as per internationally recognized food safety standards consistent with the principles and practices of e.g. Hazard Analysis Critical Control Points (HACCP) (ISO, 2005), and Codex Alimentarius (FAO and WHO, 1962-2005). Food safety principles include: i) ~~strictly maintain cold chains and other preservation processes; and ii) full institutionalisation of HACCP prerequisites as well as~~ Standard Operational Procedures, including: sanitation; ~~Good Manufacturing Practice (GMP)~~; pest control; ~~chemical control; allergen control~~; staff hygiene and education; ~~customer complaints mechanism; and traceability and reuse~~.	
Post-harvest (also see Annual Crop Production: General)			
Burning of Waste	Air quality (dust or Particulate Matter (PM) pollution) and Occupational and community health and safety	Avoid burning organic material in the field.	All organic waste materials is incorporated into the soils (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Soil Preparation Activities	Soil erosion	Maintain organic matter (to prevent wind erosion of the soil).	
Crop Residues	Waste Management	~~Reuse crop residues (as thermal energy fuel in bioenergy facilities or as feedstock in biorefineries)~~. Recycle crop residues (and other organic materials) (by plowing, composting, or leaving it in the field), but consider the potential for the spreading of pests).	
Unplanted Fields or Termination of Production	Extreme bush encroachment (Sicklebush)	Avoid/favour areas with no/few Sicklebush (where feasible).	

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		Plan for after care (e.g. hand application of arboricides, mechanical removal, stem burning, fire, intensive browsing by goats/antelope when regrowing plants are still small, etc.) to avoid the areas from becoming unsuitable for farming afterwards.	
Annual Crop Production (Construction of Transmission Lines): General			
Soil Preparation Activities	Air quality (dust or Particulate Matter (PM) pollution)	Avoid burning organic material in the field. Avoid the handling of erodible materials under high wind conditions or when a visible dust plume is present.	
	Soil erosion	Maintain organic matter (to prevent wind erosion of the soil).	
Increased Traffic / Presence and Movement of Machinery (Exhaust from Diesel Engines) / Traffic on the Farm Road(s)	Air quality (including dust or Particulate Matter (PM) pollution) and Occupational and community health and safety	Maintain the road surface to preserve surface characteristics (e.g. texture and roughness). ~~Use dust control/suppression methods, such as applying (semi-purified) water to minimise dust (oil and oil by-products is not a recommended measure to control road dust)~~. Fleet owners/operators to implement manufacturer recommended engine maintenance programs (to control vehicle emissions: Carbon Monoxide (CO), Carbon Dioxide (CO_2), Nitrogen Oxide (NO_x), Sulphur Dioxide (SO_2), Particulate Matter (PM) and Volatile Organic Compounds (VOCs)). Adopt best transport safety practices by implementing the following measures: emphasize safety aspects among drivers; improve driving skills and require licensing of drivers; adopt limits for trip duration; avoid dangerous routes and times of day; and use speed control devices. Regularly maintain vehicles and use manufacturer approved parts. Use locally sourced materials (where possible) to minimise transport distances. ~~Employ safe traffic control measures, including the use of traffic and safety warning signs and flag persons to warn of dangerous conditions~~.	
Annual Crop Production: Resource Use			

Aspect	Impact	Mitigation	Compliance / Comments (2024)
Energy Management	Resource use (e.g. coal) / depletion of natural resources	Promote the sustainable use of energy (that will result in the reduction of use and cost reductions) (e.g. energy efficient light sources). Raise awareness amongst the residents, staff (and contractors) (to save energy).	
Water Management	Resource use / depletion of natural resources	Implement a water conservation program, promoting the continuous reduction in water consumption. Raise awareness amongst the staff (and contractors) re the importance of saving water. Water storage tanks to be insect and animal-proof and to be covered to reduce evaporation.	
Annual Crop Production: Hazardous Materials Management			
Hazardous Materials Management	Social and Environmental Performance	Establish hazardous materials management priorities (based on hazard analysis of risky operations). Avoid, or minimise the use of hazardous materials. Prevent uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that may result in fire or explosion. Implement management controls (procedures, inspections and training, communication and drills) to address residual risks.	
Hazardous Materials Management	Pollution of biophysical environment (soil and water)	Implement prevention and control measures for the use, handling and storage of hazardous materials: Materials transfer: regularly inspect, maintain and repair fittings/pipes/hoses; make use of drip trays/other drip containment measures at connection/possible overflow points; Overfill protection: use trained filling operators; install gauges on tanks to measure the volume inside; make use of dripless hose connections (vehicle tanks) and fixed connections (storage tanks); use a catch basin/drip tray around the fill pipe to collect spills; Reaction, fire, and explosion prevention: hazardous materials to be stored in marked containers and separate (from non-hazardous materials); incompatible hazardous materials (acids, bases, flammables, oxidizers, reactive chemicals) to be stored in separate areas and with containment facilities separating material storage; smoking or working with open flames not to be	

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		permitted in the presence of these substances; limit access to hazardous waste storage areas and clearly label and demarcate the area; conduct regular inspections of the areas and document the findings; prepare and implement spill response and emergency plans; train employees in the use of appropriate fire fighting equipment and ensure that such equipment is on hand at all times. Train workers on the correct transfer and handling of fuels and chemicals and the response to spills. Immediately report and clean up any accidental hydrocarbon spill: Sunsorb, Drizit, Peatsorb can be used to clean up small spills; in case of larger spills, the spill together with the polluted soil should be removed and disposed of at e.g. a biological remediation site.	
A 22,700 litre fuel tank was recently put up at the irrigation area (see Figure 6); no more than 10,000 to 15,000 litres of fuel is stored at a time (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.). A Consumer (Fuel) Installation Certificate, CI/2904/2024, was issued by the Ministry of Mines and Energy (MME) on 19 June 2024.  a)  b) Figure 6: Pictures showing: a) the new fuel installation; and b) cracked bund wall (*Source: L. Maartens, 18 July 2024*). The bund wall is cracked in several places and it is advised that it be repaired.			
Hazardous Materials Management	Occupational health and safety	Implement hazard communication and training programmes (including information on Material Safety Data Sheets (MSDS)) to make employees aware of	

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		workplace chemical hazards and how to respond to these. Provide and ensure the active use of PPE.	 The staff is issued with and wear PPE (i.e. shoes, overalls, gloves, and hats (sun protection)) (herbicides and pesticides are sprayed from a cab tractor) (see Maartens, 2022a; b; 2023a; b; 2024).
Annual Crop Production: Waste Management			
Waste Management: Non-hazardous and Hazardous	Pollution of biophysical environment	Prepare an **Integrated Waste Management Plan**. The generation of waste should be **avoided** as far as practicable; where it cannot be avoided, waste should be **reduced**, **re-used** and **recovered** (including recycling and composting) (e.g. set up collection points for the recycling of solid waste); where waste cannot be reduced, re-used and/or recovered, it should be **disposed** of in an environmentally sound manner. Raise awareness amongst staff and contractors (to reduce, recycle and re-use waste). Stamp down on any form of littering. Non-hazardous and hazardous waste to be collected and stored separately. Hazardous waste: recycle petroleum (fuels and lubricants) waste products and collect and recycle batteries and print cartridges. The remainder (e.g. empty pesticide packaging and containers and unwanted pesticides) to be transported by an approved contractor to a recognised hazardous waste disposal site (Kupferberg outside Windhoek).	Due to the remoteness of Farms Wagnou No. 691 and Okambekere No. 662 (and no licenced waste disposal site nearby), all waste (that cannot be re-used (e.g. the compost bags) or recovered (the rests are worked into the soil for compost) is burnt in a hole/trench and when full, the hole is then covered with soil. Waste oil is collected and used to treat the fence posts. The old batteries and tyres are taken to Dunlop Express in Gobabis who then sells or re-uses it. The empty compost bags are collected and given to the charcoal/wood producers in the area. Maartens (2022a; b) advised that a burning exemption permit be obtained from the Ministry of Health and Social Services (MHSS) to burn waste. Mr Paul van der Merwe contacted Mr Nicco Masule from MEFT on behalf of Wagnou Irrigation CC, and the latter was advised to not burn any plastic. All plastic is now collected and disposed of at the dumpsite in Gobabis (see Maartens, 2023a). Further guidance re an exemption permit to burn waste was sought from the Office of the Environmental Commissioner on 09 March 2023 (see Maartens 2023b); no feedback has been received from the MEFT to date.
Waste Management: Sanitary	Pollution of biophysical environment	Sanitary wastewater to be released into a French drain system; use bio-degradable detergents on site. Ensure that the discharge of sanitary wastewater to land conform to the regulatory requirements (~~MAWLR's Water Quality Standards for Effluent, 2008~~ Water quality standards set out in Annexure 11 (see Part 8, Regulation 67 of Government Gazette Notice, No. 8187	At the irrigation area, there are two (2) French drains, one at the office and one at the staff accommodation (see Figure 7) (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).

Aspect	Impact	Mitigation	Compliance / Comments (2024)
		of 29 August 2023, as promulgated under Part 13, Section 72 (1) of the Water Act, Act No. 11 of 2013 - as published in the Government Gazette of the Republic of Namibia, No. 5367, of 19 December 2013, Government Notice No. 332).	
A five-bedroom house with two bathrooms (including French drain-type toilet facilities), two kitchens, and a communal outside braai-area were constructed for the six (now four) permanently employed workers (see LM Environmental Consulting, 2021; Maartens, 2022a).  a)  b) Figure 7: Pictures showing: a) the office; and b) staff accommodation at the irrigation area (*Source: L. Maartens, 18 July 2024*).			
Wastewater Management	Pollution of biophysical environment	Ensure that the discharge of process wastewater and/or sanitary wastewater and/or wastewater from utility operations and/or stormwater conform to the regulatory requirements (~~MAWLR's Water Quality Standards for Effluent, 2008~~ Water quality standards set out in Annexure 11 (see Part 8, Regulation 67 of Government Gazette Notice, No. 8187 of 29 August 2023, as promulgated under Part 13, Section 72 (1) of the Water Act, Act No. 11 of 2013 - as published in the Government Gazette of the Republic of Namibia, No. 5367, of 19 December 2013, Government Notice No. 332). Runoff from areas where surface water might have become contaminated should be captured and treated to sewage effluent standards; uncontaminated runoff should be diverted around areas where such water might become contaminated.	

Aspect	Impact	Mitigation	Compliance / Comments (2024)
Wastewater Management - Stormwater Management	Soil erosion	Regular inspection and maintenance of permanent erosion and runoff control features.	
Termination of Production			
Termination of Production	Extreme bush encroachment (Sicklebush)	Plan for after care (e.g. hand application of arboricides, mechanical removal, stem burning, fire, intensive browsing by goats/antelope when regrowing plants are still small, etc.) to avoid the area from becoming unsuitable for farming afterwards.	

2.3 Compliance: Monitoring and Reporting

Christelis *et al.* (2021) proposed a Groundwater Monitoring Programme, and gave guidance re the monitoring and reporting to be done (type/parameter/frequency; see below) (also see Section 7.5: LM Environmental Consulting, 2021).

The borehole numbers were changed by the DWA, MAWLR when Permit Number 11593 (*now 11529*) was issued. Also, the parameters and frequency for some of the monitoring actions were since updated (see text highlighted in bold; Dr Diganta Sarma, pers. comm., 7 February 2022). Comments are provided in an italic, green front (see Maartens, 2022a; b).

Type	Parameter	Frequency	Compliance/Comments (2024)
Climate data	Rainfall	**Record daily and report quarterly to the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR)** *In progress*	During the 2021/22, 2022/23, and 2023/24 seasons 401 mm, 296 mm, and 398 mm of rain were recorded, respectively.
Abstraction of groundwater for irrigation	As per the DWA, MAWLR's conditions to the abstraction permit		Rest water levels, pumping rates and total pumping volumes, are recorded monthly (as per the conditions to permit (No. 11529)). Quarterly returns are submitted to the DWA, MAWLR; to date, the pumping water level has not exceeded the Critical Dynamic Water (Mr Johan van der Merwe, Manager, Wagnou Irrigation CC, pers. comm.).
Abstraction/Production boreholes (BH4) (WW205666) **WW205739** (BH5) (WW205667) **WW205740** (BH6) (WW205668) **WW205741** (BH7) (WW205669) **WW205742** (BH8) (WW205670) **WW205743** (BH9) (WW205671) **WW205744** (BH10) (WW205672) **WW205745** (BH11) (WW205673) **WW205746** (BH12) (WW205674) **WW205747** (BH13) (WW205733) **WW205733**	Rest water levels **(after the water levels are allowed to recover, i.e. before resuming pumping after the stoppage)**	**Measure ~~weekly~~ monthly and report to the DWA quarterly** *Pumping from the production boreholes is automated (every 12 hours), and it is not feasible to record the rest water levels on a daily or weekly basis (as one day a week would need to be spent on this alone). Recorded monthly as per permit requirements.*	
		Period of 2 years; **evaluate frequency of monitoring after 2 years**	
	Pumping rates and total pumping volumes	**Record on a ~~weekly~~ monthly basis and calculate the average pumping rate per hour** *Recorded monthly as per permit requirements.*	
Monitoring boreholes (BH1, BH2, BH3, BH14 and BH15) (WW205658, WW205662, WW205663, WW205734, WW205735, and EB1) OKB-01/WWW205655	Rest water levels	**At the start of irrigation; record weekly and report to the DWA quarterly** *Recorded monthly; reporting to the DWA is not required. BH1, BH2, BH14, and BH15 are sampled. BH3 cannot be accessed during the rainy season and was replaced by OKB-01/WWW205655 (five boreholes are thus sampled).*	
Selected Production and Monitoring boreholes (WW205663, W205665, WW205669, WW205672,	**Multi-residue pesticide screening with liquid chromatography**	**Before the start of irrigation**	Note that these tests do not form part of Analytical Laboratory Services' irrigation water package (Me Helena P Daniel,

WW205673, EB1) *Samples will be collected from the inlet at the dam (water from four boreholes are pumped into the dam at a time) (e.g. EB1 cannot be sampled as it is connected to a windmill).*	**with tandem mass spectrometry (LC-MSMS) and gas chromatography with tandem mass spectrometry (GC-MSMS) (three boreholes)**		Section Head: Water Quality, Analytical Laboratory Services, pers. comm., 24 July 2024).
	Water quality (major and minor inorganic constituents including nitrate[a]), electrical conductivity (EC), pH, and phosphates (also pesticides, coliform or other potential agricultural contaminants[b]) **If significant difference is seen in the values (for EC, nitrate and phosphates) do additional LC-MSMS and GC-MSMS tests**	**~~Three~~ two times/year (before planting, and during the growth period~~, and after harvesting~~)**	Water quality samples were taken when the boreholes were drilled and test pumped. Water quality samples were again taken during July 2022 (see Maartens, 2022b), August 2023 (see Maartens, 2024), and March 2024. Maartens (2023a; b) advised that water quality samples be taken and sent for analysis (water chemistry); should significant differences be seen in the values (for EC, nitrate and phosphates), LC-MSMS and GC-MSMS tests need to be carried out (Dr Diganta Sarma, Hydrogeologist, Namib Hydrosearch, pers. comm., 31 January 2023). EC-values: 56.2 mS/m (2022); 56.5 mS/m (2023); and 58.4 mS/m (2024); Nitrate levels: 1.9 mg/l (2022); 1.6 mg/l (2023); and 2.1 mg/l (2024). Both analysed parameters seem stable; it may be good to test for phosphate in future (Dr Diganta Sarma, Hydrogeologist, Namib Hydrosearch, pers. comm., 25 July 2024).

3 Conclusions and Recommendations

It is evident that more grain crops need to be planted (and placed under irrigation) so that Namibia can become self-sufficient (and no longer have to rely on the import of staple foods from elsewhere).

Christelis *et al*. (2020) noted: The discovery of the high potential Kalahari aquifer is highly favourable for local development. However, **data should be collected (by the regional and national water authorities, supplemented by data from the various irrigation farmers in the area) and then used to develop a regional numerical flow model of the Kalahari aquifer to best estimate the sustainable yield of the aquifer and manage future abstraction**.

The following recommendations are made:

i) To develop, implement and maintain an **HIV/AIDS Policy and Programme** and a **Health and Safety Plan**;
ii) The **Water Resources Management Act 11 of 2013 and Water Resources Management Regulations 2023** to be complied with (by February 2025);
iii) The cracked **bund wall** (at the new Consumer Installation at the irrigation area) to be prepared;
iv) More **water quality samples** to be taken and sent for analysis (water chemistry) throughout the season; it is advised to also test for **phosphates** in future.

It is advised that Wagnou Irrigation CC (and their employees and contractors) should implement and observe the Environmental Management Plan on an ongoing basis. Environmental performance should be regularly monitored (so that the lessons learnt can be incorporated into the improvement of the Environmental Management Plan over time) and corrective measures taken as or when required.

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