Submitted to: Retort Charcoal Producers (Pty) Ltd
Attention: Mr Colin Lindeque
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REPORT:

IRRIGATION SYSTEM FOR AN AGRICULTURE PROJECT ON FARM GAI KAISA NO. 159, OTJOZONDJUPA REGION, NAMIBIA

PROJECT NUMBER: ECC-118-579-REP-02-D

REPORT VERSION: REV 02

DATE: 13 FEBRUARY 2026

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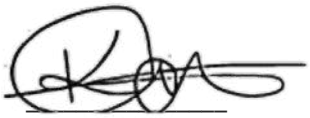

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EXECUTIVE SUMMARY

Environmental Compliance Consultancy (Pty) Ltd (ECC) has been engaged by Retort Charcoal Producers (Pty) Ltd (hereinafter referred to as "Retort" or the "Proponent") to prepare the environmental clearance certificate application for the irrigation scheme of the agriculture production project on Farm Gai Kaisa No. 159, Otjozondjupa Region, Namibia. The environmental clearance certificate application is accompanied by the scoping plus impact assessment report (this report) and an environmental and social management plan (ESMP) (Appendix A).

The Proponent proposes to expand their current operation to include irrigation. The proposed Project is required to support continued crop (biomass) production to support their charcoal and biochar operations. Irrigation is planned to be implemented in two (2) phases, each comprising ~135 hectares (ha) of cultivated area consisting of maize and fodder. Phase one (1) will require an estimated ~1 million cubic meters (Mm^3) of water per annum, while phase two (2) will expand the total cultivated area to approximately 260 ha, resulting in a total groundwater requirement of ~2 Mm^3 per annum. Furthermore, a four (4) ha portion will be set aside for the cultivation of perennial crops (fruit trees, grapes, pecans and avocado) on farm Gai Kaisa No. 159. This approach is further discussed in the test pumping analysis (Appendix C) and the groundwater study (Appendix D).

As defined by the EMA and its associated Regulations, the submission of a scoping with impact assessment report is sufficient for the Environmental Commissioner (EC) in consultation with the Department of Water Affairs (DWA) to provide a record of decision (RoD) on the Project.

SCREENING PHASE

The EMA and its 2012 Regulations, stipulate that all projects must be screened against the listed activities in the EMA and its associated regulations to determine if any of the activities of the project triggers the requirement of an environmental clearance certificate.

The screening phase determined that the most likely potential environmental and social impacts could include:

- Crop production (food security);
- Employment creation; and
- Procurement of goods and services
- Land-use efficiency;
- Soil impacts;
- Groundwater and surface water impacts;
- Biodiversity; and
- Waste management.

The Scoping plus impact assessment and appendices was submitted to I & AP's and the public for a 7-day public review period from 02 February 2026 to 09 February 2026. No comments, questions and concerns were submitted during this time. The final scoping plus impact assessment and appendices is submitted to MAFWLR (the competent authority) and MEFT for a RoD.

The phases of the scoping plus impact assessment phases are provided in Figure 1.

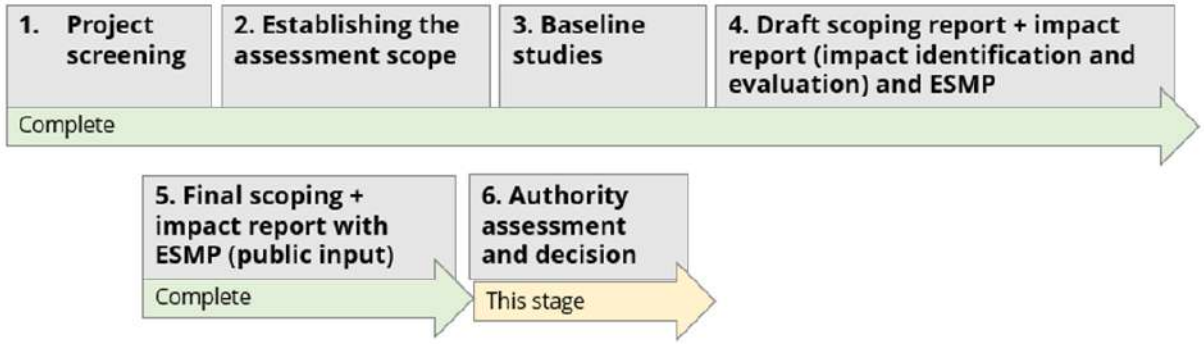

Figure 1 - Simplified scoping plus impact assessment of the Agriculture Project on Farm Gai Kaisa No. 159

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ABBREVIATIONS

Abbreviations	Description
°C	degree Celsius
%	percent
<	less than
BE	bush equivalents
CIA	cumulative impact assessment
cm	centimetre
DEAF	Department of Environmental Affairs and Forestry
DWA	Department of Water Affairs
E	east
EC	Environmental Commissioner
EC	electrical conductivity
ECC	Environmental Compliance Consultancy (Pty) Ltd
e.g.	example
EMA	Environmental Management Act, No. 7 of 2007
ESIA	environmental and social impact assessment
ESMP	environmental and social management plan
etc	et cetera
FNSP	Food & Nutrition Security Policy
GDP	the gross domestic product
ha	hectares
I&APs	interested and affected parties
IFC	International Finance Corporation
km	kilometre
km^2	square kilometre
L	litres
Ltd	limited
m	metre
mm	millimetre
Mm^3	million cubic meters
NAP	Namibia Agricultural Policy
NDP	National Development Plan
No.	number
NE	northeast
NW	northwest

Abbreviations	Description
mbsl	metres above mean sea level
MAFWLR	Ministry of Agriculture, Fisheries, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
ORC	Otjozondjupa Regional Council
Pty	propriety
RoD	record of decision
S	south
SE	southeast
SW	southwest
TDS	total dissolved solids
TE	tree equivalents
ToR	terms of reference

1 INTRODUCTION

1.1 BACKGROUND INFORMATION

Environmental Compliance Consultancy (Pty) Ltd (ECC) has been engaged by Retort Charcoal Producers (Pty) Ltd (hereinafter referred to as "Retort" or the "Proponent") to prepare the environmental clearance certificate application for the irrigation scheme of the agriculture production project on Farm Gai Kaisa No. 159, Otjozondjupa Region, Namibia. The environmental clearance certificate application is accompanied by the scoping plus impact assessment report (this report) and an environmental and social management plan (ESMP) (Appendix A).

The Proponent currently holds an environmental clearance certificate for mechanised bush thinning operations on Farm Gai Kaisa No. 159 (ECC-2402040). This environmental clearance certificate was approved by the Department of Environmental Affairs and Forestry (DEAF) on 05 December 2024 and is valid until 05 December 2027 (Appendix B). The Proponent currently produces charcoal and biochar from the harvested biomass obtained through bush thinning.

The Proponent proposes to expand their current operation to include irrigation. The proposed Project is required to support continued crop (biomass) production to support their charcoal and biochar operations. Irrigation is planned to be implemented in two (2) phases, each comprising ~135 hectares (ha) of cultivated area consisting of maize and fodder. Phase one (1) will require an estimated ~1 million cubic meters (Mm^3) of water per annum, while phase two (2) will expand the total cultivated area to approximately 260 ha, resulting in a total groundwater requirement of ~2 Mm^3 per annum. Furthermore, a four (4) ha portion will be set aside for the cultivation of perennial crops (fruit trees, grapes, pecans and avocado) on farm Gai Kaisa No. 159. This approach is further discussed in the test pumping analysis (Appendix C) and the groundwater study (Appendix D).

The Project site (i.e. Farm Gai Kasa No. 159) is located approximately 30 km southeast (SE) of the Kombat settlement and approximately 42 km southwest (SW) of Grootfontein town and can be accessed via the D2804 district road that branches out from the B8 main road in the Otjozondjupa Region (Figure 2).

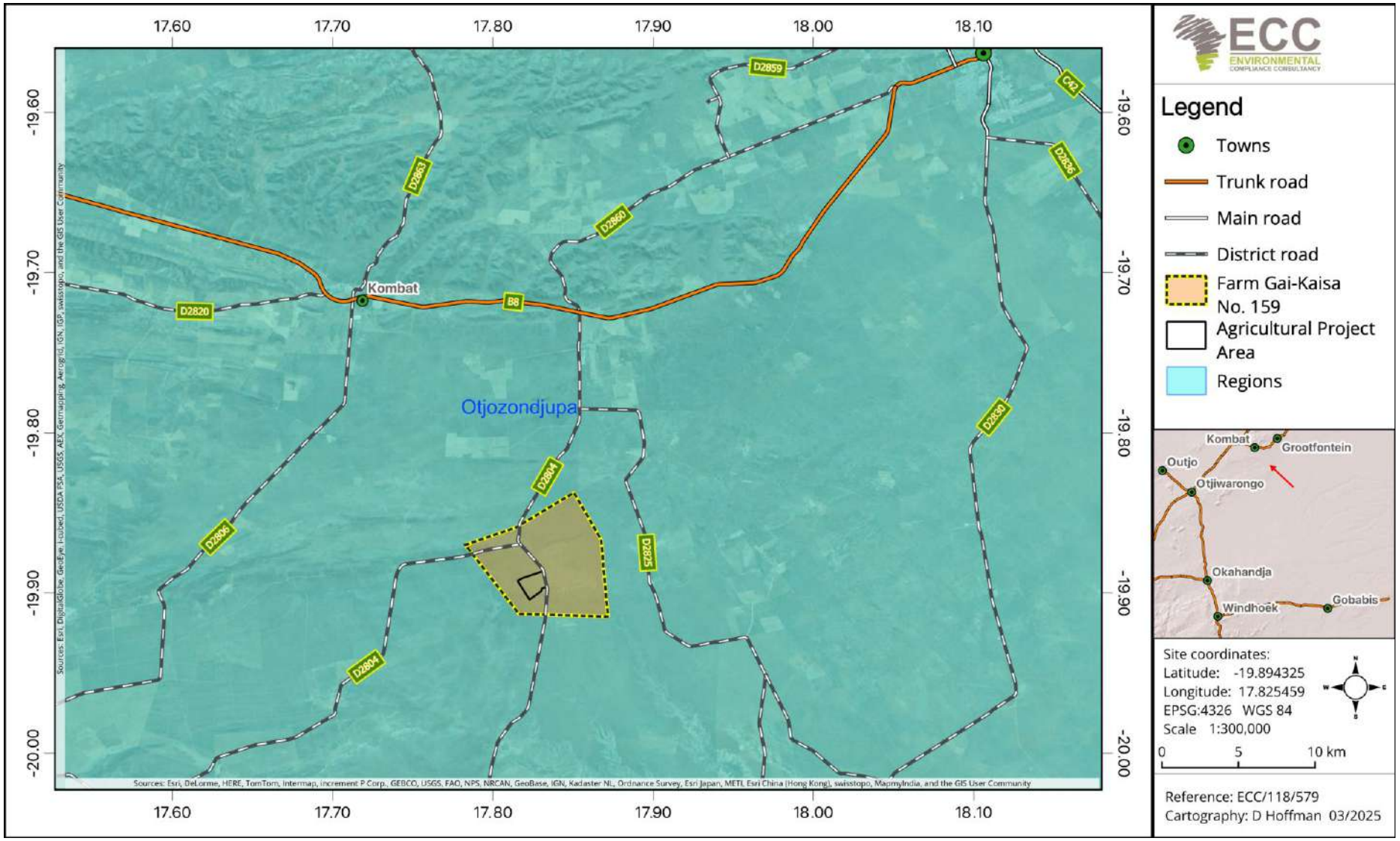


Figure 2 – Location of the Project site (Farm Gai Kaisa No. 159)

1.2 PURPOSE OF THE REPORT

As per the Environmental Management Act, No. 7 of 2007 (EMA) and its associated 2012 Regulations, any activity that triggers a listed activity requires an environmental clearance certificate. The Act defines a listed activity as a project or activity that is identified as having a significant potential impact on the environment and therefore requires an environmental clearance certificate before the activity can be undertaken. This scoping plus impact assessment report is required to assess the impact of the proposed irrigation system on the surrounding biophysical and social environment.

As part of the application for an environmental clearance certificate, an environmental and social impact assessment (ESIA) process needs to be conducted, and an environmental and social management plan (ESMP) needs to be compiled. However, before an ESIA can be conducted, the Project needs to be screened against the requirements on the Ministry of Environment and Forestry (MEFT) portal, and the scope of the assessment needs to be outlined. This includes determining the baseline biophysical and social environment and determining if there are any gaps in the available information, requiring the need for further specialist studies. This is then developed into a scoping report, which form the terms of reference (ToR) for the ESIA.

The proposed Project activities are then assessed against the social and biophysical baseline environment to identify and assess potential impacts (positive or negative) on the receiving baseline environment and how the identified impacts may impact sensitive receptors. An ESMP is then developed as a mitigation and management tool to reduce the negative or enhance the beneficial impacts of the ESIA. The ESMP becomes a legally binding document once approved by MEFT.

A standalone scoping report which is then preceded by an ESIA with multiple detailed specialist studies is not required for this Project, as the Project's activities are deemed non- or minimally invasive due to the foreseen project activities. Furthermore, the impacts of Projects such as this are usually non-significant or low. Therefore, as defined by the EMA and its associated Regulations, the submission of a scoping with impact assessment report is sufficient for the Environmental Commissioner (EC) in consultation with the Department of Water Affairs (DWA) to provide a record of decision (RoD) on the Project.

The outline of this report is shown in Table 1.

Table 1 - Report outline

Chapter	Contents
Chapter 1	Introduction to the proposed Project and scoping with impact assessment report.
Chapter 2	Provides details about the scoping with impact assessment approach, including the role of the public and specialists (if required).
Chapter 3	Provides details on the legal environment and requirements based on the Project.
Chapter 4	Provides sufficient technical details about the Project activities to identify and assess potential impacts.
Chapter 5	Provides a summary of the biophysical and social baseline environment.
Chapter 6	Provides an overview of the methodology for identifying and evaluating impacts.
Chapter 7	Details the assessment of the potential impacts before mitigation and may also provide mitigation measures, if warranted.
Chapter 8	Concludes the report, summarising the findings and providing recommendations.

1.3 PROPONENT'S DETAILS

The Proponents' details are provided in Table 2.

Table 2 – Proponent details

Company representatives	Contact details:
Mr Colin Lindeque Director of Retort Charcoal Producers and Managing Director of Carbon Capital (Pty) Ltd	Retort Charcoal Producers (Pty) Ltd P O Box 30098, Windhoek Farm Gai Kaisa No. 159 Otjozondjupa Region, Namibia +264 81 343 3424
Stefan Falk Chief Executive Officer of Retort Charcoal Producers	stefan@charcoal.com.na +264 81 316 5539

1.4 SCREENING PHASE - ENVIRONMENTAL LEGISLATIVE REQUIREMENTS

The EMA and its 2012 Regulations, stipulate that all projects must be screened against the listed activities in the EMA and its associated regulations to determine if any of the activities of the project triggers the requirement of an environmental clearance certificate. The Project has been screened and has been found to trigger the listed activities outlined in Table 3.

Table 3 - Activities triggered by the proposed Project

Listed activity	As defined by the Regulations of the Act	Relevance to the Project
8. Water resource developments	(8.1) The abstraction of ground or surface water for industrial or commercial purposes. (8.7) Irrigation schemes for agriculture excluding domestic irrigation	– Water abstraction from five (5) boreholes on Farm Gai Kaisa No. 159 will be required for the Project. The groundwater demand has been estimated at a maximum of 1 Mm^3/a per phase of cultivation. A groundwater assessment has been conducted, and a report of the findings has been developed for the Project (Appendix D). – The water abstraction licences will be obtained from Ministry of Agriculture, Fisheries, Water and Land Reform: Department of Water Affairs (MAFWLR: DWA) prior to the commencement of the Project as per the Water Resource Management Regulations of 2023, Water Resources Management Act, Act No. 11 of 2013.

2 APPROACH TO THE ASSESSMENT

2.1 PURPOSE AND SCOPE OF THE SCOPING WITH IMPACT ASSESSMENT

This scoping with impact assessment aims to scope the available data and identify any gaps that need to be filled. Thereafter, impacts that are deemed likely to be significant are identified, and the spatial and temporal scope of the assessment is outlined. Thereafter, the assessment methodology is developed, and the potential significant impacts are assessed.

The spatial and temporal scope of the assessment was determined by undertaking a preliminary assessment of the proposed Project against the receiving baseline environment, obtained through a desktop review of the area and available site-specific literature.

2.2 THE ASSESSMENT PROCESS

The methodology applied to this assessment was developed using the International Finance Corporation (IFC) standards and models, in particular, Performance Standard 1, 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012), which establishes the importance of:

- Integrated assessment to identify the environmental and social aspects, impacts and opportunities of Projects;
- Effective community engagement through disclosure of Project-related information and consultation with local communities on matters that directly affect them; and
- The Proponent's management of environmental and social performance throughout the life of the Project.

Furthermore, the Namibian Draft Procedures and Guidance for ESIA and ESMP (Republic of Namibia, 2008), as well as international and national best practice, and over twenty-five (25) years of combined ESIA experience, were also drawn upon in the developing the assessment methodology. This scoping with impact assessment is a formal process in which the potential effects of the Project on the biophysical, social and economic environments are identified, assessed and reported on so that the significance of potential impacts can be taken into account when considering whether to grant approval, consent or support for the proposed Project. The full scoping plus impact assessment process is described in Figure 3.

1. Project screening

Complete

The first stage in the ESIA process is to undertake a screening exercise to determine whether the Project triggers listed activities under the Environmental Management Act, 2007, and its regulations. The screening phase of the Project is a preliminary analysis, to determine ways in which the Project might interact with the biophysical, social, and economic environments.

Stakeholder engagement:
- Registration of the project
- Site notices, adverts and stakeholder letters

2. Establishing the assessment scope

Complete

The second stage is to scope the assessment. The main aim of this stage is to determine which impacts are likely to be significant; to scope the available data and any gaps that need to be filled; to determine the spatial and temporal scope; and to identify the assessment methodology.

The scope of this assessment was determined through undertaking a preliminary assessment of the proposed Project against the receiving environment. Feedback from consultation with the public and the Proponent informs this process. The following environmental and social topics were scoped into the assessment, as there was the potential for significant impacts to occur. Impacts that are identified as potentially significant during the screening and scoping phase are taken forward for further assessment in the scoping plus impact assessment process. These are:

SOCIOECONOMIC ENVIRONMENT
- Crop productivity
- Employment
- Procurement of goods and services

BIOPHYSICAL ENVIRONMENT
- Land-use efficiency
- Soil impacts
- Groundwater and surface water impacts
- Biodiversity
- Waste management

3. Baseline studies

Complete

A robust baseline is required, to provide a reference point against which any future changes associated with a Project can be assessed, and to allow suitable mitigation and monitoring to be identified.

The region and general area have been studied for a bush-thinning project for which an environmental clearance certificate has been issued to the Proponent. The available literature will be referenced. The Project site-specific area has been studied as part of the scoping plus impact assessment process, and the following has been conducted as part of this assessment:

- Desktop studies
- Test pumping analysis
- Groundwater study
- Consultation with stakeholders

The environmental and social baselines are provided in chapter 5 of this report.

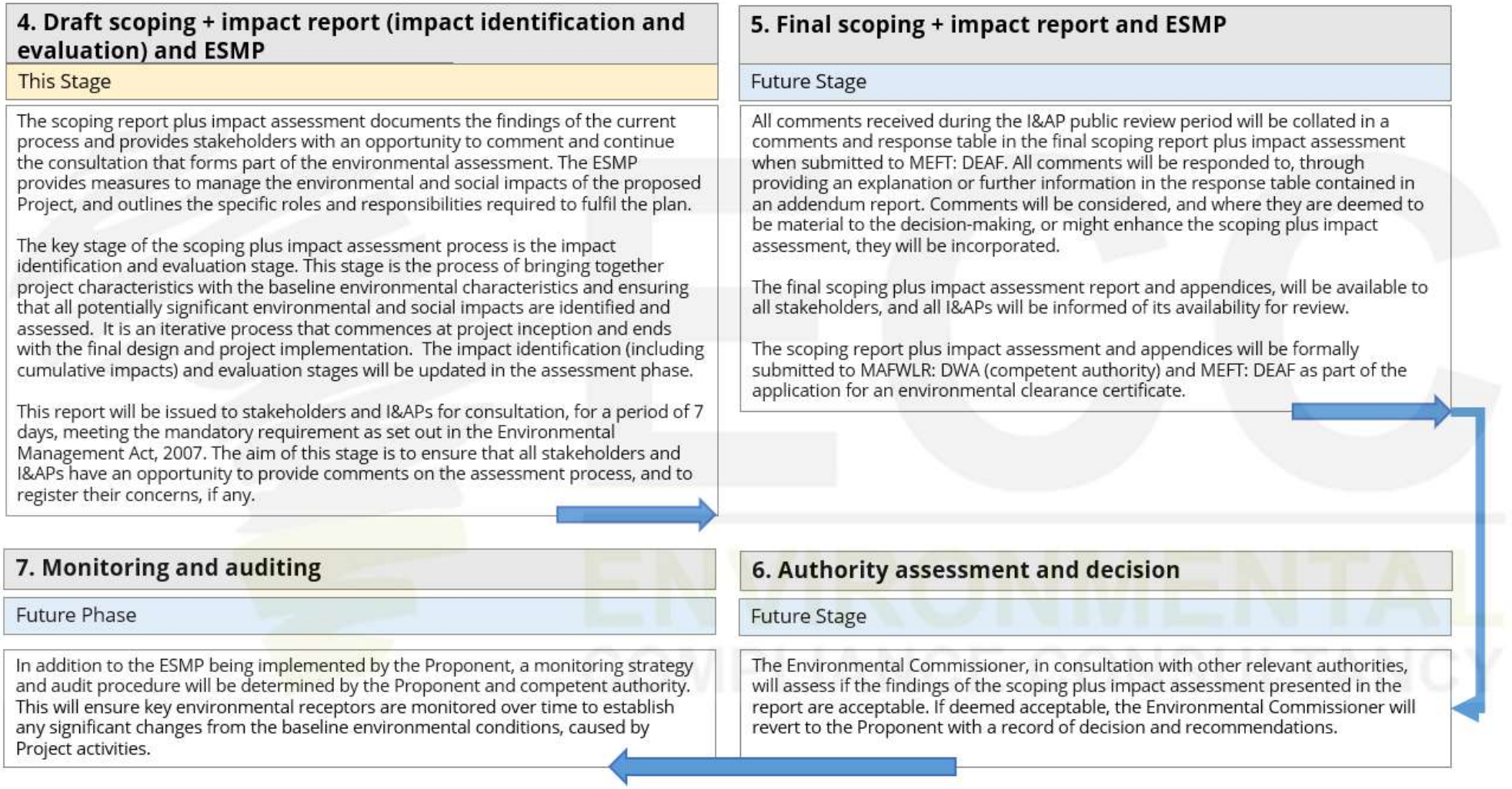


Figure 3 - The full scoping with impact assessment process

2.3 SCOPING AND THE ENVIRONMENTAL ASSESSMENT

The scoping phase of the Project is a preliminary analysis to determine ways in which the Project interacts with the biophysical, social and economic environment. Potential impacts are identified and the significance are assessed during the impact assessment phase. The detailed assessment methodology and impact assessment of significant impacts are described in chapters 6 and 7 of this report, respectively. Feedback from consultation with the Proponent and stakeholders also informed the assessment and ratings of the impacts. The following environmental and social aspects were considered for this scoping with impact assessment process, including cumulative impacts:

SOCIO-ECONOMIC ENVIRONMENT

- Crop production (food security);
- Employment creation; and
- Procurement of goods and services.

BIOPHYSICAL ENVIRONMENT

- Land-use efficiency;
- Soil impacts;
- Groundwater and surface water impacts;
- Biodiversity; and
- Waste management.

2.4 BASELINE STUDIES

Baseline studies are undertaken as part of the scoping phase, which involves collecting all pertinent information from the status of the receiving environment. This provides a baseline against which changes that occur because of the proposed Project can be measured. For the proposed Project, baseline information was obtained through a desktop study and consultation with stakeholders. The baseline information collected focused on the social and environmental receptors that could be affected by the proposed Project and was verified through site-specific information received from the Proponent. The baseline information is covered in chapter 5.

2.5 PUBLIC CONSULTATION

Public participation and consultation are a requirement of any ESIA conducted and environmental clearance certificate application submitted in Namibia. This is stipulated in the Environmental Impact Assessment Regulations (Regulations 21 and 23) of the EMA. Furthermore, consultation is a compulsory and critical component of the scoping plus impact assessment process to aid in achieving transparent decision-making and can provide further

insight on a potential project that may not have come out of the desktop studies. Consultation occurs throughout the entire process up until the application is submitted for assessment, review and RoD.

The objectives of the public participation and consultation process are to:
- Determine the relevant government, regional and local regulating authorities;
- Listen to and understand community issues, record concerns and questions; and
- Explain the process of the scoping with impact assessment and the timeframes involved; and
- Establish a platform for ongoing consultation.

2.5.1 IDENTIFICATION OF KEY STAKEHOLDERS AND INTERESTED AND AFFECTED PARTIES (I&APS)

A stakeholder mapping exercise was undertaken to identify individuals or groups of stakeholders that may be interested or affected by the Project, in order to inform them and keep them abreast of relevant information as the Project develops. The method by which they were engaged during the scoping with impact assessment process is outlined in section 2.5.2 to section 2.5.4. Additionally, stakeholders were also engaged through direct communication (letters and phone calls), the national press and directly via email.

A summarised list of stakeholders for this Project is given below:
- The neighbouring farm owners;
- The general public with an interest in the Project;
- Ministry of Environment, Forestry, and Tourism (MEFT);
- Ministry of Agriculture, Fisheries, Water & Land Reform (MAFWLR);
- Otjozondjupa Regional Council (ORC) as the custodian responsible for the management and administration of the Kombat settlement; and
- Grootfontein Municipality.

2.5.2 NEWSPAPERS AND ADVERTISMENTS

Notices regarding the proposed Project and associated activities were circulated in three (3) newspapers, namely the 'Republikein, the Namibian Sun and Allgemeine Zeitung' on 13 January 2026 and 20 January 2026 (Appendix E). The purpose of this was to commence the consultation process by informing the public about the Project and enabling I&APs to register any comments and interest raised for the Project.

2.5.3 SITE NOTICES

Site notices ensure neighbouring properties and stakeholders are made aware of the proposed Project. The notices were placed at the boundary and access road to Farm Gai Kaisa No. 159 as illustrated in Appendix F.

2.5.4 PUBLIC MEETING

In terms of Section 22 of the Environmental Management Act, No. 7 of 2007 and its regulations, a public meeting is not a requirement of public consultation.

However, public meeting may sometimes be held depending on the scale and type of project being conducted. No public meetings were held for the Project as the scale of the Project is relatively small and is not located in an ecologically sensitive area. The nature of the proposed Project is similar to other small-scaled and medium scaled agricultural production projects in other parts of the country. It was concluded that a public meeting was not required. As a result, the I&APs were engaged directly and invited to register their comments in writing to the EAP. Neighbouring farmers were engaged and consent letters were signed (Appendix G).

2.5.5 SUMMARY OF ISSUED RAISED

During the scoping and impact assessment process, and all comments, questions and concerns received are recorded in Table 4.

Table 4 - Comments, concerns and questions raised by I&APs during the scoping and impact assessment process

Stakeholder name and method through which feedback was received	Declaration of Interest	Comments/Questions Received	Response/Clarification
Sonja Stephanie Schneider Neighbouring farm owner – Received via ECC website as a registered I&AP	**1.** To whom it may concern, I, Sonja Stephanie Schneider, hereby submit this Declaration of Interest in terms of Section 23 of the Environmental Management Act (EMA) Regulations, in relation to the proposed extensive irrigation scheme by the neighbouring farm, GAIKAISA, which is reported to involve the abstraction of approximately one to two million (1,000,000 - 2,000,000) cubic metres of water per annum. I am the owner/occupier/representative of Farm Osombusatjuru, a neighbouring property that may be directly and indirectly affected by the proposed development. My interest arises from the proximity of the proposed abstraction area to my property and our reliance on sensitive groundwater-dependent resources, including naturally occurring fountains/springs. Of particular concern is the risk that large-scale groundwater abstraction may result in a lowering of	**1.** Concern regarding the proposed large-scale groundwater abstraction for an extensive irrigation scheme on Farm GAIKAISA and its potential impact on neighbouring Farm Osombusatjuru. The proposed abstraction may cause groundwater drawdown, leading to reduced or lost spring/fountain flows, negative effects on existing lawful water uses, groundwater-dependent ecosystems, and tourism activities. Request for full participation as an Interested and Affected	**1.** The detailed hydrological report (Appendix D), in combination with the pump testing data (Appendix C) - taken with a high degree of conservativeness - concludes that the planned extraction volumes are sustainably achievable, given aquifer properties and the conservative abstraction rates. The hydrological report's recommendations will form the basis of the Environmental and Social Management Plan, a legally binding set of management requirements, which will include the following adaptive monitoring measures to be taken; Category: Requirement Abstraction rates: Weekly monitoring Abstraction volumes: Weekly + monthly collation Groundwater levels: Twice daily

<table>
<tr><th>Stakeholder name and method through which feedback was received</th><th>Declaration of Interest</th><th>Comments/Questions Received</th><th>Response/Clarification</th></tr>
<tr>
<td></td>
<td>the groundwater table (groundwater drawdown). Any significant or sustained decline in groundwater levels could:
Reduce or eliminate flow from the fountains on Farm Osombusatjuru;
Negatively affect groundwater availability for existing lawful uses;
Cause irreversible damage to groundwater-dependent ecosystems;
Undermine current and planned tourism activities that rely on these natural water features; and
Result in cumulative impacts when considered together with other existing or future abstractions in the area.

The fountains on Farm Osombusatjuru are environmentally sensitive, economically valuable, and central to our long-term sustainable land-use planning. Protecting their quantity and quality is therefore of critical importance. I am concerned that, without adequate hydrogeological assessment, monitoring, and enforceable abstraction limits, the</td>
<td>Party, including access to hydrogeological assessments, groundwater modelling, monitoring measures, and enforceable abstraction limits to prevent cumulative and irreversible impacts.</td>
<td>
<table>
<tr><td>Yield review</td><td>Mandatory after 6 months</td></tr>
<tr><td>Rest period</td><td>≥24 hours/week per borehole</td></tr>
<tr><td>Borehole interference</td><td>Monitor during separate & combined pumping</td></tr>
<tr><td>Water quality</td><td>Bi-annual sampling</td></tr>
<tr><td>Regulatory readiness</td><td>Maintain auditable records</td></tr>
</table>

This adaptive approach is designed to detect and prevent over-abstraction early.

In the case that there is clear evidence to suggest that over-abstraction is taking place, we will be prepared to scale down our abstraction plans accordingly.

Additionally, we are taking a phased development approach, scaling up over time, which again will allow us opportunities to adapt plans if necessary.
</td>
</tr>
</table>

Stakeholder name and method through which feedback was received	Declaration of Interest	Comments/Questions Received	Response/Clarification
	proposed irrigation scheme may compromise these resources. I therefore request to be formally registered as an Interested and Affected Party (I&AP) and to participate fully in the Environmental Impact Assessment process. This includes access to all relevant reports, particularly hydrogeological and groundwater modelling studies, as well as notification of all public participation opportunities and decisions. This declaration is submitted in good faith to ensure responsible environmental management, protection of shared groundwater resources, and sustainable development within the catchment area. Kindly acknowledge receipt of this declaration and confirm my registration as an Interested and Affected Party. Yours faithfully, Sonja Schneider		

3 REVIEW OF THE LEGAL FRAMEWORK

This chapter outlines the regulatory framework applicable to the proposed Project. As previously stated in chapter 1, an environmental clearance certificate is required for any activity listed in the Government Notice No. 29 of 2012 of the EMA. A thorough review of relevant national legislations has been conducted for the proposed Project. Table 5 identifies relevant legal requirements specific to the Project, Table 6 provides the national policies and plans and Table 7 specifies permits(s) and licence(s) required for the proposed Project.

3.1 NATIONAL REGULATORY FRAMEWORK

Table 5 - Details of the regulatory framework as it applies to the proposed Project

National regulatory regime	Summary	Applicability to the Project
Constitution of the Republic of Namibia (1990)	The constitution defines the country's position about sustainable development and environmental management. The constitution states that the State shall actively promote and maintain the welfare of the people by adopting policies aimed at the following: "Maintenance of ecosystems, essential ecological processes and biological diversity of Namibia, and the utilisation of living, natural resources on a sustainable basis for the benefit of all Namibians, both present, and future."	The Proponent is committed to the sustainable use of the environment and has aligned its corporate mission, vision and objectives with this ambit of the Constitution of the Republic of Namibia (1990).
Environmental Management Act, 2007 (Act No. 7 of 2007) and its regulations (2012), including the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011)	The Act aims to promote sustainable management of the environment and the use of natural resources. The Act requires certain activities to obtain an environmental clearance certificate prior to Project development. The Act states that an EIA should be undertaken and submitted as part of the environmental clearance certificate application process. The MEFT is responsible for the protection and management of Namibia's natural environment. The	This scoping report with impact assessment documents the findings of the scoping phase and includes an environmental and social impact assessment sufficient for the project's activities. The process has been undertaken in line with the requirements of the EMA and its regulations.

National regulatory regime	Summary	Applicability to the Project
	DEAF, under the MEFT, is responsible for the administration of the EIA process.	
Labour Act, No. 11 of 2007	The Labour Act, No. 11 of 2007 (Regulations relating to the Occupational Health & Safety provisions of Employees at Work, promulgated in terms of Section 101 of the Labour Act, No. 6 of 1992 - GN156, GG 1617 of 1 August 1997)	The Proponent must adhere to all labour provisions and guidelines, as enshrined in the Labour Act.
Water Resources Management Act, 2013 (Act No. 11 of 2013) and associated Water Resource Management Regulations, No.269 of 2023	Regulation 66 (1) states that a person who intends to apply for a licence under section 72 of the Act must apply to the Executive Director on a form approved by the Minister, which form is obtainable from the offices or official website of the Ministry	Water abstraction from nearby five (5) boreholes will be required for the project. The relevant water abstraction licences will be obtained from MAFWLR: DWA prior to the commencement of the Project.
Soil Conservation Act, No. 76 of 1969 (as amended)	This Act makes provision for the prevention and control of soil erosion, and for the protection, improvement, and conservation of soil and vegetation.	During the Project, the soil structure may be impacted due to soil compaction during agricultural activities. However, the Proponent intends to apply methods such as the use of biochar to improve soil productivity, water retention and nutrient holding capacity.

3.2 NATIONAL POLICIES AND PLANS

Table 6 - National policies and plans applicable to the proposed Project

Policy or plan	Description	Relevance to the Project
Vision 2030	Vision 2030 sets out the nation's development targets and strategies to achieve its national objectives. Vision 2030 states that the overall goal is to improve the quality of life of the Namibian people aligned with the developed world.	The Proponent is encouraged to meet the objectives of Vision 2030 and shall contribute to the overall development of the country through continued employment opportunities and ongoing contributions to the gross domestic product (GDP).
Sixth National Development Plan (NDP6)	The NDP6 is the sixth plan in the series of seven five-year national development plans that outline the objectives and aspirations of Namibia's long-term vision as expressed in Vision 2030. There are four pillars on which NDP6 is built, these are: – Economic growth, transformation and resilience; – Human development and community resilience; – Environmental sustainability; and – Effective governance and public service delivery.	The Proponent is encouraged to support the government's objectives of the NDP 6 through creating opportunities and drawing efforts towards environmental sustainability.

Policy or plan	Description	Relevance to the Project
Namibia's Green Plan, 1992	Namibian has developed a 12-point plan for integrated sustainable environmental management to ensure a safe and healthy environment and to maintain a viable economy.	The Proponent is encouraged to adhere to best practice throughout both phases of the proposed Project.
Namibia Agriculture Policy (2015)	The Namibia Agricultural Policy (NAP) provides the overarching framework guiding the development, management, and growth of the agricultural sector in Namibia. Its main aim is to promote sustainable, competitive, and resilient agriculture that contributes to food security, rural development and economic growth.	The proposed Project aligns with the policy as it intends to improve food security in Namibia, support sustainable land and water use and employment creation.
Food & Nutrition Security Policy 1995 (Updated version - 2021)	The Food & Nutrition Security Policy (FNSP) aims to ensure that all Namibians have reliable access to sufficient, safe, nutritious and affordable food, while strengthening national systems that support sustainable food production, distribution and consumption. The updated draft aligns with modern challenges such as climate change, economic shocks, rising food prices and malnutrition trends.	The agriculture project supports the policy objectives by increasing national food availability, improving nutrition, promoting sustainable resource use, and contributing to local livelihoods and food security resilience.

3.3 ENVIRONMENTAL PERMITS AND LICENCE (S)

Table 7 – Permits and licences required for the proposed Project

Permit or licence	Act or Regulation	Related activities requiring a permit/licence	Relevant Authority
Environmental clearance certificate	Environmental Management Act, No 7 of 2007	Required for all listed activities shown in Table 3. The environmental clearance certificate must be approved by the Environmental Commissioner (EC).	Ministry of Environment, Forestry and Tourism (MEFT): Department of Environmental Affairs and Forestry (DEAF)
Water abstraction licences	Water Resources Management Act, 2013 (Act No. 11 of 2013)	Required as water will be abstracted from five (5) boreholes within Farm Gai Kaisa No. 159.	Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR): Department of Water Affairs (DWA)

4 PROJECT DESCRIPTION

4.1 NEED FOR THE PROJECT

Namibia still faces challenges related to food availability and nutrition, particularly in rural areas, largely due to semi-arid climatic conditions and water scarcity. Sustainable agricultural practices, such as water efficient irrigation are known to enhance the resilience of farming systems to climate variability. The sustainability and advantages of such irrigation practices to be conducted as part of the Project has been assessed in the groundwater assessment (Appendix D). Furthermore, integrated soil fertility management can improve crop yields while simultaneously reducing greenhouse gas emissions and enhancing carbon sequestration, thereby contributing to improved carbon storage as soil organic carbon.

The National Food and Nutrition Security Policy further emphasise the importance of increasing domestic food production in Namibia. Its second objective states that, "by 2030, domestic food production for local consumption should increase from 30% to 60%, alongside enhanced processing, marketing and consumption of food to improve access to nutritious and safe food for the populace of Namibia at all times" (Ministry of Agriculture, Water and Land Reform (MAWLR), 2021). Sustainable cultivation of staple foods and perennial crops directly supports this objective by increasing local food production, diversifying diets and reducing reliance on imported food products.

Additionally, the proposed Project aims to create more employment opportunities and promote research initiatives that strengthen environmentally sustainable agricultural practices within the country. This approach aligns with Namibia's national development objectives, as outlined in the Namibia Agricultural Policy (Ministry of Agriculture, Water and Forestry (MAWF), 2015). By promoting sustainable cultivation methods, the Project is expected to deliver long-term economic benefits while supporting resilient and sustainable food production systems.

4.2 ALTERNATIVES CONSIDERED

In terms of the Environmental Management Act, No. 7 of 2007 and its Regulations, alternatives considered should be analysed and presented in the scoping plus impact assessment report. This requirement ensures that during the design evolution and decision-making process, potential environmental impacts, costs and technical feasibility have been considered, leading to the best option(s) being identified and assessed.

The Proponent intends to look at alternative methods to improve soil and water-soluble nutrient retention to enhance crop productivity while minimising nutrient losses and environmental impacts.

4.2.1 NO-GO ALTERNATIVES

Should the Project not occur, it would avoid project-related environmental disturbances. However, it would also result in the loss of potential socio-economic benefits associated with the crop production. These include increased local production of staple foods and perennial crops, contributions to national food security objectives, the creation of employment and skills development and acquisition of practical work experiences for the workforce. Additionally, opportunities to improve land productivity through the implementation of sustainable agricultural practices, such as enhanced soil fertility management, water-use efficiency and climate-resilient farming techniques would not be realised. Consequently, the no-go alternative would limit progress toward national development goals and policy objectives related to sustainable agriculture, food and nutrition security and rural economic development.

4.3 PROPOSED PROJECT ACTIVITIES

The Proponent proposes to use an irrigation system for a crop production project, whereby the crop residues will be processed into charcoal and biochar for export to national and international markets. The development of the irrigation system will be done in two (2) phases, with a combined estimated use of approximately one (1) $Mm^3$of water annually. The irrigation system will support approximately 270 hectares (ha) of staple foods (maize and wheat production) as well as other perennial crops (fruit trees, grapes, pecans and avocado) on farm Gai Kaisa No. 159.

4.3.1 EQUIPMENT AND MATERIALS

The Project involves centre pivot irrigation systems for crops production (maize and wheat) and drip irrigation for perennials crops. Drip irrigation is applied closer to roots systems and is preferred as it reduces evaporation, runoff and ensure deep percolation and requires water to be applied in smaller volumes. The section below differentiates the materials used in the two (2) irrigation systems:

Centre Pivot Irrigation System

- Steel or aluminium pipes;
- Electrical cabling and switchgear;
- Concrete (for foundations);
- Rubber hoses and fittings; and
- Lubricants and hydraulic fluids.

Drip Irrigation System

- PVC and HDPE pipes;
- Drip tapes or drip lines;
- Emitters and connectors;
- Fertiliser storage tanks;
- Filter media; and
- Plastic fittings and valves.

4.3.1 WATER SUPPLY

Based on existing use and the typical water requirements for these types of crops, Phase 1 has a water requirement of approximately one (1) Mm^3/a. Thereafter, Phase 2 will include an increased hectarage to ~260 ha, which will need a total groundwater requirement of two (2) Mm^3/a. Water will be sourced from five (5) boreholes within Farm Gai Kaisa No. 159 as depicted in Figure 14 of the groundwater study (Appendix D).

4.3.2 POWER SUPPLY

Power will be supplied from the existing PV Solar Park already used for Retort operations.

4.3.3 WORK FORCE AND ACCOMMODATION

The few employees to be hired during the Project will be accommodated on Farm Gai Kai No. 159. Employees will be provided with communal bathrooms with access to warm running water and a communal kitchen.

4.3.4 WASTE MANAGEMENT

General, solid and domestic waste shall be segregated and recycled, where feasible. The solid waste will be disposed at the Grootfontein Municipal landfill site or the nearest appropriate licenced disposal site. Effluent streams shall be directed to a designated containment to prevent the uncontrolled release into natural drainage lines.

5 SUMMARY OF THE BASELINE ENVIRONMENT

This chapter provides an overview of the biophysical and socio-economic baseline environments. It summarises the key characteristics of the biophysical environment including climate, geology, topography, soils, water, vegetation and fauna, as well as the existing socio-economic conditions such as population and healthcare as well as cultural heritage. The information presented serves to guide the identification of impacts and the associated mitigation measures as set out in chapter 7 of this report.

Table 8 provides a brief description of the area and environment pertaining to the proposed activities.

Table 8 - Summary of the baseline environment

Summary of the local environment	
Climate	Farm Gai Kaisa No. 159 receives between 500 mm to 550 mm of rain per year, with a variation coefficient of <30%. Potential evaporation is between 1 960 mm and 2 100 mm per year, meaning an average water deficit of between 1 500 mm and 1 700 mm per year. Relative humidity is low, rarely more than (>) 20% in winter but may reach 85% in summer before or after thunderstorm build-up. Maximum temperatures average around 32°C - 34°C, mainly recorded during the afternoons between November and January, while minimum temperatures are around 4°C - 6°C and are normally recorded during nights in June and July. Deviations from these averages are common, with the highest temperatures reaching 38°C - 40°C and the lowest temperatures below 0°C (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).
Geology	The Project is located within the Swakop Group, which forms part of the Damara Supergroup (600 million years old – 850 million years old), show a surficial transition to the Waterberg Basin of the Karoo Supergroup (180 million years old – 300 million years old). Over millions of years, a lime and dolomite rock mass of up to 5 000 m thick was formed, which was pressed upwards and folded intensely as the result of a gigantic collision between the two mainlands, approximately 650 million years ago. To the east (E), a transition to the more recent Kalahari deposits (<70 million years old) becomes increasing apparent.
Topography and soil	There is increasing elevation towards the Otavi Mountains in the northwest (NW), reaching an elevation of almost 1 600 metres above

Summary of the local environment	
	mean sea level (mbsl). Towards the southeast (SE), the landscape flattens gradually to an elevation of 1 350 – 1 300 mbsl. The Project area is mostly dominated by molic leptosols. Leptosols are marked by a shallow soil profile (indicating little influence of soil-forming processes) and contain large amounts of gravel. Leptosols are coarse-textured, underlain by solid rock within 30 cm from the surface. The soil is thus poorly developed and thin, lacks appreciable quantities of accumulated clay and organic material and is susceptible to erosion during the rainy season, especially in the beginning of the rainy season when vegetation cover is sparse. Eutric fluvisols (in the south (S) of the study area) are associated with the ephemeral drainage lines of the Kalahari. These soils were intensely reworked during its formation, as a result of flooding.
Hydrogeology and hydrology	Being a karst landscape, the Otavi Mountains are without any surface drainage channels. Tributaries of the Omatako River originate on or near the study area, which are ephemeral. The study area is located in the Omatako Groundwater Basin. The general direction of the groundwater flow is E and SE towards the Omatako River. Freshwater is obtained from existing boreholes. There are five (5) boreholes on Farm Gai Kaisa No. 159.
Vegetation	The study area is covered with the Northern Kalahari vegetation type of the broad-leaved tree-and-shrub savanna sub-biome, showing a transition towards the thornbush shrubland vegetation type of acacia tree-and-shrub savanna to the northeast (NE). Plant diversity is estimated to be more than 500 species in the general Kombat area. Endemism in this area is viewed as “average” with 6 - 15 species and known for its local endemics. Encroacher species include *Senegalia mellifera*, *Dichrostachys cinerea*, *Acacia nolitica* and *Terminalia pruniodes*.
Fauna species	Endemic fauna species is expected to be low, although the overall terrestrial biodiversity in the study area ranges from medium to high, showing a clear increase towards the higher elevations associated with the Otavi Mountains. The number of mammal species ranges between 76 and 90, bird species range between 201 and 230, reptiles between 71 – 80 species, amphibians between 12 – 15 species and 10 – 11 scorpion (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).
Socio-economic baseline	The population density of the Otjozondjupa Region, where the Project is located, is low (1.5 persons per km^2). The total population

Summary of the local environment	
	of Otjozondjupa Region is estimated at 220,811 as of 2023. The economy of the Otjozondjupa Region is predominantly agriculture-based. Extensive livestock farming forms the livelihood of many people. Greater parts of the region are covered by commercial and communal farms, mainly for cattle ranching. Guest farms and hunting farms are also common. On both commercial and communal land, bush encroachment decreases the carrying capacity of the farms markedly over the last four (4) decades. The largest percentage of people in the Otjozondjupa Region utilise intermediate hospitals for medical care (45.9%) and only 25% have to rely on clinics. Less than 10% of the total population of the Otjozondjupa Region receive their medical treatment from a doctor (Namibia Statistics Agency, 2017).
Heritage	It is to be expected that more paleontological sites of the same kind may exist in the wider landscape associated with the Etjo Mountains including farm Gai Kaisa No. 159. The archaeological assessment reported that the area is not archaeologically sensitive based on the indicative value of potential surface finds and existing survey data to which the assessment was limited. However, within the Gai Kaisa Farm boundaries two grave sites were recorded as per the previous archaeological assessment (Appendix H). It should be noted that the Project is not planned to encroach on these sites.

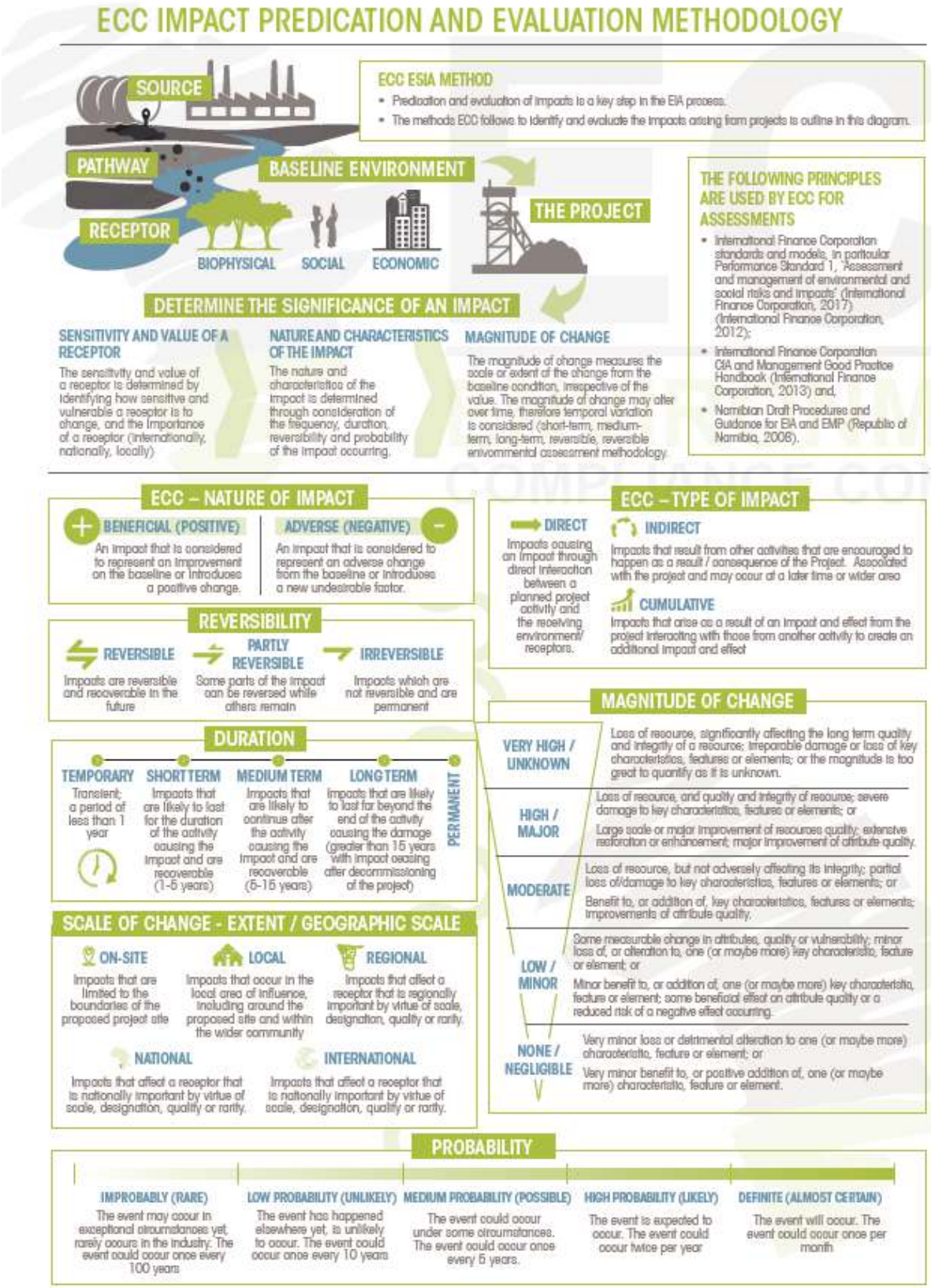
6 IMPACT IDENTIFICATION AND EVALUATION METHODOLOGY

6.1 INTRODUCTION

The impact assessment methodology described in this chapter, was developed by ECC and is designed to systematically identify and evaluate potential biophysical and socio-economic impacts that may arise from the proposed Project. The methodology takes into consideration the baseline characteristics of the Project area and assesses the significance of impacts based on various factors, including the sensitivity and value of environmental and social receptors, the nature and characteristics of the potential impact and the magnitude of potential change.

This chapter further provides a structured approach for evaluating the potential impacts of the proposed Project on the environment and social aspects. The method shown in Figure 4 provides assessment guidance that is used to evaluate impacts, and it also acknowledges any limitations, uncertainties and assumptions associated with the assessment methodology. It outlines how impacts are identified and evaluated and how the level of significance is derived. The methodology also addresses the application of mitigation measures in the assessment and how additional mitigations are identified.

Overall, this chapter provides a comprehensive and systematic approach for conducting impact assessments, which can help ensure that potential biophysical and socio-economic impacts are thoroughly evaluated and addressed in the decision-making process for the proposed Project. However, it is important to note that the effectiveness of this methodology would ultimately depend on its implementation and the accuracy of the baseline data and assumptions used in the assessment, as discussed further in section 6.3.


ECC IMPACT PREDICATION AND EVALUATION METHODOLOGY
SOURCE
PATHWAY
RECEPTOR
BASELINE ENVIRONMENT
BIOPHYSICAL
SOCIAL
ECONOMIC
THE PROJECT
ECC ESIA METHOD
• Predication and evaluation of impacts is a key step in the EIA process.
• The methods ECC follows to identify and evaluate the impacts arising from projects is outline in this diagram.
THE FOLLOWING PRINCIPLES ARE USED BY ECC FOR ASSESSMENTS
• International Finance Corporation standards and models, in particular Performance Standard 1, 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012);
• International Finance Corporation CIA and Management Good Practice Handbook (International Finance Corporation, 2013) and,
• Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008).
DETERMINE THE SIGNIFICANCE OF AN IMPACT
SENSITIVITY AND VALUE OF A RECEPTOR
The sensitivity and value of a receptor is determined by identifying how sensitive and vulnerable a receptor is to change, and the importance of a receptor (internationally, nationally, locally)
NATURE AND CHARACTERISTICS OF THE IMPACT
The nature and characteristics of the impact is determined through consideration of the frequency, duration, reversibility and probability of the impact occurring.
MAGNITUDE OF CHANGE
The magnitude of change measures the scale or extent of the change from the baseline condition, irrespective of the value. The magnitude of change may alter over time, therefore temporal variation is considered (short-term, medium-term, long-term, reversible, reversible environmental assessment methodology
ECC – NATURE OF IMPACT
BENEFICIAL (POSITIVE)
An impact that is considered to represent an improvement on the baseline or introduces a positive change.
ADVERSE (NEGATIVE)
An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
ECC – TYPE OF IMPACT
DIRECT
Impacts causing an impact through direct interaction between a planned project activity and the receiving environment/ receptors.
INDIRECT
Impacts that result from other activities that are encouraged to happen as a result / consequence of the Project. Associated with the project and may occur at a later time or wider area
CUMULATIVE
Impacts that arise as a result of an impact and effect from the project interacting with those from another activity to create an additional impact and effect
REVERSIBILITY
REVERSIBLE
Impacts are reversible and recoverable in the future
PARTLY REVERSIBLE
Some parts of the impact can be reversed while others remain
IRREVERSIBLE
Impacts which are not reversible and are permanent
DURATION
TEMPORARY
Transient; a period of less than 1 year
SHORT TERM
Impacts that are likely to last for the duration of the activity causing the impact and are recoverable (1-5 years)
MEDIUM TERM
Impacts that are likely to continue after the activity causing the impact and are recoverable (5-15 years)
LONG TERM
Impacts that are likely to last far beyond the end of the activity causing the damage (greater than 15 years with impact ceasing after decommissioning of the project)
PERMANENT
SCALE OF CHANGE - EXTENT / GEOGRAPHIC SCALE
ON-SITE
Impacts that are limited to the boundaries of the proposed project site
LOCAL
Impacts that occur in the local area of influence, including around the proposed site and within the wider community
REGIONAL
Impacts that affect a receptor that is regionally important by virtue of scale, designation, quality or rarity.
NATIONAL
Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity.
INTERNATIONAL
Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity.
MAGNITUDE OF CHANGE
VERY HIGH / UNKNOWN
Loss of resource, significantly affecting the long term quality and integrity of a resource; irreparable damage or loss of key characteristics, features or elements; or the magnitude is too great to quantify as it is unknown.
HIGH / MAJOR
Loss of resource, and quality and integrity of resource; severe damage to key characteristics, features or elements; or
Large scale or major improvement of resources quality; extensive restoration or enhancement; major improvement of attribute quality.
MODERATE
Loss of resource, but not adversely affecting its integrity; partial loss of/damage to key characteristics, features or elements; or
Benefit to, or addition of, key characteristics, features or elements; improvements of attribute quality.
LOW / MINOR
Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (or maybe more) key characteristic, feature or element; or
Minor benefit to, or addition of, one (or maybe more) key characteristic, feature or element; some beneficial effect on attribute quality or a reduced risk of a negative effect occurring.
NONE / NEGLIGIBLE
Very minor loss or detrimental alteration to one (or maybe more) characteristic, feature or element; or
Very minor benefit to, or positive addition of, one (or maybe more) characteristic, feature or element.
PROBABILITY
IMPROBABLY (RARE)
The event may occur in exceptional circumstances yet, rarely occurs in the industry. The event could occur once every 100 years
LOW PROBABILITY (UNLIKELY)
The event has happened elsewhere yet, is unlikely to occur. The event could occur once every 10 years
MEDIUM PROBABILITY (POSSIBLE)
The event could occur under some circumstances. The event could occur once every 5 years.
HIGH PROBABILITY (LIKELY)
The event is expected to occur. The event could occur twice per year
DEFINITE (ALMOST CERTAIN)
The event will occur. The event could occur once per month

- The significance of impacts has been derived at by applying the identified thresholds for receptor sensitivity and magnitude of change, as well as the definition of significance. Moderate and major adverse impacts are considered as significant.
- The following thresholds were therefore used to double check the assessment of significance had been applied appropriately: a significant impact would meet at least one of the following criteria:
- It exceeds widely recognized levels of acceptable change;
- It threatens or enhances the viability or integrity of a receptor or receptor group of concern; and
- It is likely to be material to the ultimate decision about whether or not the environmental clearance certificate is granted.

				SIGNIFICANCE OF IMPACT			
			Significance of Impact	Impacts are considered to be loco factors that are unlikely to be critical to decision-making	Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent	Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/ or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/ features that are unique and which, if lost, cannot be replaced or relocated.	Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non-reversible on a national scale and/ or have international significance or result in a legislative non-compliance.
	Biophysical	**Social**		**Low**	**Minor (2)**	**Moderate (3)**	**Major (4)**
SENSITIVITY	A biophysical receptor that is protected under legislation or international convention (CITIES) listed as rare, threatened or endangered IUCN species. Highly valued/ sensitive resource/ receptors.	Those affected people/ communities will not be able to adapt to changes or continue to maintain pre-impact livelihoods.	**High (3)**	**Minor (3)**	**Moderate (6)**	**Major (9)**	**Major (12)**
	Of value, importance/ rarity on a regional scale, and with limited potential for substitution; and/or not protected or listed (globally) but may be a rare or threatened species in the country; with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support	**Medium (2)**	**Low (2)**	**Minor (4)**	**Moderate (6)**	**Major (8)**
	Not protected or listed as common/abundant, or not critical to other ecosystems functions.	Those affected are able to adapt with relative ease and maintain pre-impact status. There is no perceptible change to people's livelihood.	**Low (1)**	**Low (1)**	**Low (2)**	**Minor (3)**	**Moderate (4)**

SENSITIVITY AND VALUE

Low
Of value, importance or rarity on a local scale; and/or not particularly sensitive to change or has considerable capacity to accommodate a change.

Medium
Of value, importance or rarity on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change, or moderate capacity to accommodate a change.

High
Of value, importance or rarity on an international and national scale, and with very limited potential for substitution; and/or very sensitive to change or has little capacity to accommodate a change.

MITIGATION

Mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement. The mitigation hierarchy is avoidance; reduction at source; reduction at receptor level; repairing and correcting; compensation; remediation; and enhancement.

Mitigation measures can be split into three distinct categories, broadly defined as:

- Standard practices and other best practice measures for avoiding and minimizing environmental impacts. These are considered as good practice measures.
- Actions undertaken by the EIA process that influence the design process, through implementing design measures that would entirely avoid or eliminate an impact or modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered as embedded mitigation.
- Specified additional measures or follow-up action to be implemented to further reduce adverse impacts that remain after the incorporation of embedded mitigation. These are considered as additional mitigation.

The EIA is an iterative process whereby the outcomes of the environmental and social assessments inform the project.
The EMP provides the good practice mitigation measures and specified additional measures or follow-up actions ECC has recommended for the project.

SIGNIFICANCE DESCRIPTION

Low - Major Beneficial (All Scores)
Impacts are considered to be beneficial to the environment and society.

Low (negative) 0 - 25
Impacts are considered to be local factors that are unlikely to be critical to decision-making.

Minor (negative) 25 - 50
Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent.

Moderate (negative) 50 - 75
Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/ or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/ features that are unique and which, if lost, cannot be replaced or relocated.

Major (negative) 75 - 100
Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non- reversible on a national scale and/or have international significance or result in a legislative non- compliance.

Figure 4 - ECC ESIA methodology based on IFC standards

6.2 ASSESSMENT GUIDANCE

The principal documents used to inform the assessment method are:

- International Finance Corporation standards and models, in particular Performance Standard 1, Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012);
- International Finance Corporation CIA and Management Good Practice Handbook (International Finance Corporation, 2013); and
- Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008).

6.3 LIMITATIONS, UNCERTAINTIES AND ASSUMPTIONS

The limitations and uncertainties associated with the assessment methodology in Namibia were observed to include the absence of topic-specific assessment guidance, with a generic methodology being applied based on IFC guidance and professional judgement. This implies that there may be limitations in terms of tailoring the assessment to specific topics or issues relevant to Namibia and that the methodology may not fully capture the unique characteristics and nuances of the local context.

The ECC impact assessment process also acknowledged the presence of uncertainties and assumptions were made based on realistic worst-case scenarios to ensure that potential environmental impacts were identified and assessed comprehensively. These assumptions and uncertainties were identified and documented during the assessment process, shown in Table 9, and are in line with best practice.

A cautious approach was applied where uncertainties existed, allowing for the identification and assessment of potential impacts based on worst-case scenarios. The limitations and uncertainties were acknowledged and described in the baseline section of the assessment (chapter 5), indicating transparency and awareness of potential limitations in the methodology.

It is important to note that the limitations and uncertainties identified in the assessment methodology may introduce potential biases or inaccuracies in the assessment results. Therefore, it is recommended to regularly review and update the methodology to address these limitations and uncertainties and to ensure that it remains robust and relevant for the specific context of Namibia. Additionally, incorporating stakeholder feedback and local

knowledge can also contribute to improving the accuracy and comprehensiveness of the assessment process.

Table 9 - Limitations, uncertainties and assumptions

Limitation/uncertainty	Assumption
Expected rainfall to support the Project	Namibia is semi-arid and rainfall is characterised by high spatial and temporal variability. Therefore, the groundwater assessment evaluates three (3) separate scenarios of taking into consideration different rainfall conditions and the efficacy of biochar application to improve soil – all of which were assessed.

6.4 CUMULATIVE IMPACTS

6.4.1 CUMULATIVE IMPACTS ASSESSMENT METHOD

Cumulative impacts may arise as a result of other Project activities, or due to the combination of two (2) or more projects in the Project area. A cumulative impact assessment (CIA) will be undertaken by applying the IFC CIA Good Practice Handbook (International Finance Corporation, 2013), which recommends that a rapid CIA is undertaken.

A rapid CIA takes into consideration the challenges associated with a good CIA process, which include a lack of basic baseline data, uncertainty associated with anticipated development, limited government capacity, and the absence of strategic regional, sectoral, or integrated resource planning schemes.

The following five-step rapid CIA process will be followed:

- **Step 1**: scoping – determine spatial and temporal boundaries;
- **Step 2**: scoping – identify valued environmental and social receptors and identify reasonably foreseeable developments;
- **Step 3**: determine the present condition of valued environmental and social receptors (the baseline);
- **Step 4**: Evaluate the significance of the cumulative impacts; and
- **Step 5:** Identify mitigation measures to avoid or reduce cumulative impacts.

The following information will be applied to the assessment in line with the above steps and IFC guidance:

- The spatial and temporal boundaries of the CIA are the extent of the Project boundaries and the duration of the exploration and rehabilitation phases of the proposed Project;

- Valued environmental and social receptors that may be affected;
- A review of existing and reasonable, anticipated and/or planned developments has been undertaken, which is based on the information presented in chapter 4;
- The predicted future conditions of sensitive and common environmental and social receptors have been taken into consideration in the assessment;
- The assessment findings are presented in the assessment chapter will have the CIA applied in combination with professional judgment and published environmental assessment reports; and
- A review of mitigation and monitoring measures will be undertaken, with any additional ones identified.

6.5 MITIGATION

Impacts that are identified throughout the scoping plus impact assessment process will be subjected to a process of impact mitigation, which is inherent in all aspects of the scoping plus impact assessment system. Embedded mitigation and good practice mitigation will be considered in the assessment. Additional mitigation measures will be identified when the significance of an impact requires it and causes the impact to be further reduced.

The principal of impact mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement and will be applied to all impacts associated with the proposed Project. The mitigation hierarchy is avoidance; reduction at source; reduction at receptor level; repairing and correcting; compensation; remediation; and enhancement. The ESMP for the Project provides good practice measures of the impact mitigation and specifies additional measures or follow-up action, where required. The ESMP is appended to this report (Appendix A). On completion of the impact assessment, the mitigation measures from the impact assessment and recommendations are then incorporated into the final ESMP, which forms an appendix of the final scoping plus impact assessment.

Mitigation measures can be split into three (3) distinct categories, broadly defined as:

- Actions undertaken by the scoping plus impact assessment process that influence the design process, through implementing design measures that would entirely avoid or eliminate an impact or modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered embedded mitigation;
- Standard practices or other best practice measures for avoiding and minimising environmental impacts. These are considered good practice measures; and
- Specified additional measures or follow up actions to be implemented, to further reduce adverse impacts that remain after the incorporation of embedded mitigation. These are considered additional mitigation measures.

Where additional mitigation is identified, a final assessment of the significance of impacts (residual impacts) will be carried out, taking into consideration the additional mitigation.

The scoping plus impact assessment is an iterative process whereby the outcomes of the environmental assessments inform the environmental management of the proposed Project through the ESMP. The ESMP in Appendix A provides an outline of the good practice measures and specified additional measures or follow-up actions to be undertaken. The Project ESMP will be finalised on completion of the impact assessment process and included in the final scoping plus impact assessment report.

7 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

7.1 INTRODUCTION

This chapter presents the findings of the impact assessment for the proposed activities, with a focus on potential significant environmental and social impacts. The design of the proposed Project and best practice measures were considered during the desktop assessment to identify likely significant impacts and recommend mitigation measures. The Proponent is advised to obtain the appropriate licences as indicated in section 3.3. A summary list of potential impacts was provided, including water (surface and groundwater), soil, landscape, socioeconomics (employment, demographics, and land use), noise, ecology (fauna and flora), air quality (emissions, pollutants, and dust), and heritage (including culture, history, archaeology, and palaeontology).

The section below presents the impact assessment findings, identify the activities that could be the source of impacts, the receptors that could be affected and the pathways between them.

7.2 IMPACTS DEEMED AS NOT SIGNIFICANT

The impacts that have been assessed as not being significant are summarised in Table 10 and are not discussed further in this report. The listed impacts are non-significant and do not render any threat to the environment in a way that adversely challenges its resilience to continue in its modified form.

Table 10 - Table of non-significant impacts

Environmental and social topic	Potential impact	Summary of assessment findings
Traffic and road impacts	Alteration of traffic flow and negative impacts on the quality of nearby roads	– Farm Gai Kaisa No. 159 has a gravel road leading up to the B8 road. The Project will not cause material changes to the existing traffic volumes, neither the quality of the road.
Community (farmers and landowners)	Social tensions and conflict due to lack of engagements and disruptions to routine movements.	– The Proponent holds an environmental clearance certificate for the mechanised bush thinning operations on the Project footprint and maintains continuous engagement with all

Environmental and social topic	Potential impact	Summary of assessment findings
		neighbouring farmers. Additionally, the planned Project activities are not expected to disrupt the normal operations of neighbouring farmers.
Air quality impacts	Potential dust generation from Project activities	– The Project operations are unlikely to generate excessive aerial emissions that would not be manageable or that will significantly impact sensitive receptors (nearby farmers).Mitigations are already in place to minimise the air quality impact for the current Project.
Noise impacts	Noise impacts on nearby farmer	– Noise activities on the Project sites are restricted to working hours and planned activities will unlikely generate excessive noise that would propagate and upset offsite receptors.
Cultural heritage	Destruction of and damage to heritage sites and artifacts	– Within the Gai Kaisa Farm boundaries two grave sites were recorded as per the previous archaeological assessment (Appendix H). – The two (2) identified heritage sites on the Farm will not be impacted by the Project activities.
Terrestrial ecology and biodiversity	Increased movement of transportation trucks and vehicles for construction and operation activities may results into residing, nesting and slow-	– As outlined in the ESMP, existing tracks and routes will be utilised and movements will be restricted to daytime operating hours as far as reasonably practical.

Environmental and social topic	Potential impact	Summary of assessment findings
	moving organisms being disturbed, injured or killed.	

7.3 SIGNIFICANT IMPACTS

7.3.1 SOCIOECONOMIC IMPACTS

The term socio-economic impact assessment embraces both social impacts and economic impacts. Impacts include areas such as employment creation, increased productivity and profitability and procurement of goods from the local economy. The significant socioeconomic impacts are summarised in this section. Table 11 outlines the socioeconomic impact ratings (findings). An overview of the significant socio-economic, before mitigation is shown in Figure 5. Each specific impact is discussed further in this section.

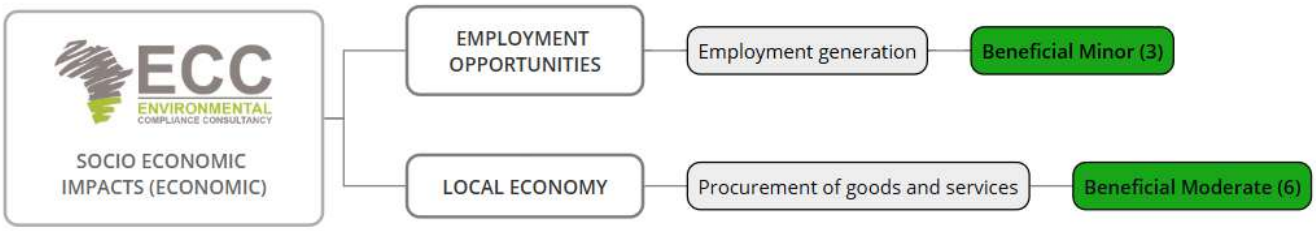


Figure 5 - Overview of the socioeconomic impacts

7.3.1.1 Employment creation

During the irrigation operations, it is expected that job opportunities will be created to ensure the Project processes function effectively. The nature of the impact is beneficial and will impact people directly, providing them with incomes that would enable them to spend in the local economy and improve their livelihoods. The impact may be reversible as jobs may be lost should the Project enter a decommissioning phase. The duration of the impact is rated medium as Project is expected to be over a period of 10-15 years. The probability of the impact is rated likely to occur as preference will be given to locals to minimise unnecessary relocation of employees. The magnitude of the change is minor as added workforce is expected to be few, and the sensitivity of receptor is rated low due to the local scale of the impact. The overall significance of the impact is beneficial minor (Table 11).

7.3.1.2 Procurement of goods and services

During the irrigation operation, sourcing of goods and services from local or regional businesses could increase economic benefits. The nature of the impact is beneficial and will impact local businesses directly. The impact is rated as reversible should business activities cease. The duration of activities may occur during a medium period (10-15 years). The impact

is likely to occur regionally due to availability, convenience and lower transport cost. The magnitude of the change is rated minor due to the minor benefit to local surrounding businesses. The sensitivity of receptor is low due to the local scale of the impact. The overall significance of the impact is beneficial moderate (Table 11).

Table 11 - Socioeconomic impact assessment findings

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Operational phase	Socio-economic	Employment generation	Beneficial Direct Reversible Medium term Local Likely	Low	Minor	Beneficial Minor (3)
		Procurement of goods and services	Beneficial Direct Reversible Medium term Regional Likely	Medium	Minor	Beneficial Moderate (6)

7.3.2 SOCIAL IMPACTS

Social impacts refer to the potential effects on stakeholders, communities and the wider Namibian society. These impacts consider how the Project affects the well-being, livelihoods, culture, and social dynamics of individuals and groups. An overview of the significant social impacts, before mitigation is shown in Figure 6. The specific impact is discussed in this section.

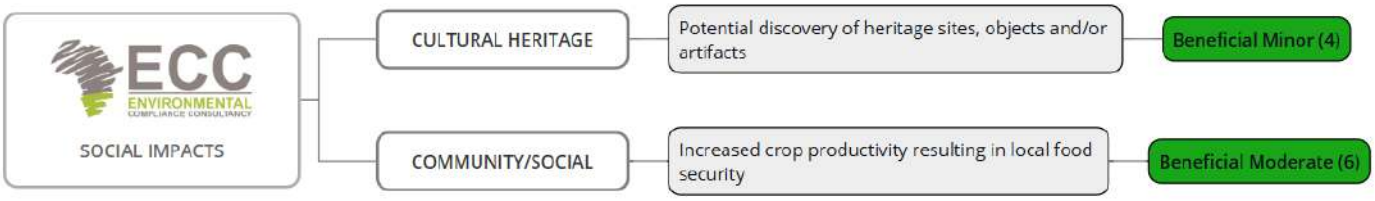


Figure 6 - Overview of social impacts

7.3.2.1 Cultural heritage – chance find of heritage sites, objects and/or artifacts

During agriculture operations, new cultural heritage sites, objects and artifacts may be discovered or unearthed within the Project footprint. In cases where heritage sites are discovered, the chance find procedure will be used as outlined in the ESMP.

The nature of the impact is beneficial, directly impacting the Namibia's national heritage register which is maintained by the National Heritage Council (NHC) under the National Heritage Act, 2004 (Act No. 27 of 2004). The impact is considered irreversible and permanent. The probability of the impact is unlikely, as the Project site has previously been surveyed during the initial environmental impact assessment study for the mechanised bush clearing activities. No major earthworks will be undertaken. However, in the likely event that any major heritage discovery is made, this may be substantial for cultural tourism as the area would warrant protection and preservation in terms of the National Heritage Act, No. 27 of 2004. The magnitude of change is rated as moderate as heritage sites hold spiritual, cultural and social significance for local communities, including traditional authorities and descendants of affected groups. Additionally, all archaeological material, graves and culturally significant sites are protected by law, regardless of whether they are formally recorded. The sensitivity of receptor is rated as medium due to the national cultural benefit associated with this impact. The significance of the impact is rated beneficial minor (Table 12). The chance find procedure is outlined in Appendix A of the ESMP.

7.3.2.2 Increased crop productivity resulting in local food security

Irrigation schemes have the ability to enhance crop yields through more consistent, steady crop production and extended growing seasons, especially in arid environments prone to drought. Increased crop productivity leads to food security and drought relief savings for the local government and assist the local economy (Mudima, 2002).

The nature of the impact is rated as beneficial and directly impact the economy and the regional community. The impact may be reversible as outcomes could be unpredictable due to variabilities in climate, moisture and other environmental factors. The duration of the Project is expected to be over a medium term (10-15 years), supporting receptors on a regional scale. The probability of the impact occurring is considered high as it is likely expected that with improved irrigation schemes, there will be improved yields. The magnitude of the change is moderate due to food availability and access to nutrition, particularly in rural areas. The sensitivity of receptor is rated medium due to the regional scale of the impact. The overall significance of the impact is beneficial moderate (Table 12).

Table 12 – Social impacts

Activity	Receptor	impact	Nature of impact	Value and sensitivity	Magnitude of change	Significance of impact
Irrigation – operational phase	Cultural heritage	Potential discovery of new heritage sites, objects and/or artifacts	Beneficial Direct Irreversible Permanent National Unlikely	Medium	Moderate	Beneficial Minor (4)
	Community	Increased crop productivity resulting in local food security	Beneficial Direct Reversible Medium term Regional Likely	Medium	Moderate	Beneficial Moderate (6)

7.3.3 BIOPHYSICAL IMPACTS

Biophysical impacts refer to the effects of human activities or processes on the physical and biological aspects of the environment. It encompasses changes to ecosystems, species, habitats and the physical environment, such as air, water and soil. An overview of the significant biophysical impacts, before mitigation is shown in Figure 7. Each specific impact is discussed further in this section.

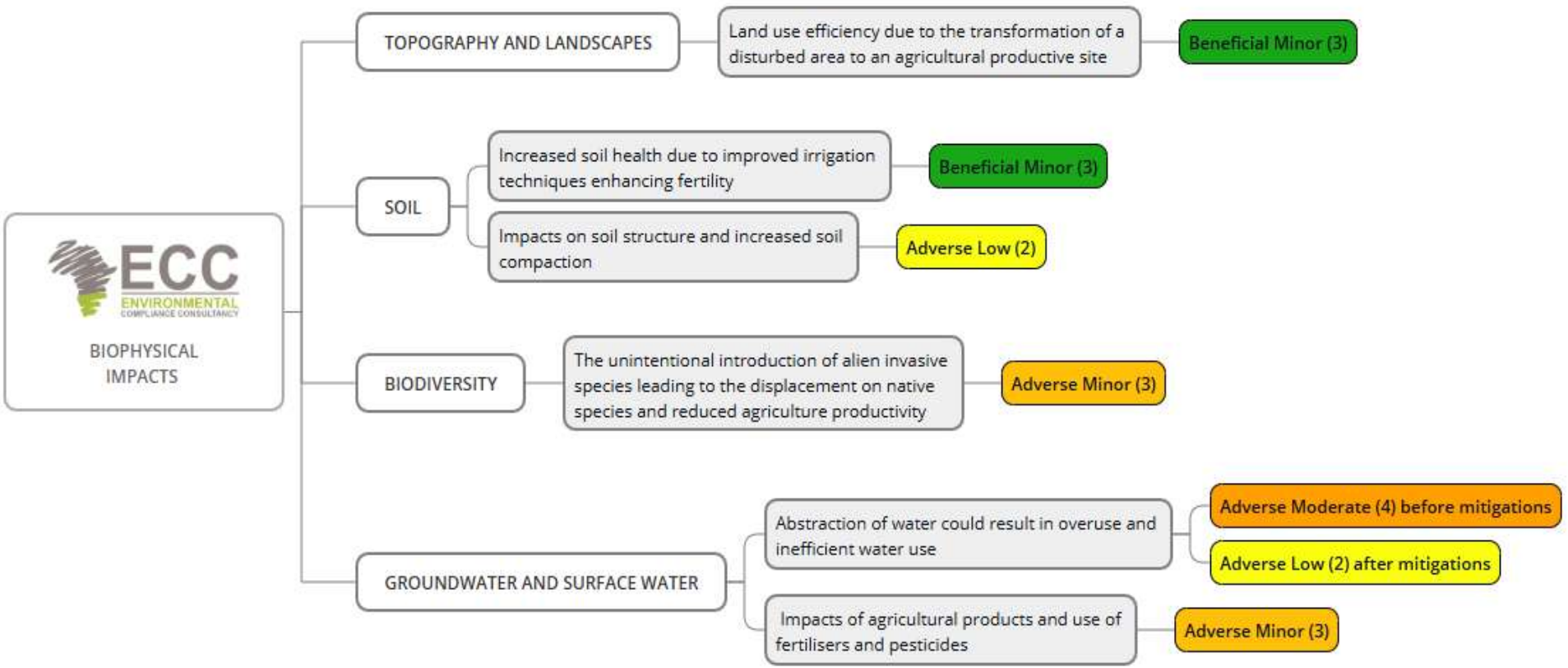


Figure 7 - Overview of the biophysical impacts

7.3.3.1 Increased land-use efficiency

The current Project activities involve thinning encroached bushes, often leaving the site disturbed and in extreme cases barren. The operation of the irrigation scheme will allow for the continued efficient use of the disturbed area, leading to increased yields and food security.

The nature of the impact is rated beneficial and directly impacting the landscape. The impact may be partly reversible, should the Project cease as the area may become less productive in the absence of continued management and human interventions. The duration of the Project is expected to be over a medium term (10 -15 years) and will impact the land used for the site. The magnitude of the change is rated moderate due to the sizable positive impact, while the sensitivity of receptor is rated low as the impact is restricted. The overall significance of the impact is beneficial minor (Table 13).

7.3.3.2 Increased soil health

Irrigation systems and planned agricultural programmes can improve soil health in various ways through preventing over-irrigation, reducing soil erosion and enforcing crop rotation and diversity (Food and Agriculture Organization of the United Nations (FAO), 2017). Through careful management programs of the irrigation scheme, the capacity of the soil to retain moisture improves and support sustained agricultural productivity.

The nature of the impact is beneficial and directly impacting the soil quality. The impact may be reversible, depending on the productivity and success of the agricultural venture. The duration of the Project is expected to be over a medium term (10-15 years) and is expected to impact the health of the soil on-site. The magnitude of the change is rated minor, and the sensitivity is low due to the impact affecting soil on-site. The overall significance of the impact is beneficial minor (Table 13).

7.3.3.3 Impacts on soil structure and increased compaction

Increased water use may saturate the soil, resulting in waterlogging, leaving little room for air and poor drainage. The nature of the impact is adverse, directly impacting the soil and could be reversible through measures such as limiting heavy machinery use and improving the soil through eco-friendly methods. The impact may occur over long-term as the soil may remain compacted even post operations (more than 15 years). The impact will be limited to the site. The probability of the impact occurring is rated possible due to the activities that are foreseen.

The magnitude of change is minor due to the small change it causes as the soil is already disturbed, and the sensitivity of the impact is low due to the impact occurring on-site and does not extend beyond the boundaries of the Project location. The overall significance of the impact prior to mitigation is rated adverse low (Table 13). The mitigation measures have been included ESMP (Appendix A).

7.3.3.4 Unintentional introduction of alien invasive species

The use and operation of irrigation system during the Project may unintentionally introduce or facilitate the spread of alien invasive species. This may occur through contaminated irrigation water, soil movement, or the transfer of seeds and propagules on machinery and vehicles. Disturbed areas provide favourable conditions for invasive species to establish and proliferate (Convention on Biological Diversity (CBD), 2002).

The nature of the impact is adverse, directly impact the cultivated area, vegetation and soil. The impact is partly reversible as early detection, and rapid response can effectively control invasive species. The impact may occur over a medium term, throughout the project life cycle (10-15 years). Alien invasive species may spread beyond the Project footprint and may therefore affect the local area. The probability of the impact occurring is deemed possible as increased moisture availability and disturbance promote the establishment of invasive species.

The magnitude of change is rated moderate due to potential displacement of indigenous vegetation, increased water consumption, reduced agricultural productivity and impacts on adjacent natural habitats. The sensitivity of the impact is rated low due to local scale as the spread of alien invasive species are expected to occur just beyond the site. The overall significance of the impact is rated adverse minor, prior to mitigation (Table 13). The mitigation measures have been included in the ESMP (Appendix A).

7.3.3.5 Potential over abstraction of groundwater and depletion of water resources

Over abstraction of groundwater through unsustainable use of irrigation systems may lead to reduced water levels of boreholes, especially during dry seasons and lead to water scarcity in the vicinity or could potentially lead to reduced water quality as it increases the salinity electrical conductivity (EC), and total dissolved solids (TDS) in borehole water (Food and Agriculture Organization of the United Nations (FAO), 2012). Sustainable abstraction therefore requires alignment with water use licences, accurate metering and the implementation of water-efficient irrigation systems such as the drip or centre-pivot irrigation as proposed by the Proponent. It is therefore imperative that the mitigations described under this section, the Test Pumping Analysis and Memo (Appendix C) and the groundwater study (Appendix D) should be implemented throughout the Project lifecycle.

The nature of the impact is adverse, directly impacting the biophysical and social environment and is partly reversible provided abstraction remains within sustainable limits and effective management measures are implemented. The impact may potentially occur during the life cycle of the Project which is over a medium term (10-15 years). The impact is likely to occur over a local scale as local farms may be impacted. Abstraction of water is foreseen as it is a requirement but remains variable, with higher demand during peak irrigation periods.

The magnitude of change is rated major due to the potential loss or hinderance to a significant resource. The sensitivity of the impact is rated low due to the local scale. The overall significance of the impact prior to mitigation is rated adverse moderate, before mitigation (Table 13) and has been rated adverse low, after mitigation.

Mitigation measures are listed below and are included in the ESMP (Appendix A):

- Strict adherence to the Test Pumping Analysis and Memo (Appendix C) and the groundwater study (Appendix D);
- Sustainable and water-conscious irrigation techniques that promotes water saving;
- Monitor groundwater levels or surface water availability on a regular basis;
- A water management plan should be developed in order to efficiently manage and monitor the water use and water levels throughout the Project lifecycle; and
- The relevant water abstraction licences should be obtained from MAFWLR: DWA as per the Water Resources Management Act, 2013 (Act No. 11 of 2013) and associated Water Resource Management Regulations, No.269, and its conditions must be adhered to (which also include their renewals in advance).

7.3.3.6 Agricultural products impact on water sources

Fertilisers are generally used during irrigation schemes. When fertilisers are applied to crops, excess nutrients may run off and leach into nearby surface water bodies or groundwater. Excess nutrients, especially phosphorus and nitrogen could lead to eutrophication. Eutrophication is an ecological process in which a water body becomes increasingly enriched with essential nutrients. This process can result in heavy algal blooms, reduced water clarity, oxygen depletion and negative impacts on aquatic life and human health (Smith, 2009).

The nature of the impact is adverse, directly impacting the biophysical environment and is partly reversible, provided that the application of fertilisers is carefully managed and controlled. The impact may potentially occur over a medium term during the life cycle of the Project (10-15 years). The impact is likely to occur over a local scale. The magnitude of change is moderate due to the sizable impact on water quality, which ultimately also threaten aquatic life. The sensitivity of receptor is rated low due to the localised nature of the impact. The overall significance of the impact is rated adverse minor, before mitigation (Table 13). The mitigation measures have been included in the ESMP (Appendix A).

Table 13 - Biophysical impact assessment findings

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Operational phase	Topography, landscape	Land use efficiency due to the	Beneficial Direct	Low	Moderate	Beneficial Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
	and land-use	transformation of a disturbed area to an agricultural productive site	Partly reversible Medium term On-site Definite			
	Soil	Increased soil health due to improved irrigation techniques enhancing fertility	Beneficial Direct Reversible Long term On-site Likely	Low	Moderate	Beneficial Minor (3)
		Impacts on soil structure and increased soil compaction	Adverse Direct Reversible Long term On site Possible	Low	Minor	Adverse Low (2)
	Biodiversity	The unintentional introduction of alien invasive species leading to the displacement on native species and reduced agriculture productivity	Adverse Direct Partly reversible Medium term Local Possible	Low	Moderate	Adverse Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
	Resource use – surface water	Abstraction of water could result in overuse and inefficient water use	Adverse Direct Partly reversible Medium term Local Likely	Low	Major	Adverse Moderate (4)
	Surface and ground Water quality	Impacts of agricultural products and use of fertilisers and pesticides	Adverse Direct Partly reversible Medium term Local Likely	Low	Moderate	Adverse Minor (3)

7.4 CUMULATIVE IMPACTS

The Environmental Impact Assessment Regulations, 2012, state that cumulative impacts should be considered as part of the ESIA for a proposed project. Good practice requires that, as a minimum, cumulative impacts are assessed during the scoping plus impact assessment process. Cumulative impacts can arise when a single resource or receptor is affected by more than one impact from the proposed Project (intraspecific). Cumulative impacts may also arise because of the combination of two (2) or more projects (interspecific).

Cumulative impacts have a wide temporal and spatial scope and are not restricted to a local area nor need to happen at the same time. It is, therefore, crucial to identify a suitable study and assessment area, as well as a timeframe to assess. Cumulative impacts can also be vast and complicated; therefore, it is important to focus on the significant impacts.

The cumulative impacts that may arise as a result of the Project, before mitigation are presented in Figure 8, for illustrative purposes only and are outlined in Table 14.

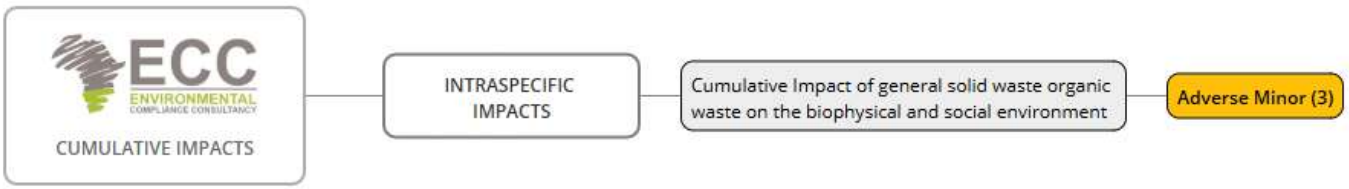


Figure 8 - Overview of the intraspecific cumulative impacts

7.4.1 INTRASPECIFIC CUMULATIVE IMPACT

This section discusses intraspecific cumulative impacts which refer to the combined effects of multiple impacts from a Project activity on a single receptor.

7.4.1.1 Cumulative Impact of general solid waste and organic waste on the biophysical and social environment

During Project activities, various waste streams may be generated as a result of agricultural production and routine operational activities. These include organic waste such as crop residues, spoiled or rejected produce, and plant trimmings, as well as general solid waste comprising packaging materials (fertiliser and seed bags), damaged irrigation components and domestic-type waste from on-site workers. If not appropriately managed, the accumulation and improper disposal of agricultural and general waste may lead to soil and water contamination, odour nuisance, and visual degradation of the surrounding environment.

The impact is considered adverse and cumulative due to various types of waste generated that affects the biophysical environment. The impact is reversible as waste-related effects can be eliminated through proper waste collection, treatment, and disposal. The impact will occur over a medium term during the Project operations (10-15 years). The impact is local, largely confined to the Project site and immediate surroundings including storage areas, cultivated fields and worker activity areas. The impact is considered likely as waste generation is an inevitable component of agricultural operations.

The magnitude of change is rated moderate. Although waste volumes are generally manageable when properly handled, potential mismanagement may have sizable consequences on biophysical and social aspects. The sensitivity of the impact is rated low as the impact is limited to the Project site. The overall significance of the impact is rated adverse minor, prior to mitigations (Table 14). Mitigation measures are outlined in the Project ESMP.

Table 14 - Intraspecific cumulative impacts on the Irrigation system for the Agriculture Project on Farm Gai Kaisa No. 159

Receptor	Impacts	Significance of impact	Impact management
Biophysical environment (soil, surface water and groundwater) and social aspects (potential odour and visual)	**Activity:** Generation of general solid waste and organic waste. **Impact:** Soil and water contamination, odour nuisance, and visual nuisance and degradation.	Adverse Minor (3)	– Separate waste streams at the source (organic crop residues, recyclables, hazardous containers, general solid waste) and use clearly labelled bins for different waste types; – Compost crop residues and plant trimmings where feasible to produce soil amendments; – Mulch organic waste on-site to reduce volume and return nutrients to the soil; – Avoid open burning of organic waste to prevent air pollution; – Store agrochemical containers and fertilisers in secure, designated areas; – Dispose of hazardous waste at the nearest licenced waste disposal facility; – Provide waste bins and collection points for non-organic waste (e.g., packaging, plastics, damaged irrigation components); – Solid waste should be collected and disposed at a licenced waste disposal site; – Encourage reuse and recycling where possible, e.g., repair irrigation parts, repurpose packaging materials; – Promote a “clean site” culture to prevent littering and improper waste disposal; and – Conduct periodic inspections of storage areas to ensure compliance with waste management protocols.

8 CONCLUSION

The scoping plus impact assessment study identified that no major potential risks required specialist studies. The areas of concern will need to be carefully monitored and managed according to the ESMP (Appendix A) to ensure that the significance of these impacts is reduced as far as reasonably possible. Beneficial minor to moderate socioeconomic impacts were also assessed such increased crop productivity (food security), employment creation and procurement of goods from local businesses.

Table 15 summarises the impacts after mitigation. On a scale of 1 to 12, low to high, the beneficial (B) and negative (N) impact significance is stated.

Table 15 - Summary of the significance rating before mitigation for the expected impact

Socioeconomic environment: economic		**Socioeconomic Environment: social**		**Biophysical environment**	
Employment creation	B3	Cultural heritage	B4	Topography and landscape impacts	B3
				Increased soil health – improved irrigation techniques	B3
Procurement of goods and services	B6	Increased crop productivity	B6	Adverse soil impacts	N2
				Biodiversity impacts	N3
				Groundwater and surface water	N3
				Generation of general solid waste and organic waste	N3

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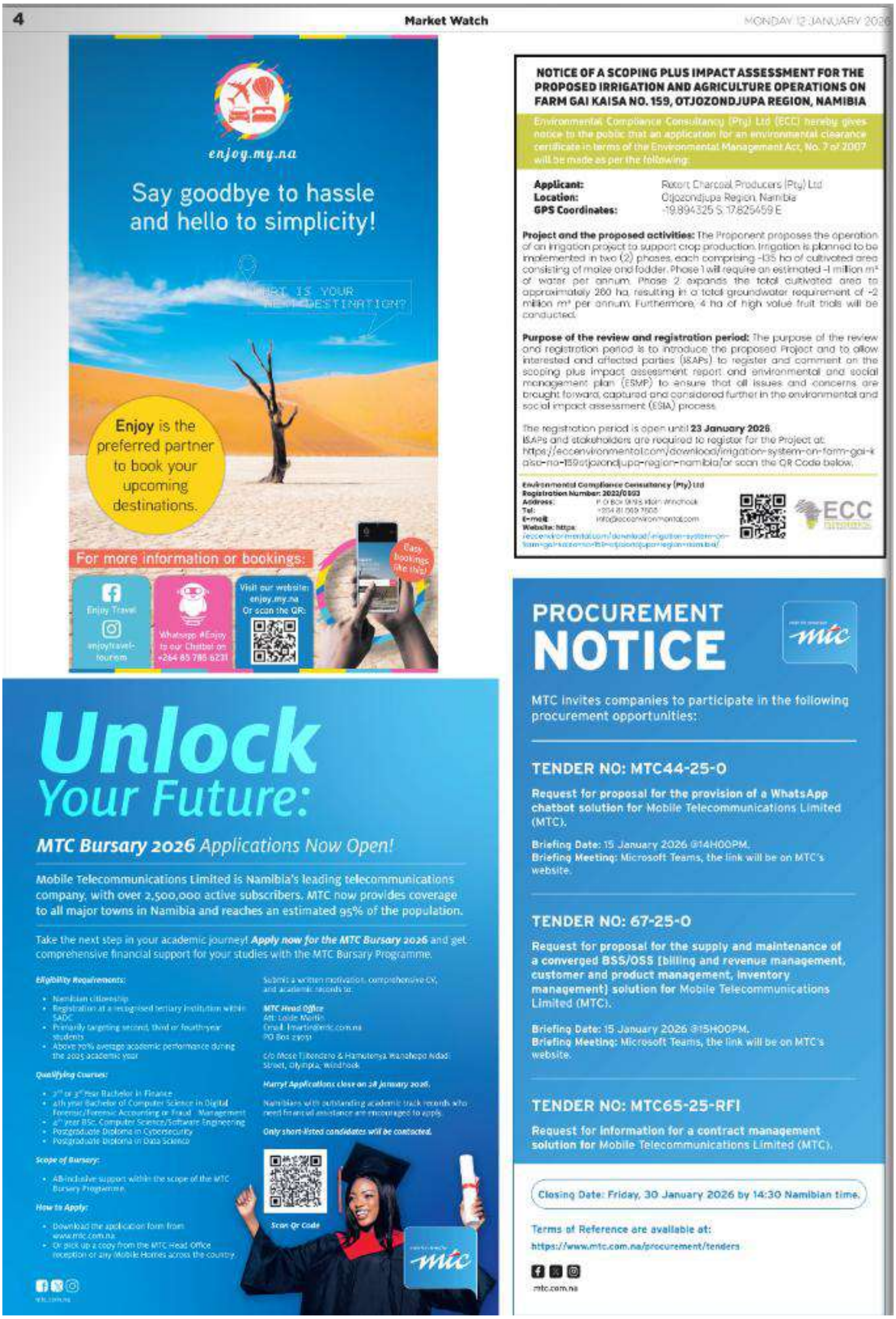
APPENDIX A – ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

APPENDIX B – ENVIRONMENTAL CLEARANCE CERTIFICATE FOR MECHANISED BUSH THINNING OPERATIONS ON FARM GAI KAISA NO. 159 (ECC-2402040)

APPENDIX C - TEST PUMPING ANALYSIS

APPENDIX D – GROUNDWATER STUDY

APPENDIX E – NEWSPAPER ADVERTISEMENT



4 Market Watch MONDAY 12 JANUARY 2026

NOTICE OF A SCOPING PLUS IMPACT ASSESSMENT FOR THE PROPOSED IRRIGATION AND AGRICULTURE OPERATIONS ON FARM GAI KAISA NO. 159, OTJOZONDJUPA REGION, NAMIBIA

Environmental Compliance Consultancy (Pty) Ltd (ECC) hereby gives notice to the public that an application for an environmental clearance certificate in terms of the Environmental Management Act, No. 7 of 2007 will be made as per the following:

Applicant: Retort Charcoal Producers (Pty) Ltd
Location: Otjozondjupa Region, Namibia
GPS Coordinates: -19.894325 S, 17.825459 E

Project and the proposed activities: The Proponent proposes the operation of an irrigation project to support crop production. Irrigation is planned to be implemented in two (2) phases, each comprising ~135 ha of cultivated area consisting of maize and fodder. Phase 1 will require an estimated ~1 million m³ of water per annum. Phase 2 expands the total cultivated area to approximately 260 ha, resulting in a total groundwater requirement of ~2 million m³ per annum. Furthermore, 4 ha of high value fruit trials will be conducted.

Purpose of the review and registration period: The purpose of the review and registration period is to introduce the proposed Project and to allow interested and affected parties (I&APs) to register and comment on the scoping plus impact assessment report and environmental and social management plan (ESMP) to ensure that all issues and concerns are brought forward, captured and considered further in the environmental and social impact assessment (ESIA) process.

The registration period is open until **23 January 2026**.
I&APs and stakeholders are required to register for the Project at: https://eccenvironmental.com/download/irrigation-system-on-farm-gai-kaisa-no-159otjozondjupa-region-namibia/ or scan the QR Code below.

Environmental Compliance Consultancy (Pty) Ltd
Registration Number: 2022/0593
Address: P O Box 91193 Klein Windhoek
Tel: +264 81 669 7608
E-mail: info@eccenvironmental.com
Website: https: //eccenvironmental.com/download/irrigation-system-on-farm-gai-kaisa-no-159-otjozondjupa-region-namibia/

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Environmental Compliance Consultancy (Pty) Ltd
Registration Number: 2022/0583
Address: P.O. Box 9983, Klein Windhoek
Tel: +264 81 669 7068
E-mail: info@eccenvironmental.com
Website: https /eccenvironmental.com/download/irrigation-system-on-farm-gai-kaisa-no-159-otjozondjupa-region-namibia/

EU eyes tariffs on €93bn of US goods

US President Donald Trump on Saturday announced a 10% tariff on goods from eight European countries starting February 1, rising to 25% in June, unless there's a deal for the "purchase of Greenland.

The EU is also weighing additional countermeasures beyond the tariffs but will first try to find a diplomatic solution.

JORGE VALERO AND ALBERTO NARDELLI

The European Union (EU) is in talks to potentially impose tariffs on €93 billion ($108 billion) of US goods if President Donald Trump follows through on his threat to hit European countries with a 10% levy on February 1.

The EU is also weighing additional countermeasures beyond the tariffs but will first try to find a diplomatic solution, according to people familiar with the discussions. Representatives from the EU's 27 countries met Sunday to begin preparing options.

EU leaders will hold an emergency meeting in Brussels later this week to explore possible retaliatory measures. European Council President Antonio Costa said in a social media post Sunday that the bloc's nations were united in support of Denmark and Greenland and were ready "to defend ourselves against any form of coercion."

Trump on Saturday announced a 10% tariff on goods from eight European countries starting February 1, rising to 25% in June, unless there's a deal for the "purchase of Greenland." Trump levied the threat after the countries said they would undertake token Nato military planning exercises in the semi-autonomous Danish territory.

UK Prime Minister Keir Starmer blasted Trump's comments as "completely wrong" and Sweden's Ulf Kristersson said his country wouldn't be "blackmailed." French Prime Minister Emmanuel Macron, who called the threat "unacceptable," plans to request that the EU activate its most powerful trade retaliation tool, the so-called anti-coercion instrument.

The most immediate and tangible reaction from the EU was that it will halt approval of its July trade deal with the US, which still requires an endorsement from the European Parliament. The European People's Party, the largest group in parliament, said it would join other parties in blocking ratification of the accord.

"President Trump has triggered an avalanche that threatens to destroy decades of transatlantic cooperation," Stefan Löfven, president of the Party of European Socialists, said in a Sunday statement. The party, whose parliamentary group is the second largest in Brussels, supports suspending the trade agreement and called on the EU to examine using the anti-coercion instrument.

The trade deal, which many in Europe criticised as too lopsided in Washington's favour, saw the EU agree to remove nearly all tariffs on American products. The EU also accepted a 15% duty on most exports to the US and 50% on steel and aluminium. The US has since expanded the list of goods included in the higher 50% rate to include hundreds of additional products that contain the metals.

The EU has already approved retaliatory tariffs on €93 billion of US products but suspended their implementation. If Trump moves forward with his threat and imposes duties on the countries at the beginning of February, the EU can allow the countermeasures to be reintroduced, said the people, who spoke on the condition of anonymity. - Bloomberg

MEATCO Namibia

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20 January 2026

NOTICE: Meatco Annual General Meeting

Meatco Annual General Meeting scheduled for 20 February 2026

By virtue of Section 14 (8) of the Meat Corporation of Namibia Act, Act 1 of 2001, notice is hereby given to all registered Members of the Meat Corporation of Namibia, that Meatco's 37th Annual General Meeting (AGM) that was deferred from 2025 will be held on **Friday, 20 February 2026, at 09:00 in Windhoek NIPAM (Executive Conference Hall).**

Date: Friday, 20 February 2026
Time: 09:00
Venue: NIPAM (Executive Conference Hall)

Submission of Motions:
Deadline: (09h00, 6th February 2026)
A member can submit a motion to be included on the Agenda on/or before the above-mentioned date and time, either hand-delivered or via the e-mail below:

Attention: The Deputy Chairperson - Board of Directors
E-mail: chairperson@meatco.com.na
Hand-delivery: Meatco Head Office, 1 Simataa Khama, Northern Industrial Area, Windhoek

Consistent with Sections 13 and 14 of the Meatco Act, Act 1 of 2001, only registered Meatco Members may attend and vote at the AGM.

By virtue of a resolution passed at the 35th AGM, to qualify for registration as a member of the Corporation as per Section 17(1) of the Meatco Act 2001, a Producer must at least sell one unit of livestock to the Corporation during the period immediately preceding three (3) years for Members South of the Veterinary Cordon Fence (SVCF) and five (5) years for Members North of the Veterinary Cordon Fence (NVCF/NCA) from the date of which his/her membership is determined.

Accordingly, SVCF Producers who were Meatco Members as of 20 February 2023, and NCA producers who were Meatco Members as of 20 February 2021, are eligible to register between 07:30 and 08:30 before the AGM starts.

Directors: Ms. S.M. De Klerk (Deputy Chairperson), Mr. J. Andreas, Mr. M. J. P. Hilbert, Mr. C. Khaiseb, Mr. A Muremi, Ms. P.J. Olivier, Mr. A. Tjipangandjara, Mr. P.K. Tjipueja, Dr. D van Schalkwyk

Interim Chief Executive Officer: Ambassador A. Aochamub, Company Secretary: Ms. N Mhanda

APPENDIX F – SITE NOTICES

-19°51'37.9"S 17°48'60.0"E

-19°54'55.3"S 17°49'57.5"E

APPENDIX G – STAKEHOLDER LETTERS

Environmental Compliance Consultancy (Pty) Ltd
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ECC-118-579-LET-09-A

30 January 2026

Identified stakeholder and potential interested or affected party for the following Project:

RE – NOTICE OF A SCOPING PLUS IMPACT ASSESSMENT FOR THE PROPOSED IRRIGATION AND AGRICULTURE OPERATIONS ON FARM GAI KAISA NO.159, OTJOZONDJUPA REGION, AS PART OF AN ENVIRONMENTAL CLEARANCE CERTIFICATE APPLICATION

Dear Sir or Madam,

Environmental Compliance Consultancy (Pty) Ltd (ECC) (herein referred to as the environmental assessment practitioner (EAP)), has been engaged by Retort Charcoal Producers (Pty) Ltd, (herein referred to as the Proponent) to conduct a scoping plus impact assessment and compile an environmental and social management plan (ESMP) for the proposed Irrigation and Agriculture Operations on Farm Gai Kaisa No. 159, Otjozondjupa Region, Namibia.

In line with the requirements of the Environmental Management Act, No. 7 of 2007 and its 2012 associated Regulations, an environmental clearance certificate application is being compiled and will be submitted to the Department of Water Affairs (DWA) of the Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR) (competent authority). The application will then be forwarded to the environmental commissioner (EC) at the Ministry of Environment, Forestry and Tourism (MEFT) for review and to make a record of decision (RoD) regarding the proposed Project.

The Proponent proposes the operation of an irrigation project to support crop production. Irrigation is planned to be implemented in two (2) phases, each comprising ~135 ha of cultivated area consisting of maize and fodder. Phase 1 will require an estimated ~1 million m³ of water per annum. Phase 2 expands the total cultivated area to approximately 260 ha, resulting in a total groundwater requirement of ~2 million m³ per annum. Furthermore, 4 ha of high value fruit trials will be conducted.

The Project site is located approximately 30 km southeast (SE) of the Kombat settlement and approximately 42 km southwest (SW) of Grootfontein town and can be accessed via the D2804 district road that branches out from the B8 main road in the Otjozondjupa Region (Figure 1).

The scoping plus impact assessment and environmental and social management plan (ESMP) provides further details of the Project, which can be downloaded from the link provided below: https://eccenvironmental.com/download/irrigation-system-on-farm-gai-kaisa-no-159-otjozondjupa-region-namibia/

This letter serves to engage potential I&APs for the Project and to establish a communication channel with ECC for the scoping plus impact assessment process. You have been identified as a stakeholder and potential I&AP and ECC would therefore like to inform you of the opportunities available for your participation in the process.

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If you are unable to complete the registration form online, please contact us via email for assistance at info@eccenvironmental.com, or alternatively call our office at +264 81 669 7608.

Should you require our assistance with the details contained within this letter, please do not hesitate to contact us and we will gladly assist.

Yours sincerely,

Stephan Bezuidenhout
stephan@eccenvironmental.com

Jessica Bezuidenhout Mooney
jessica@eccenvironmental.com

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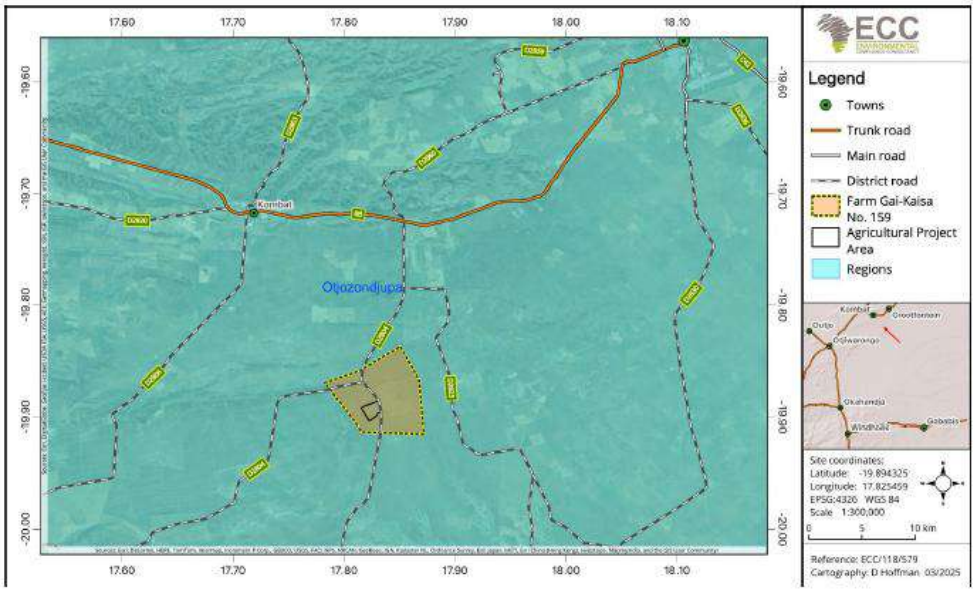

Figure 1 – Location map of the Agriculture Project on Farm Gai Kaisa No.159, Otjozondjupa Region

APPENDIX H – ARCHAEOLOGICAL ASSESSMENT

ECC- **2402040**

Serial: **24vwGDE2040**

REPUBLIC OF NAMIBIA

MINISTRY OF ENVIRONMENT, FORESTRY AND TOURISM

OFFICE OF THE ENVIRONMENTAL COMMISSIONER

ENVIRONMENTAL CLEARANCE CERTIFICATE

ISSUED

In accordance with Section 37(2) of the Environmental Management Act (Act No. 7 of 2007)

TO

Retort Charcoal Producers (Pty) Ltd

P. O. Box 30098, Windhoek

TO UNDERTAKE THE FOLLOWING LISTED ACTIVITY

Bush thinning operations on Farm Gai Kaisa No. 159 in the Otjozondjupa Region, Namibia.

MINISTRY OF ENVIRONMENT, FORESTRY AND TOURISM
Private Bag 13306
WINDHOEK NAMIBIA
13 DEC 2024
ENVIRONMENTAL COMMISSIONER
REPUBLIC OF NAMIBIA

ENVIRONMENTAL COMMISSIONER

Issued on the date: **2024-12-05**

Expires on this date: **2027-12-05**

(See conditions printed overleaf)

This certificate is printed without erasures or alterations

CONDITIONS OF APPROVAL (READ JOINTLY WITH NOTIFICATION OF DECISION)

1. This environmental clearance is valid for a period of 3 (three) years, from the date of issue unless withdrawn by this office
2. This certificate does not in any way hold the Ministry of Environment, Forestry and Tourism Accountable For Misleading Information, nor any adverse effects that may arise from these activities. Instead, full accountability rests with the proponent and its consultants
3. This Ministry reserves the right to attach further legislative and regulatory conditions during the operational phase of the project
4. All applicable and required permits are obtained and mitigation measures stipulated in the EMP are applied particularly respect to management of ecological impacts.
5. Strict compliance with conditions attached to the consent received from National Heritage Council is expected throughout the life span of the proposed activity, therefore any new archaeological finds must be reported to the National Heritage Council for appropriate handling of such.

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Attention Mr Stefan Falk
Chief Executive Officer
Retort Charcoal Producers

ECC-118-588-LET-01-A
17 December 2024

RECEIVED BY OFFICIAL STAMP

Signature: _____

Date: / /

Dear Mr Falk,

Test pumping analysis of five (5) boreholes on Farm Gai Kaisa, no. 159, Otjozondjupa Region

Environmental Compliance Consultancy (Pty) Ltd (ECC) was appointed to undertake test pumping analysis of five boreholes drilled on Farm Gai Kaisa no. 159 near Grootfontein, Otjozondjupa Region (Figure 1). The boreholes all target sediments of the Damara Super Group, Swakop Group (Karibib marble formation and undifferentiated sediments of the Swakop Group).

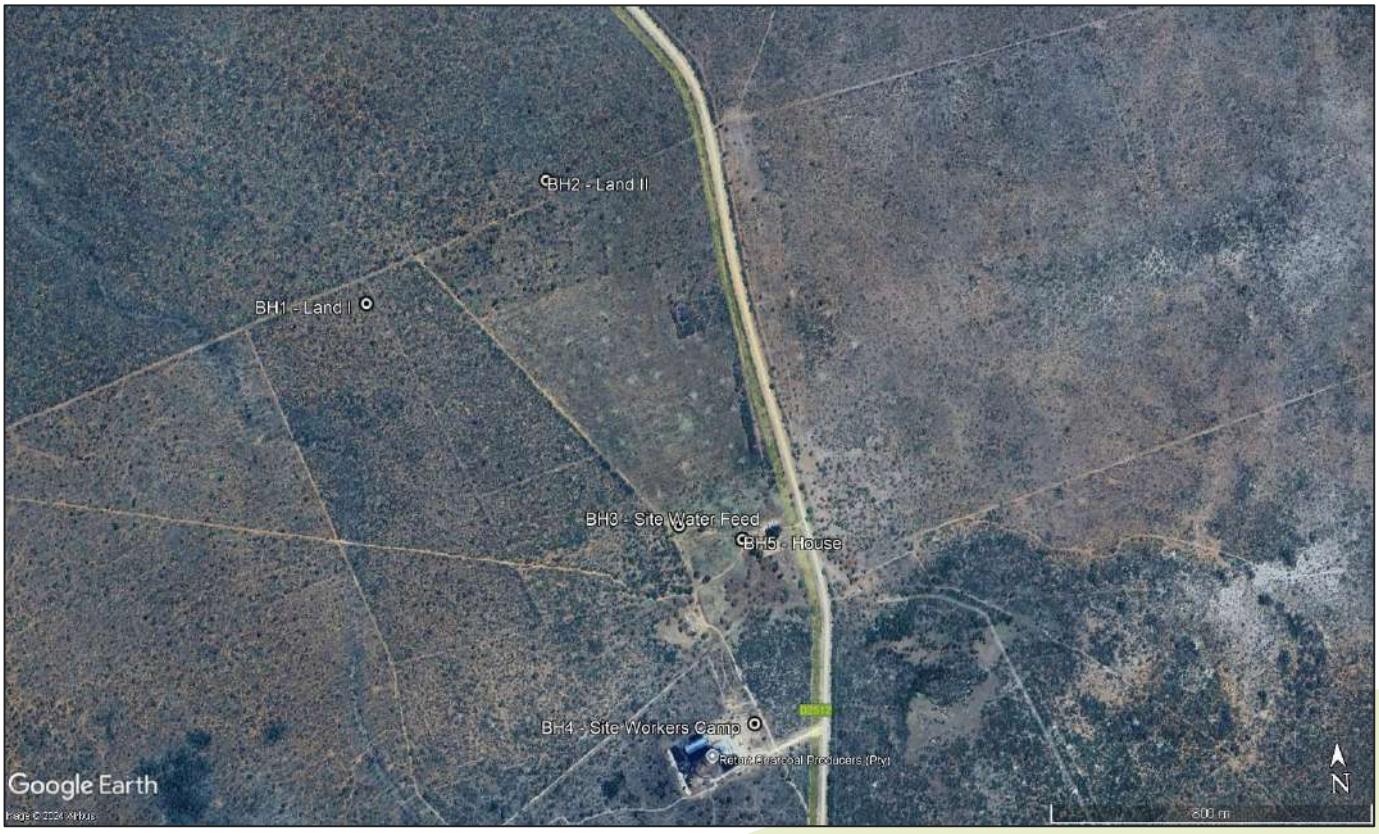

Figure 1 – Map of borehole locations on Farm Gai Kaisa no. 159

Table 1 provides an overview of the various tests undertaken at the five (5) boreholes. As analytical solutions for karstic aquifers are not readily available, a combination of unconfined Theis (1935) and Neumann (1974) solutions were applied to determine the aquifer parameters for the karstic aquifer. The aquifer thickness was

conservatively assumed to be 120 m for all boreholes. Analysis for aquifer parameters and forward solution modelling of long term drawdown values was undertaken in Aqtesolv software developed by HydroSolve Inc., while FC programme was used to evaluate derivative curves and subjective information regarding boundaries and flow regimes. Parameter estimation was undertaken for periods of radial flow where possible. All analyses were carried out with conservative available drawdown values to protect main water strikes intersected during drilling (similarly for recommended pump installation depths). All drilling information is contained in the associated drillers reports prepared by Africa Drilling cc. No storage estimates are available due to a lack of observation borehole data during individual pumping tests (minimum of three required). Water quality samples were collected for analysis, with hand held meters indicating neutral pH values, low Electrical Conductivity and low metals; the water quality is anticipated to be classified as good and acceptable for potable use once tested.

Forward solution modelling of drawdown was undertaken based on 2 years of continuous pumping with an assumed zero (0) recharge to the aquifer. All boreholes are recommended to pump at least 6 days a week, allowing up to 24 hours for recovery and evaluation of dynamic water levels and borehole performances. All results indicate constant head or recharge boundaries to be present, decreasing drawdown and resulting in rapid recovery and deviation from solution type curves, particularly at late time.

Table 1 – Borehole and test pumping details

BH ID	BH Name	Lat	Long	BH Depth (m)	Rest water level (mbgl)	Test Yield (m^3/hr)					CDT Duration (min)	Final Drawdown (m)
						Step1	Step2	Step3	Step4	CDT		
BH1	Land I	-19.89001	17.82349	105	11.86	30	50	80	100	100	1440	5.99
BH2	Land II	-19.8875	17.82782	129	10.73	20	30	50	70	40	1440	15.02
BH3	Site Water Feed	-19.8952	17.83057	45	8.8	30	50	70	100	100	1440	3.98
BH4	Site Workers Camp	-19.8997	17.82729	51	7.4	30	60	80	112	110	1440	1.4
BH5	House	-19.8956	17.83204	105	7.98	30	60	90	113	105	1440	2.5

Borehole 1 – Land I

BH1 – Land I underwent a stepped discharge test on 23/09/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 240 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 1 provides a summary of the borehole construction and testing details. Figure 2 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test. Step 4 (100 m^3/hr) was cut short for unknown reasons.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 24/09/2024 at a rate of 100 m^3/h. Figure 3 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding, with limited drawdown and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 4), a Transmissivity value of 379 m^2/d was determined. The recommended yield of 65 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 2. Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation.

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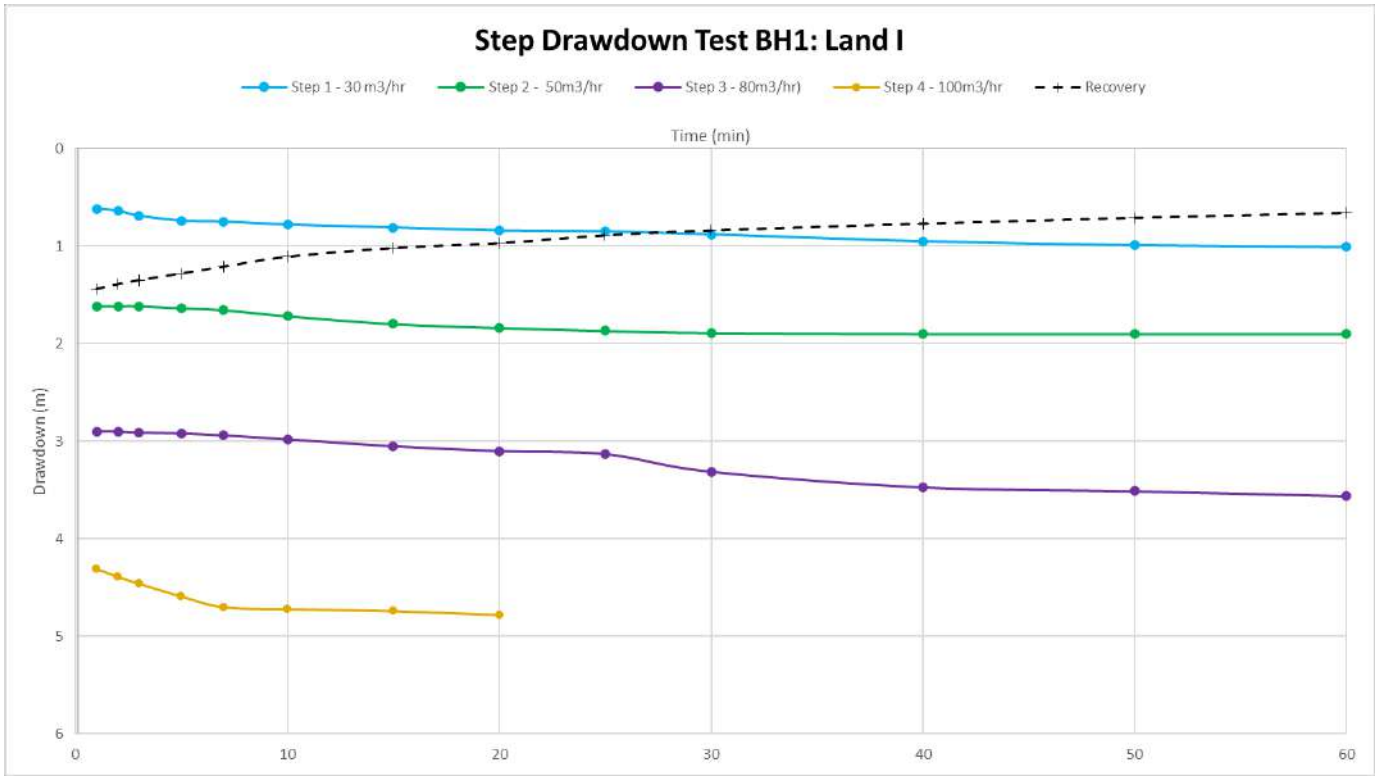

Figure 2 – Step test at BH1 – Land I

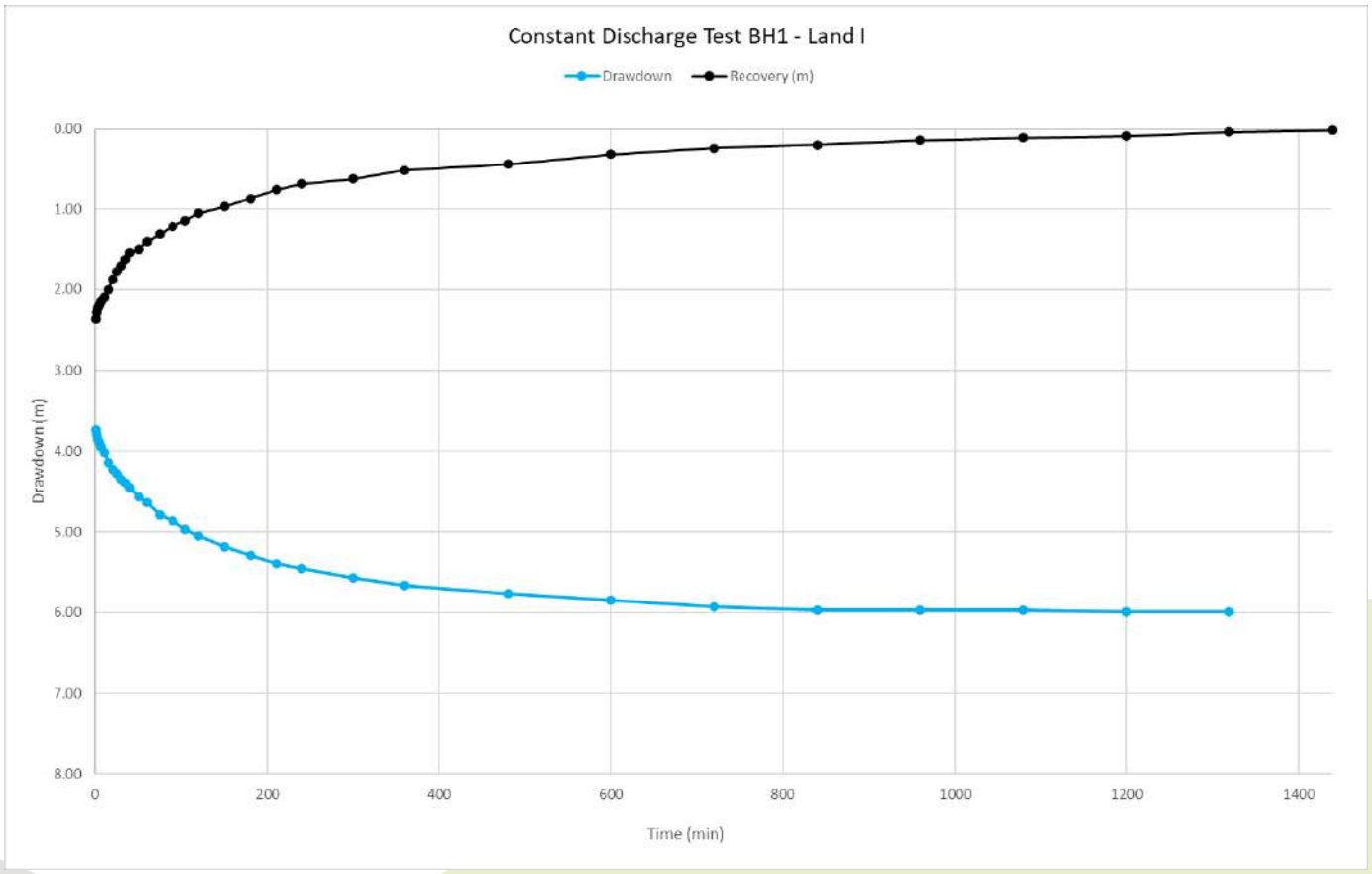

Figure 3 – CDT at BH1 – Land I at a rate of 100 m^3/h for 24 hours

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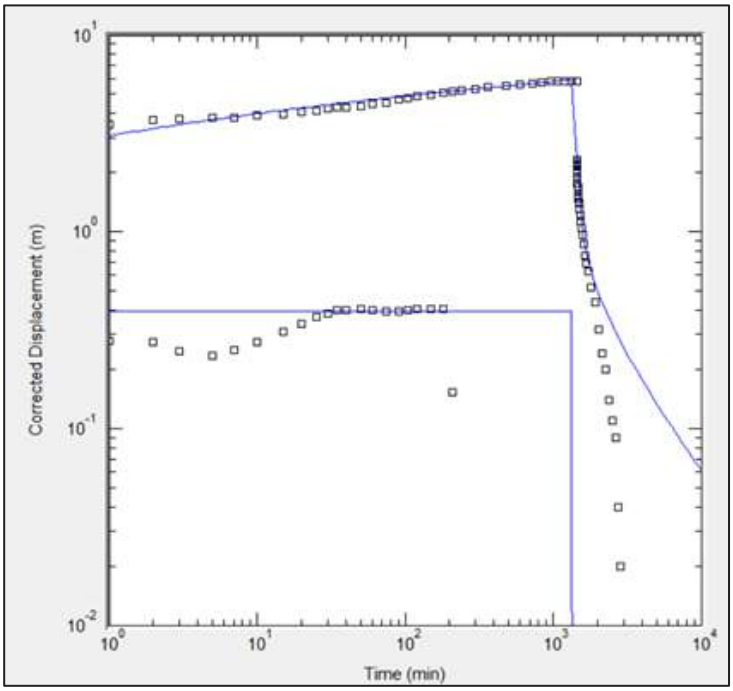

Figure 4 – Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

Borehole 2 – Land II

BH2 – Land II underwent a stepped discharge test on 17/10/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 480 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 1 provides a summary of the borehole construction and testing details. Figure 5 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test. Step 4 (70 m^3/hr) could not be maintained for a full hour before the available drawdown was exhausted.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 18/10/2024 at a rate of 40 m^3/h. Figure 6 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is moderately high yielding, and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 7), a Transmissivity value of 93 m^2/d was determined. The recommended yield of 25 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 2.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation.

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Figure 5 - Step test at BH2 – Land II

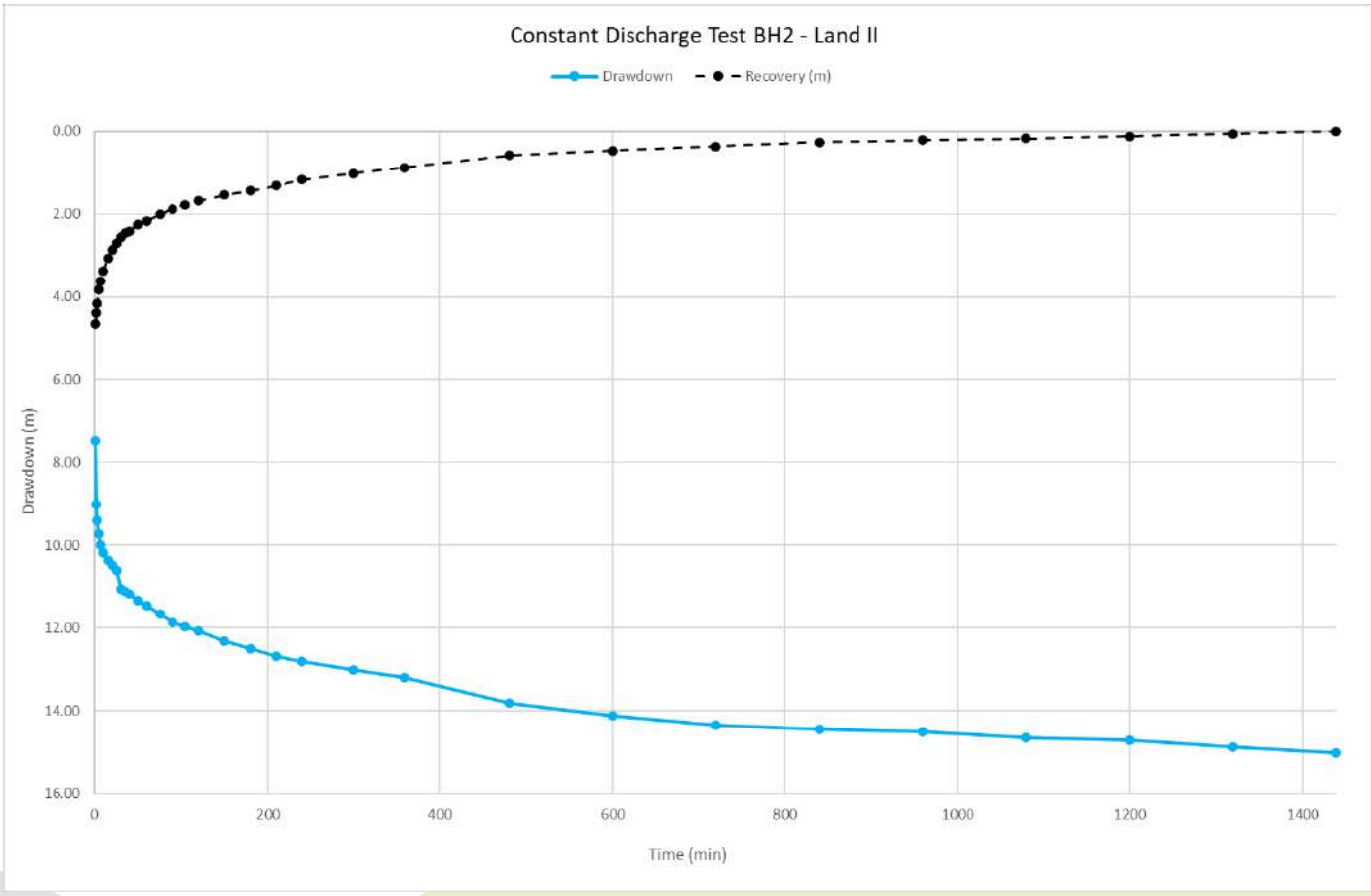

Figure 6 – CDT at BH2 – Land II at a rate of 40 m^3/h for 24 hours

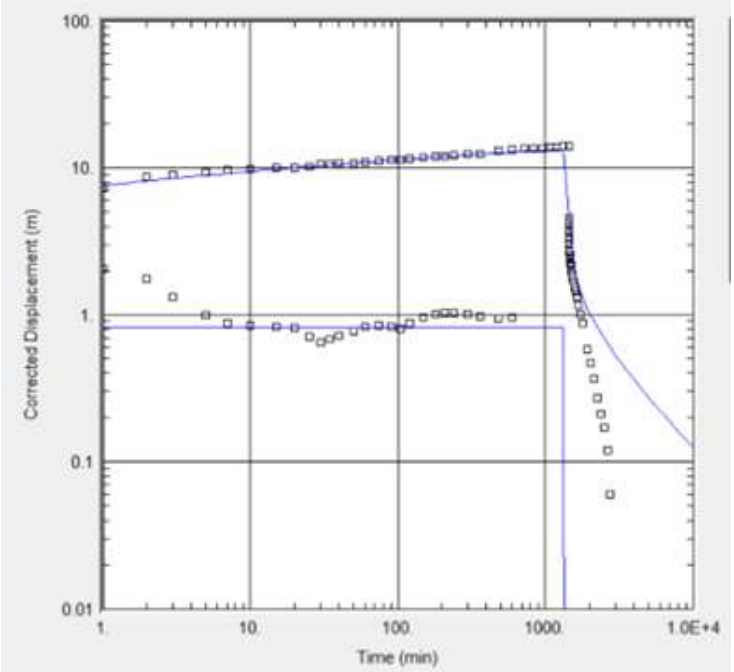

Figure 7 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

Borehole 3 – Site Water Feed

BH3 – Site Water Feed underwent a stepped discharge test on 12/11/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 120 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 1 provides a summary of the borehole construction and testing details. Figure 8 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 13/11/2024 at a rate of 100 m^3/h. Figure 9 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding, and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 11), a Transmissivity value of 3250 m^2/d was determined. The recommended yield of 80 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 2.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation. This borehole is ~160 m west of BH 5 – House and should be monitored to ensure no hydraulic connection (borehole interference) exists between the two boreholes if pumped simultaneously.

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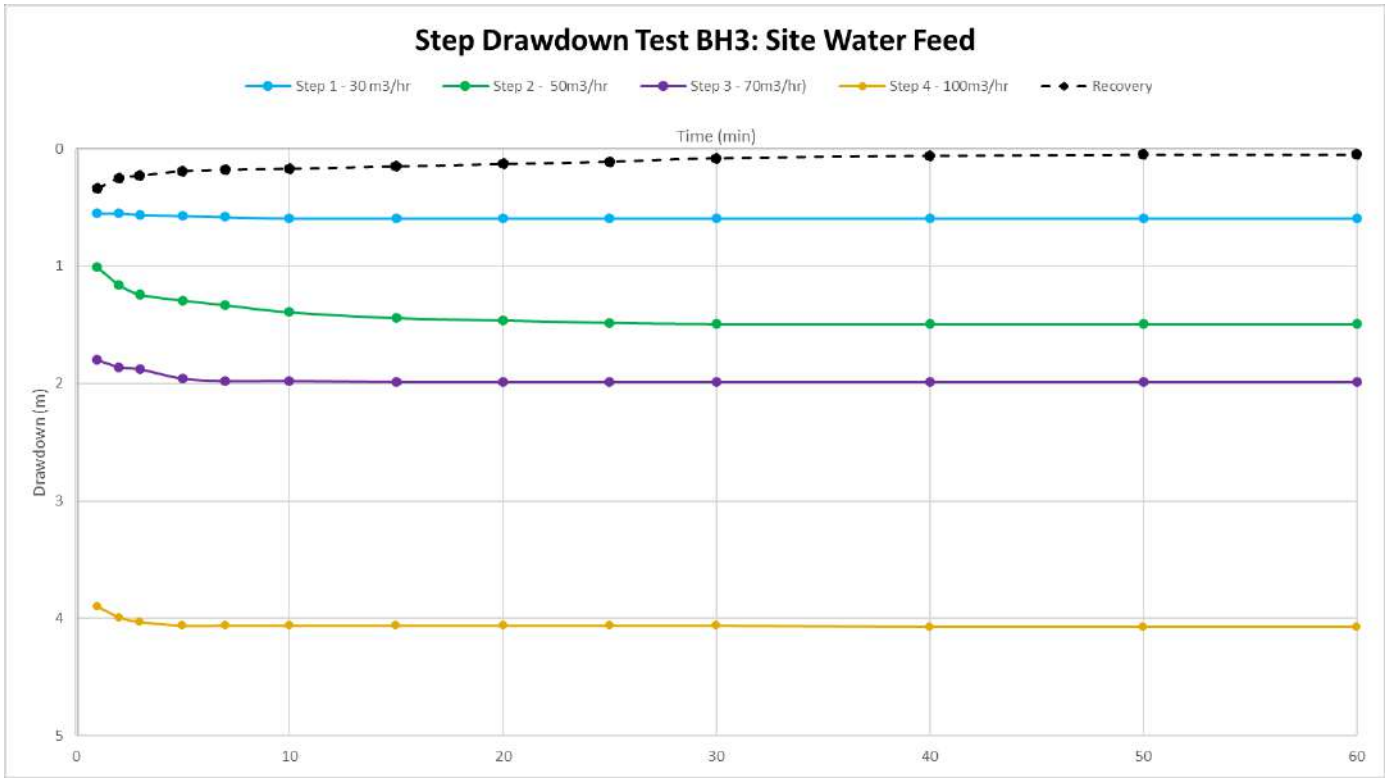

Figure 8 - Step test at BH3 – Site Water Feed

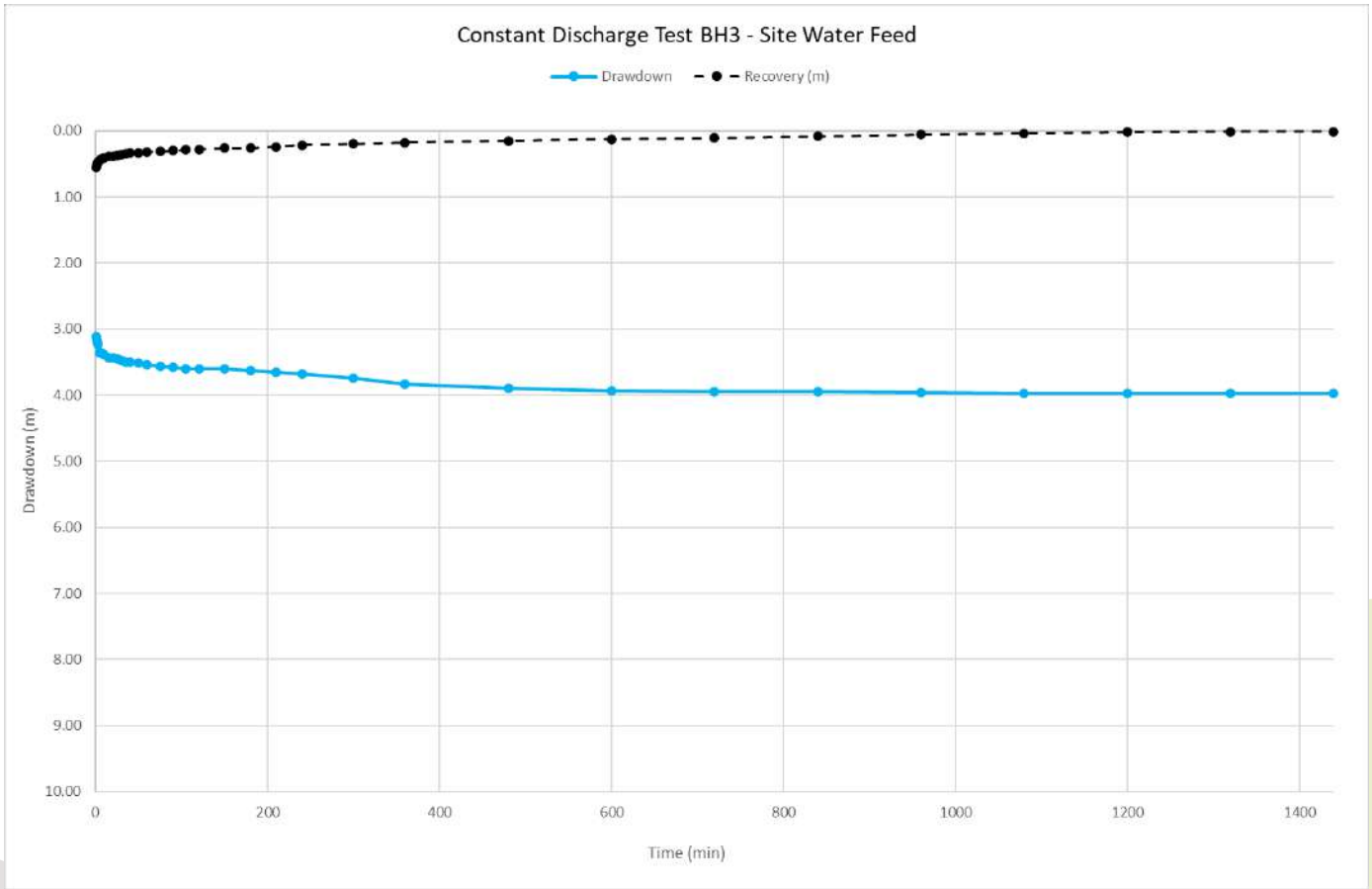

Figure 9 – CDT at BH3 – Site Water Feed at a rate of 100 m^3/h for 24 hours

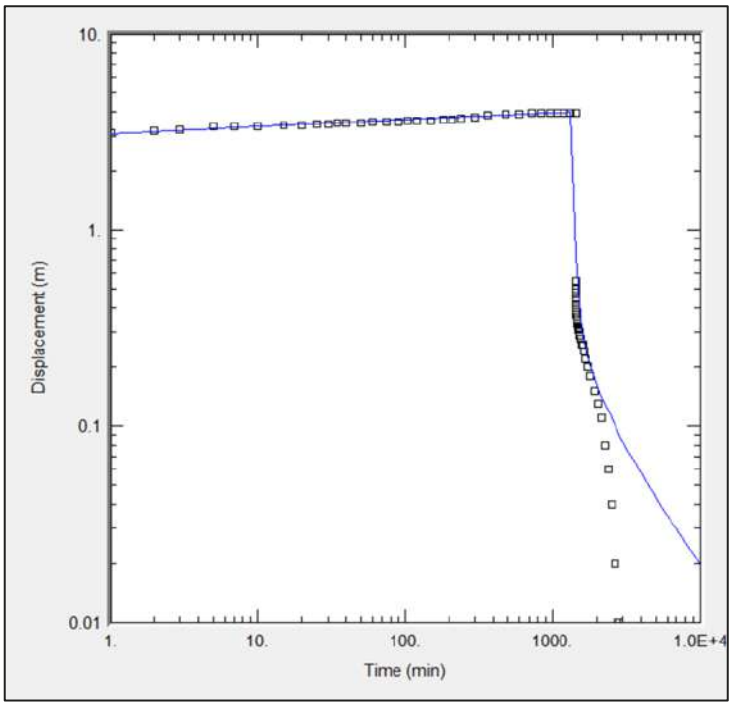

Figure 10 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

Borehole 4 – Site Workers Camp

BH4 – Site Workers Camp underwent a stepped discharge test on 15/11/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 300 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 1 provides a summary of the borehole construction and testing details. Figure 11 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 16/11/2024 at a rate of 110 m^3/h. Figure 12 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding, and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 13), a Transmissivity value of 2700 m^2/d was determined. The recommended yield of 90 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 2.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation.

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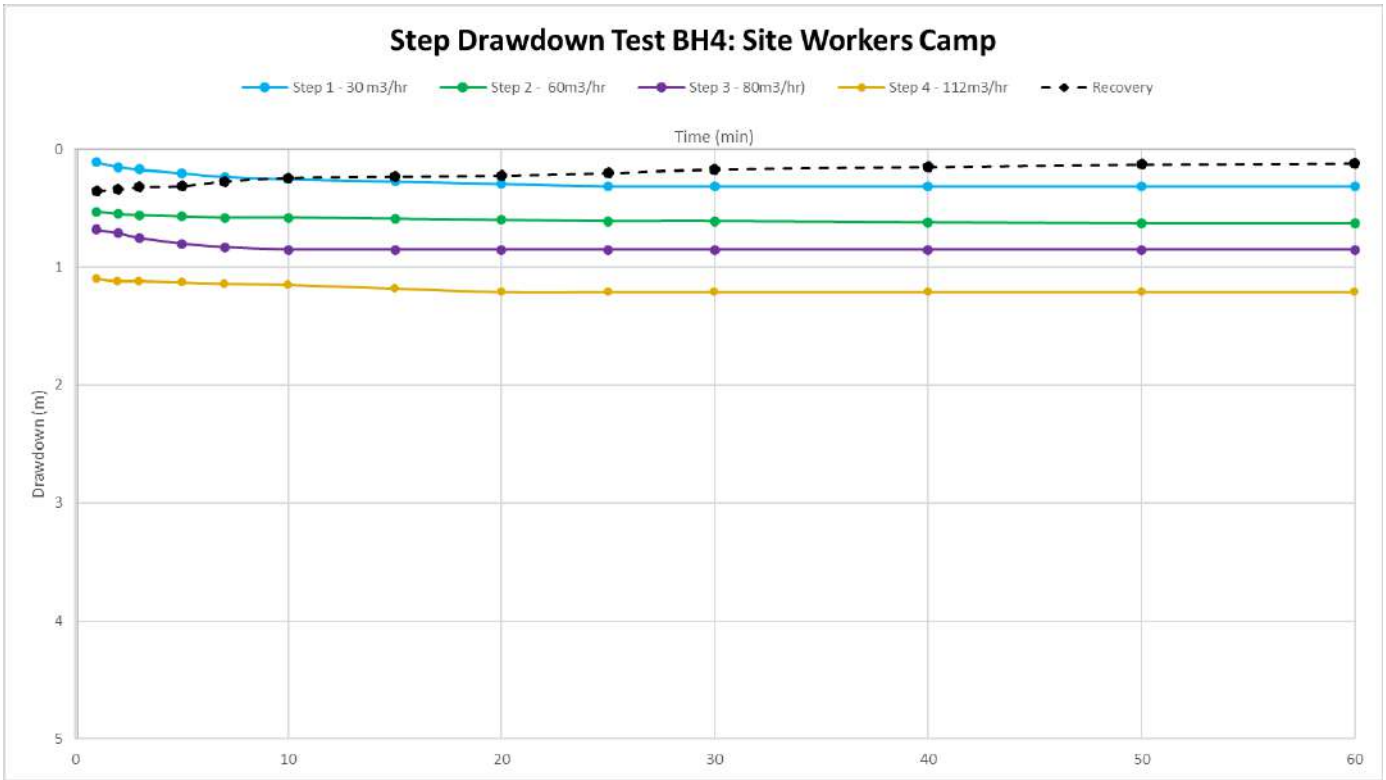

Figure 11 - Step test at BH4 – Site Workers Camp

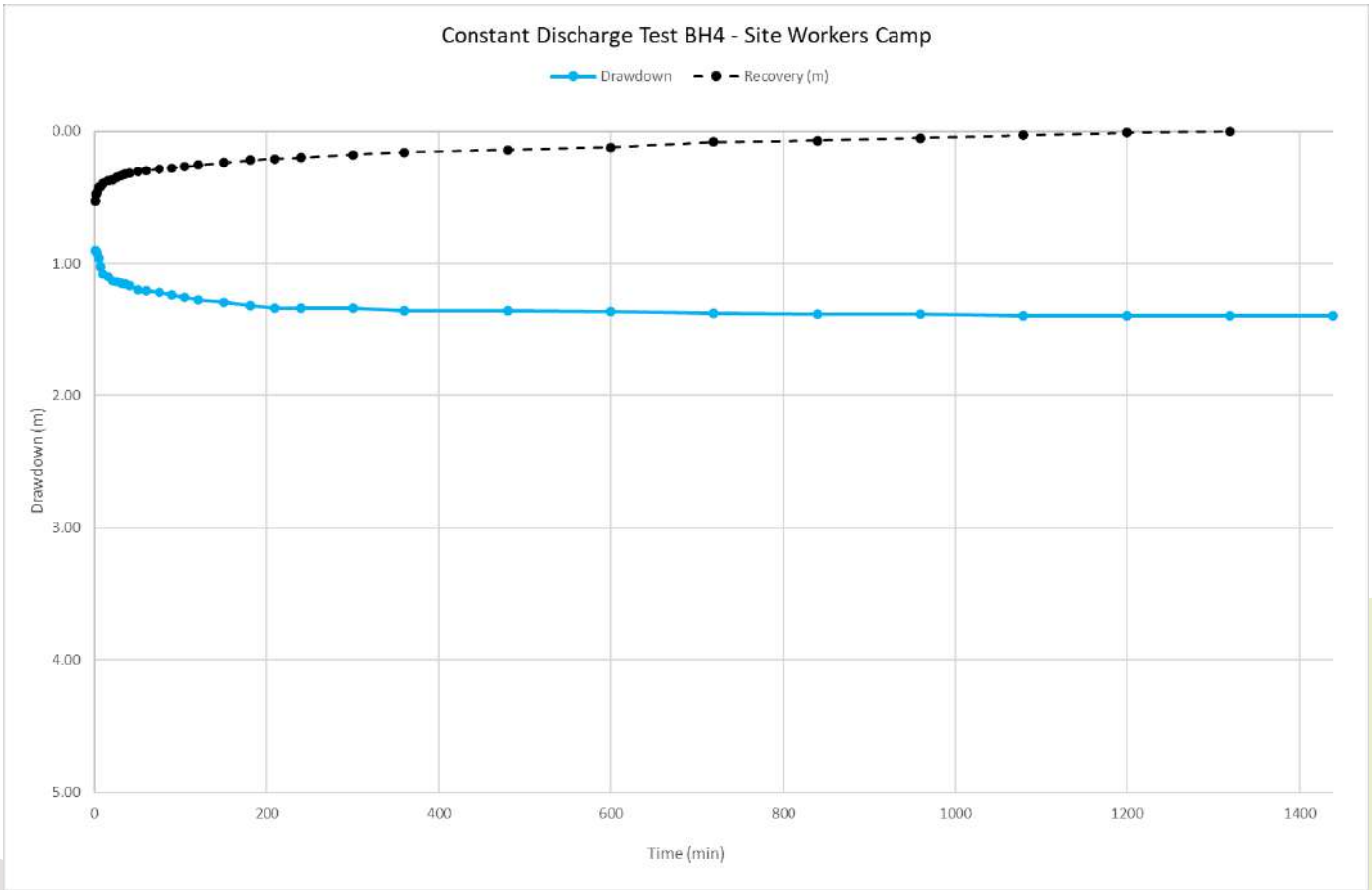

Figure 12 - CDT at BH4 – Site Workers Camp at a rate of 110 m^3/h for 24 hours

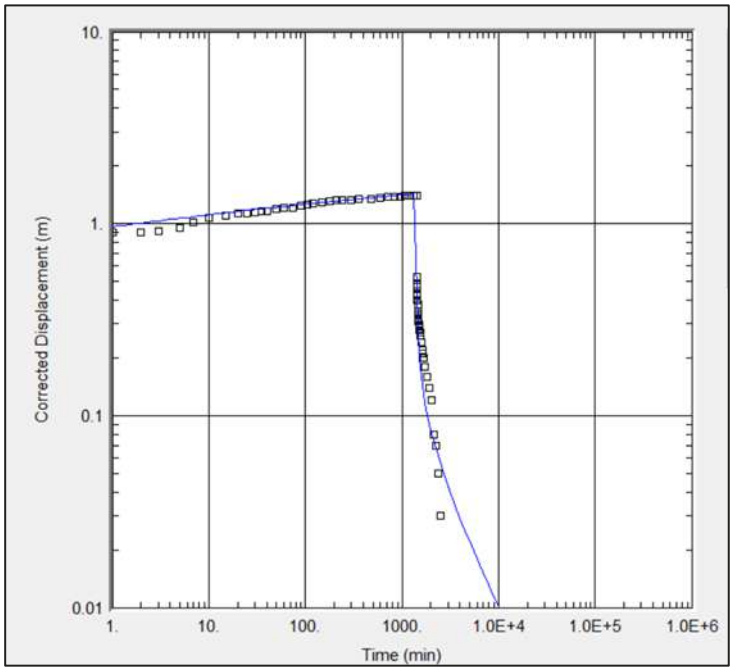

Figure 13 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

Borehole 5 – House

BH5 – House underwent a stepped discharge test on 18/11/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 180 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 1 provides a summary of the borehole construction and testing details. Figure *14* provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 19/11/2024 at a rate of 105 m^3/h. Figure 15 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding, and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 16), a Transmissivity value of 1440 m2/d was determined. The recommended yield of 90 m3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 2.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation. BH 5 is nearest BH3 (~160m) and while it is unknown if the same karstic feature is targeted, it is recommended that groundwater level monitoring be undertaken during separate and combine pumping to evaluate borehole interference and compounding of drawdown effects. All recommendations do however account for the possibility of interference / hydraulic connection between boreholes and recommended yields are anticipated to provide protection to main water strikes and pump infrastructure.

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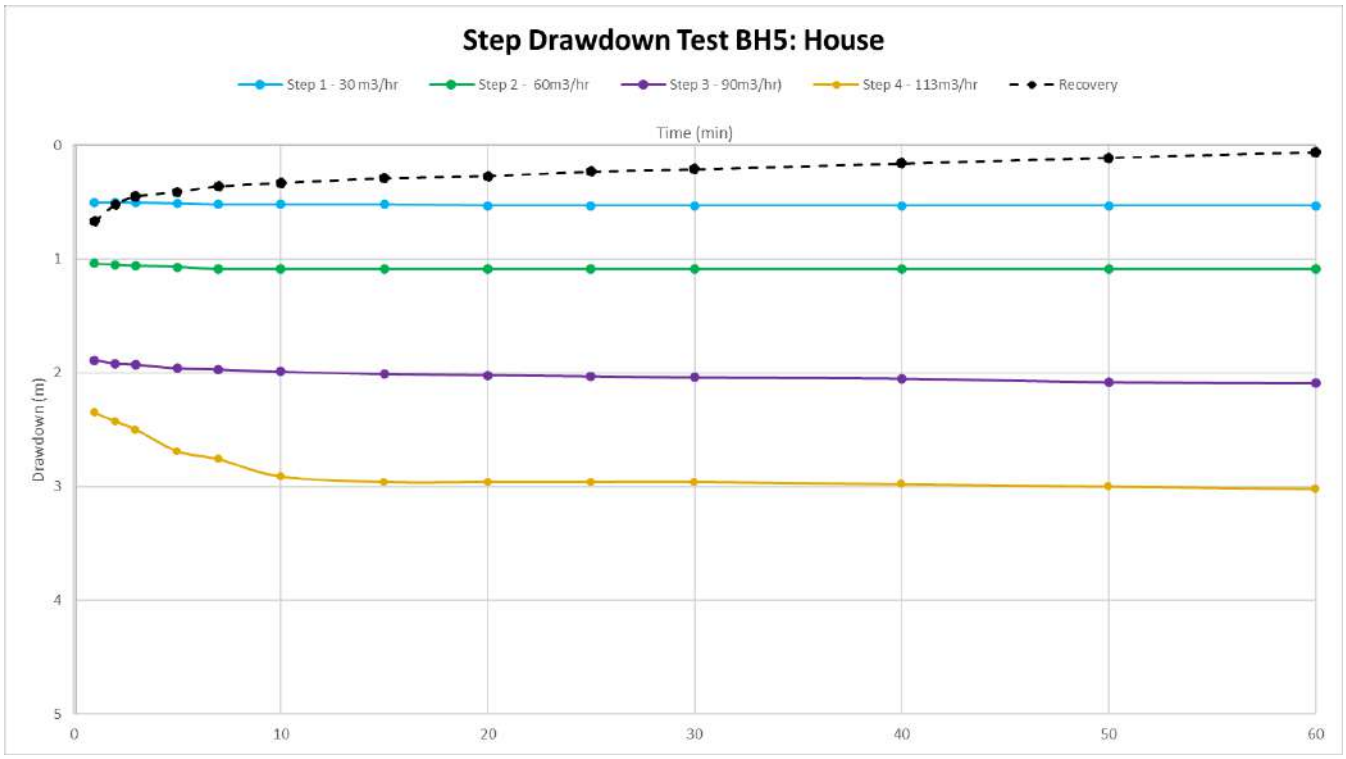

Figure 14 - Step test at BH5 – House

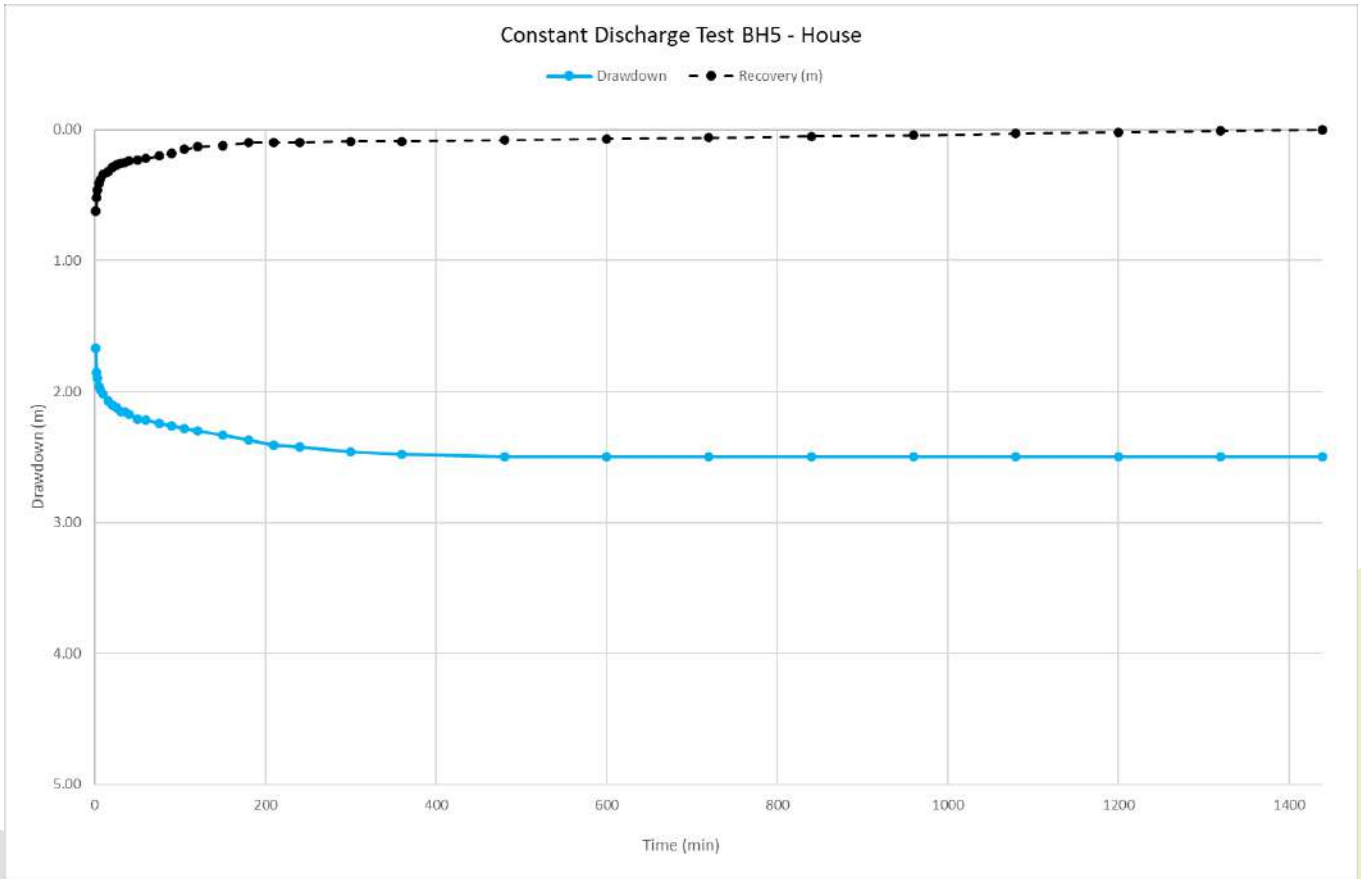

Figure 15 – CDT at BH5 – House at a rate of 105 m^3/h for 24 hours

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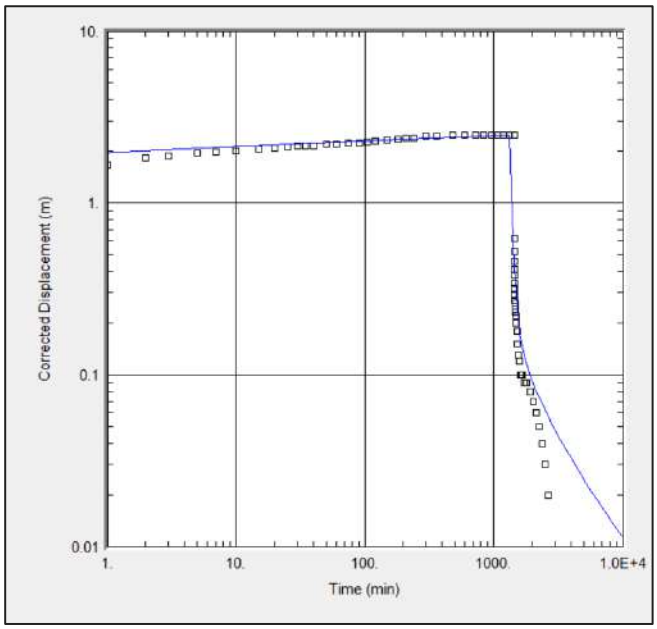

Figure 16 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

All boreholes drilled targeted the karstic aquifer and are resultantly high yielding. It is recommended that bi-annual sampling of groundwater be included in the water level and volumetric monitoring prescribed per borehole. The analysis undertaken and results obtained (Table 2) may be used in support of an abstraction licence application to the Department of Water Affairs, for a volume of ~2.625 million cubic metres per annum.

Table 2 – Summary table of results and recommendations

BH ID	T (m^2/d) (Theis)	K (m/d)	Recommended Pump Installation Depth (mbgl)	Available Drawdown based on pump	Recommended Yield (m^3/hr)	Pumping regime (hrs/month)	Yield per month (m^3)	Yield per annum (m^3/a)	Aquifer Type	Modelled Drawdown after 2 years, zero recharge
BH1 - Land I	379	3.00	30	18	65	625	40625	487500	Karstic	9
BH2 - Land II	93	0.8	30	20	25	625	15625	187500	Karstic	10
BH3 - Site Water Feed	1450	12	30	21	80	625	50000	600000	Karstic	4
BH4 - Site worker Camp	3250	27	30	22	90	625	56250	675000	Karstic	2
BH5	2700	22	30	22	90	625	56250	675000	Karstic	2.5
Total					**350**	**625**	**218750**	**2625000**		

Yours sincerely,

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Principal Hydrogeologist

RETORT CHARCOAL PRODUCERS

Submitted to: Ministry of Agriculture, Water and Land Reform
Attention: The Executive Director: Mr Nghitila
Private Bag 13193
Windhoek, Namibia.

REPORT:

GROUNDWATER ASSESSMENT AND DEVELOPMENT – FARM GAI KAISA NO. 159

PROJECT NUMBER: ECC-118-611-REP-02-A

REPORT VERSION: REV 01

DATE: 22 OCTOBER 2025

ECC ENVIRONMENTAL COMPLIANCE CONSULTANCY

TITLE AND APPROVAL PAGE

Project Name:	Groundwater assessment and development – Farm Gai Kaisa no. 159
Submitted to:	Ministry of Agriculture, Water and Land Reform
Attention:	The Executive Director: Mr Nghitila
Applicant:	Retort Charcoal Producers (Pty) Ltd
Authors:	Luke Towers
Status of Report:	Final
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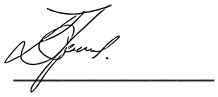
Quality Assurance

Authors:



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ABBREVIATIONS

ABBREVIATION	DESCRIPTION
%	percentage
~	approximately
°	degree
DWA	Department of Water Affairs
ECC	Environmental Compliance Consultancy Pty Ltd
MAWLR	Ministry of Agriculture, Water and Land Reform
mamsl	metres above mean sea level
m	metre
mbgl	metres below ground level
mg/l	milligrams per litre
m^3/d	cubic metres per day
ML	mining licence
mm	millimetre
No.	number
WRMA	Water Resources Management Act, no 11 of 2013

1 INTRODUCTION

1.1 BACKGROUND

Environmental Compliance Consultancy (Pty) Ltd (ECC) was appointed by Retort Charcoal Producers (Pty) Ltd (RCP) to prepare a groundwater assessment for Farm Gai Kaisa no. 159 (the farm).

RCP is a 100%, broad-based, Namibian owned and operated industrial charcoal and biochar manufacturing company producing significant quantities of high-quality charcoal using an industrial, mechanised, process. In addition to the production of charcoal, the industrial process produces large quantities of biochar. The biochar is applied to local (and in future, global) soils, which in turn improves water and water soluble nutrient retention. Over time, RCP will be conducting tests to see if the biochar can be used to improve crop yields in the northern communal areas and are engaging tertiary research institutions to conduct scientific feasibility studies.

To date, the charcoal project has made investments in the region of NAD100 million, creating and sustaining over 250 local jobs. Further, the project has seen over NAD 20 million reinvested into the local farming community over the last 3 years.

RCP are expanding investments into crop production, thus making use of the biochar enriched soils on the farm. In assessing the agronomic feasibility of the farm, over NAD 1.5 million has been invested to ensure the required environmental legislative requirements are met, to secure sustainable water supply, to assess soil conditions, and evaluate risks related to the effects of climate change.

RCP plan to cultivate and irrigate a minimum of 270 hectare (ha) on Farm Gai Kaisa with a combination of staples (grains) to feed Namibia and assist with food security and high-value export crops (at trial scale initially) to develop a new export crop zone for the country.

The irrigation activity is included as an amendment to the environmental clearance certificate issued to RCP for the mechanised bush thinning operations on the farm (ECC-2402040).

The desktop groundwater assessment and results from geophysical surveying (Electromagnetics – EM), borehole drilling, and test pumping aim to support sustainable groundwater abstraction and use. The objective of this report is to provide the regulator sufficient physiographic and hydrogeological information to evaluate a groundwater abstraction licence application.

2 SITE DESCRIPTION

2.1 LOCALITY

The farm (Latitude: -19.885995°, Longitude: 17.837234°) covers an area of ~5000 hectare (ha) and is located 30 km southeast of the Kombat settlement and 42 km southwest of Grootfontein in the Otavi Constituency, Otjozondjupa Region (Figure 1).

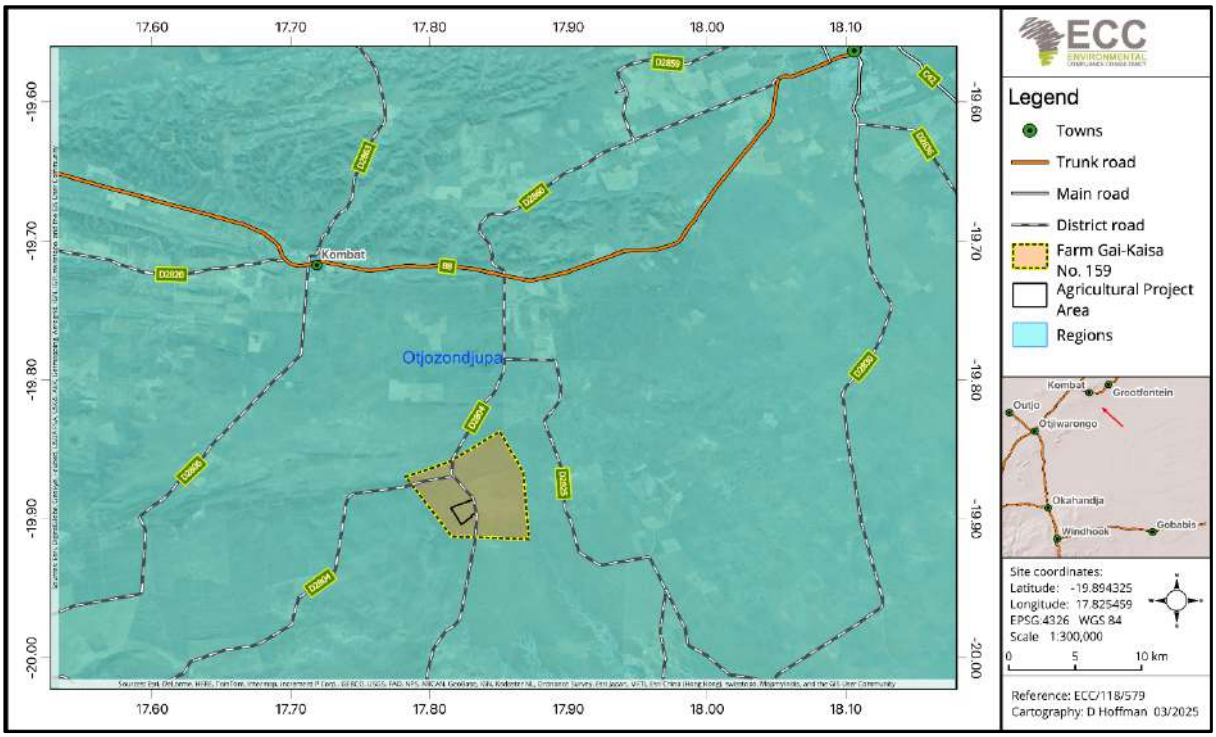

Figure 1 – Locality map of Farm Gai Kaisa no. 159

2.2 CLIMATE

Farm Gai Kaisa occurs in the BWh region of the Köppen-Geiger classification which is hot arid desert climate characterised by low annual precipitation (450-500 mm per annum, Figure 3) and high temperatures throughout the year (23.9°C mean annual temperature). Mean annual evaporation (MAE) is reportedly between 3000 – 3200 mm; exceeding MAP by an order of magnitude and resulting in a hydrological deficit for the region. Climatic data from the nearby area of Kombat is shown as representative of the farm in Figure 2.

Rainfall is predominantly in the summer months of November to March and is experienced as brief but intense downpours, often resulting in localised flooding. The rest of the year is relatively dry, with minimal rainfall and low humidity levels. Rainfall distribution and evapotranspiration are important factors to consider in developing the crop water requirements.

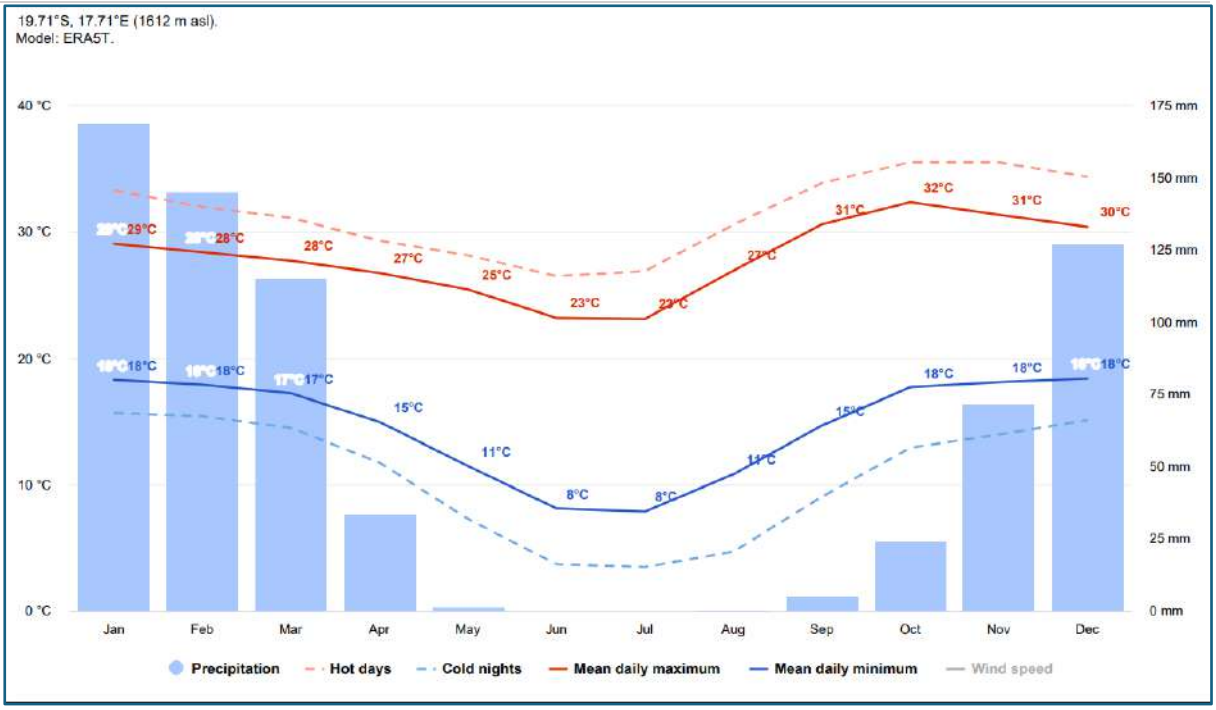

Figure 2 – Precipitation and mean daily maximum and minimum temperatures for the area of Farm Gai Kaisa

Figure 3 – Mean Annual Precipitation map for Farm Gai Kaisa (blue band = 450 – 500 mm/a)

2.3 TOPOGRAPHY, SOIL AND DRAINAGE

The general topography of the area (Figure 4) shows a gradual decrease in elevation from north to south, ranging from approximately 1430 meters above mean sea level (mamsl) to1381 mamsl. Similarly, the elevation decreases from west to east, ranging from ~1414 mamsl to 1398 mamsl resulting in a regional south easterly gradient. The north western corner of the farm boundary abuts an area of high relief formed by folded outcrop of resistant marble and calc-silicate rocks. The terrain is influenced by the underlying geology, with variations in elevation shaped by geological structures and natural erosion processes. Further north, the Otavi Mountains dominate the landscape, serving as a notable topographical feature in the region.

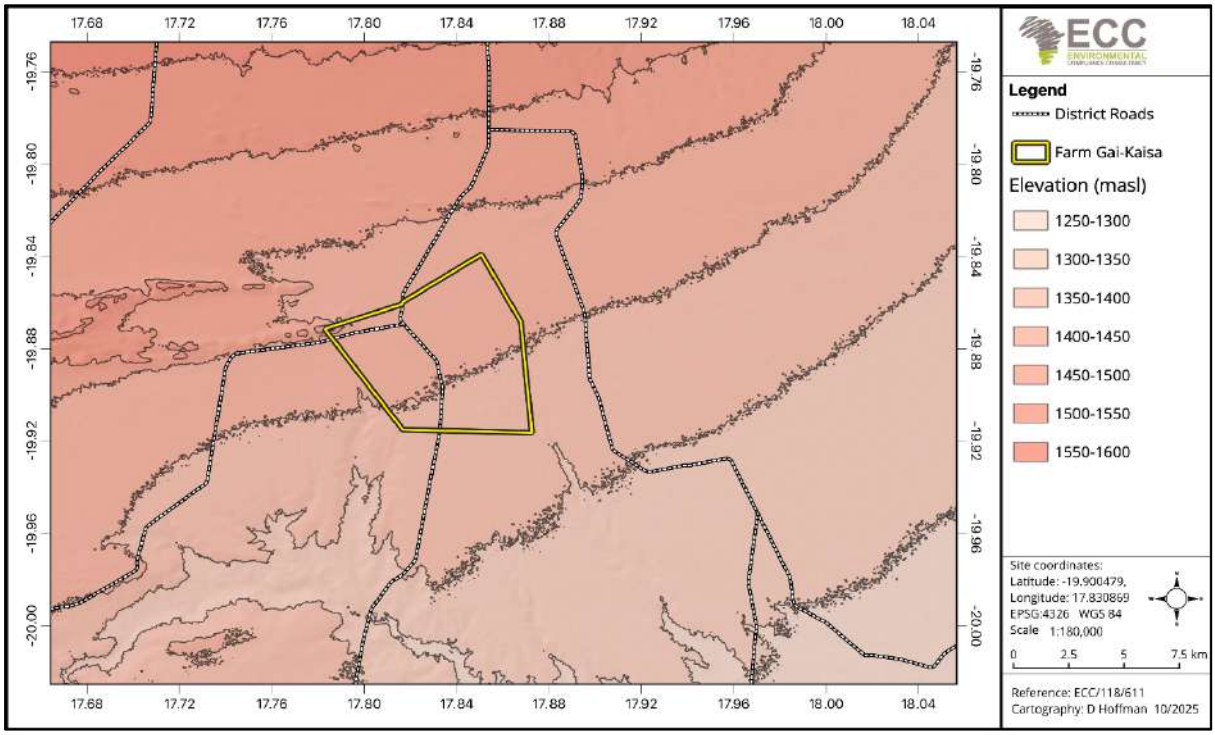

Figure 4 – Terrain map of the study area showing decrease in elevation to the south east

Based on the 1:1 000 000 soil classification of Namibia, Petric Calcisol are the dominant soil type, followed by Leptosol as the secondary type, and Calcic Cambisol as the tertiary type. The dominant Petric Calcisol is characterised by a significant accumulation of secondary calcium carbonate ($CaCO_3$), often forming a hardened layer known as the petrocalcic horizon (calcrete). These soils typically develop in arid and semi-arid regions, where low rainfall limits leaching and allows calcium carbonate to precipitate and accumulate. Petric Calcisols are commonly found in desert landscapes, where they are primarily used for rangelands or agricultural activities, often with irrigation.

A typical Petric Calcisol profile has an A Horizon (topsoil) that is usually weakly developed; can be sandy, loamy, or silt-rich; may have organic matter but the amount is often limited due to

arid/semi-arid climate conditions. The B Horizon (subsoil) may contain more clay and some carbonate accumulation, but the key feature is the transition to the Petrocalcic Horizon – a cemented carbonate layer, often occurring at 10–100 cm depth, sometimes thicker.

The soil below the petrocalcic horizon may be unconsolidated material (parent material) or more calcareous layers. Texturally these soils are usually loamy or sandy loam above the petrocalcic horizon; below, it may be more calcareous and coarse. The soil structure is typically weak to moderate in the topsoil; massive and cemented in the petrocalcic layer with high porosity in the upper layers and very low porosity in the petrocalcic layer where water infiltration is slow. Soil chemistry is usually alkaline due to the high calcium carbonate content, low salinity but also low nitrogen and phosphorous (nutrients) content (moderate in potassium).

Numerous studies have demonstrated that incorporating biochar into soils can significantly enhance water retention, with improvements often exceeding 10% (Santos, 2022; Thao, 2024, Kabir, 2023, Acharya, 2023). These enhancements are attributed to biochar's ability to increase soil porosity, improve pore size distribution, and enhance the soil's water-holding capacity. Such improvements are particularly beneficial in the region of the farm where soil properties show poor water retention and water conservation is crucial for sustainable agriculture.

2.4 HYDROLOGY

The farm occurs in the central western extent of the Omatako River Catchment and has two minor ephemeral drainage lines passing through the farm, one flowing southward to join the ephemeral Ondanguara River (tributary of the Omabonda River) and the other has a confluence directly with the Omabonda River. The Omabonda River in turn flows south eastward to the confluence with the Omatako River.

Increased erosion associated with the water courses can be seen within the sandstones known to occur in the southern portion of the farm, as opposed to the more competent carbonatitic rocks occurring in the south, resulting in preferential; weathering and incised water courses. Depending on the thickness of the sandstones, paleo springs may be associated with the contact between the two identified lithologies, giving rise to the drainage features observed.
None of the farm’s boreholes are located within ~400 m of any water courses.

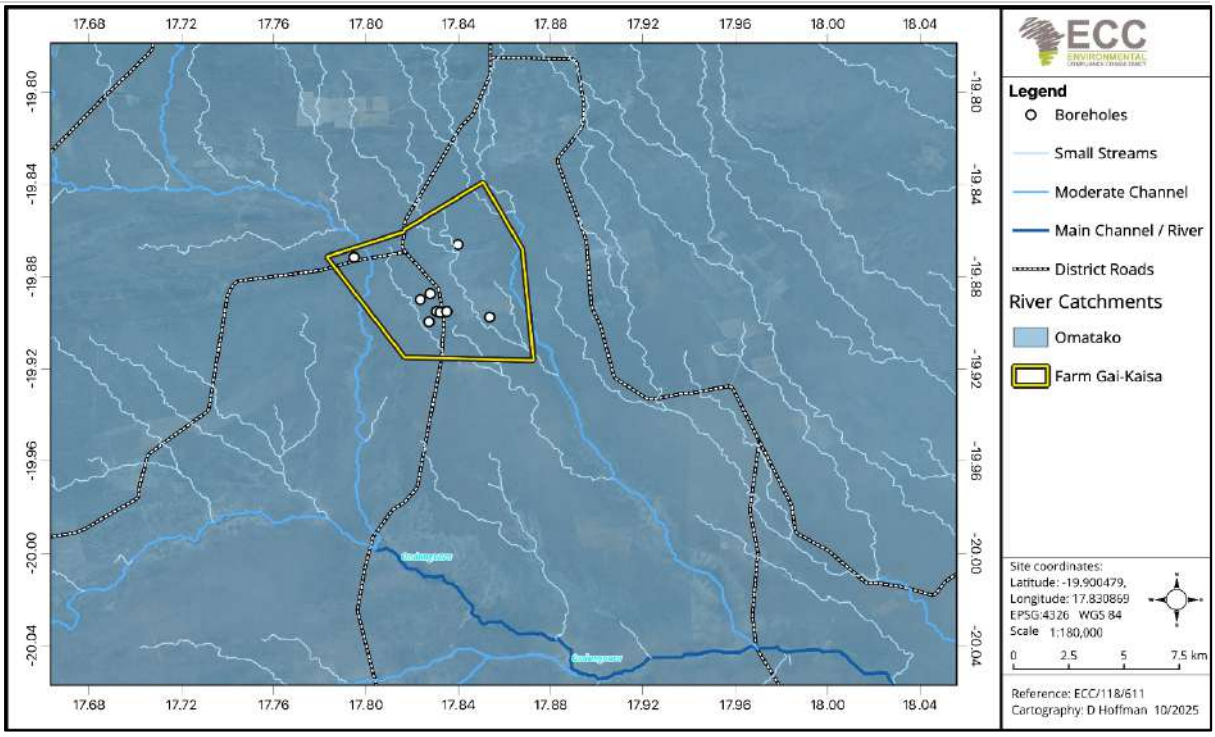

Figure 5 – Hydrological drainage map of the study area

2.5 GEOLOGY

The farm occurs within the southern central tectonographic zone of Namibia's Damara belt. A significant structural feature, the Omaruru Lineament (OL), transects the property (Figure 6). This lineament is considered an extension of the Waterberg Thrust, a prominent regional tectonic structure / fault line extending over ~250km from Grootfontein to Omaruru. The Waterberg Thrust is characterised by large-scale, low-angle thrusting that accommodated significant shortening of the Damara Supergroup during continental collision. The Omaruru Lineament similarly represents a zone of crustal-scale deformation, where intense fracturing and shearing have occurred.

Along this structural trend, the lineament juxtaposes metasedimentary rocks of the Swakop Group, Karibib Formation (Damara Supergroup) against sandstones of the Etjo Formation (Karoo Supergroup). The Swakop Group rocks are older, having been deposited during the Neoproterozoic era (~750–540 Ma). Within the Swakop Group, the Karibib Formation is a prominent lithostratigraphic unit dominated by medium- to thick-bedded dolomitic and calcitic carbonates, locally interbedded with calcareous shales. It is generally light grey in colour and displays karstic features, solution cavities, and minor brecciation along structural zones. The formation represents shallow marine carbonate deposition (approximately 700–580 Ma).

The Etjo Formation of the Karoo Supergroup is significantly younger, having been deposited in the Early Jurassic (~200–180 Ma). It is characterised by well-sorted, cross-bedded aeolian

sandstones, reflecting deposition in an extensive desert dune system. These sandstones are typically medium- to coarse-grained, with high primary porosity, and are often interbedded with minor interdune mudstones.

The juxtaposition of these older and younger units along the Omaruru Lineament results in a sharp lithological and structural contrast, with older, lithified carbonates of the Karibib Formation abutting younger, porous aeolian sandstones of the Etjo Formation. This contact is of considerable significance for both structural interpretation and hydrogeological assessment, as it represents a zone of potential groundwater accumulation, preferential flow, and structural control on aquifer connectivity.

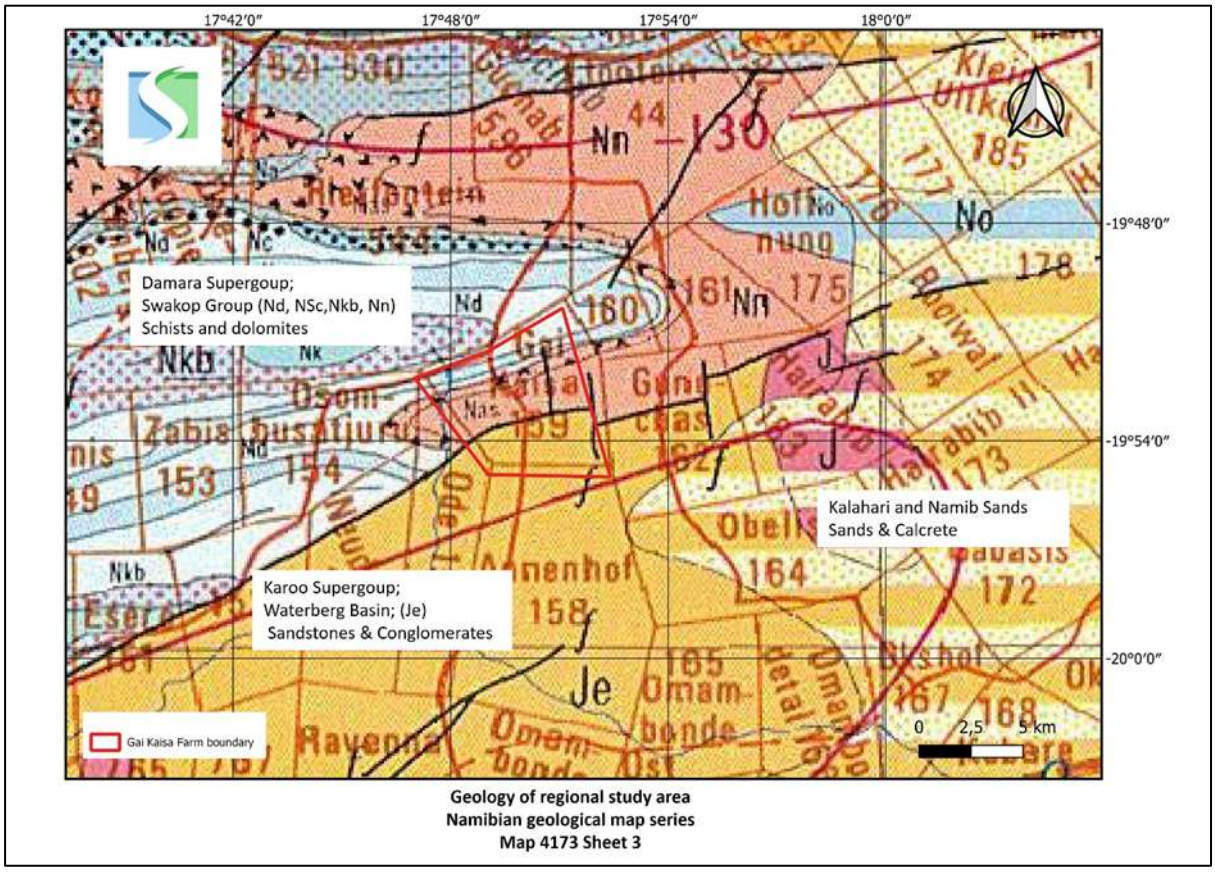

Figure 6 – Digital geological map of the study area

2.6 HYDROGEOLOGY

2.6.1 AQUIFER CHARACTERISATION

The farm lies ~20 km to the south, outside of the Grootfontein-Tsumeb-Otavi (GTO) water control area. According to the Hydrogeological Map of Namibia (Ministry of Agriculture, Water and Lan Reform, 2021), the project area is underlain by two distinct aquifer types (Figure 7). These reflect the contrasting lithologies and structural characteristics of the geological units present, namely the Swakop Group sediments in the north and the Karoo sediments in the south (see Table 2).

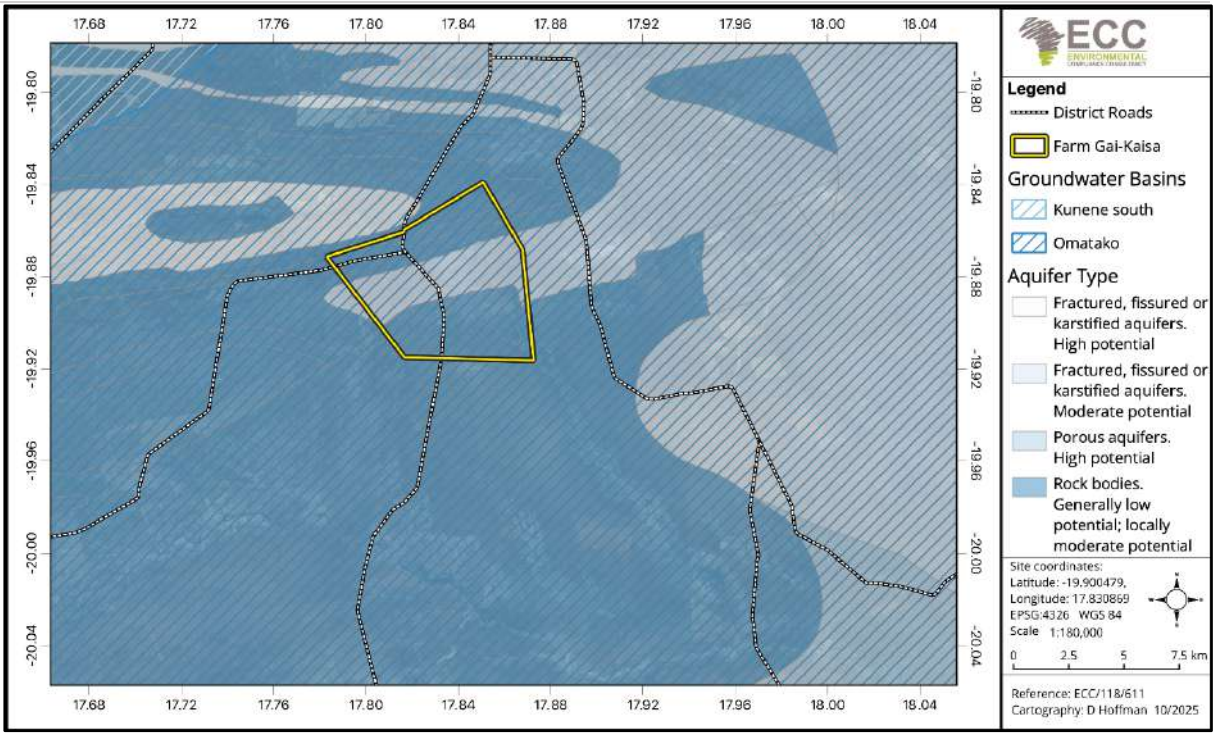

Figure 7 – Hydrogeological map of Namibia showing two aquifer types of varies potential beneath Farm Gai Kaisa

The Swakop Group sediments form a fractured, fissured, or karstic aquifer (secondary aquifer) with high groundwater potential. These aquifers are developed within non-porous lithologies such as marbles, quartzites, conglomerates, and dolomitic limestones, where secondary porosity has formed through fracturing, faulting, and dissolution. In the study area, this aquifer type is associated with the metasedimentary rocks of the Karibib Formation and undifferentiated meta-sediments of the Swakop Group, occurring in the northern portion of the farm and further north toward Kombat and Rietfontein.

These marble dominated units, exhibit well-developed karstification and structural permeability along fractures and lineaments associated with the Omaruru Lineament and the Waterberg Thrust system. Such conditions create zones of enhanced groundwater storage and transmissivity, making them highly prospective for groundwater development. It is anticipated that, the Karstic aquifer behaves in a semi-confined manner, with unconfined conditions potentially developing around structural features and near surface. Pressure changes in fractures and karsts, particularly at depth, may be expected to behave in a confined manner, where by saturated thickness does not change, but there remains a release of water per decline in head and a change in a potentiometric surface level. This approach will be adopted when undertaking first order groundwater storage estimations.

The Karoo sediments with generally low to locally moderate groundwater potential occur within poorly fissured or compacted lithologies, forming localised aquifers or regional aquitards. The Etjo sandstones are well-cemented aeolian deposits with limited intergranular

porosity and low fracture permeability. Groundwater occurrence in these units is typically discontinuous and perched, and borehole yields are variable to low unless structurally enhanced. The presence of the OL likely enhances hydraulic conductivity within the sandstones on the farm and provides increased groundwater potential. The sandstones are anticipated to respond in an unconfined manner, as is seen in areas to the south west where these sandstones are known to outcrop and be exposed (e.g., Waterberg Plateau).

The Omaruru Lineament, a major structural feature traversing the farm, juxtaposes the karstified Swakop Group metasediments against the Etjo sandstones. This structure, while not explicitly represented in regional hydrogeological models, is likely to play a significant role in groundwater movement and storage, as fault and fracture zones often act as preferential flow pathways in otherwise low-permeability formations.

Groundwater development within the area should therefore focus on lineament zones and structural intersections within the Swakop Group units north of the farm, where secondary porosity is greatest and groundwater yields are typically higher. Conversely, the Etjo Formation in the southern portion of the property is less favourable for groundwater development due to its limited primary porosity and weak fracture permeability. The potential of the sandstones (including the thickness of the unit) should however be explored in future to gain a better understanding of the hydrodynamics between the different aquifer types.

2.6.2 GROUNDWATER FLOW AND RECHARGE

Regional studies by Mukwenda (2009), who developed a groundwater flow model for the Kombat region (including the area south of the Otavi Mountain Land and encompassing the farm), indicate that groundwater flow occurs predominantly toward the south and southeast (Figure 8), within the Omatako Groundwater Basin in the region of the farm. Recharge is derived primarily from precipitation over the Otavi Mountain Land to the north, where Otavi Group and Swakop Group metasediments are karstified and outcrop facilitating significant infiltration and recharge.

While the Omaruru Lineament was not included in Mukwenda's modelled flow framework, its structural influence likely enhances local recharge and subsurface connectivity between karstic and fractured zones.

Recharge in semi-arid central Namibia typically represents ~1–5% of the Mean Annual Rainfall (MAR), depending on lithology and soil infiltration capacity (MAWLR, 2021). Based on a MAR of approximately 500 mm/a, estimated average recharge for the area ranges between 5 and 25 mm/a, with locally higher recharge rates (>5%) expected in karstified and fractured zones within the Swakop Group.

As a first order estimate and based on a conservative adoption of rainfall (500 mm/a) and recharge (5 - 25mm/a), the 5000 ha farm surface area may facilitate between 250 000 m^3 – 1.25 million m^3 of recharge per annum. This is strictly theoretical, however, as groundwater is not constrained by property boundaries, and consideration of infiltration rates, residence time, flow boundaries, lateral recharge, and flow direction are not accounted for.

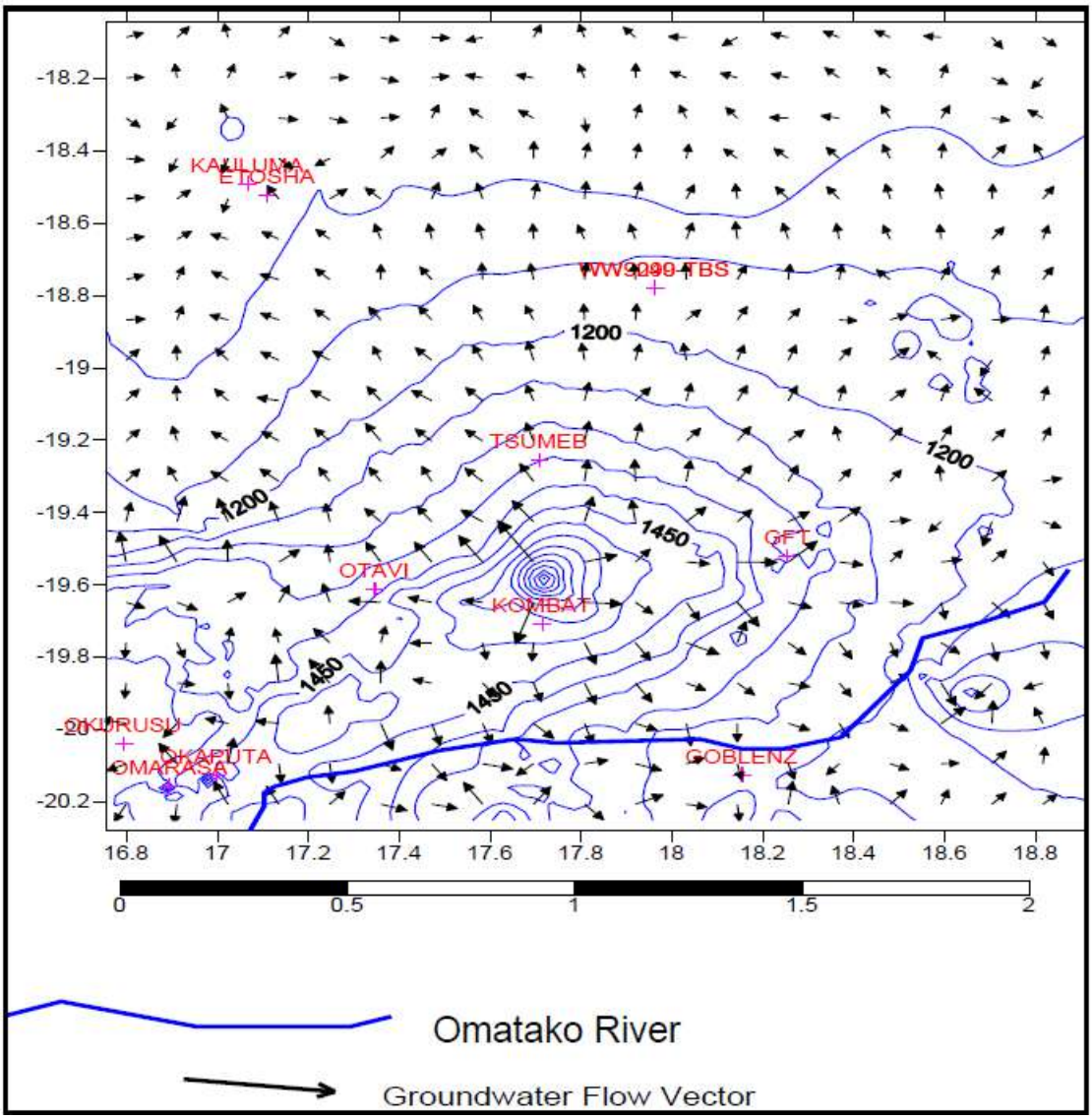

Figure 8 – Regional groundwater flow modelled by Mukwenda (2009)

2.6.3 GROUNDWATER LEVEL

Groundwater levels in the broader Otavi–Omatako basin region are generally shallow, typically less than 20 metres below ground level (mbgl). Converting groundwater levels to metres above mean sea level (mamsl), shows a consistent water table elevation, with the minor depression seen at borehole Site Water Feed, likely influenced by historic abstraction for the existing industrial and domestic uses. Regional groundwater flow broadly follows the

natural topographic gradient toward the south and southeast, consistent with Mukwenda's (2009) model.

Table 1 – Groundwater levels measure on Farm Gai Kaisa

BH Name	Lat	Long	Elev (mamsl)	BH Depth (m)	Rest water level (mbgl)	Rest water level (mamsl)
Land I	-19.89001	17.8234	1408	105	11.9	1396
Land II	-19.8875	17.8278	1407	129	10.7	1396
Site Water Feed	-19.8952	17.8305	1402	45	8.8	1393
Site Workers Camp	-19.8997	17.8272	1404	51	7.4	1397
House	-19.8956	17.8320	1404	105	8.0	1396

Local deviations from this trend are observed where geological structures, lithological contrasts, and historical abstraction practices influence hydraulic gradients. Lineament or structure-controlled flow paths are particularly significant within the Swakop Group terrains, enhancing both recharge and lateral connectivity between discrete aquifer compartments.

2.6.4 GROUNDWATER QUALITY

Regionally, groundwater in the Otavi–Omatako Basin is mapped as excellent quality, suitable for potable and agricultural use. Results from sampling on the farm provide the following insights to groundwater quality:

Low salinity: Total Dissolved Solids (TDS < 600 mg/L), pH: Neutral to slightly alkaline (~7.0–7.5), Hardness: Slight to moderate, primarily due to dissolved calcium and magnesium from carbonate lithologies, nitrate and sulphate concentrations are low, typically below drinking water guideline limits. Trace metals (Fe, Mn): Low concentrations, generally below detection thresholds.

These parameters reflect good recharge quality, limited anthropogenic influence, and carbonate buffering from the Karibib Formation. The overall groundwater chemistry is consistent with a Ca–HCO_3 hydrochemical facies, typical of fresh groundwater circulating within carbonate and mixed lithological terrains.

3 HYDROGEOLOGICAL IMPLICATIONS AND DEVELOPMENT POTENTIAL

Given the contrasting hydrogeological characteristics of the two main lithostratigraphic units, groundwater exploration and borehole siting should target fractured and karstified zones within the Swakop Group north of the Omaruru Lineament, particularly along structural intersections, and fault-related fracture zones.

The Etjo Formation in the southern portion of the property is expected to yield lower borehole productivity, with drilling efforts here considered less favourable unless supported by structural enhancement or perched aquifers.

Future groundwater development should integrate structural mapping, geophysical lineament analysis, and targeted test drilling to refine the local hydrogeological model and optimise borehole yields.

A first order groundwater availability assessment based on the aerial extent of Swakop sediment underlying the farm (~3500 ha) and literature based values for aquifer parameters such as aquifer thickness (150 m) and Storativity (specific storage – 1E-5 and specific yield: 0.05 – depending on confined or unconfined conditions) the following volumes are derived:
Unconfined conditions indicate a total drainable pore volume of ~260 million m^3 (water in static storage beneath the farm). Confined conditions, drainage per decrease in 1 m head is estimated at 52500 m^3.

Note the above calculations are order of magnitude planning values to derive an indication of the groundwater potential within the farm boundaries only. Volumes are indicative only and do not account for larger areas of flow (as opposed to property boundaries only), addition of recharge and variation in aquifer parameters and thickness. Volumes derived indicate a positive groundwater potential, supporting bulk abstraction from the aquifer, supported by high frequency monitoring of volumes, pump rates and groundwater levels.

Table 2 – Geological and hydrogeological characterisation underlying Farm Gai Kaisa

Geological Unit	Supergroup / Group	Age & Era	Typical Lithology	Depositional Environment	Structural Relationship	Hydrogeological Characteristics
Etjo Formation	Karoo Supergroup	Early Jurassic (~200–180 Ma, Mesozoic)	Well-sorted, cross-bedded aeolian sandstones, locally with thin interdune siltstones and mudstones	Aeolian dune and interdune depositional system under arid continental conditions	Overlies the Omingonde Formation or, where eroded, rests unconformably on older Damara metasediments. Along the Omaruru Lineament, it is juxtaposed against the Karibib Formation by faulting.	Acts as a secondary fractured and porous aquifer. Primary porosity in uncemented zones may exceed 15–20%. Recharge is local through rainfall and preferential infiltration along fractures and lineaments. Water quality is generally fresh, though locally variable depending on cementation and depth.
Karibib Formation	Swakop Group, Damara Supergroup	Neoproterozoic (~700–580 Ma)	Thick-bedded dolostones and limestones with subordinate calcareous schists and quartzites; locally karstified and brecciated	Shallow marine carbonate platform environment during Damara basin sedimentation	Thrust and fault-bounded unit along the Omaruru Lineament (extension of the Waterberg Thrust). Intensely deformed and recrystallized under greenschist-facies metamorphism.	Locally forms a karstic to fractured carbonate aquifer with moderate to high secondary permeability along joints and dissolution cavities. Groundwater yield is variable (low in crystalline zones, higher in karstified sections). Water quality can be hard due to dissolved carbonates.
Structural Feature: Omaruru Lineament	—	Neoproterozoic in origin; reactivated during Mesozoic and later	Zone of shearing, faulting, and fracturing extending northeast–southwest across central Namibia	Deep-seated crustal discontinuity; marks the contact between the Damara Orogenic Belt and the Karoo Basin margin	Controls juxtaposition of Neoproterozoic metasediments (Karibib Fm.) and Mesozoic sandstones (Etjo Fm.)	Provides enhanced secondary permeability; acts as a hydrogeological conduit for regional and localised groundwater flow and storage.

3.1.1 EXISTING BOREHOLES

A request for details of existing boreholes on the farm and its immediate neighbours (farm Ode no.156, Gunuchas no. 162, Gesundbunnen no. 1326 and Kududam no. 161) was submitted to the Geohydrology Division of Department of Water Affairs. Very limited details were available in the DWA records, with only some borehole locations derived from the GROWAS database. The lack of records, coupled with limited land use activities in the region imply limited to no bulk abstraction taking place in the vicinity of the farm.

There are four existing registered boreholes on the farm, however, an additional five boreholes (EB1-EB5) require registration and are planned for abstraction (Table 1). Work undertaken to develop groundwater on the farm (i.e. from the five aforementioned boreholes) is described in subsequent sections.

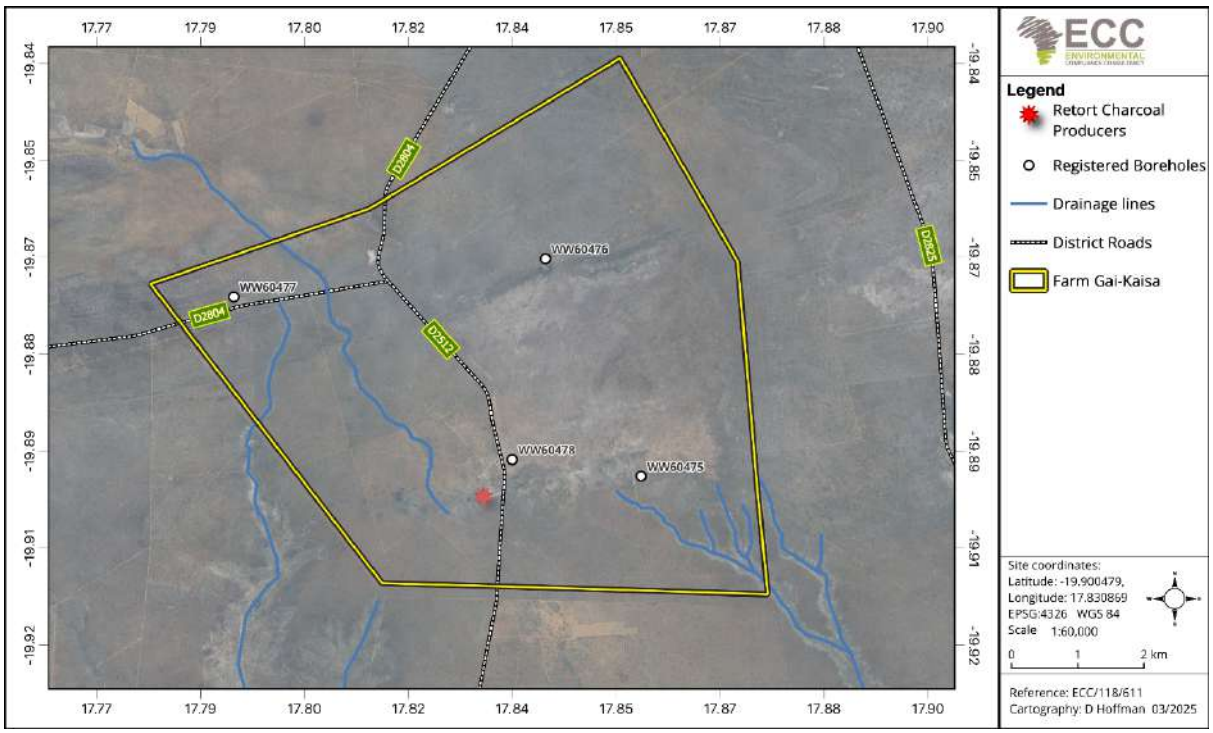

Figure 9 – Map of existing borehole locations derived from GROWAS and DWA databases

4 WATER REQUIREMENT AND IRRIGATION

Existing groundwater use is estimated at 800 m^3/a for charcoal and biochar production and 200 m^3/a for domestic use, totalling 1000 m^3/a.

Irrigation is planned under two (2) phases each comprising a total cultivation of ~135 ha. Table 3 calculates the expected crop water requirement (CWR) and the gross volumetric abstraction requirement for phase 1 under various scenarios adopting the following assumptions:

- Total rainfall of 500 mm per annum with effective rainfall of 60 % (this is the portion of rainfall that is available to crops);
- Maize growing season = Oct–Apr (~362 mm effective rainfall)
- Perennials = full year = 300 mm effective rainfall
- Biochar is assumed to increase plant available water and reduce irrigation need by ~10%
- Scenario 1: no rainfall contribution i.e. crops must be fully irrigated to meet the crop water requirement and no influence of biochar;
- Scenario 2:
- For annual crops (maize) the CWR is treated as a single-season value; for perennials (fruit trees, grapes, pecans, avocado) an annual crop water requirement is used.
- "Typical CWR" values used:
    - Maize: ~600 mm/season
    - Cherries: ~900 mm/a
    - Nectarines: ~850 mm/a
    - Pecans: ~1,400 mm/a
    - Avocado: ~1,500 mm/a
    - Soft citrus: ~1,200 mm/a
    - Grapes: ~500 mm/a
- 1 mm = 10 m^3/ha for volume calculations
- Seasonal distribution of rainfall has an impact on CWR and gross abstraction requirements
- Drip irrigation for trees/vineyards reduces losses and can often achieve crop water needs with smaller volumes (applied closer to root zone); however, the CWR stays roughly the same
- Drip irrigation efficiency is adopted at 90% and pivot irrigation efficiency at 80%.

Table 3 – Gross abstraction volumes required for irrigation under various cultivation and rainfall scenarios

Crop (method)	Area (ha)	CWR (mm/yr or season)	Gross irrigation Scenario 1: No rainfall, no biochar (m³/a)	Gross irrigation Scenario 2: Rainfall 500 mm, no biochar (m³/a)	Gross irrigation Scenario 3: Rainfall 500 mm, with biochar (10% saving) (m³/a)
Maize (pivot)	130.0	600	975000	765000	688500
Cherries (drip)	0.2	900	2000	1433	1290
Nectarines (drip)	0.2	850	1889	1350	1215
Pecan nuts (drip)	0.5	1400	7778	5556	5000
Avocado (drip)	0.5	1500	8333	5556	5000
Soft citrus (drip)	1.0	1200	13333	9444	8500
Grapes (drip)	1.0	500	5556	1889	1700
TOTAL	134	—	**1013889**	**790228**	**711205**

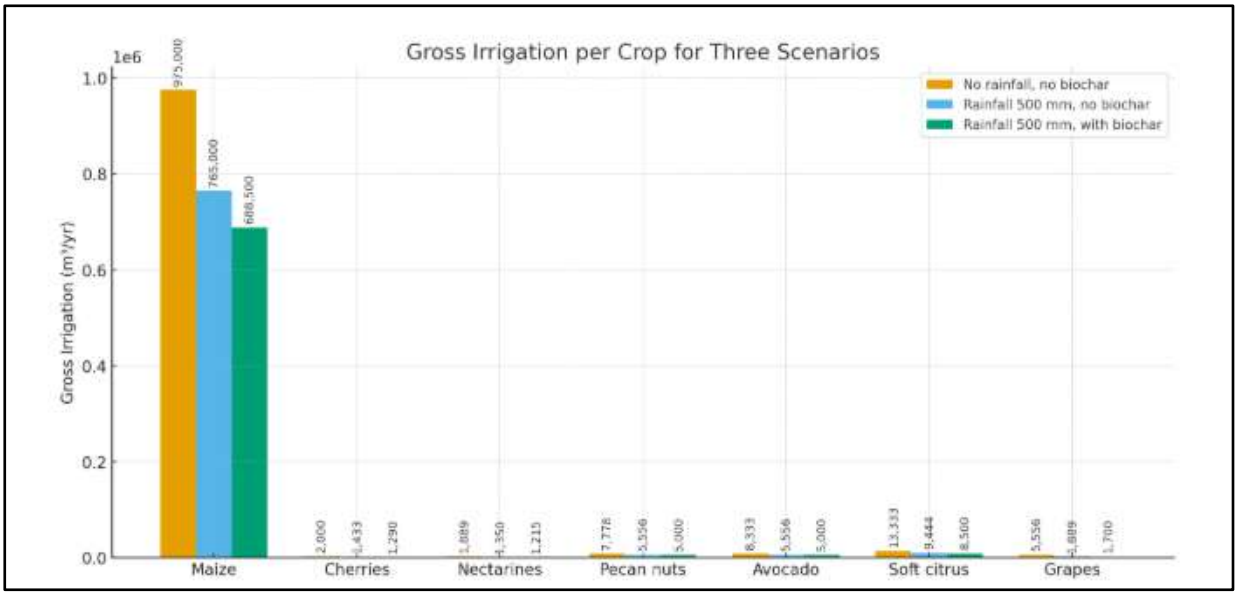

Figure 10 – Gross volume of water to abstract (includes losses) under various cultivations and rainfall scenarios

Figure 11 – Area on Farm Gai Kaisa (red polygon) planned for centre pivot irrigation (green circles)

Based on existing use and typical crop water requirements, Phase 1 has a water requirement of ~1 million m^3 per annum. Phase 2 includes an increased hectarage to ~260 ha and motivates a total groundwater requirement of 2 million m^3 per annum. As shown in Table 3, actual volumes are anticipated to decrease depending on rainfall conditions and the efficacy of the biochar application. Values given are typical/representative seasonal or annual CWR estimates — local evapotranspiration, crop variety, management, phenology, planting density, and seasonal rainfall timing will influence values.

Based on the high level groundwater potential determined in preceding sections, it is anticipated that groundwater sourced on the farm can sustainably supply the required volumes of water required for both phases of irrigation.

5 GROUNDWATER DEVELOPMENT

5.1 GEOPHYSICS AND BOREHOLE DRILLING

A geophysical contractor undertook a survey using the Electromagnetic (EM) technique (Figure 12) targeting lineaments, potential structures and contacts presumably identified during desktop mapping. Results of the MLEM survey identified several areas of increased potential and boreholes were sited, however, for unknow reasons, boreholes were drilled in different locations, not coinciding with the locations of increased potential (Figure 13).

It is noted that while mapped as a lineament or single linear feature, it is likely that the OL incorporates a larger area or zone along which increased groundwater potential may be expected, likely resulting in the positive outcomes obtained during borehole drilling.

Figure 12 – Photos taken during the EM survey on Farm Gai Kaisa

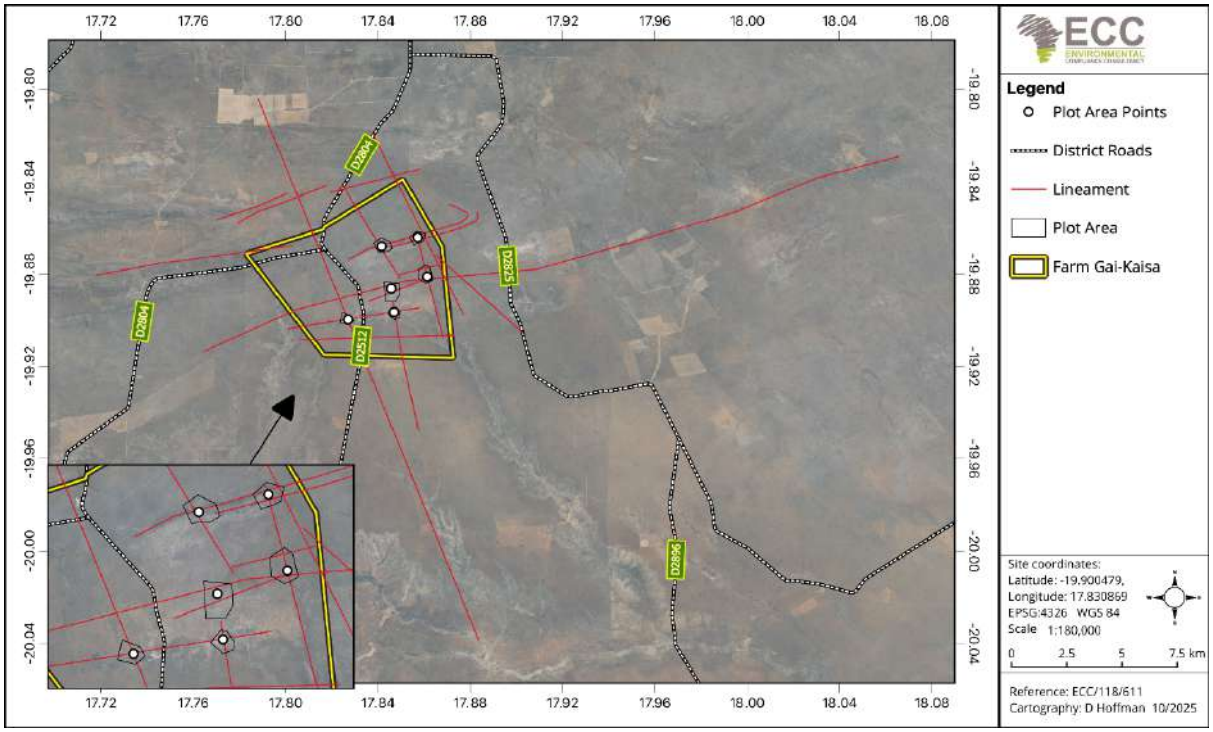

Figure 13 – Lineament mapping, areas of increased groundwater potential and proposed borehole drilling locations

Table 4 provides a summary of the borehole drilling details, Figure 14 shows borehole locations and drillers / borehole completion reports are provided in Appendix A.

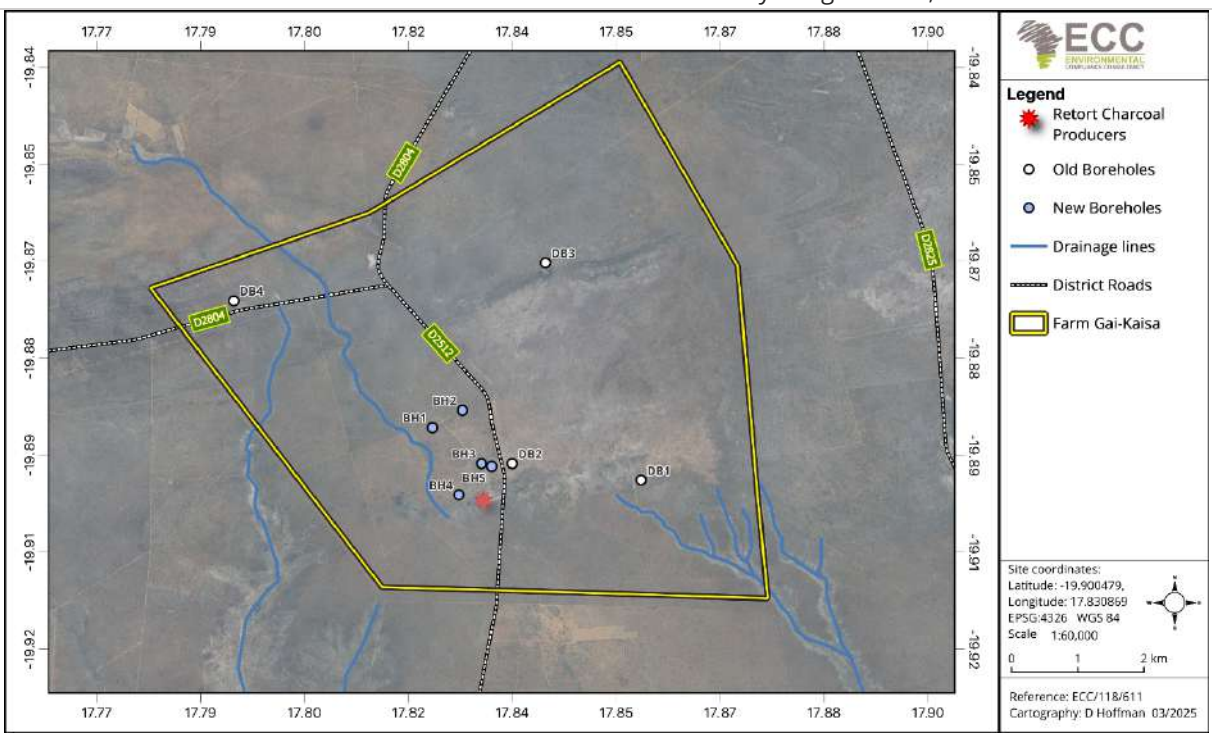

Figure 14 – Map of drilled borehole locations (note DB denotes existing, registered boreholes)

Table 4 – Borehole drilling details and results

BH No.	BH Name	Lat	Long	BH Depth (m)	Drilling Diameter (mm)	Drilling Interval (mbgl)		Casing interval (mm)		Casing Type and diameter	Water Strike (mbgl)	Blow Yield (m^3/h)	Collar Height (m)	RWL (mbgl)
						From	To	From	To					
BH1	Land I	-19.89	17.82	105	254	0	6	0	6	219 mm plain steel casing	19, 22, 32, 63, 85	24	0.5	12.5
					203	6	105	6	105	None (open)				
BH2	Land II	-19.89	17.83	129	254	0	6	0	6	219 mm steel casing	13, 23, 42, 112	42	0.5	10.85
					203	6	129	6	129	None (open)				
BH3	Site Workers Camp	-19.90	17.83	51	304	0	6	0	3	274 mm plain steel casing	9, 13, 37, 31, 36	250	0.5	8.6
					254	6	30	0	30	219 mm plain steel casing				
					203	30	51	30	51	219 mm perforated steel casing				
BH4	House	-19.90	17.83	105	254	0	6	0	6	219 mm plain steel casing	14, 47, 87, 101	159	0.5	7.9
					203	6	105	6	105	None (open)				
BH5	Site Water Feed	-19.90	17.83	111	254	0	6	0	6	219 mm plain steel casing	30, 38, 41, 58, 65, 106	111	0.5	10.4
					203	6	111	6	111	None (open)				

5.2 TEST PUMPING

After borehole drilling was complete, test pumping was undertaken on the five (5) drilled boreholes. Test design comprised a step discharge test, recovery, constant rate discharge test, followed by recovery measurements. Table 5 provides an overview of the various tests undertaken at the five (5) boreholes and all test pumping data is in Appendix B with water quality results in Appendix C. As analytical solutions for karstic aquifers are not readily available, a combination of unconfined Theis (1935) and Neumann (1974) solutions were applied to determine the aquifer parameters for the karstic aquifer. The aquifer thickness was conservatively assumed to be 120 m for all boreholes. Analysis for aquifer parameters and forward solution modelling of long term drawdown values was undertaken in Aqtesolv software developed by HydroSolve Inc., while FC programme was used to evaluate derivative curves and subjective information regarding boundaries and flow regimes. Parameter estimation was undertaken for periods of radial flow where possible. All analyses were carried out with conservative available drawdown values to protect main water strikes intersected during drilling (similarly for recommended pump installation depths).

Table 5 – Test pumping details per borehole

BH Name	Lat	Long	BH Depth (m)	Rest water level (mbgl)	Rest water level (mamsl)	Test Yield (m^3/hr)					CDT Duration (min)	Final drawdown (m)
						Step1	Step2	Step3	Step4	CDT		
Land I	-19.89001	17.82349	105	11.9	1396	30	50	80	100	100	1440	5.99
Land II	-19.8875	17.82782	129	10.7	1396	20	30	50	70	40	1440	15.02
Site Water Feed	-19.8952	17.83057	45	8.8	1393	30	50	70	100	100	1440	3.98
Site Workers Camp	-19.8997	17.82729	51	7.4	1397	30	60	80	112	110	1440	1.4
House	-19.8956	17.83204	105	8.0	1396	30	60	90	113	105	1440	2.5

5.2.1 LAND I

Land I underwent a stepped discharge test on 23/09/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 240 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 5 provides a summary of the borehole construction and testing details. Figure 15 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test. Step 4 (100 m^3/hr) was cut short for unknown reasons.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 24/09/2024 at a rate of 100 m^3/h. Figure 16 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding, with limited drawdown and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 17), a Transmissivity value of 379 m^2/d was determined. The recommended yield of 65 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A

summary of results and recommendations is provided in Table 6. Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation.

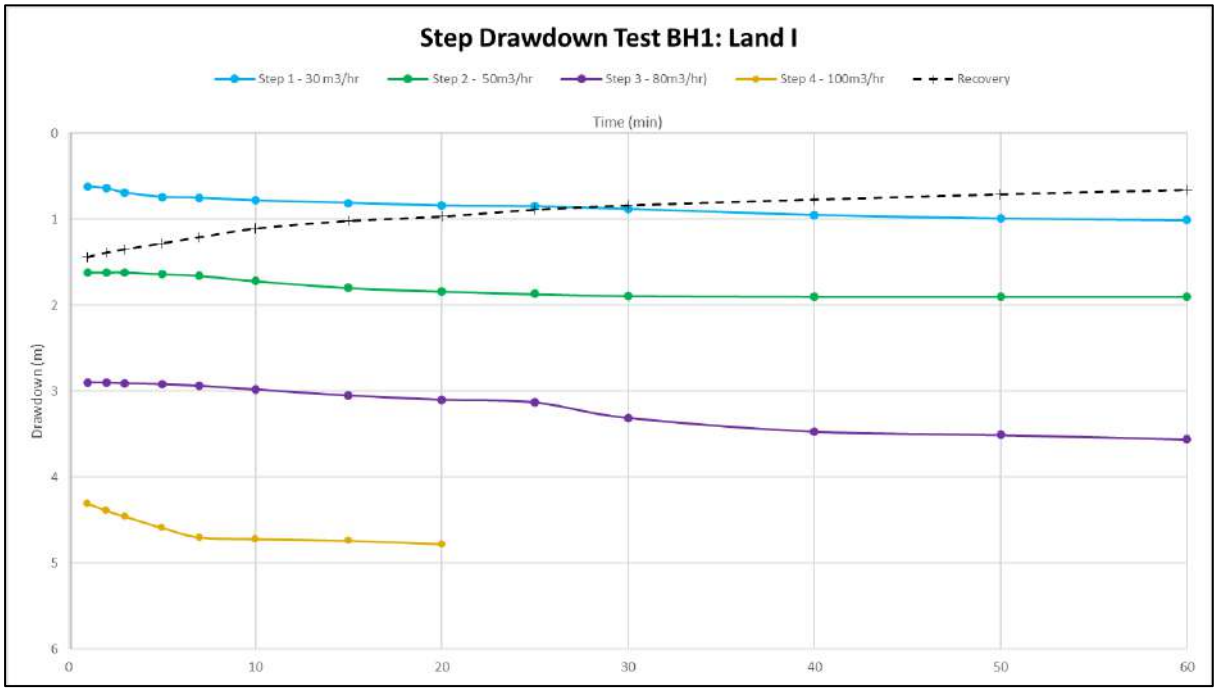

Figure 15 Step test at BH Land I

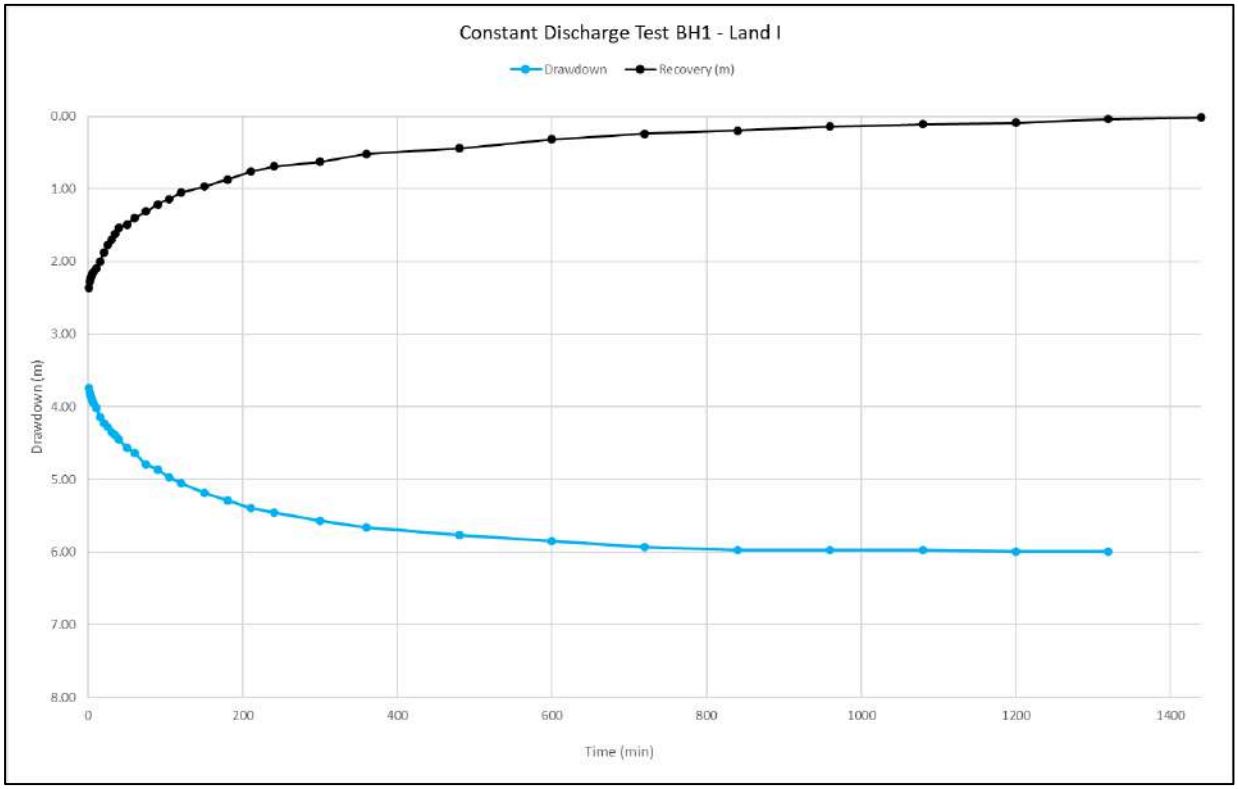

Figure 16 – CDT at BH1 – Land I at a rate of 100 m^3/h for 24 hours

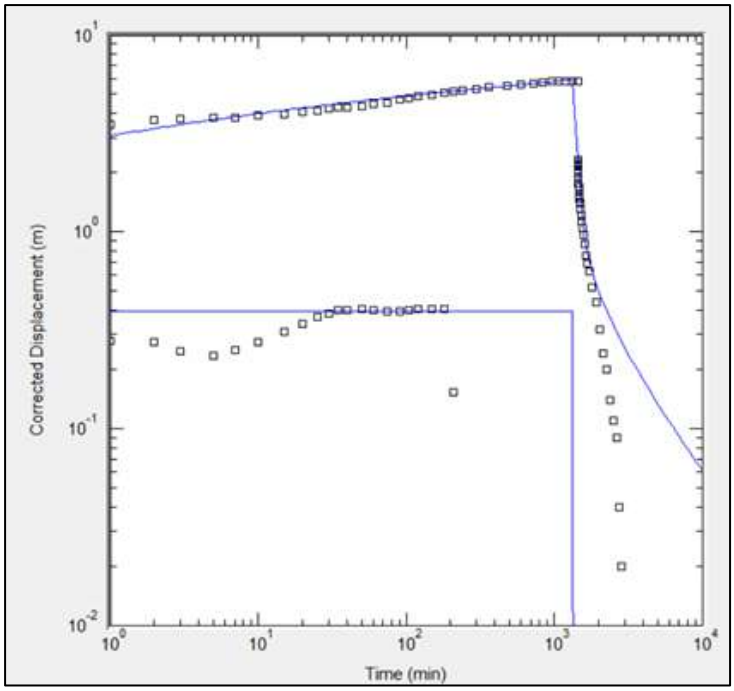

Figure 17 – Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

5.2.2 LAND II

Land II underwent a stepped discharge test on 17/10/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 480 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 5 provides a summary of the borehole construction and testing details. Figure 18 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test. Step 4 (70 m^3/hr) could not be maintained for a full hour before the available drawdown was exhausted.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 18/10/2024 at a rate of 40 m^3/h. Figure 19 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is moderately high yielding and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 20), a Transmissivity value of 93 m^2/d was determined. The recommended yield of 25 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 6.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation.

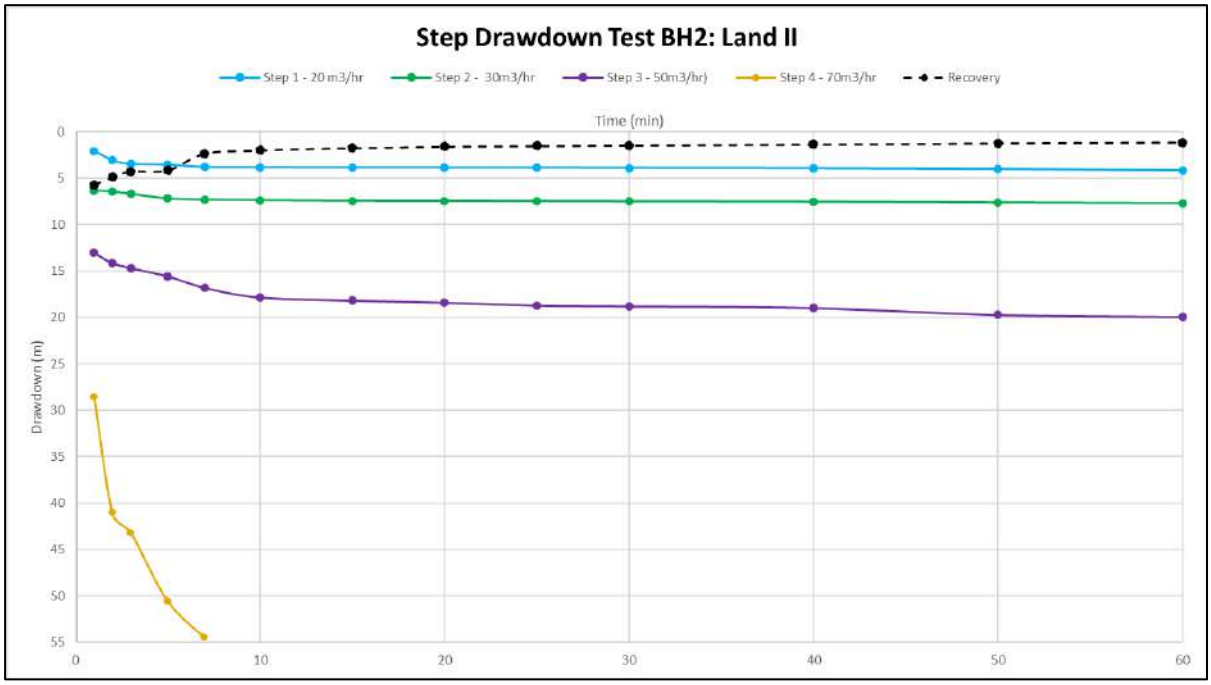

Figure 18 - Step test at BH2 – Land II

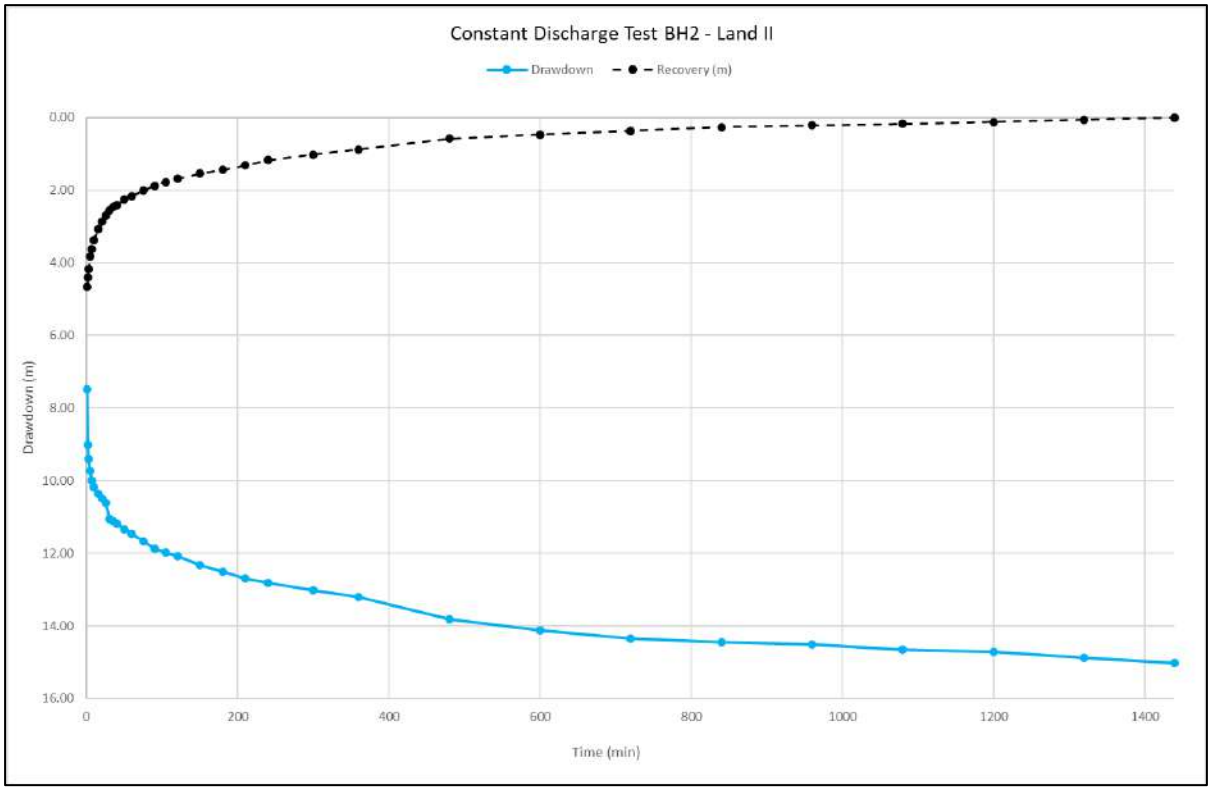

Figure 19 – CDT at BH2 – Land II at a rate of 40 m³/h for 24 hours

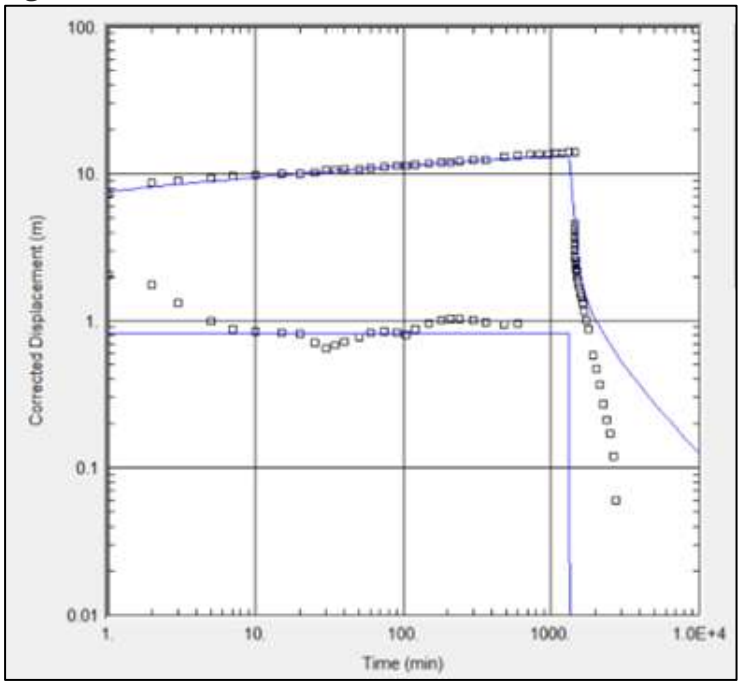

Figure 20 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

5.2.3 SITE WATER FEED

Site Water Feed underwent a stepped discharge test on 12/11/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 120 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 5 provides a summary of the borehole construction and testing details. Figure 21 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 13/11/2024 at a rate of 100 m³/h. Figure 22 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 24), a Transmissivity value of 3250 m²/d was determined. The recommended yield of 80 m³/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 6.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation. This borehole is

~160 m west of BH – House and should be monitored to ensure no hydraulic connection (borehole interference) exists between the two boreholes if pumped simultaneously.

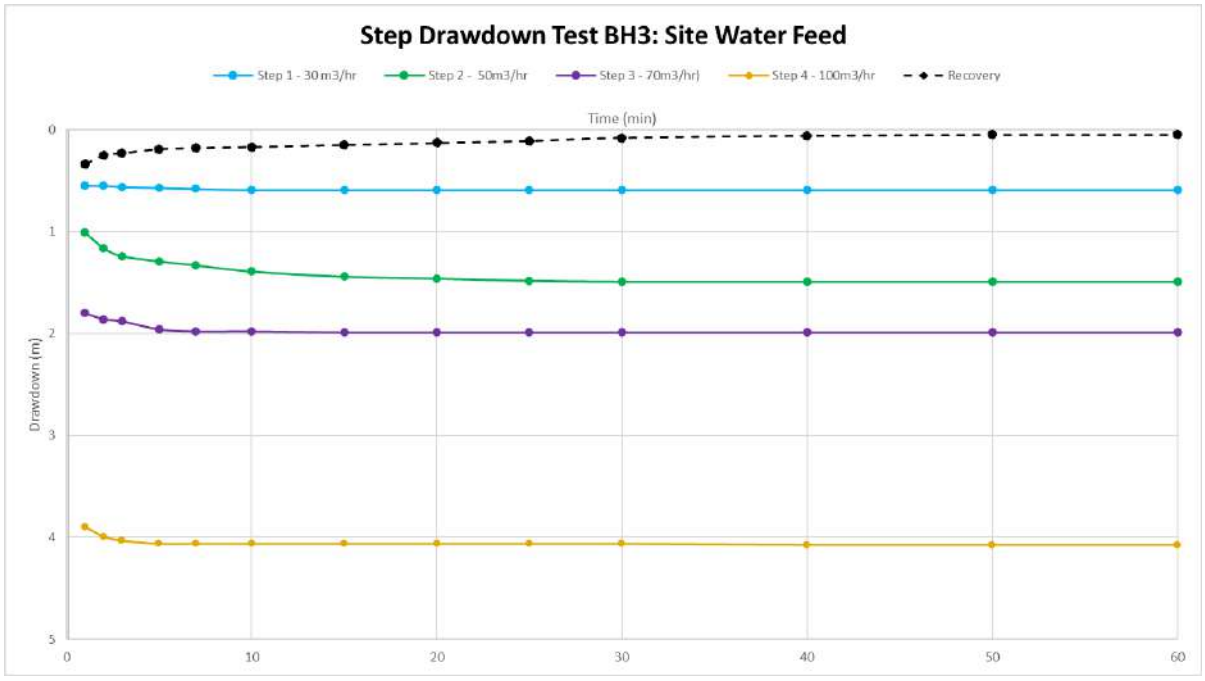

Figure 21 - Step test at BH3 – Site Water Feed

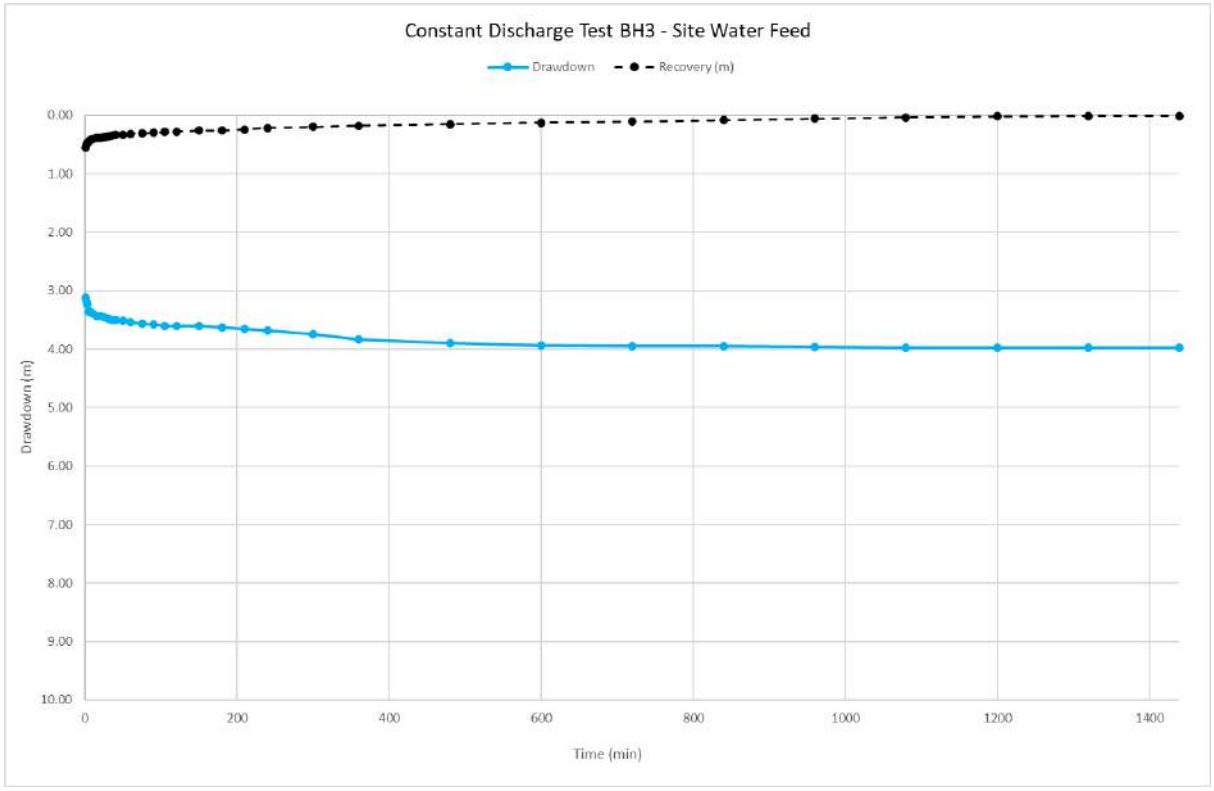

Figure 22 – CDT at BH3 – Site Water Feed at a rate of 100 m^3/h for 24 hours

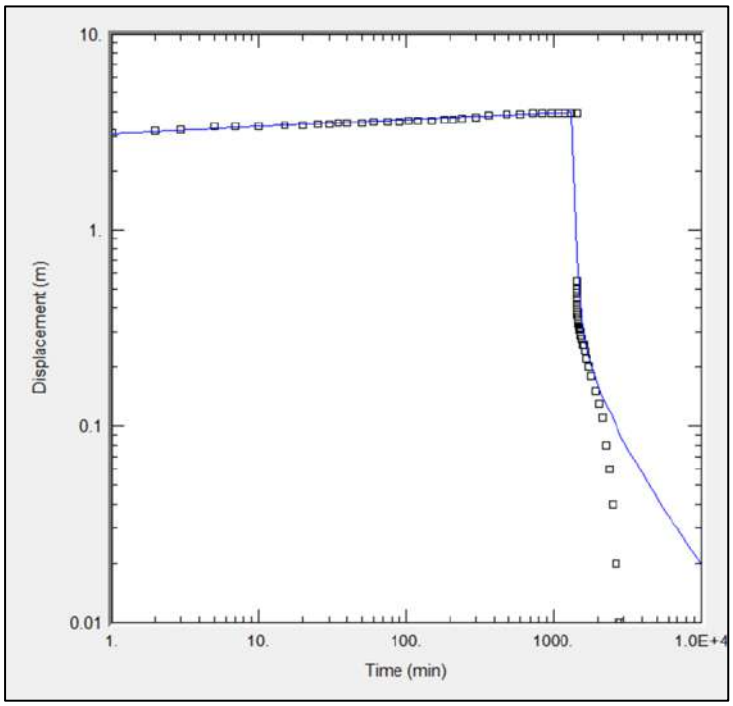

Figure 23 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

5.2.4 SITE WORKERS CAMP

Site Workers Camp underwent a stepped discharge test on 15/11/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 300 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 5 provides a summary of the borehole construction and testing details. Figure 24 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test.

The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 16/11/2024 at a rate of 110 m^3/h. Figure 25 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 26), a Transmissivity value of 2700 m^2/d was determined. The recommended yield of 90 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 6.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation.

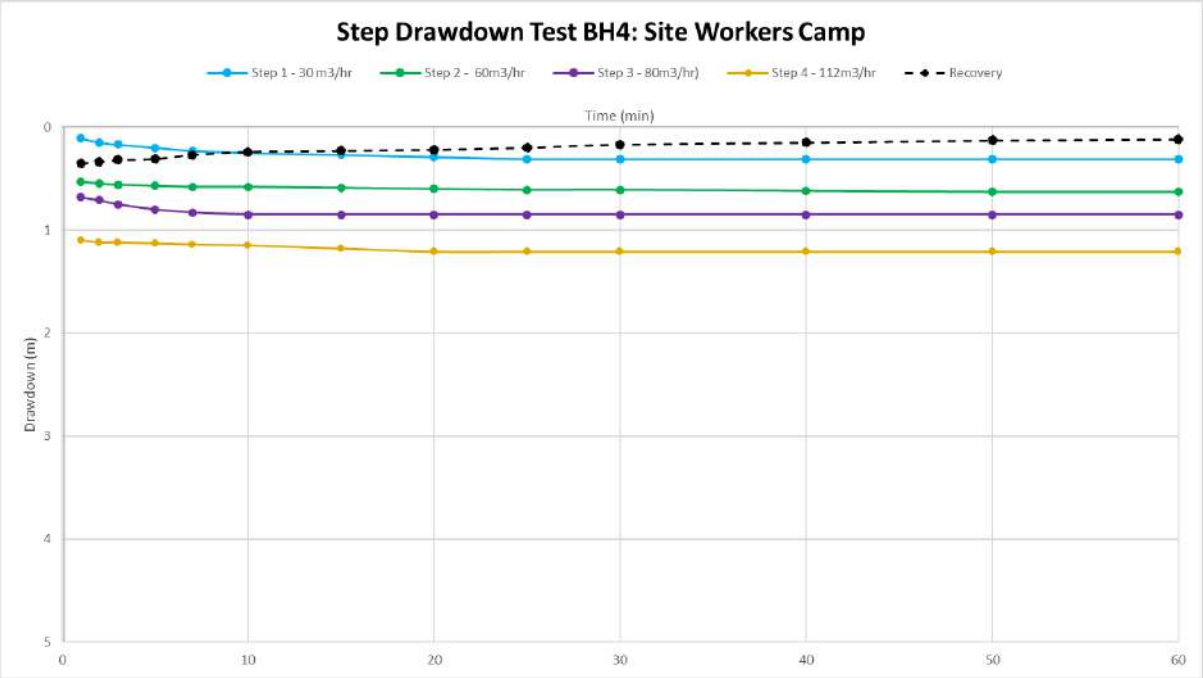

Figure 24 - Step test at BH4 – Site Workers Camp

Figure 25 - CDT at BH4 – Site Workers Camp at a rate of 110 m^3/h for 24 hours

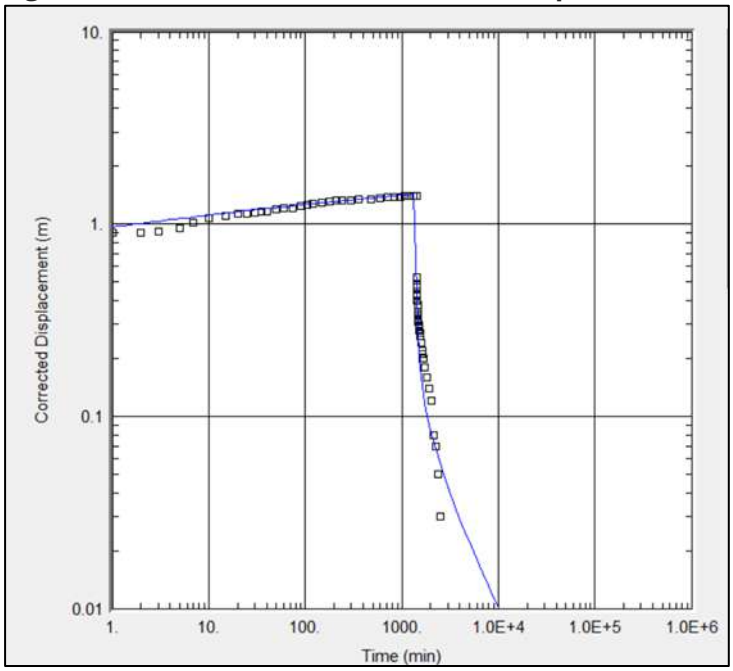

Figure 26 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

5.2.5 HOUSE

BH House underwent a stepped discharge test on 18/11/2024 comprising four (4) one hour long discharge steps, followed by recovery monitoring for 180 minutes until the water level recovered to 100% of the rest level measured prior to testing. Table 5 provides a summary of the borehole construction and testing details. Figure 27 provides an overview of elapsed time since start of pumping versus drawdown of water level recorded during the step test.
The Constant Rate Discharge Test (CDT) was undertaken for 24 hours (1440 minutes) on 19/11/2024 at a rate of 105 m^3/h. Figure 28 shows the time versus drawdown during the constant rate discharge test and recovery monitoring. The borehole is high yielding and shows rapid recovery after cessation of pumping.

Applying a combination of the Theis (1935) and Neumann (1974) analytical solutions (Figure 29), a Transmissivity value of 1440 m^2/d was determined. The recommended yield of 90 m^3/hr is determined based on subjective information related to flow boundaries, a two year forward modelling of drawdown and the assumption of zero recharge entering the system. It is recommended that the borehole be allowed to recover for at least 24 hours per week. A summary of results and recommendations is provided in Table 6.

Abstraction rates (weekly), volumes (weekly and collated monthly) and groundwater levels (twice daily) are recommended to be monitored at the borehole, allowing a revision (upward or downward) of the recommended yield after 6 months of operation. BH 5 is nearest BH3 (~160m) and while it is unknown if the same karstic feature is targeted, it is recommended

that groundwater level monitoring be undertaken during separate and combine pumping to evaluate borehole interference and compounding of drawdown effects. All recommendations do however account for the possibility of interference / hydraulic connection between boreholes and recommended yields are anticipated to provide protection to main water strikes and pump infrastructure.

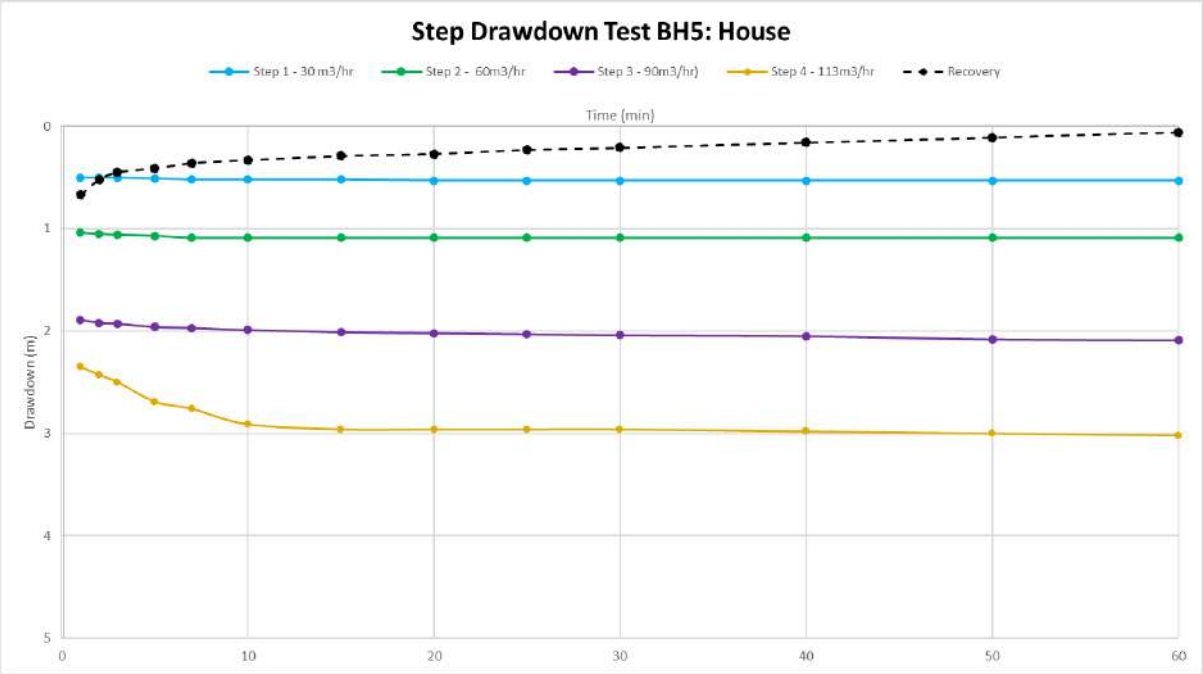

Figure 27 - Step test at BH5 – House

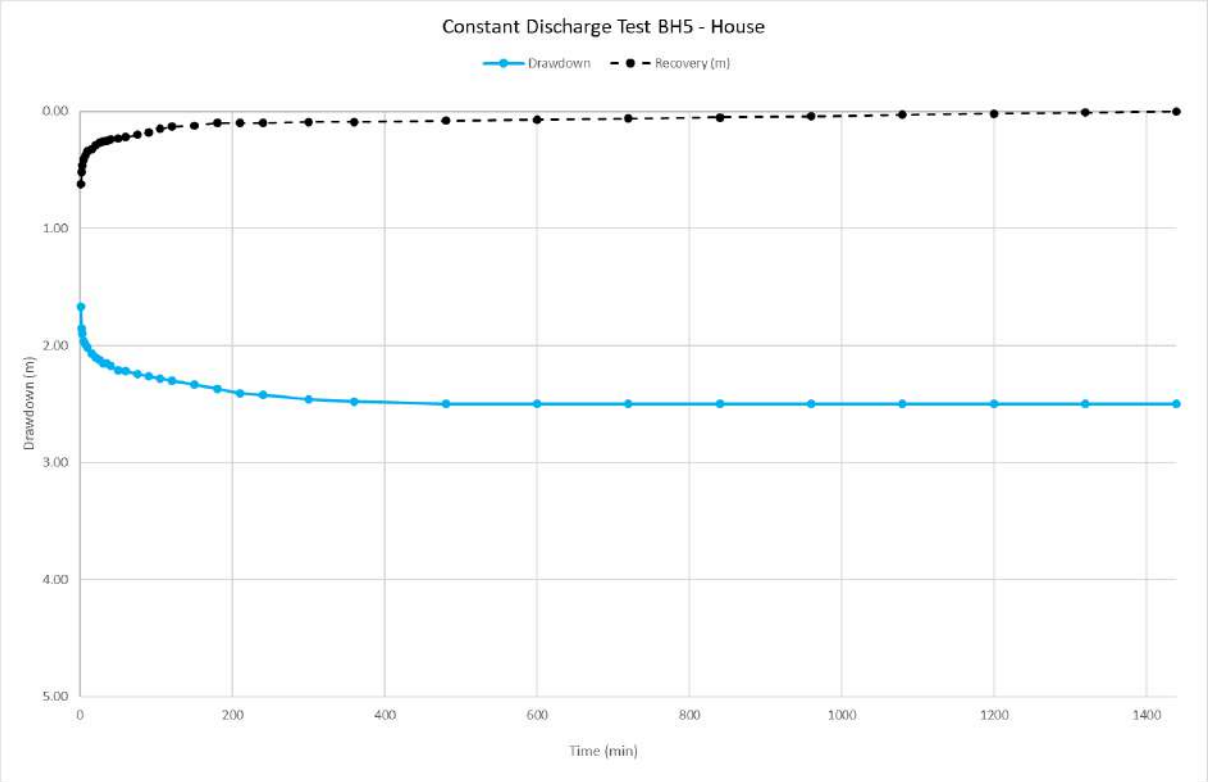

Figure 28 – CDT at BH5 – House at a rate of 105 m³/h for 24 hours

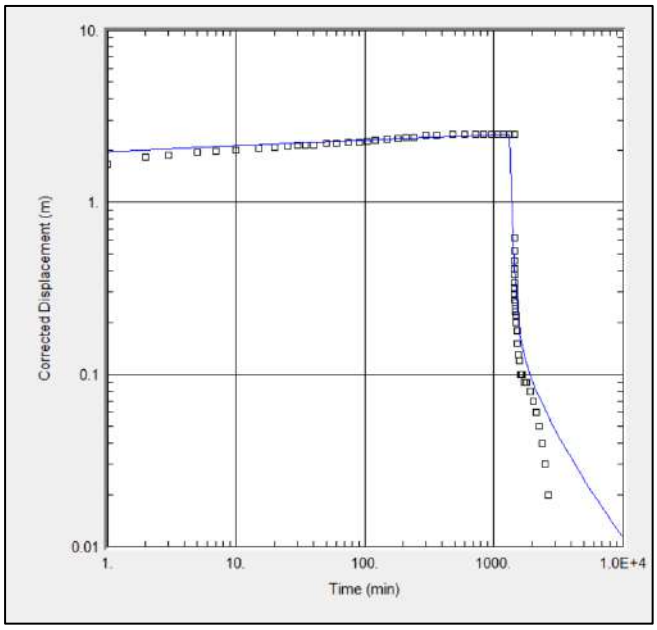

Figure 29 - Curve matching drawdown vs time and derivative data with the Theis (1934) solution for aquifer parameter estimation

All boreholes drilled targeted the karstic aquifer and are resultantly high yielding. It is recommended that bi-annual sampling of groundwater be included in the water level and volumetric monitoring prescribed per borehole. The analysis undertaken and results obtained (Table 6) may be used in support of an abstraction licence application to the Department of Water Affairs, for a volume of ~2 million cubic metres per annum.

Table 6 – Summary table of results and recommendations

BH ID	T (m²/d) (Theis)	K (m/d)	Recommended Pump Installation Depth (mbgl)	Available Drawdown based on pump	Recommended Yield (m³/hr)	Pumping regime (hrs/month)	Yield per month (m³)	Yield per annum (m³/a)	Aquifer Type	Modelled Drawdown after 2 years, zero recharge
BH1 - Land I	379	3.00	30	18	65	625	40625	487500	Karstic	9
BH2 - Land II	93	0.8	30	20	25	625	15625	187500	Karstic	10
BH3 - Site Water Feed	1450	12	30	21	80	625	50000	600000	Karstic	4
BH4 - Site worker Camp	3250	27	30	22	90	625	56250	675000	Karstic	2
BH5	2700	22	30	22	90	625	56250	675000	Karstic	2.5
Total					**350**	**625**	**218750**	**2625000**		

6 CONCLUSION AND RECOMMENDATIONS

A desktop groundwater assessment was undertaken for Farm Gai Kaisa no. 159. The farm occurs in the Omatako groundwater basin, to the south of the Otavi-Grootfontein-Tsumeb water control area.

The farm requires groundwater supply for irrigation to support a new agricultural project on the farm, comprising predominantly maize and minor perennials. The groundwater demand for irrigation has been estimated at a maximum of 1 million m^3 per annum per phase, there are two planned phases of cultivation.

The farm is underlain to the north by meta-sediments (marbles)of the Swakop Group while the southern portion of the farm is underlain by less productive Etjo sandstones of the Karroo Super Group.

Borehole drilling yielded favourable results with very high blow yields recorded per borehole. These yields were further supported and confirmed through test pumping, wherein each of the boreholes underwent a step discharge test followed by a constant rate drawdown test. Test pumping results further supported the favourable groundwater potential of the farm, as was alluded to during the desktop assessment.

The following recommendations are provided:

- All boreholes should have a lockable cap to protect the borehole if not in use.
- All boreholes should be ring fenced by a 2 m diameter fence to prevent game or livestock from contaminating the borehole.
- Pum installation depths, pump specifications and pumping rates should adhere to the recommendations provided in Table 6.
- Groundwater monitoring is recommended to comprise the following:
- All production boreholes should be fitted with automated level loggers and measure water level during and after pumping has ceased at a frequency of 30 minutes. Loggers are to be downloaded, and measurements verified annually on a monthly basis.
- Abstraction volumes should be measured through the installation of flow meters on each production borehole. Volumes should be collated on a monthly basis and compared to recommended abstraction volumes. Each boreholes abstraction rate should also be checked once a month to ensure borehole productivity is monitored.
- A hydrogeologist should assess water level responses, abstracted volumes, borehole yields every six months for the first two (2) years of abstraction and adjust recommended yields (upward or downward) based on monitoring results.
- At least six (6) shallow groundwater monitoring boreholes should be installed across the farm in strategic locations informed by a hydrogeologist. This is to monitor aquifer health in areas where pumping is not taking place.

- Groundwater quality sampling should be undertaken every three months for the first two years of abstraction, thereafter every six months will suffice. Parameters requiring analysis include the following (as a minimum):

  Electrical Conductivity (EC), Total Dissolved solids (TDS), pH, major ions (potassium, sodium, calcium, magnesium, bicarbonate, sulphate, chloride, fluoride), nutrients (nitrates, nitrites, orthophosphate), total hardness, trace metals (aluminium, iron, manganese, copper, lead, zinc, nickel, cadmium, cobalt, chromium, arsenic, uranium).

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APPENDIX A - DRILLING REPORT

Land I

Page 1 of 2

BOREHOLE COMPLETION REPORT

Please indicate at reverse side the position of the borehole and draw a casing plan.

APPLICANT: Rehoboth Classroad Trustees	BOREHOLE NUMBER: WW
FARM: Gai-Kaisa NUMBER: 159	TOPO & WELL NUMBER:
DISTRICT: Great Karas.	LATITUDE: S. 19 °53,399
DATE COMMENCED:	LONGITUDE: E. 017 °49,413
DATE COMPLETED:	COLLAR HEIGHT: 0·5 m

GEOLOGY

from - to in (m)	DESCRIPTION
0 – 6m	Drill 6m x 254 mm
	with 6m x 219 mm
	Casing.
6m – 105m	Drill 203mm X
	99m

TOTAL DEPTH FROM SURFACE: 105 m

DIAMETER OF BOREHOLE
254 mm from 0 to 6
203 mm from 6 to 105
mm from to

FIRST WATER STRIKE 0 m
SECOND WATER STRIKE 22 m
THIRD WATER STRIKE 33 m 63m, 85m
WATER LEVEL 13.5 m
YIELD m³/h 24
APPARENT QUALITY OF WATER: Good
TDS WHEN DRILLED:

INITIAL CAPACITY TEST
AIRLIFT YIELD * ☑
PUMP YIELD * ☐
YIELD IN m³/h: 24
DATE:
DURATION 1 Hour.

DRILLING COSTS

ITEM	N $
m drilled N$ per m	
testing of borehole:	
CASING	
plain length m N$ per m	
perforated length m N$ per m	
TOTAL COST	

State whether the borehole is*:
☑ successful ☐ unsuccessful
☑ Casing left in borehole ☐ Casing recovered

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I, the driller, declare that the information supplied above is true and correct	I, the drilling inspector, declare that the information supplied above is true and correct
Signature:	Signature:
Rank: Driller	Rank:
Place: Date:	Place: Date:

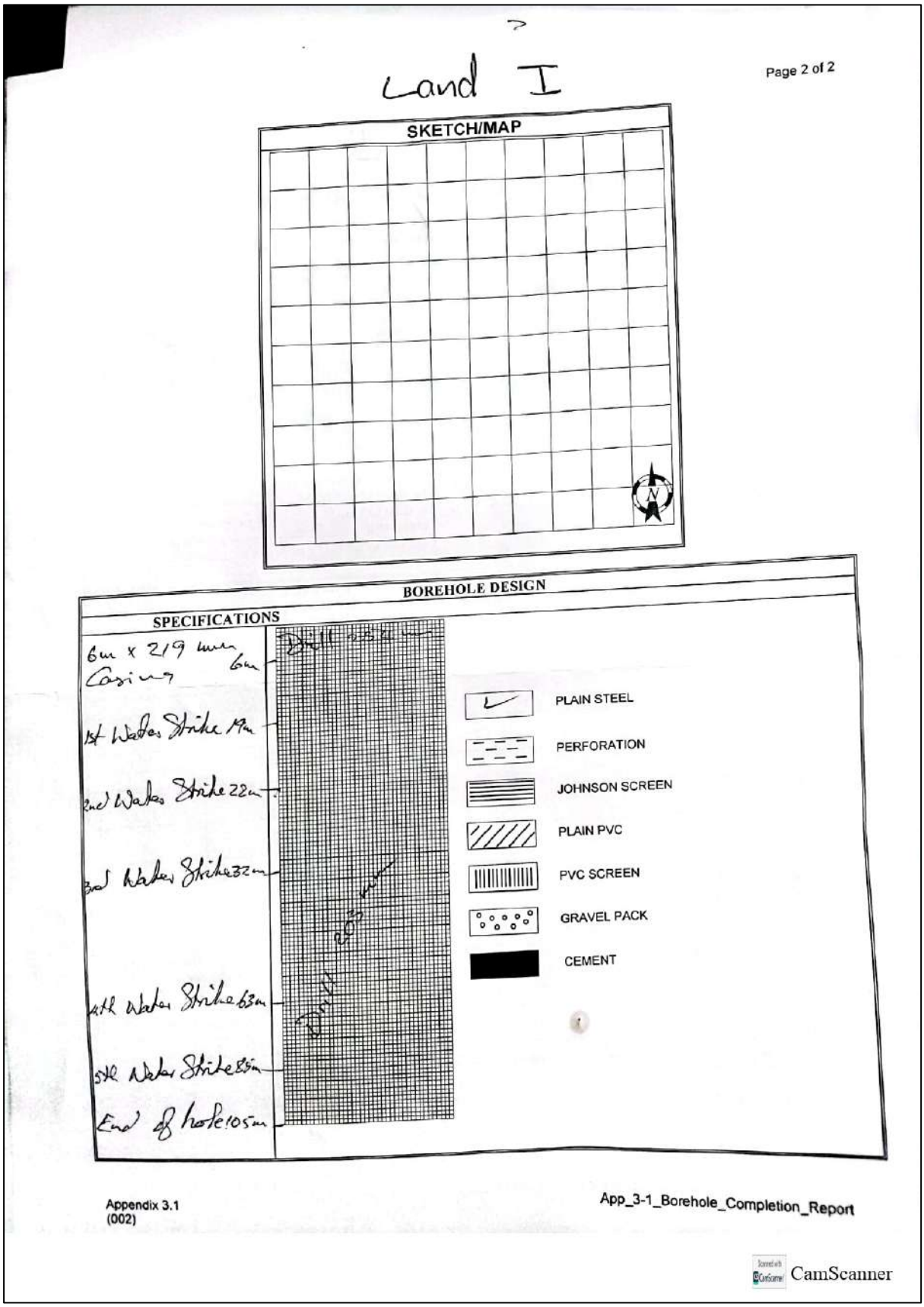
* mark applicable block

Remarks:

RESPONSIBLE GEOHYDROLOGIST ..... DATE

Appendix 3.1
(002)

App_3-1_Borehole_Completion_Report


Land I
Page 2 of 2
SKETCH/MAP
BOREHOLE DESIGN
SPECIFICATIONS
6m x 219 mm Casing
1st Water Strike 19m
2nd Water Strike 22m
3rd Water Strike 32m
4th Water Strike 63m
5th Water Strike 83m
End of hole 105m
PLAIN STEEL
PERFORATION
JOHNSON SCREEN
PLAIN PVC
PVC SCREEN
GRAVEL PACK
CEMENT
Appendix 3.1
(002)
App_3-1_Borehole_Completion_Report
CamScanner

Donny 2.

BOREHOLE COMPLETION REPORT

Please indicate at reverse side the position of the borehole and draw a casing plan.

APPLICANT:	BOREHOLE NUMBER: WW
FARM: NUMBER:	TOPO & WELL NUMBER:
DISTRICT:	LATITUDE: S, 19°52,080'
DATE COMMENCED:	LONGITUDE: E, 017°50,511'
DATE COMPLETED:	COLLAR HEIGHT: 0.5 m

GEOLOGY	
from - to in (m)	DESCRIPTION
0 - 6	Drill 6m x 254mm
	with 6m x 219 mm
	Casing
6 - 111	Drill 105m x 203mm

TOTAL DEPTH FROM SURFACE: 111 m

DIAMETER OF BOREHOLE
254 mm from 0 to 6
203 mm from 6 to 111
mm from to

FIRST WATER STRIKE 28 m
SECOND WATER STRIKE 38 m
THIRD WATER STRIKE 41 m 58,65,106m
WATER LEVEL 10.4 m
YIELD m³/h 111.8
APPARENT QUALITY OF WATER: Good
TDS WHEN DRILLED:

INITIAL CAPACITY TEST
AIRLIFT YIELD * ☑
PUMP YIELD * ☐
YIELD IN m³/h: 111.8
DATE:
DURATION 1 Hour

DRILLING COSTS	
ITEM	N $
m drilled N$ per m	
testing of borehole:	
CASING	
plain length m N$ per m	
perforated length m N$ per m	
TOTAL COST	

State whether the borehole is*:
☑ successful ☐ unsuccessful
☑ Casing left in borehole ☐ Casing recovered

DECLARATION BY DRILLER AND DRILLING INSPECTOR	
I, the driller, declare that the information supplied above is true and correct	I, the drilling inspector, declare that the information supplied above is true and correct
Signature:	Signature:
Rank: Driller	Rank:
Place: Date:	Place: Date:

* mark applicable block

Remarks:

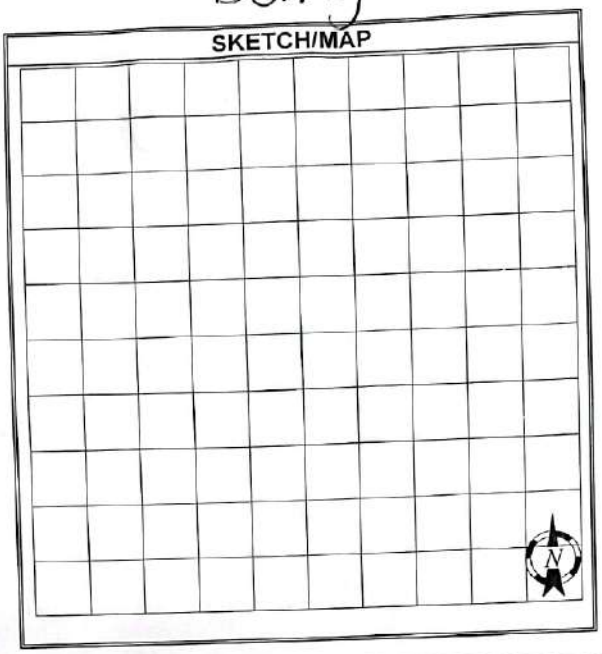
RESPONSIBLE GEOHYDROLOGIST ..... DATE

Appendix 3.1

Donny.

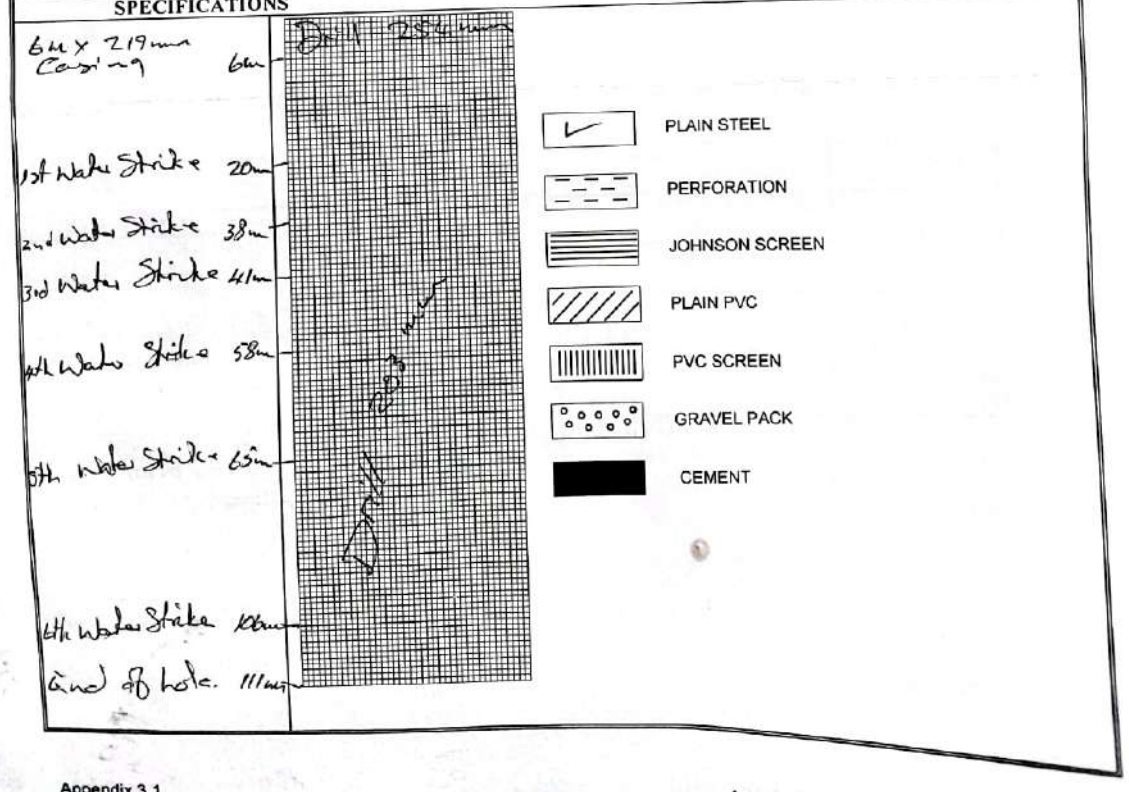
Page 2 of 2

SKETCH/MAP



BOREHOLE DESIGN

SPECIFICATIONS



Appendix 3.1
(002)

App_3-1 Borehole -

3

Haise.

BOREHOLE COMPLETION REPORT

Please indicate at reverse side the position of the borehole and draw a casing plan.

APPLICANT:	**BOREHOLE NUMBER: WW**
FARM: NUMBER:	**TOPO & WELL NUMBER:**
DISTRICT:	**LATITUDE:** S, 19 °53, 727'
DATE COMMENCED:	**LONGITUDE:** E, 017 °49, 928'
DATE COMPLETED:	**COLLAR HEIGHT:** 0-4 m

GEOLOGY	
from - to in (m)	**DESCRIPTION**
0 - 6	Drill 254mm x 6m
	with 219mm x 6m
	Casing.
6 - 105	Drill 203mm x 99m

TOTAL DEPTH FROM SURFACE: 105 m

DIAMETER OF BOREHOLE
254 mm from 0 to 6
203 mm from 6 to 105
..... mm from ..... to .....

FIRST WATER STRIKE 14 m
SECOND WATER STRIKE 47 m
THIRD WATER STRIKE 87 m 101m
WATER LEVEL 79 m
YIELD m³/h 159 e
APPARENT QUALITY OF WATER: Good
TDS WHEN DRILLED:

INITIAL CAPACITY TEST
AIRLIFT YIELD * ☑
PUMP YIELD * ☐
YIELD IN m³/h:
DATE:
DURATION

DRILLING COSTS	
ITEM	**N $**
m drilled N$ per m	
testing of borehole:	
CASING	
plain length m N$ per m	
perforated length m N$ per m	
TOTAL COST	

State whether the borehole is*:
☑ successful
☐ unsuccessful
☑ Casing left in borehole
☐ Casing recovered

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I, the driller, declare that the information supplied above is true and correct	**I, the drilling inspector, declare that the information supplied above is true and correct**
Signature:	**Signature:**
Rank: Driller.	**Rank:**
Place: **Date:**	**Place:** **Date:**

* mark applicable block

Remarks:

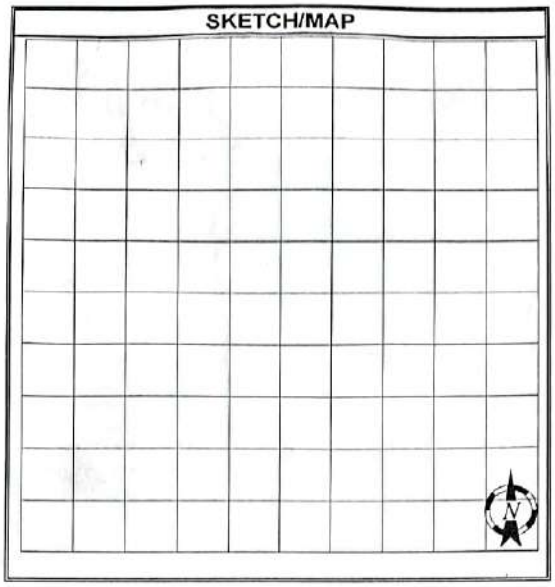
.....
RESPONSIBLE GEOHYDROLOGIST

.....

Hause.

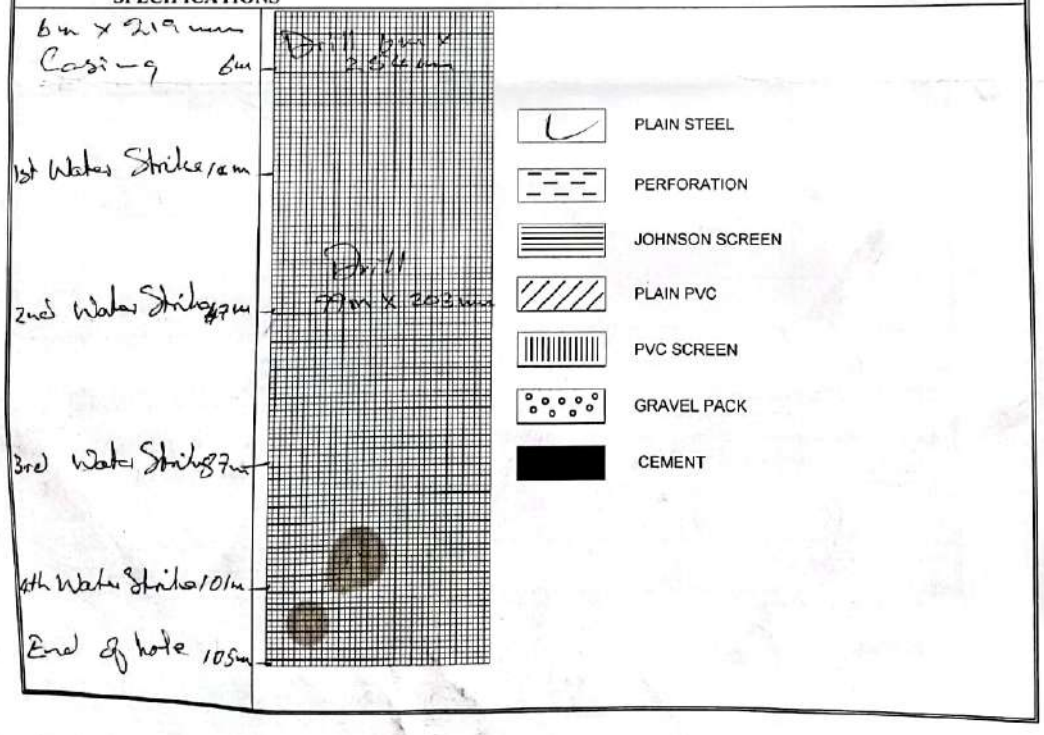
Page 2 of 2

SKETCH/MAP



BOREHOLE DESIGN

SPECIFICATIONS



Appendix 3.1
(002)

App_3-1_Borehole_Completion_Report

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Solar Panel

Page 1 of 2

BOREHOLE COMPLETION REPORT

Please indicate at reverse side the position of the borehole and draw a casing plan.

APPLICANT:	BOREHOLE NUMBER: WW
FARM: NUMBER:	TOPO & WELL NUMBER:
DISTRICT:	LATITUDE: S, 19° 53.716'
DATE COMMENCED:	LONGITUDE: E, 017° 49.937'
DATE COMPLETED:	COLLAR HEIGHT: 0-4 m

GEOLOGY

from - to in (m)	DESCRIPTION
0 - 49	Clean 165mm hole.
49 - 57	Drill 8m x 165 mm.

TOTAL DEPTH FROM SURFACE: 57 m

DIAMETER OF BOREHOLE
165 mm from 0 to 49 Clean
165 mm from 49 to 57
..... mm from ..... to .....

FIRST WATER STRIKE ..... m
SECOND WATER STRIKE ..... m
THIRD WATER STRIKE ..... m
WATER LEVEL ..... m
YIELD m³/h 50.
APPARENT QUALITY OF WATER: Good
TDS WHEN DRILLED: .....

INITIAL CAPACITY TEST

AIRLIFT YIELD * ☑
PUMP YIELD * ☐
YIELD IN m³/h: 50
DATE: .....
DURATION 1 Hour

DRILLING COSTS

ITEM	N $
m drilled N$ per m	
testing of borehole:	
CASING	
plain length m N$ per m	
perforated length m N$ per m	
TOTAL COST	

State whether the borehole is*:
☑ successful ☐ unsuccessful
☐ Casing left in borehole ☐ Casing recovered

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I, the driller, declare that the information supplied above is true and correct	I, the drilling inspector, declare that the information supplied above is true and correct
Signature:	Signature:
Rank: Driller.	Rank:
Place: Date:	Place: Date:

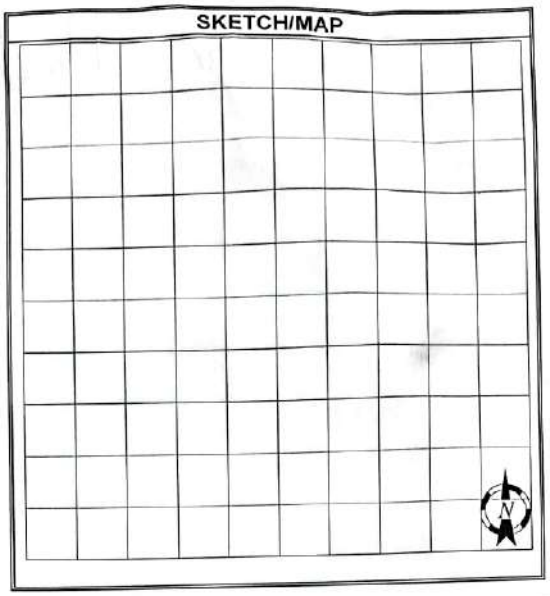
* mark applicable block

Remarks:

.....

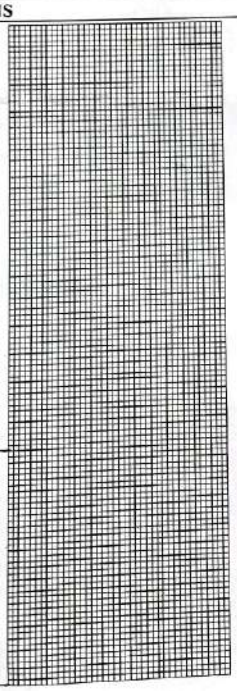
Solar Panel.

SKETCH/MAP



BOREHOLE DESIGN

SPECIFICATIONS



PLAIN STEEL
PERFORATION
JOHNSON SCREEN
PLAIN PVC
PVC SCREEN
GRAVEL PACK
CEMENT

End of hole 49m before deepening.

End of hole. 57m

Appendix 3.1
(002)

App_3-1_Borehole_Completion_Report

Land II

Page 1 of 2

BOREHOLE COMPLETION REPORT

Please indicate at reverse side the position of the borehole and draw a casing plan

APPLICANT: Stefan Foth	BOREHOLE NUMBER: WW
FARM: Gai Kaisa NUMBER: 159	TOPO & WELL NUMBER:
DISTRICT: Grootfontein	LATITUDE: S. 19°33.231'
DATE COMMENCED:	LONGITUDE: E. 017°07.667'
DATE COMPLETED:	COLLAR HEIGHT: 0-3 m
	TOTAL DEPTH FROM SURFACE: 129 m
	DIAMETER OF BOREHOLE: 224 mm from 0 to 6; 219 mm from 6 to 129; ..... mm from ..... to .....
	FIRST WATER STRIKE 73 m
	SECOND WATER STRIKE 23 m 112
	THIRD WATER STRIKE 42 m
	WATER LEVEL 10.35m
	YIELD m³/h 42 m³
	APPARENT QUALITY OF WATER: Good
	TDS WHEN DRILLED:

GEOLOGY

from - to in (m)	DESCRIPTION
0 - 6	Drill 6m x 224mm
	with 6m x 219mm
	Casing Plain.
6 - 129	Drill 123m x 203mm

INITIAL CAPACITY TEST

AIRLIFT YIELD * ☑
PUMP YIELD * ☐
YIELD IN m³/h:.....
DATE:.....
DURATION .....

DRILLING COSTS

ITEM	N $
m drilled N$ per m	
testing of borehole:	
CASING	
plain length m N$ per m	
perforated length m N$ per m	
TOTAL COST	

State whether the borehole is:*
☑ successful ☐ unsuccessful
☑ Casing left in borehole ☐ Casing recovered

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I, the driller, declare that the information supplied above is true and correct
Signature:
Rank: Driller
Place: Grootfontein Date:

I, the drilling inspector, declare that the information supplied above is true and correct
Signature:
Rank:
Place: Grootfontein Date:

* mark applicable block

Remarks:

RESPONSIBLE GEOHYDROLOGIST ..... DATE

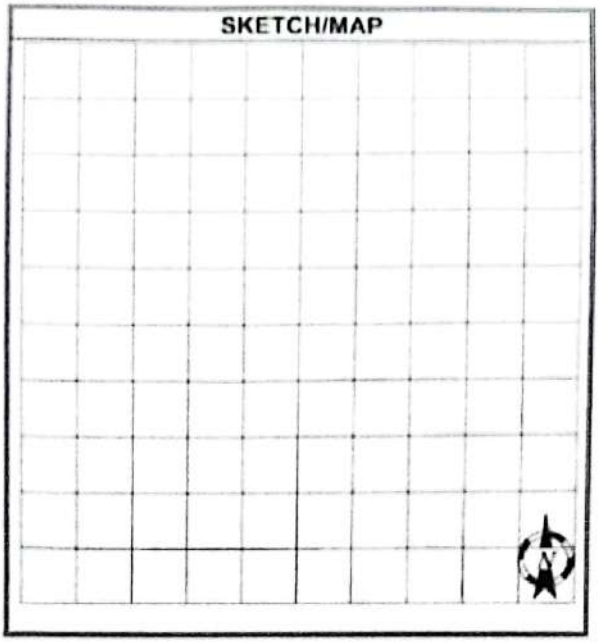
Appendix 3.1

Borehole_Completion.doc

Land II

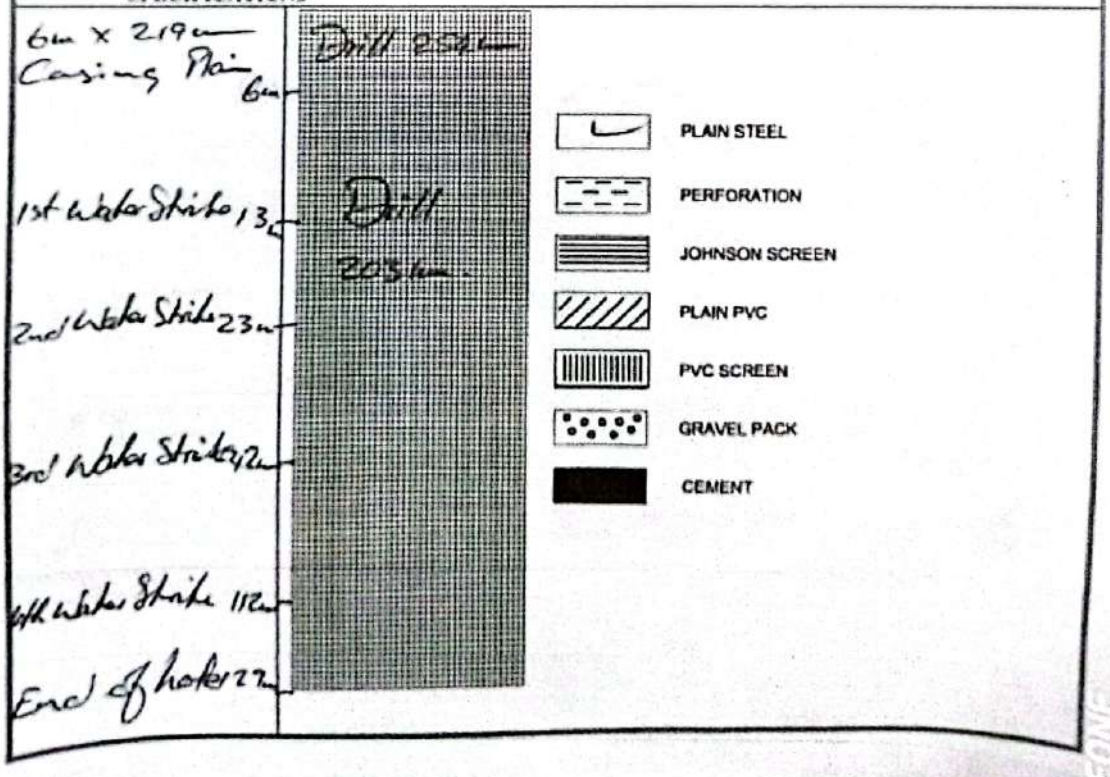
Page 2 of 2

SKETCH/MAP



BOREHOLE DESIGN

SPECIFICATIONS



Page 1 of 2

Site Workers Camp.

BOREHOLE COMPLETION REPORT

Please indicate at reverse side the position of the borehole and draw a casing plan.

APPLICANT: Stefan Folk	BOREHOLE NUMBER: WW
FARM: Geelaus NUMBER: 159	TOPO & WELL NUMBER:
DISTRICT: Grootfontein	LATITUDE: S 19°53'.984'
DATE COMMENCED:	LONGITUDE: E 017°41'.636'
DATE COMPLETED:	COLLAR HEIGHT: 0.5 m

GEOLOGY

from - to in (m)	DESCRIPTION
0 – 6	Drill 304mm X6m with 3m X 273m Casing Plain
6 – 30	Drill 254mm X24m with 4X6m X 219mm casing Plain and 2X6m X 219mm perforated

TOTAL DEPTH FROM SURFACE: 51 m

DIAMETER OF BOREHOLE
- 304 mm from 0 to 6
- 254 mm from 6 to 30
- 203 mm from 30 to 51

FIRST WATER STRIKE 9 m
SECOND WATER STRIKE 13 m
THIRD WATER STRIKE 37 m 36m
WATER LEVEL 3.6 m
YIELD m³/h ± 250
APPARENT QUALITY OF WATER: Good
TDS WHEN DRILLED:

INITIAL CAPACITY TEST
AIRLIFT YIELD * ☒
PUMP YIELD * ☐
YIELD IN m³/h:
DATE:
DURATION

DRILLING COSTS

ITEM			N$
m drilled	N$ per m		
testing of borehole:			
CASING			
plain	length	m	
N$ per m			
perforated	length	m	
N$ per m			
TOTAL COST			

State whether the borehole is:*
☒ successful
☐ unsuccessful
☒ Casing left in borehole
☐ Casing recovered

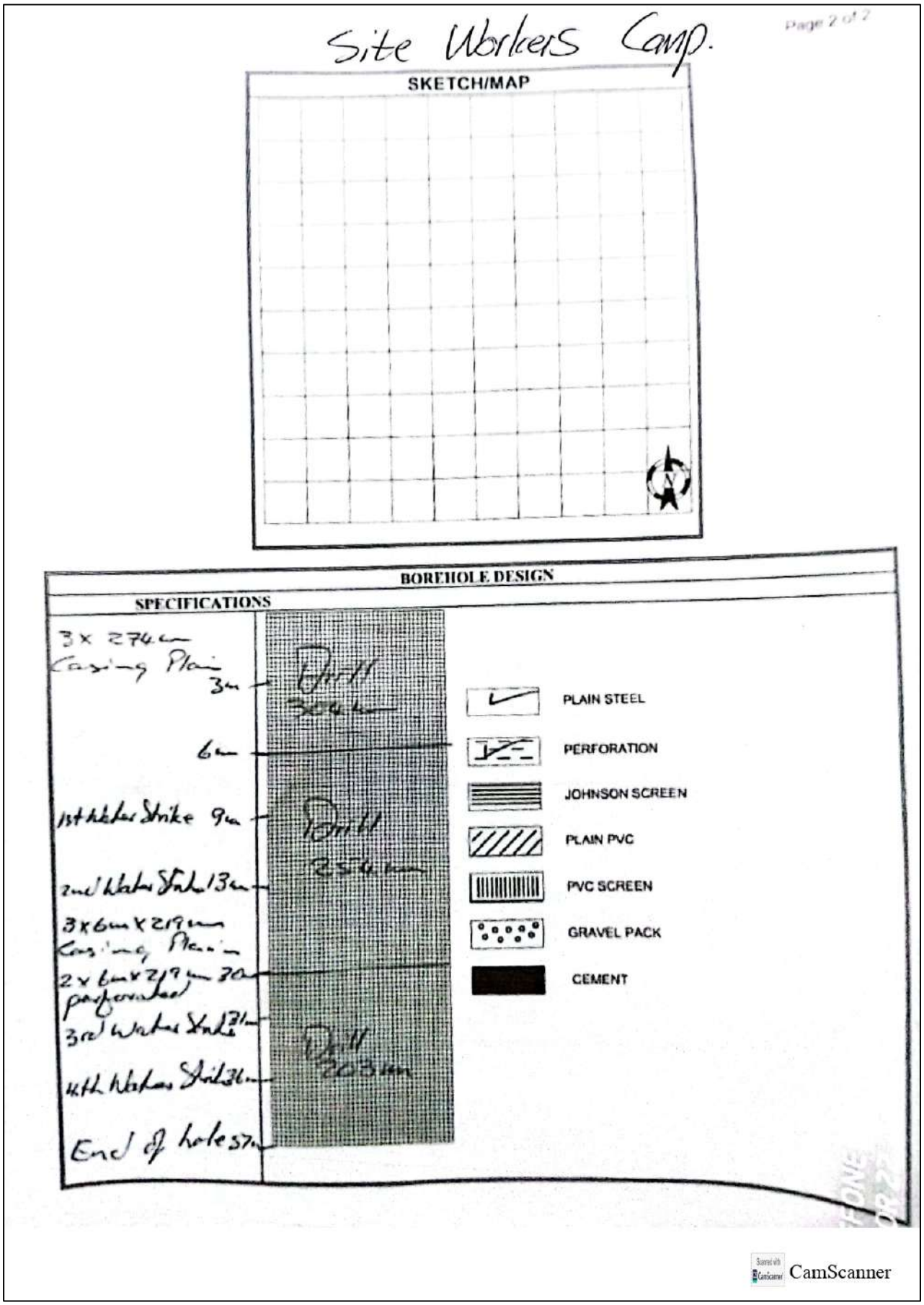
DECLARATION BY DRILLER AND DRILLING INSPECTOR

I, the driller, declare that the information supplied above is true and correct	I, the drilling inspector, declare that the information supplied above is true and correct
Signature:	Signature:
Rank: Driller	Rank:
Place: Grootfontein Date:	Place: Grootfontein Date:

* mark applicable block

Remarks:

Scanned with CamScanner


Site Workers Camp.
Page 2 of 2
SKETCH/MAP
BOREHOLE DESIGN
SPECIFICATIONS
3x 274cm Casing Plain
3m
6m
1st Water Strike 9m
2nd Water Strike 13m
3x 6m x 219mm Casing Plain
2x 6m x 219mm perforated
3rd Water Strike 31m
4th Water Strike 36m
End of hole 57m
Drill 274mm
Drill 257mm
Drill 203mm
PLAIN STEEL
PERFORATION
JOHNSON SCREEN
PLAIN PVC
PVC SCREEN
GRAVEL PACK
CEMENT
Scanned with CamScanner

APPENDIX B – TEST PUMPING DATA

Land I

Rate (l/s)	Step 1 - 30 m^3/hr		Step 2 - 50m3/hr		Step 3 - 80m3/hr)		Step 4 - 100m3/hr		Recovery		AD	RWL
Time	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	(m)	11.86
0	11.86	0		0		0		0		0	54.14	
1	12.48	0.62	13.48	1.62	14.76	2.9	16.17	4.31	13.30	1.44	54.14	
2	12.5	0.64	13.48	1.62	14.76	2.9	16.25	4.39	13.25	1.39	54.14	
3	12.55	0.69	13.48	1.62	14.77	2.91	16.32	4.46	13.21	1.35	54.14	
5	12.6	0.74	13.5	1.64	14.78	2.92	16.45	4.59	13.14	1.28	54.14	
7	12.61	0.75	13.52	1.66	14.8	2.94	16.56	4.7	13.07	1.21	54.14	
10	12.64	0.78	13.58	1.72	14.84	2.98	16.58	4.72	12.97	1.11	54.14	
15	12.67	0.81	13.66	1.8	14.91	3.05	16.6	4.74	12.88	1.02	54.14	
20	12.7	0.84	13.7	1.84	14.96	3.1	16.64	4.78	12.83	0.97	54.14	
25	12.71	0.85	13.73	1.87	14.99	3.13		-11.86	12.75	0.89	54.14	
30	12.74	0.88	13.75	1.89	15.17	3.31		-11.86	12.70	0.84	54.14	
40	12.81	0.95	13.76	1.9	15.33	3.47		-11.86	12.63	0.77	54.14	
50	12.85	0.99	13.76	1.9	15.37	3.51		-11.86	12.57	0.71		
60	12.87	1.01	13.76	1.9	15.42	3.56		-11.86	12.52	0.66		
									12.45	0.59		
									12.30	0.44		
									12.23	0.37		
									12.09	0.23		
									12.00	0.14		
									11.96	0.1		
									11.89	0.03		
									11.87	0.01		
									11.86	0		

RWL	**11.86**			
Time (min)	Drawdown (m)	Water Level (mbgl)	Recovery (m)	Recovery (mbgl)
1	3.54	15.4	2.36	14.22
2	3.74	15.6	2.28	14.14
3	3.80	15.66	2.23	14.09
5	3.85	15.71	2.19	14.05
7	3.89	15.75	2.15	14.01
10	3.95	15.81	2.09	13.95
15	4.02	15.88	2.00	13.86
20	4.14	16	1.88	13.74
25	4.22	16.08	1.77	13.63
30	4.28	16.14	1.70	13.56
35	4.35	16.21	1.62	13.48
40	4.39	16.25	1.54	13.4
50	4.45	16.31	1.49	13.35
60	4.57	16.43	1.40	13.26
75	4.64	16.5	1.31	13.17
90	4.79	16.65	1.21	13.07
105	4.87	16.73	1.14	13
120	4.97	16.83	1.05	12.91
150	5.05	16.91	0.97	12.83
180	5.19	17.05	0.87	12.73
210	5.29	17.15	0.76	12.62
240	5.39	17.25	0.69	12.55
300	5.46	17.32	0.63	12.49
360	5.57	17.43	0.52	12.38
480	5.66	17.52	0.44	12.3
600	5.77	17.63	0.32	12.18
720	5.85	17.71	0.24	12.1
840	5.93	17.79	0.20	12.06
960	5.97	17.83	0.14	12
1080	5.97	17.83	0.11	11.97
1200	5.97	17.83	0.09	11.95
1320	5.99	17.85	0.04	11.9
1440	5.99	17.85	0.02	11.88

Land II

Rate (l/s)	Step 1 - 20 m^3/hr		Step 2 - 30m3/hr		Step 3 - 50m3/hr)		Step 4 - 70m3/hr		Recovery	
Time	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)
0	10.73	0		0		0		0		0
1	12.78	2.05	17.05	6.32	23.77	13.04	39.3	28.57	16.45	5.72
2	13.81	3.08	17.18	6.45	24.87	14.14	51.8	41.07	15.61	4.88
3	14.2	3.47	17.42	6.69	25.4	14.67	53.91	43.18	15.00	4.27
5	14.29	3.56	17.91	7.18	26.29	15.56	61.29	50.56	14.87	4.14
7	14.54	3.81	18.04	7.31	27.51	16.78	65.18	54.45	13.08	2.35
10	14.56	3.83	18.1	7.37	28.57	17.84			12.71	1.98
15	14.59	3.86	18.16	7.43	28.9	18.17			12.46	1.73
20	14.59	3.86	18.17	7.44	29.12	18.39			12.31	1.58
25	14.6	3.87	18.2	7.47	29.43	18.7			12.24	1.51
30	14.63	3.9	18.23	7.5	29.52	18.79			12.17	1.44
40	14.67	3.94	18.27	7.54	29.7	18.97			12.08	1.35
50	14.75	4.02	18.35	7.62	30.45	19.72			11.95	1.22
60	14.9	4.17	18.43	7.7	30.67	19.94			11.86	1.13
70									11.79	1.06
80									11.72	0.99
90									11.64	0.91
100									11.60	0.87
120									11.54	0.81
150									11.41	0.68
180									11.30	0.57
210									11.24	0.51
240									11.19	0.46
270									11.10	0.37
300									11.06	0.33
330									11.00	0.27
360									10.95	0.22
390									10.91	0.18
420									10.87	0.14
450									10.82	0.09
480									10.77	0.04

RWL	**10.73**			
Time (min)	Drawdown (m)	Water Level (mbgl)	Recovery (m)	Recovery (mbgl)
1	7.48	18.21	4.66	15.39
2	9.02	19.75	4.40	15.13
3	9.41	20.14	4.17	14.9
5	9.74	20.47	3.83	14.56
7	9.99	20.72	3.62	14.35
10	10.17	20.9	3.37	14.1
15	10.37	21.1	3.07	13.8
20	10.49	21.22	2.87	13.6
25	10.61	21.34	2.70	13.43
30	11.05	21.78	2.56	13.29
35	11.12	21.85	2.46	13.19
40	11.18	21.91	2.41	13.14
50	11.35	22.08	2.26	12.99
60	11.47	22.2	2.17	12.9
75	11.67	22.4	2.01	12.74
90	11.88	22.61	1.88	12.61
105	11.98	22.71	1.78	12.51
120	12.07	22.8	1.69	12.42
150	12.32	23.05	1.54	12.27
180	12.51	23.24	1.44	12.17
210	12.69	23.42	1.32	12.05
240	12.81	23.54	1.17	11.9
300	13.02	23.75	1.02	11.75
360	13.21	23.94	0.88	11.61
480	13.82	24.55	0.58	11.31
600	14.12	24.85	0.47	11.2
720	14.35	25.08	0.37	11.1
840	14.45	25.18	0.27	11
960	14.52	25.25	0.21	10.94
1080	14.65	25.38	0.17	10.9
1200	14.72	25.45	0.12	10.85
1320	14.88	25.61	0.06	10.79
1440	15.02	25.75	0.00	10.73

Site Water Feed

Rate (l/s)	Step 1 - 30 m^3/hr		Step 2 - 50m3/hr		Step 3 - 70m3/hr)		Step 4 - 100m3/hr		Recovery	
Time	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)
0	8.80	0		0		0		0		0
1	9.35	0.55	9.81	1.01	10.6	1.8	12.7	3.9	9.14	0.34
2	9.35	0.55	9.96	1.16	10.66	1.86	12.79	3.99	9.05	0.25
3	9.36	0.56	10.04	1.24	10.68	1.88	12.83	4.03	9.03	0.23
5	9.37	0.57	10.09	1.29	10.76	1.96	12.86	4.06	8.99	0.19
7	9.38	0.58	10.13	1.33	10.78	1.98	12.86	4.06	8.98	0.18
10	9.39	0.59	10.19	1.39	10.78	1.98	12.86	4.06	8.97	0.17
15	9.39	0.59	10.24	1.44	10.79	1.99	12.86	4.06	8.95	0.15
20	9.39	0.59	10.26	1.46	10.79	1.99	12.86	4.06	8.93	0.13
25	9.39	0.59	10.28	1.48	10.79	1.99	12.86	4.06	8.91	0.11
30	9.39	0.59	10.29	1.49	10.79	1.99	12.86	4.06	8.88	0.08
40	9.39	0.59	10.29	1.49	10.79	1.99	12.87	4.07	8.86	0.06
50	9.39	0.59	10.29	1.49	10.79	1.99	12.87	4.07	8.85	0.05
60	9.39	0.59	10.29	1.49	10.79	1.99	12.87	4.07	8.85	0.05
70									8.84	0.04
80									8.83	0.03
90									8.82	0.02
100									8.82	0.02

RWL	**8.8**			
Time (min)	Drawdown (m)	Water Level (mbgl)	Recovery (m)	Recovery (mbgl)
1	3.12	11.92	0.55	9.35
2	3.18	11.98	0.50	9.3
3	3.23	12.03	0.48	9.28
5	3.36	12.16	0.45	9.25
7	3.36	12.16	0.43	9.23
10	3.39	12.19	0.41	9.21
15	3.44	12.24	0.39	9.19
20	3.44	12.24	0.38	9.18
25	3.45	12.25	0.37	9.17
30	3.47	12.27	0.36	9.16
35	3.50	12.3	0.35	9.15
40	3.50	12.3	0.34	9.14
50	3.52	12.32	0.33	9.13
60	3.54	12.34	0.32	9.12
75	3.56	12.36	0.31	9.11
90	3.58	12.38	0.30	9.1
105	3.60	12.4	0.29	9.09
120	3.61	12.41	0.28	9.08
150	3.61	12.41	0.26	9.06
180	3.63	12.43	0.26	9.06
210	3.65	12.45	0.24	9.04
240	3.68	12.48	0.22	9.02
300	3.75	12.55	0.20	9
360	3.83	12.63	0.18	8.98
480	3.90	12.7	0.15	8.95
600	3.93	12.73	0.13	8.93
720	3.95	12.75	0.11	8.91
840	3.95	12.75	0.08	8.88
960	3.96	12.76	0.06	8.86
1080	3.98	12.78	0.04	8.84
1200	3.98	12.78	0.02	8.82
1320	3.98	12.78	0.01	8.81
1440	3.98	12.78	0.01	8.81

Site Worker Camp

Rate (l/s)	Step 1 - 30 m^3/hr		Step 2 - 60m3/hr		Step 3 - 80m3/hr)		Step 4 - 112m3/hr		Recovery	
Time	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)
0	7.40	0		0		0		0		0
1	7.51	0.11	7.93	0.53	8.08	0.68	8.5	1.1	7.75	0.35
2	7.55	0.15	7.95	0.55	8.11	0.71	8.52	1.12	7.74	0.34
3	7.57	0.17	7.96	0.56	8.15	0.75	8.52	1.12	7.72	0.32
5	7.6	0.2	7.97	0.57	8.2	0.8	8.53	1.13	7.71	0.31
7	7.63	0.23	7.98	0.58	8.23	0.83	8.54	1.14	7.67	0.27
10	7.65	0.25	7.98	0.58	8.25	0.85	8.55	1.15	7.64	0.24
15	7.67	0.27	7.99	0.59	8.25	0.85	8.58	1.18	7.63	0.23
20	7.69	0.29	8	0.6	8.25	0.85	8.61	1.21	7.62	0.22
25	7.71	0.31	8.01	0.61	8.25	0.85	8.61	1.21	7.60	0.2
30	7.71	0.31	8.01	0.61	8.25	0.85	8.61	1.21	7.57	0.17
40	7.71	0.31	8.02	0.62	8.25	0.85	8.61	1.21	7.55	0.15
50	7.71	0.31	8.03	0.63	8.25	0.85	8.61	1.21	7.53	0.13
60	7.71	0.31	8.03	0.63	8.25	0.85	8.61	1.21	7.52	0.12
70									7.50	0.1
80									7.49	0.09
90									7.49	0.09
100									7.48	0.08
120									7.48	0.08
150									7.46	0.06
180									7.44	0.04
210									7.42	0.02
240									7.42	0.02
270									7.41	0.01

RWL	**7.4**			
Time (min)	Drawdown (m)	Water Level (mbgl)	Recovery (m)	Recovery (mbgl)
1	0.90	8.3	0.53	7.93
2	0.91	8.31	0.48	7.88
3	0.92	8.32	0.47	7.87
5	0.96	8.36	0.43	7.83
7	1.02	8.42	0.42	7.82
10	1.08	8.48	0.40	7.8
15	1.10	8.5	0.38	7.78
20	1.13	8.53	0.37	7.77
25	1.14	8.54	0.35	7.75
30	1.15	8.55	0.34	7.74
35	1.16	8.56	0.33	7.73
40	1.17	8.57	0.32	7.72
50	1.20	8.6	0.31	7.71
60	1.21	8.61	0.30	7.7
75	1.22	8.62	0.29	7.69
90	1.24	8.64	0.28	7.68
105	1.26	8.66	0.27	7.67
120	1.28	8.68	0.26	7.66
150	1.30	8.7	0.24	7.64
180	1.32	8.72	0.22	7.62
210	1.34	8.74	0.21	7.61
240	1.34	8.74	0.20	7.6
300	1.34	8.74	0.18	7.58
360	1.36	8.76	0.16	7.56
480	1.36	8.76	0.14	7.54
600	1.37	8.77	0.12	7.52
720	1.38	8.78	0.08	7.48
840	1.39	8.79	0.07	7.47
960	1.39	8.79	0.05	7.45
1080	1.40	8.8	0.03	7.43
1200	1.40	8.8	0.01	7.41
1320	1.40	8.8	0.00	7.4
1440	1.40	8.8		

House

Rate (l/s)	Step 1 - 30 m^3/hr		Step 2 - 60m3/hr		Step 3 - 90m3/hr)		Step 4 - 113m3/hr		Recovery	
Time	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)	WL mbgl	s (m)
0	7.98	0		0		0		0		0
1	8.48	0.5	9.02	1.04	9.87	1.89	10.33	2.35	8.65	0.67
2	8.48	0.5	9.03	1.05	9.9	1.92	10.41	2.43	8.50	0.52
3	8.48	0.5	9.04	1.06	9.91	1.93	10.48	2.5	8.43	0.45
5	8.49	0.51	9.05	1.07	9.94	1.96	10.67	2.69	8.39	0.41
7	8.5	0.52	9.07	1.09	9.95	1.97	10.74	2.76	8.34	0.36
10	8.5	0.52	9.07	1.09	9.97	1.99	10.89	2.91	8.31	0.33
15	8.5	0.52	9.07	1.09	9.99	2.01	10.94	2.96	8.27	0.29
20	8.51	0.53	9.07	1.09	10	2.02	10.94	2.96	8.25	0.27
25	8.51	0.53	9.07	1.09	10.01	2.03	10.94	2.96	8.21	0.23
30	8.51	0.53	9.07	1.09	10.02	2.04	10.94	2.96	8.19	0.21
40	8.51	0.53	9.07	1.09	10.03	2.05	10.96	2.98	8.14	0.16
50	8.51	0.53	9.07	1.09	10.06	2.08	10.98	3	8.09	0.11
60	8.51	0.53	9.07	1.09	10.07	2.09	11	3.02	8.04	0.06
70									8.02	0.04
80									8.00	0.02
90									8.00	0.02
100									7.99	0.01
120									7.99	0.01
150									7.99	0.01

RWL	**7.98**			
Time (min)	Drawdown (m)	Water Level (mbgl)	Recovery (m)	Recovery (mbgl)
1	1.67	9.65	0.62	8.6
2	1.85	9.83	0.52	8.5
3	1.90	9.88	0.46	8.44
5	1.96	9.94	0.41	8.39
7	1.99	9.97	0.38	8.36
10	2.02	10	0.34	8.32
15	2.07	10.05	0.32	8.3
20	2.10	10.08	0.29	8.27
25	2.12	10.1	0.27	8.25
30	2.15	10.13	0.26	8.24
35	2.15	10.13	0.25	8.23
40	2.17	10.15	0.24	8.22
50	2.21	10.19	0.23	8.21
60	2.22	10.2	0.22	8.2
75	2.24	10.22	0.20	8.18
90	2.26	10.24	0.18	8.16
105	2.28	10.26	0.15	8.13
120	2.30	10.28	0.13	8.11
150	2.33	10.31	0.12	8.1
180	2.37	10.35	0.10	8.08
210	2.41	10.39	0.10	8.08
240	2.42	10.4	0.10	8.08
300	2.46	10.44	0.09	8.07
360	2.48	10.46	0.09	8.07
480	2.50	10.48	0.08	8.06
600	2.50	10.48	0.07	8.05
720	2.50	10.48	0.06	8.04
840	2.50	10.48	0.05	8.03
960	2.50	10.48	0.04	8.02
1080	2.50	10.48	0.03	8.01
1200	2.50	10.48	0.02	8
1320	2.50	10.48	0.01	7.99
1440	2.50	10.48	0.00	7.98

APPENDIX C – LAB RESULTS

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I231776/1

To: **Retort Charcoal Producers(Pty)**
P.O.Box 30098
Windhoek

Date received: 18/Sep/23
Date analysed: 20-27 September 2023
Date reported: 30/Sep/23

Attn: Stefan
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A20402
Lab Reference: I231776
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Site
Date of sampling	2023/09/18; 08h40
Test item number	I231776/1

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.1**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**80.5**	**mS/m**	A	150	300	400	
Turbidity	**0.10**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**445**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**435**	**mg/l**					
Total Hardness as $CaCO_3$	**431**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**275**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**156**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**11**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.3**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**13**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**0.8**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**6.8**	**mg/l**	A	100	400	800	2000
Potassium as K	**0.9**	**mg/l**	A	200	400	800	
Magnesium as Mg	**38**	**mg/l**	A	70	100	200	500
Calcium as Ca	**110**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.8**						
Langelier Index	**0.3**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.5**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.1**	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			

Approved Technical Signatory
Ms. Helena Daniel

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I231776/1

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in bottles provided by the laboratory.
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

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TEST REPORT I231776/2

To: **Retort Charcoal Producers(Pty)**
P.O.Box 30098
Windhoek

Date received: 18/Sep/23
Date analysed: 20-27 September 2023
Date reported: 30/Sep/23

Attn: Stefan
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A20402
Lab Reference: I231776
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Donny
Date of sampling	2023/09/18; 08h15
Test item number	I231776/2

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.1**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**93.7**	**mS/m**	A	150	300	400	
Turbidity	**0.20**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**533**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**525**	**mg/l**					
Total Hardness as $CaCO_3$	**518**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**357**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**161**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**11**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.3**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**13**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**0.8**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**6.8**	**mg/l**	A	100	400	800	2000
Potassium as K	**0.9**	**mg/l**	A	200	400	800	
Magnesium as Mg	**39**	**mg/l**	A	70	100	200	500
Calcium as Ca	**143**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.01**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.5**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.1**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.1**	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			

Approved Technical Signatory
Ms. Helena Daniel

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TEST REPORT I231776/2

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in bottles provided by the laboratory.
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

C

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TEST REPORT – I231628

To: **Retort Charcoal Producers (PTY) Ltd**
PO Box 30098
Windhoek

Att: Mr. Stefan Falk
E-mail: stefan@charcoal.com.na
Tel: 081 316 5539

Date sample(s) received: 24/08/2023
Date sample(s) analysed: 24 - 30/08/2023
Date reported: 30/08/2023

Client reference No.: Not applicable
Quotation No.: QUA30302
Lab. Reference: I231628
Enquiries: Ms. Tanja Düvel | Windhoek Lab

1. **Temperature of cooler box at receipt:** Unsatisfactory (13°C)
2. **Number and Type of samples received:** 5 x water samples
3. **Sampling date & time:** 23/08/2023, 17:55 – 18:25
4. **Sampling location:** not provided
5. **Sampling done by:** Customer

6. **Remark: Sample acceptance**

Samples were accepted with exception
Difference(s) against the criteria was/were observed that may have influenced the accuracy of the results
- The sample was warm upon receipt, improper storage or transport of sample has occurred prior to receipt

7. **Test(s) Requested**
   - METH M 026: Total Colony count (TCC), cfu/ml
   - METH M 046: Total coliforms, MPN/100ml
   - METH M 046: *E. coli*, MPN/100ml

8. **Results**

Sample Description	Matrix	Lab Sample Number	Total Colony Count cfu/ml	Total coliforms MPN/100ml	*E. coli* MPN/100ml
Staff	Potable water	I231628/1	290	<1	<1
Residence	Potable water	I231628/2	540	2	<1
Alex	Potable water	I231628/3	640	2	<1
Donny	Potable water	I231628/4	3 200	23	<1
Site	Potable water	I231628/5	3 100	12	<1

Comments:
- < = less than
- cfu/ml = Colony forming units per millilitre
- MPN/100ml = Most probable number per 100 ml; this number is based on probability formulas and is an estimate of the mean density of bacteria in the sample
- External reference methods are listed on FM 7.1-1-5 Sample Submission Form: Microbiology Testing version 001

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TEST REPORT – I231628

Remark: Statement of conformity

- **Potable water:** test results should meet acceptable limits as per guideline of the water act (ACT 54 of 1956) and its requirements in terms of water supplies for drinking water and for wastewater treatment and discharge, Department of Water Affairs, Namibia, July 1988, to be considered as pass.

Overall classification of water considering only constituents that have been tested for:

Group A: a very safe water
Group B: microbiologically still suitable for human consumption
Group C: water with a risk factor which requires rectification
Group D: unsuitable for human consumption

Group	A	B	C	D
Total colony count, cfu/ml	≤100	≤1 000	≤10 000	>10 000
Coliform, MPN/100ml	<1	≤10	≤100	>100
E.coli, MPN/100ml	<1	<1	≤10	>10
Faecal coliform, MPN/100ml	<1	≤5	≤50	>50

Sample Description	Lab Sample Number	Classification of water
Staff	I231628/1	Group B
Residence	I231628/2	Group B
Alex	I231628/3	Group B
Donny	I231628/4	Group C
Site	I231628/5	Group C

Approved Technical Signatory
Ms. Rosina Shangula

The result(s) relate(s) only to the specific sample(s) tested as identified herein and do not apply to any similar sample that has not been tested
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FM 7.8-2 Microbiology: Statement of Conformity Version 000 Effective Date: 07.06.2022 Page **2** of **2**

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TEST REPORT I231628/1

To: **Retort Charcoal Producers**
P.O.Box 30098
Windhoek

Date received: 24/Aug/23
Date analysed: 29 August - 05 September 2023
Date reported: 07/Sep/23

Attn: Stefan Falk
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A30302
Lab Reference: I231628
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Staff
Date of sampling	2023/08/23; 18h00
Test item number	I231628/1

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.0**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**94.7**	**mS/m**	A	150	300	400	
Turbidity	**0.15**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**545**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**515**	**mg/l**					
Total Hardness as $CaCO_3$	**545**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**385**	**mg/l**	B	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**161**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**9**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.2**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**15**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**2.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**7.2**	**mg/l**	A	100	400	800	2000
Potassium as K	**1.0**	**mg/l**	A	200	400	800	
Magnesium as Mg	**39**	**mg/l**	A	70	100	200	500
Calcium as Ca	**154**	**mg/l**	B	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.2**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.1**	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			

Approved Technical Signatory
Ms. Helena Daniel

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FM 7.8-4: Water Quality (SOC) Version 001 Effective Date: 01.10.2022 Page 1 of 3

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I231628/1

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

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TEST REPORT I231628/1

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
0-6 mg/l nitrate as N: no adverse health effects

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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TEST REPORT I231628/2

To: **Retort Charcoal Producers**
P.O.Box 30098
Windhoek

Date received: 24/Aug/23
Date analysed: 29 August - 05 September 2023
Date reported: 07/Sep/23

Attn: Stefan Falk
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A30302
Lab Reference: I231628
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Residence
Date of sampling	2023/08/23; 18h05
Test item number	I231628/2

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.0**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**88.5**	**mS/m**	A	150	300	400	
Turbidity	**1.7**	**NTU**	B	1	5	10	
Total Dissolved Solids (calc.)	**511**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**490**	**mg/l**					
Total Hardness as $CaCO_3$	**517**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**352**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**165**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**8**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.2**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**15**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**1.0**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**7.3**	**mg/l**	A	100	400	800	2000
Potassium as K	**1.0**	**mg/l**	A	200	400	800	
Magnesium as Mg	**40**	**mg/l**	A	70	100	200	500
Calcium as Ca	**141**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.05**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.3**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.1**	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			

Approved Technical Signatory
Ms. Helena Daniel

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FM 7.8-4: Water Quality (SOC) Version 001 Effective Date: 01.10.2022 Page 1 of 3

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TEST REPORT I231628/2

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

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FM 7.8-4: Water Quality (SOC) Version 001 Effective Date: 01.10.2022 Page 2 of 3

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TEST REPORT I231628/3.

To: **Retort Charcoal Producers**
P.O.Box 30098
Windhoek

Date received: 24/Aug/23
Date analysed: 29 August - 05 September 2023
Date reported: 07/Sep/23

Attn: Stefan Falk
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A30302
Lab Reference: I231628
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Alex
Date of sampling	2023/08/23; 18h15
Test item number	I231628/3.

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.0**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**76.4**	**mS/m**	A	150	300	400	
Turbidity	**0.25**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**454**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**440**	**mg/l**					
Total Hardness as $CaCO_3$	**445**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**410**	**mg/l**	B	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**35**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**6**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.3**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**5**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**0.7**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**2.0**	**mg/l**	A	100	400	800	2000
Potassium as K	**0.6**	**mg/l**	A	200	400	800	
Magnesium as Mg	**8.6**	**mg/l**	A	70	100	200	500
Calcium as Ca	**164**	**mg/l**	B	150	200	400	1000
Manganese as Mn	**0.03**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.01**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.2**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.0**	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			

Approved Technical Signatory
Ms. Helena Daniel

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FM 7.8-4: Water Quality (SOC) Version 001 Effective Date: 01.10.2022 Page 1 of 3

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TEST REPORT I231628/3.

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
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Sample acceptance: Sample was collected in clients' own bottle
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

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TEST REPORT I231628/4

To: **Retort Charcoal Producers**
P.O.Box 30098
Windhoek

Date received: 24/Aug/23
Date analysed: 29 August - 05 September 2023
Date reported: 07/Sep/23

Attn: Stefan Falk
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A30302
Lab Reference: I231628
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Donny
Date of sampling	2023/08/23; 18h25
Test item number	I231628/4

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.0**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**108.7**	**mS/m**	A	150	300	400	
Turbidity	**0.30**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**619**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**630**	**mg/l**					
Total Hardness as $CaCO_3$	**626**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**285**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**342**	**mg/l**	B	290	420	840	2057
Chloride as Cl^-	**7**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.5**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**17**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**0.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**16**	**mg/l**	A	100	400	800	2000
Potassium as K	**1.2**	**mg/l**	A	200	400	800	
Magnesium as Mg	**83**	**mg/l**	B	70	100	200	500
Calcium as Ca	**114**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.3**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.0**	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			

Approved Technical Signatory
Ms. Helena Daniel

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TEST REPORT I231628/4

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
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Group D: high risk or water unsuitable for human consumption

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Sample acceptance: Sample was collected in clients' own bottle
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

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Analytical Laboratory Services
OUR QUALITY IS IN THE DETAIL

TEST REPORT I231628/5

To: **Retort Charcoal Producers**
P.O.Box 30098
Windhoek

Date received: 24/Aug/23
Date analysed: 29 August - 05 September 2023
Date reported: 07/Sep/23

Attn: Stefan Falk
e-mail: stefan@charcoal.com.na
Tel: 081-316 5539

Client Reference no.: Verbal
Quotation no.: QU-A30302
Lab Reference: I231628
Enquiries: Mrs Imogen Carew

Sample details	Water Sample
Location of sampling point	-
Description of sampling point	Site
Date of sampling	2023/08/23; 17h55
Test item number	I231628/5

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**7.0**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**93.6**	**mS/m**	A	150	300	400	
Turbidity	**0.20**	**NTU**	A	1	5	10	
Total Dissolved Solids (calc.)	**540**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**520**	**mg/l**					
Total Hardness as $CaCO_3$	**549**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**385**	**mg/l**	B	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**165**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**8**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.3**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**14**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**0.8**	**mg/l**	A	10	20	40	100
Nitrite as N	**<0.01**	**mg/l**					10
Sodium as Na	**7.3**	**mg/l**	A	100	400	800	2000
Potassium as K	**1.0**	**mg/l**	A	200	400	800	
Magnesium as Mg	**40**	**mg/l**	A	70	100	200	500
Calcium as Ca	**154**	**mg/l**	B	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.1**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**0.0**	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			

Approved Technical Signatory
Ms. Helena Daniel

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FM 7.8-4: Water Quality (SOC) Version 001 Effective Date: 01.10.2022 Page 1 of 3

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I231628/5

Remark: Overall classification of water, considering only constituents that have been tested for:
Group B: good quality water

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

Analytical Laboratory Services
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TEST REPORT – I231776

To: **Retort Charcoal Producers (PTY) Ltd**
PO Box 30098
Windhoek

Att: Mr. Stefan Falk
E-mail: stefan@charcoal.com.na
Tel: 081 316 5539

Date sample(s) received: 18/09/2023
Date sample(s) analysed: 19 - 24/09/2023
Date reported: 25/09/2023

Client reference No.: Not applicable
Quotation No.: QUA20402
Lab. Reference: I231776
Enquiries: Ms. Tanja Düvel | Windhoek Lab

1. **Temperature of cooler box at receipt:** Acceptable
2. **Number and Type of samples received:** 2 x water samples
3. **Sampling date & time:** 18/09/2023, 08:40 and 08:45
4. **Sampling location:** not provided
5. **Sampling done by:** Customer

6. **Remark: Sample acceptance**
   - Samples were suitable for testing

7. **Test(s) Requested**
   - METH M 026: Total Colony count (TCC), cfu/ml
   - METH M 046: Total coliforms, MPN/100ml
   - METH M 046: *E. coli*, MPN/100ml

8. **Results**

Sample Description	Matrix	Lab Sample Number	Total Colony Count cfu/ml	Total coliforms MPN/100ml	*E. coli* MPN/100ml
Site	Potable water	I231776/1	1 200	16	<1
Donny	Potable water	I231776/2	420	<1	<1

Comments:
- < = less than
- cfu/ml = Colony forming units per millilitre
- MPN/100ml = Most probable number per 100 ml; this number is based on probability formulas and is an estimate of the mean density of bacteria in the sample
- External reference methods are listed on FM 7.1-1-5 Sample Submission Form: Microbiology Testing version 001

Approved Technical Signatory
Ms. Rosina Shangula

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TEST REPORT – I231776

Remark: Statement of conformity

- **Potable water:** test results should meet acceptable limits as per guideline of the water act (ACT 54 of 1956) and its requirements in terms of water supplies for drinking water and for wastewater treatment and discharge, Department of Water Affairs, Namibia, July 1988, to be considered as pass.

Overall classification of water considering only constituents that have been tested for:

Group A: a very safe water
Group B: microbiologically still suitable for human consumption
Group C: water with a risk factor which requires rectification
Group D: unsuitable for human consumption

Group	A	B	C	D
Total colony count, cfu/ml	≤100	≤1 000	≤10 000	>10 000
Coliform, MPN/100ml	<1	≤10	≤100	>100
E.coli, MPN/100ml	<1	<1	≤10	>10
Faecal coliform, MPN/100ml	<1	≤5	≤50	>50

Sample Description	Lab Sample Number	Classification of water
Site	I231776/1	Group C
Donny	I231776/2	Group B

Approved Technical Signatory
Ms. Rosina Shangula

The result(s) relate(s) only to the specific sample(s) tested as identified herein and do not apply to any similar sample that has not been tested
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FM 7.8-2 Microbiology: Statement of Conformity Version 000 Effective Date: 07.06.2022 Page **2** of **2**

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TEST REPORT

Client: **Carbon Capital (Pty) Ltd**
Address: **P O Box 81009**
Windhoek

Attn: **Mr C. Lindeque**
email: colin@carboncapital.com.na
Tel: 0813433424

Date received: **0-Jan-00**
Date analysed: **3-May-21**
Date reported: **05-19-May-21**
Client Reference: verbal
Quotation: none
Lab Reference: **I210866**
Enquiries: Ms Silke Rugheimer

Test:	Manganese	Iron	Copper	Zinc	Boron	Molybdenum
Method Description:	extractable 1M ammonium acetate EDTA (pH 4.65) followed by ICP-OES				hot water ICP-OES	ammonium oxalate ICP-OES
Unit:	mg Mn/kg	mg Fe/kg	mg Cu/kg	mg Zn/kg	mg B /kg	mg Mo /kg
Lab No. **Gai Kaisa, 2021/03/24**						
1 Hole 1 <30cm	**44**	**48**	**1.6**	**6.1**	**0.3**	**0.5**
2 Hole 1 >30 <60cm	**38**	**13**	**1.3**	**0.6**	**0.5**	**0.7**

Remark Assessment of soil fertility: micronutrients
Availability of most micronutrients is largely pH dependent; availability decreases as pH increases (except for molybdenum, which becomes more available as pH increase.
Deficiencies rarely occur in soils with pH below 6.5.
Lowering soil pH to increase zinc, manganese and iron availability on a field scale is not economical. However, adding acidifying materials
such as elemental sulphur to fertiliser mixes can acidify microzones around the fertilizer material and increase micronutrient availability.
If you suspect a micronutrient deficiency, plant tissue testing may be a better diagnostic tool than soil testing.

Approved Technical Signatory
Ms S. Rügheimer

Page 1 of 1

2 December 2020

ECC Environmental
Windhoek
Namibia

For attention: Mr Lester Harker, Environmental Assessment Practitioner

ARCHAEOLOGICAL ASSESSMENT FOR PROPOSED BUSH THINNING AND CHARCOAL BURNING PROJECT NEAR KOMBAT, OTJOZONDJUPA REGION

DECLARATION

I hereby declare that I do:

(a) have knowledge of and experience in conducting assessments, including knowledge of Namibian legislation, specifically the National Heritage Act (27 of 2004), as well as regulations and guidelines that have relevance to the proposed activity;

(b) perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

(c) comply with the aforementioned Act, relevant regulations, guidelines and other applicable laws.

I also declare that I have no interests or involvement in:

(i) the financial or other affairs of either the applicant or his consultant

(ii) the decision-making structures of the National Heritage Council of Namibia.

John Kinahan, Archaeologist

EXECUTIVE SUMMARY

An archaeological/heritage reconnaissance survey was carried out on the farm Gai-Kaisa in the Otjozondjupa Region. The field survey did not locate any archaeological sites, but did record two recent grave sites. It is recommended that the project adopt the attached Chance Finds Procedure in the event of encountering buried archaeological remains in the course of development work. It is pointed out that the grave sites are protected in terms of the Burial Places Ordinance (27 of 1966).

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

Environmental Compliance Consultancy (ECC) is carrying out an environmental assessment of the farm Gai-Kaisa (159) of the Otjozondjupa Region for the purposes of a bush-thinning and charcoal production project. Land-use changes are listed in the Environmental Management Act (2007) as activities requiring environmental assessment and the issuance of an Environmental Clearance Certificate.

Archaeological remains in Namibia are protected under the National Heritage Act (2004) and National Heritage Regulations (Government Notice 106 of 2005), and ECC has accordingly appointed the undersigned, J. Kinahan, archaeologist, to carry out an assessment of the project. A field visit to the site was carried out on 19th and 20th November 2020.

1.2 Terms of Reference

The primary task of the archaeological assessment reported here was to identify sensitive archaeological/heritage sites that could be affected by the proposed exploration and mining activities. The archaeological/heritage assessment forms the basis of recommended management actions to avoid or reduce negative impacts, as part of the environmental assessment. The study is intended to satisfy the requirements of the relevant legislation and regulations, in which the process of review and clearance may require further, or different mitigation measures to be adopted.

Specifically, the archaeological/heritage assessment addresses the following primary elements:

1. The identification and assessment of potential impacts on archaeological/heritage resources, including historical sites arising from the proposed exploration and mining activities.
2. The identification and demarcation of highly sensitive archaeological/heritage sites requiring special mitigation measures to eliminate, avoid or compensate for possible destructive impacts.
3. Formulation and motivation of specific mitigation measures for the project to be considered by the authorities for the issuance of clearance certificates.
4. Identify permit requirements as related to the removal and/or destruction of heritage resources.

1.3 Assumptions & Limitations

Archaeological assessment relies on the indicative value of surface finds recorded in the course of field survey. Field survey results are augmented wherever possible by inference from the results of surveys and excavations carried out in the course of previous work in the same general area as the proposed project, as well as other sources such as historical documentation. Based on these data, it is possible to predict the likely occurrence of further archaeological sites with some accuracy, and to present a general statement (see Receiving Environment, below) of the local archaeological site distribution and its sensitivity. However, since the assessment is limited

to surface observations and existing survey data, it is necessary to caution the proponent that hidden, or buried archaeological or palaeontological remains might be exposed as the project proceeds.

2. LEGAL REQUIREMENTS

The principal instrument of legal protection for archaeological/heritage resources in Namibia is the National Heritage Act (27 of 2004). Part V Section 46 of the Act prohibits removal, damage, alteration or excavation of heritage sites or remains. Section 48 *ff* sets out the procedure for application and granting of permits such as might be required in the event of damage to a protected site occurring as an inevitable result of development. Section 51 (3) sets out the requirements for impact assessment. Part VI Section 55 Paragraphs 3 and 4 require that any person who discovers an archaeological site should notify the National Heritage Council. Heritage sites or remains are defined in Part 1, Definitions 1, as "any remains of human habitation or occupation that are 50 or more years old found on or beneath the surface".

It is important to be aware that no specific regulations or operating guidelines have been formulated for the implementation of the National Heritage Act in respect of archaeological assessment. However, archaeological impact assessment of large projects has become accepted practice in Namibia during the last 25 years, especially where project proponents need also to consider international guidelines. In such cases the appropriate international guidelines are those of the World Bank OP/ BP 4.11 in respect of "Physical Cultural Resources" (R2006-0049, revised April 2013). Of these guidelines, those relating to project screening, baseline survey and mitigation are the most relevant.

Archaeological/heritage impact assessment in Namibia may also take place under the rubric of the Environmental Management Act (7 of 2007) which specifically includes anthropogenic elements in its definition of environment. The List of activities that may not be undertaken without Environmental Clearance Certificate: Environmental Management Act, 2007 (Govt Notice 29 of 2012), and the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Govt Notice 30 of 2012) both apply to the management of impacts on archaeological sites and remains whether these are considered in detail by the environmental assessment or not.

Graves are protected under the Burial Places Ordinance (27 of 1966) and permission is required in the evnt of development work encroaching on such sites.

3. THE RECEIVING ENVIRONMENT

Farm Gai-Kaisa (159) lies 20km SE of Kombat in the northern Otjozondjupa Region. The farm is characterized by typical tree and shrub savanna with a large component of *Combretum imberbe* woodland on the headwaters of two well developed drainage lines, both northern tributaries of the Omatako omuramba. Between the drainage

lines the terrain is relatively subdued, with outcropping calcretes and dolomites of the Otavi Group overlain by shallow sandy loam soils.

Figure 1 shows the location of Gai-Kaisa in relation to known archaeological sites and proclaimed National Monuments. There has been little recent archaeological field research carried out in this area, other than a corridor survey for a NamPower transmission line (now in place) running close to the northern boundary of the property. The survey did not record any archaeological sites in this vicinity. Figure 1 shows a relatively dense distribution of archaeological sites to the SW of Gai-Kaisa and few if any records from the area to the east of the property. Although this pattern confirms the archaeological significance of the high density distribution, the existence of these records also reflects the fact that more archaeological work has been carried out on commercial farmland rather than communal farmland. In other words, the eastern parts of the Otjozondjupa Region are disproportionately under researched and the available data do not therefore provide a reliable reflection of the local archaeology.

The known archaeological/heritage record of this region spans the entire upper Pliocene to recent historical period. Early hominoid fossil remains were recovered from a limestone breccia at Berg Aukas[1] and there have been numerous investigations of sites yielding important palaeoclimatic evidence in this area[2]. Little is known of the upper Pleistocene and Holocene human occupation of the area, although the accumulated site records shown in Figure 1 demonstrate its likely importance. A systematic survey of rock art on commercial farms in the Otjozondupa Region[3] yielded a number of sites indicating the presence of hunter-gatherer communities in this area during the last 5000 years. Historical and ethnographic research on hunter-gatherer populations in this region points to the existence of widespread social networks which probably formed part of trade routes that were used by recent indigenous and colonial peoples[4]. The 19th century hunter and trader Axel Eriksson (1846

[1] Conroy, G.C., Pickford, M., Senut, B., Van Couvering, J. & Mein, P. 1992. *Otavipithecus namibiensis*, first Miocene hominoid from southern Africa. *Nature* 356: 144–8.

[2] e.g. Sletten, H.R., Railsback, L.B., Liang, F., Brook, G., Marais, E., Hardt, B.F., Cheng, H. & Edwards, L.R. 2013. A petrographic and geochemical record of climate change over the last 4600 years from a northern Namibia stalagmite, with evidence of abruptly wetter climate at the beginning of southern Africa's Iron Age. *Palaeogeography, Palaeoclimatology, Palaeoecology* 376: 149–62. See also Deacon, J. and Lancaster, N. 1988. *Late Quaternary Palaeoenvironments of Southern Africa.* Clarendon, Oxford.

[3] Breunig, P. 1986 (ed.) *Ernst-Rudolf Scherz, Felsbilder in Südwest-Afrika Vol. 3*. Die Malereien. Zusammenfassungen. Köln Wien: Böhlau Verlag.

[4] Kose, E, 2009. New light on iron-working groups along the middle Kavango in northern Namibia. *South African Archaeological Bulletin* 64: 130 – 147; Kose, E. and Richter, J. 2007. The prehistory of the Kavango people. *Sprache und Geschichte in Afrika* 18: 103-129; see also Wiessner, P. 1994. The pathways of the past: !Kung San hxaro exchange and history. In: Bollig, M. & Klees, F. eds *Uberlebensstrategien in Afrika. Colloquium Africanum* 1: 101 – 124. Cologne, Heinrich Barth Institute, and Wilmsen, E. 1989. *Land filled with flies: a political economy of the Kalahari.* University of Chicago Press. 402pp.

– 1901) is buried at Rietfontein north of Gai-Kaisa[5], and the *omiramba* drainage lines which also bisect the Gai-Kaisa property were central to Ovaherero settlement and landuse in the 18th and 19th centuries[6].

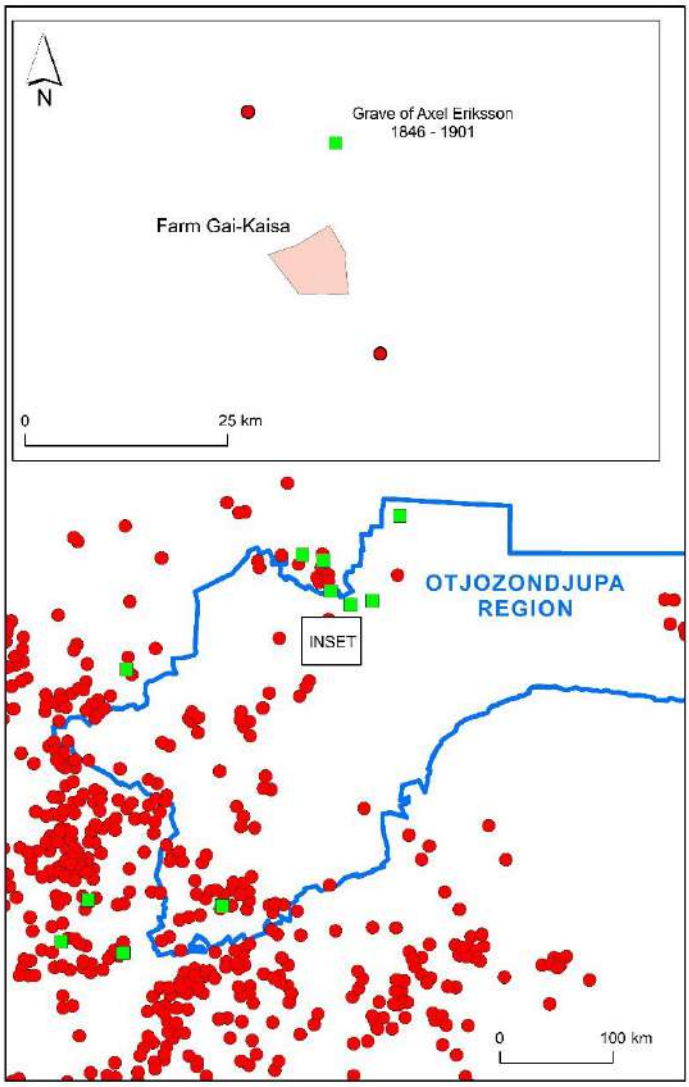

Figure 1: The location of Farm Gai-Kaisa in the Otjozondjupa Region shown in relation to known archaeological sites (red circles) and proclaimed National Monuments (green squares).

[5] Vogt, A. 2004. *National Monuments in Namibia: An inventory of proclaimed national monuments in the Republic of Namibia.* Windhoek: Macmillan.

[6] Lindholm,K.-J. 2006. *Wells of Experience: A pastoral land-use history of Omaheke, Namibia.* Studies in Global Archaeology 9, University of Uppsala.

Earlier surveys provide an indication of the archaeological importance of this general area, although the intensity of survey varies considerably and large parts of the area are archaeologically unknown, including that of Gai-Kaisa itself. The general sequence and archaeological characteristics of the area under consideration, based on current knowledge, are as follows:

a. **Pliocene and early Pleistocene (ca. 10my to 0.128my; including OIS 6, 7, 19 &c):** represented by limestone breccia material as well as surface scatters of stone tools and artefact debris, usually transported from original context by fluvial action, and seldom occurring in sealed stratigraphic context.
b. **Mid- to upper Pleistocene (ca. 0.128my to 0.040my; OIS 3, 4 & 5a-e):** represented by dense surface scatters and rare occupation evidence in sealed stratigraphic context, with occasional associated evidence of food remains.
c. **Late Pleistocene to late Holocene (ca. 0.040my to recent; OIS 1 & 2):** represented by increasingly dense and highly diverse evidence of settlement, subsistence practices and ritual art, as well as grave sites and other remains.
d. **Historical (the last ca. 250 years):** represented by remains of crude buildings, livestock enclosures, wagon routes and watering points, as well as graves, comprising small cemeteries near farm settlements or isolated burial sites.

In summary, Pliocene and early Pleistocene sites are associated with sinkholes, exhumed breccias, pans, outwash gravels, drainage lines and river gravels. These sites are difficult to detect and because they are easily overlooked in the course of development work and are often damaged or destroyed in the process. Mid- to upper Pleistocene sites occur in similar contexts to the earlier material, but hill foot-slopes and outcrops of rock suitable for artefact production (e.g. chert, fine-grained quartzites) are also focal points. Late Pleistocene to late Holocene sites occur in almost every terrain setting, with the exception of very steep slopes and mountain tops. These sites often exhibit locally integrated distribution patterns which allow some reconstruction of land-use and subsistence. Major Holocene sites include stratified occupation deposits, containing an array of organic and inorganic residues. Heritage sites relating to the historical period relate mainly to early mining and farming settlement in the vicinity of Otavi, Grootfontein, Tsumeb and outlying villages.

3.2 Observations

A reconnaissance survey of Gai-Kaisa traversed the drainage lines of the eastern and southern margins of the property and, following existing farm tracks, traversed the entire property from east to west at several points. No archaeological sites such as described above were found in the course of the survey, although two grave sites of recent date were recorded in the near vicinity of the farmhouse. These are shown in Figures 2 and 3.

Figure 2: Grave of Rosmarie (1948) and Ernst Adalbert (1963) von Goldfus.

Figure 3: Grave of Theodor, farmworker (1966), with headstone circled.

The grave of Rosmarie (1948) and Ernst Adalbert (1963) von Goldfus (Figure 2), has a dolerite headstone and is surrounded by a fenced enclosure about 200m SW of the farmhouse (-19.89653S 17.83071E). The grave and its surroundings are clearly demarcated and adequately protected. The site is not considered to be vulnerable to disturbance. However, the grave of Theodor (Figure 3), a farmworker (1966) located approximately 240m NE of farmhouse (-19.89643S 17.83109E) is a different matter. The grave is marked by a crude concrete crucifix (now fallen) and the entire site (which may contain more than one grave) has been undermined by animal burrows. The site lies approximately 250m N of what appears to be an abandoned workers' compound. This site is considered to be vulnerable and merits enclosure as in the case of the previous site.

4. CONCLUSIONS & RECOMMENDATIONS

On the basis of the field survey reported here Gai-Kaisa is not considered to be archaeologically sensitive. No archaeological sites requiring further investigation or mitigation were located in the course of the survey. It is however recommended that the proponent should adopt the Chance Finds Procedure in Appendix 1 as part of the project Environmental Management Plan.

The two grave sites located on the farm are protected in terms of the Burial Place Ordinance (27 of 1966) which was enacted to "prohibit the desecration or disturbance of graves in burial places and to regulate matters relating to the removal or disposal of dead bodies". Permission will be required if the proposed development of the farm will encroach on the grave sites.

Appendix 1: Chance Finds procedure

Areas of proposed development activity are subject to heritage survey and assessment at the planning stage. These surveys are based on surface indications alone, and it is therefore possible that sites or items of heritage significance will be found in the course of development work. The procedure set out here covers the reporting and management of such finds.

Scope: The "chance finds" procedure covers the actions to be taken from the discovery of a heritage site or item, to its investigation and assessment by a trained archaeologist or other appropriately qualified person.

Compliance: The "chance finds" procedure is intended to ensure compliance with relevant provisions of the National Heritage Act (27 of 2004), especially Section 55 (4): *" a person who discovers any archaeological …. object ……must as soon as practicable report the discovery to the Council".* The procedure of reporting set out below must be observed so that heritage remains reported to the NHC are correctly identified in the field.

Responsibility:

Operator	To exercise due caution if archaeological remains are found
Foreman	To secure site and advise management timeously
Superintendent	To determine safe working boundary and request inspection
Archaeologist	To inspect, identify, advise management, and recover remains

Procedure:

Action by person identifying archaeological or heritage material

a) If operating machinery or equipment stop work

b) Identify the site with flag tape

c) Determine GPS position if possible

d) Report findings to foreman

Action by foreman

a) Report findings, site location and actions taken to superintendent

b) Cease any works in immediate vicinity

Action by superintendent

a) Visit site and determine whether work can proceed without damage to findings

b) Determine and mark exclusion boundary

c) Site location and details to be added to project GIS for field confirmation by archaeologist

Action by archaeologist

a) Inspect site and confirm addition to project GIS

b) Advise NHC and request written permission to remove findings from work area

c) Recovery, packaging and labelling of findings for transfer to National Museum

In the event of discovering human remains

a) Actions as above

b) Field inspection by archaeologist to confirm that remains are human

c) Advise and liaise with NHC and Police

d) Recovery of remains and removal to National Museum or National Forensic Laboratory, as directed.

Appendix 2: Burial Place Ordinance 27 of 1966

Republic of Namibia
Annotated Statutes

Burial Place Ordinance 27 of 1966

(OG 2728)
came into force on date of publication: 10 June 1966

ORDINANCE

To prohibit the desecration or disturbance of graves in burial places and to regulate matters relating to the removal or disposal of dead bodies.

(Assented to 3rd June, 1966)
(English text signed by the Administrator)

ARRANGEMENT OF SECTIONS

BE IT ORDAINED by the Legislative Assembly for the Territory of South West Africa as follows:-

Definitions

1. In this ordinance, unless the context indicates otherwise -

"Administrator" means the Administrator of the Territory of South West Africa;

"body" means any human dead body including the body of any still-born child;

"burial place" means any burial ground, whether public or private, or any place wherein one or more bodies are buried, cremated or otherwise disposed of or intended to be buried, cremated or otherwise disposed of.

Desecration of graves and removal of bodies

2. (1) No person shall desecrate or destroy a grave in a burial place or, without the written permission of the Administrator, disturb or cause such grave to be disturbed.

(2) Except where the exhumation of a dead body is ordered in terms of any other law for the purposes of forensic medicine or public health and subject to the provisions of section 222 of the Municipal Ordinance, 1963 (Ordinance 13 of 1963) no person shall exhume or cause to be exhumed or disturb or cause to be disturbed or remove or cause to be removed a body or the mortal remains of a body buried in a burial place without the written permission of the Administrator or unless such precautions are observed as may be prescribed by the Administrator or any medical practitioner appointed by him: Provided that no person shall be guilty of a contravention of this sub-section who temporarily of necessity disturbs or causes to be disturbed a body or the mortal remains of a body which is buried for the purpose of burying another body in the same grave.

[The Municipal Ordinance 13 of 1963 has been replaced by the Local Authorities Act 23 of 1992.]

(3) No person shall, except with the permission of the Administrator, in any way disturb, damage, remove or destroy a grave, monument, gravestone, cross, inscription, rail, enclosure, chain or erection of any kind whatever, or part thereof in any burial place.

(4) Any person acting in contravention of the provisions of this ordinance shall be guilty of an offence and shall on conviction be liable to a fine not exceeding *one hundred* rand or, in default of payment, to imprisonment for a period not exceeding *six* months or to both such fine and such imprisonment.

Short title

3. This ordinance shall be called the Burial Place Ordinance, 1966.