ENERTRAG SOUTH AFRICA (PTY) LTD

HENDRINA GREEN HYDROGEN AND AMMONIA FACILITY

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MDARDLEA REFERENCE NUMBER: 1/3/1/16/1N-347

08 MAY 2023

DRAFT

HENDRINA GREEN HYDROGEN AND AMMONIA FACILITY

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ENERTRAG SOUTH AFRICA (PTY) LTD

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DOCUMENT DESCRIPTION

APPLICANT

ENERTRAG South Africa (Pty) Ltd

PROJECT NAME

Proposed Hendrina Green Hydrogen and Ammonia Facility, Mpumalanga, South Africa

MDARDLEA REFERENCE NUMBER

1/3/1/16/1N-347

REPORT TYPE

Draft Environmental Impact Assessment Report

WSP PROJECT NUMBER

41104000

PRODUCTION TEAM

APPLICANT

Enertrag South Africa (Pty) Ltd	Mercia Grimbeek

WSP

Project Manager	Ashlea Strong
Consultant	Thirushan Nadar
Air Quality Specialist	Kirsten Collet

SPECIALISTS

Heritage & Palaeontology Specialist	Jaco van der Walt & Marion Bamford (Beyond Heritage)
Agriculture Specialist	Johan Lanz (Independent)
Ecology Specialist	David Hoare (David Hoare Consulting (Pty) Ltd
Aquatic Specialist	Stephen Burton
Avifauna Specialist	Chris van Rooyen (Chris van Rooyen Consulting)
Social Specialist	Pierre van Jaarsveld (Urban-Econ Development Economists)
Visual Specialist	Kerry Schwartz (SLR Consulting (Pty) Ltd))
Risk Specialist	Debra Mitchell (Ishecon cc)
Bat Specialists	Werner Marais (Animalia Consultants (Pty) Ltd)
Traffic Specialist	Ahveani Ramawa (JG Afrika (Pty) Ltd)
Groundwater Specialist	Ockie Scholtz (Shangoni Management Services (Pty) Ltd)
Geotechnical	Mohammad Osman (SLR Consulting (Pty) Ltd)
Acoustic Specialist	Morné de Jager (Enviro-Acoustic Research cc)

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1 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This draft Environmental Impact Report (EIR) documents the processes and findings of the impact assessment phase of the Scoping and Environmental Impact Reporting (S&EIR) process for the proposed establishment of the for the proposed Hendrina Green Hydrogen & Ammonia Facility, located approximately 17km West of Hendrina in the Mpumalanga Province of South Africa.

The EIR aims to provide stakeholders with information on the proposed development including location, layout and technological alternatives, the scope of the environmental assessment and key impacts to be addressed in the environmental assessment, and the consultation process undertaken through the environmental impact assessment (EIA) process.

1.2 BACKGROUND INFORMATION

The proponent is proposing the development of the Hendrina Renewable Energy Complex within the vicinity of the Hendrina Power Station in Mpumalanga. The Complex consists of five distinct projects referred to as:

— Hendrina North Wind Energy Facility (up to 200MW) over 3350ha;
— Hendrina South Wind Energy Facility (up to 200MW) over 2900ha;
— Hendrina North Grid Infrastructure (up to 275kV) – 15km;
— Hendrina South Grid Infrastructure (up to 275kV) – 16km;
— **Green Hydrogen and Ammonia Facility (up to 25ha).**

The Complex (except for the Green Hydrogen and Ammonia project) is being developed in the context of the Department of Mineral Resources and Energy's (DMRE Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

The focus of this draft EIR is the proposed Hendrina Green Hydrogen and Ammonia Facility, including grid connection infrastructure project.

The proposed facility will connect directly to the nearby Collector substation through an up to 132kV powerline, which will supply the GH&A facility with green energy for the production of hydrogen (and ultimately Ammonia) via the Haber–Bosch process.

In order for the proposed project to proceed, it will require an Environmental Authorisation (EA) from the Competent Authority (CA) (i.e. the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA)).

1.3 KEY ROLE PLAYERS

1.3.1 PROJECT PROPONENT

Enertrag South Africa (Pty) Ltd is the project proponent (Applicant) with regards to this application for the construction and operation of the Facility and associated infrastructure. **Table 1-1** provides the relevant details of the project proponent.

Table 1-1: Details of Project Proponent

PROPONENT:	HENDRINA GREEN ENERGY (RF) (PTY) LTD
Contact Person:	Mercia Grimbeek
Postal Address	Suite 104, Albion Springs, 183 Main Road, Rondebosch, Cape Town, South Africa 7700
Telephone:	071 752 8033
Email:	Sandhisha.jaynarain@enertrag.co.za

1.3.2 COMPETENT AUTHORITY

Section 24C(2)(a) of NEMA stipulates that the Minister of Forestry, Fisheries, and the Environment ("the Minister") must be identified as the CA if the activity has implications for international environmental commitments or relations. GN 779 of 01 July 2016 identifies the Minister as the CA for the consideration and processing of environmental authorisations and amendments thereto for activities related the Integrated Resource Plan (IRP) 2010 – 2030.

The CA (i.e., MDARDLEA) was confirmed during the virtual Pre-Application Meeting held on **16 August 2022**.

Table 1-2 provides the relevant details of the competent authority on the Project.

Table 1-2: Competent Authority

ASPECT	COMPETENT / COMMENTING AUTHORITY	CONTACT DETAILS
Competent Authority: Environmental Authorisation	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA)	Case Officer: Dineo Tswai dineotswai77@gmail.com MDARDLEA Reference: 1/3/1/16/1N-347

1.3.3 COMMENTING AUTHORITIES

The following commenting authorities have been identified for this application:

- Department of Mineral Resources and Energy (DMRE);
- DFFE: Biodiversity and Conservation;
- DFFE: Protected Areas;
- Mpumalanga Department Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA);
- Department of Agriculture, Land Reform and Rural Development (DALRRD)
- Department of Water and Sanitation (DWS);
- Vaal Water Management Area (WMA) Authority;
- South African Heritage Resource Agency (SAHRA);
- Mpumalanga Heritage Resources Authority (MHRA);
- Mpumalanga Tourism and Parks Agency (MTPA);
- Civil Aviation Authority (CAA);
- Air Traffic and Navigation Services (ATNS);
- Department of Defence (SA Army) (DD);

- Astronomy Management Authority (AMA);
- South African Weather Services (SAWS);
- South African National Roads Agency Limited (SANRAL);
- National Energy Regulator of South Africa (NERSA)
- Nkangala District Municipality;
- Steve Tshwete Local Municipality

1.3.4 ENVIRONMENTAL ASSESSMENT PRACTITIONER

WSP Group Africa (Pty) Ltd (WSP) has been appointed in the role of Independent Environmental Assessment Practitioner (EAP) to undertake the S&EIR processes for the development of the Project. The CV of the EAP is available in **Appendix A**. The EAP declaration of interest and undertaking is included in **Appendix B**. **Table 1-3** details the relevant contact details of the EAP. In order to adequately identify and assess potential environmental impacts, a number of specialists will support the EAP.

Table 1-3: Details of the Environmental Assessment Practitioner

ENVIRONMENTAL ASSESSMENT PRACTITIONER	WSP GROUP AFRICA (PTY) LTD
Contact Person:	Ashlea Strong
Postal Address:	Building C, Knightsbridge, 33 Sloane Street, Bryanston, 2191, South Africa
Telephone:	011 361 1392
Fax:	011 361 1381
E-mail:	Ashlea.Strong@wsp.com
EAP Qualifications:	— Masters in Environmental Management, University of the Free State — B Tech, Nature Conservation, Technikon SA — National Diploma in Nature Conservation, Technikon SA
EAPASA Registration Number:	EAPASA (2019/1005)

STATEMENT OF INDEPENDENCE

Neither WSP nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any business, financial, personal or other interest that could be reasonably regarded as being capable of affecting their independence. WSP has no beneficial interest in the outcome of the assessment.

1.3.5 SPECIALISTS

Specialist input was required in support of this application for EA. The details of the specialists are provided in **Table 1-4** below. The specialist declarations are included in **Appendix C**.

Table 1-4: Details of Specialists

ASSESSMENT	NAME OF SPECIALIST	COMPANY	SECTIONS IN REPORT
Agriculture	Johann Lanz	Independent consultant	Section 7.1.5 Section 8.4 Section 9.3 Section 10.3 Section 11.2.16 **Appendix H-1**
Avifauna	Chris van Rooyen	Chris van Rooyen Consulting	Section 7.2.6 Section 8.8 Section 9.8 Section 10.4 Section 11.2.3 **Appendix H-2**
Terrestrial Biodiversity Animal Species Plant Species	David Hoare	David Hoare Consulting (Pty) Ltd	Section 7.2.2, 7.2.3 & 7.2.4 Section 8.6, 8.7 & 8.8 Section 9.5, 9.6 & 9.7 Section 104, 10.5 & 10.6 Section 11.2.4, 11.2.5 & 11.2.6 **Appendix H-3** **Appendix H-13** **Appendix H-14**
Aquatic/Wetland	Stephen Burton	Independent	Section 7.1.6 Section 8.9 Section 9.4 Section 10.2 Section 11.2.7 **Appendix H-4**
Bats	Werner Marais	Animalia Consultants (Pty) Ltd	Section 7.2.5 Section 8.3 Section 9.16 Section 10.11 Section 11.2.14 **Appendix H-5**
Heritage	Jaco van der Walt	Beyond Heritage	Section 7.3.4 Section 8.4 Section 9.12 Section 10.7 Section 11.2.8 **Appendix H-6**

ASSESSMENT	NAME OF SPECIALIST	COMPANY	SECTIONS IN REPORT
Palaeontology	Marion Bamford	Beyond Heritage	Section 7.3.4 Section 8.4 Section 9.13 Section 10.7 Section 11.2.11**Appendix H-6**
Socio-economic	Pierre van Jaarsveld	Urban Econ Development Economists	Section 7.3.6 Section 9.14 Section 10.10 Section 11.2.10 **Appendix H-7**
Traffic	Avheani Ramawa	JG Afrika (Pty) Ltd	Section 7.3.3 Section 9.11 Section 10.9 Section 11.2.13 **Appendix H-8**
Visual	Kerry Schwartz	SLR Consulting (Pty) Ltd	Section 7.3.5Section 9.9 Section 10.8 Section 11.2.12 **Appendix H-9**
Noise	Morné de Jager	Enviro-Acoustic Research cc	Section 7.3.2 Section 8.5 Section 9.2 Section 10.1 Section 11.2.2 **Appendix H-10**
SHE Risk	Debra Mitchel	Ishecon cc	Section 7.3.7 Section 9.15 Section 11.2.15 **Appendix H-12**
Air Quality	Kirsten Collett	WSP Group Africa (Pty) Ltd	Section 7.1.2 Section 8.2 Section 9.1 Section 11.2.1 **Appendix H-11**
Desktop Geotechnical	Muhammad Osman	SLR Consulting (South Africa) (Pty) Ltd	Section 7.1.4 Section 11.2.9 **Appendix H-15**
Groundwater	Ockie Scholtz	Shangoni Management Services (Pty) Ltd	Section 7.1.7 Section 9.17 Section 11.2.17 **Appendix H-16**

1.4 IMPACT ASSESSMENT TERMS OF REFERENCE

The 2014 Environmental Impact Assessment (EIA) Regulations (GNR 982), as amended, identifies the proposed Hendrina G&A development as an activity being subject to an S&EIR process due to the applicability of the EIA Listing Notices 1 and 2 (GNR 983 and 984, as amended). In order for the project to proceed it will require an Environmental Authorisation (EA) from MDARDLEA.

WSP has been appointed as the independent EAP to carry out the S&EIR process in accordance with the EIA Regulations, 2014, as amended in 2017.

The Scoping Process has been completed and involved consultation with interested and affected parties and the drafting of the Plan of Study (PoS) for EIA, which culminated in the submission of a Final Scoping Report (FSR) to the MDARDLEA. The MDARDLEA acceptance of the FSR and authorisation to proceed with the EIR was received on 15 March 2023 (dated 14 March 2023) (**Appendix G**).

This draft EIAr will be made available for public comment from **8 May 2023 to 7 June 2023.**

As defined in Appendix 3 of GNR 982, as amended, the objective of the impact assessment process is to, through a consultative process:

- Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
- Describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- Identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
- Determine the—
  - Nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
  - Degree to which these impacts-
    - Can be reversed;
    - May cause irreplaceable loss of resources, and
    - Can be avoided, managed or mitigated;
- Identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
- Identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
- Identify suitable measures to avoid, manage or mitigate identified impacts; and
- Identify residual risks that need to be managed and monitored.

Public participation is a requirement of the S&EIR process; it consists of a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the S&EIR decision-making process. Effective public participation requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the Proposed Project. The objectives of the public participation process can be summarised as follows:

- Identify relevant individuals, organisations and communities who may be interested in or affected by the Proposed Project;
- Clearly outline the scope of the Proposed Project, including the scale and nature of the existing and proposed activities;
- Identify viable Proposed Project alternatives that will assist the relevant authorities in making an informed decision;
- Identify shortcomings and gaps in existing information;

— Identify key concerns, raised by Stakeholders that should be addressed in the subsequent specialist studies;
— Highlight the potential for environmental impacts, whether positive or negative; and
— To inform and provide the public with information and an understanding of the Proposed Project, issues and solutions.

1.5 IMPACT ASSESSMENT REPORT STRUCTURE

Table 1-5 cross-references the sections where the legislated requirements as per Appendix 3 of GNR 982 of 2014 can been located within the EIR.

Table 1-5: Legislated Report Requirements as detailed in GNR 982

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
(a)	Details of	
	the EAP who compiled the report; and	Section 1.3.4 Appendix A
	the expertise of the EAP, including a Curriculum Vitae	Appendix A
(b)	The location of the activity, including-	
	The 21-digit Surveyor code for each cadastral land parcel;	Section 6.1
	Where available, the physical address and farm name	Section 6.1
	Where the required information in terms of (i) and (ii) is not available, the coordinates of the boundary of the property.	N/A
(c)	A plan which locates the proposed activities applied for at an appropriate scale, or, if it is-	
	A linear activity, a description of the corridor in which the proposed activity or activities is to be undertaken; or	Section 6
	On land where the property has not been defined, the coordinates within which the activity is to be undertaken.	N/A
(d)	A description of the proposed activity, including-	
	All listed and specified activities triggered and being applied for;	Section 2.1
	A description of the associated structures and infrastructure related to the development;	Section 6
(e)	A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	Section 2
(f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	Section 5
(h)	A full description of the process followed to reach the proposed development footprint within the approved site, including-	
	Details of the development footprint alternatives considered;	Section 6.5
	Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Section 4.3

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
	A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Appendix D
	The environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Section 7
	The impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated.	Section 9
	The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;	Section 4.2
	Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Section 9
	The possible mitigation measures that could be applied and level of residual risk;	Section 9
	If no alternative development locations for the activity were investigated, the motivation for not considering such; and	Section 6.5
	A concluding statement indicating the preferred alternative development location within the approved site.	Section 6.5
(i)	A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including-	
	A description of all environmental issues and risks that were identified during the environmental impact assessment process; and;	Section 9
	An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	Section 9
(j)	An assessment of each identified potentially significant impact and risk, including-	
	Cumulative impacts;	Section 10
	The nature, significance and consequences of the impact and risk;	Section 9
	The extent and duration of the impact and risk;	Section 9
	The probability of the impact and risk occurring;	Section 9
	The degree to which the impact and risk can be reversed;	Section 9

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
	The degree to which the impact and risk may cause irreplaceable loss of resources; and	Section 9
	The degree to which the impact and risk can be mitigated.	Section 9
(k)	Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report.	Section 11.2
(l)	An environmental impact statement which contains-	
	A summary of the key findings of the environmental impact assessment:	Section 111
	A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	Section 111
	A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.	Section 6.5 & Section 11.3
(m)	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.	Appendix I
(n)	The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment.	Section 6.5
(o)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Section 9
(p)	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed.	Section 1.7
(q)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	Section 11.5
(r)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised.	N/A
(s)	An undertaking under oath or affirmation by the EAP in relation to-	
	The correctness of the information provided in the report;	Appendix B
	The inclusion of comments and inputs from stakeholders and l&APs;	Appendix B
	The inclusion of inputs and recommendations from the specialist reports where relevant; and	Appendix B
	Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.	Appendix B

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
(t)	where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts	N/A
(u)	An indication of any deviation from the approved scoping report, including the plan of study, including-	N/A
	any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and	N/A
	a motivation for the deviation	N/A
(v)	Any specific information required by the competent authority; and	N/A
(w)	Any other matter required in terms of section 24(4)(a) and (b) of the Act	N/A

1.6 ADDITIONAL PERMITS AND AUTHORISATIONS

Table 1-6 outlines the additional permits and authorisations required for the proposed development, as well as the relevant Competent Authorities responsible.

Table 1-6: Additional Permits and Authorisations required for the proposed development

PERMITS/AUTHORISATION	LEGISLATION	RELEVANT AUTHORITY	STATUS
Water Use Licence / General Authorisation	National Water Act (Act No. 36 of 1998)	Department of Water and Sanitation	Application process will run concurrently with the EIA Phase.
Atmospheric Emissions License	National Environmental Management: Air Quality Act (Act 39 of 2004)	Nkangala District Municipality	Application process will run concurrently with the EIA Phase.
Section 38 Notification	National Heritage Resource Act (Act No. 25 of 1999)	Mpumalanga Heritage Resources Authority	In Process

1.7 ASSUMPTION AND LIMITATIONS

General assumptions and limitations

- The EAP hereby confirms that they have undertaken to obtain project information from the client that is deemed to be accurate and representative of the project;
- Site visits have been undertaken to better understand the project and ensure that the information provided by the client is correct, based on site conditions observed;
- The EAP hereby confirms their independence and understands the responsibility they hold in ensuring all comments received are accurately replicated and responded to within the EIA documentation;
- The comments received in response to the public participation process, will be representative of comments from the broader community; and
- Based on the Pre-Application meeting and subsequent minutes, the CA would not require additional specialist input, in order to make a decision regarding the application.

Agricultural

There are no specific assumptions, uncertainties or gaps in knowledge or data that affect the findings.

Risk

The following assumptions and limitations are associated with the study:

- For the purpose of this high-level risk assessment a general area visit was conducted.
- A desktop study of the available information, preliminary layouts of the facilities and associated locations, reports of related incidents and various literature sources was undertaken.
- The facility and the project were divided into the sections/phases and using a checklist approach the hazards in each section/phase were identified.
- Each identified hazard was then analysed in terms of causes, consequences, expected and suggested preventive and mitigative measures to be in place.
- Each hazard was qualitatively assessed using a qualitative risk ranking system.

Aquatic Ecology

The following assumptions and limitations are associated with the study:

- Findings and data analysis are based on the wetland assessment site visit completed in 2019, and again in 2021. The site visits were adequate to address the objectives of the study.
- Wetlands situated within the 500 m zone of regulation were assessed on a desktop level with very limited ground-truthing and some discrepancies within this zone may occur.
- The wetland and aquatic study forms part of this larger EIA and should be read in conjunction with the EIA and other related specialist studies.
- Findings, recommendations, and conclusions provided in the report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author and/or a relevant reference to the report by the inclusion of an appropriately detailed citation. Any recommendations, statements, or conclusions drawn from or based on this report must cite or reference this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.

Avifauna

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

- The SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring which was conducted over 12 months at the two proposed Hendrina wind farms.
- Conclusions in this specialist report are based on experience of these and similar species at wind farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.
- The precautionary principle was applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."

Plant Species

- The purpose of the fieldwork undertaken for this Project was to characterize the habitat of the study area, compile checklists from as diverse a variety of habitats as possible, and to map habitats within the entire collection of farms within which the Project is situated.
- The proposed project layout was provided during the EIA process; therefore no development footprint areas were assessed for the Project, only the general area in which the project is located.

— A final walk-through to survey conducted in Spring or early Summer is therefore recommended to check for potential species of conservation concern within footprints of the development.

Animal Species

— Inventory surveys of animal species occurring on a site are difficult to achieve within the time-frames associated with an EIA. In order to compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons, be undertaken over a number of years and include extensive sampling. It is more important to know of fauna of value, as well as ecological processes. Therefore, the assessment attempts to identify threatened and other significant species, important habitats, and ecological processes.

— Compiling the list of species that could potentially occur on site is limited by the density of collection records for the area. The list of animal species that could potentially occur on site was therefore taken from a wider area and from literature sources that may include species that do not occur on site and may miss species that do occur on site.

— The assessment is based on a field survey conducted 3-7 February 2020. The current study is based on an extensive site visit as well as a desktop study of the available information. The time spent on site was adequate for understanding general patterns across affected areas. The seasons in which the fieldwork (peak summer flowering period) was conducted was ideal for assessing the composition and condition of the vegetation, which is also suitable for assessing habitat condition and suitability for animals.

Terrestrial Biodiversity

The following assumptions, limitations, uncertainties are listed regarding the ecological assessment of the Hendrina site:

— The assessment is based on a field survey conducted 3-7 February 2020. The current study is based on an extensive site visit as well as a desktop study of the available information. The time spent on site was adequate for understanding general patterns across affected areas.

— The seasons in which the fieldwork (peak summer flowering period) was conducted was ideal for assessing the composition and condition of the vegetation.

— The vegetation was in good condition for sampling at the time of the field assessment, and the species lists obtained are considered reliable and relatively comprehensive.

— Compiling the list of species that could potentially occur on site is limited by the paucity of collection records for the area.

— The list of plant species that could potentially occur on site was therefore taken from a wider area and from literature sources that may include species that do not occur on site and may miss species that do occur on site. To compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons, be undertaken over several years and include extensive sampling. Due to time constraints, this was not possible for this study. However, the comprehensive field survey is sufficient for the purposes of this report.

Social

The following assumptions are associated with the social impact assessment study:

— The construction of the facility is planned to commence in 2025 contingent on project approval and will take 24 months to complete.

— The total South African investment into the establishment of the Green Hydrogen and Ammonia Facility is valued at R 4,2 billion.

— Only local expenditure is considered in the analysis.

— The construction of the facility will create an estimated 300 project specific full time equivalent (FTE) employment positions.

— The facility is anticipated to begin operating once construction is completed in 2027.

— The facility will operate for 20 years.

— The operations and maintenance cost of the facility will be valued at R 80,0 million per annum over the 20-year operational life of the project.

— The operation of the facility will create an estimated 100 full time equivalent (FTE) employment.

- The costs of decommissioning the plant are not yet known. Given the nature of green hydrogen technology, it is highly likely that instead of decommissioning the plant, the facility will be refurbished in order to extend its lifespan beyond the 20-year period.

Visual

The following assumptions and limitations are associated with the visual study:

- Given the nature of the receiving environment and the assumed height of certain components of the Facility and associated grid infrastructure, the study area or visual assessment zone is assumed to encompass an area of 5km from the boundaries of the three proposed site alternatives, and 5km from the outer boundary of the combined powerline assessment corridor. This limit on the visual assessment zone relates to the fact that visual impacts decrease exponentially over distance. Thus, although the higher elements of the Facility and the powerline towers may theoretically still be visible beyond 5km, the degree of visual impact would diminish considerably. As such, the need to assess the impact on potential receptors beyond this distance would not be warranted.
- The identification of visual receptors involved a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potential receptors within the study area. Where possible, these receptor locations were verified and assessed during a site visit which was undertaken in September 2019. Due to the extent of the study area however and the number of receptors that could potentially be sensitive to the proposed development, it was not possible to visit or verify every potentially sensitive visual receptor location. As such, several broad assumptions have been made in terms of the likely sensitivity of the receptors to the proposed development.
- It should be noted that not all receptor locations would necessarily perceive the proposed development in a negative way. This is usually dependent on the use of the facility, the economic dependency of the occupants on the scenic quality of views from the facility and on people's perceptions of the value of "Green Energy". Sensitive receptor locations typically include sites such as tourism facilities and scenic locations within natural settings which are likely to be adversely affected by the visual intrusion of the proposed development. Thus, the presence of a receptor in an area potentially affected by the proposed development does not necessarily mean that any visual impact will be experienced.
- The potential visual impact at each sensitive visual receptor location was assessed using a matrix developed for this purpose. The matrix is based on three main parameters relating to visual impact and, although relatively simplistic, it provides an indicative assessment of the degree of visual impact likely to be experienced at each receptor location as a result of the proposed development. It is however important to note the limitations of quantitatively assessing a largely subjective or qualitative type of impact and as such the matrix should be seen merely as a representation of the likely visual impact at a receptor location.
- As stated, the exact status of all the receptors could not be verified during the field investigation and as such the receptor impact rating was largely undertaken via desktop means.
- Where receptors have been identified within the Hendrina North or South Wind Energy Facility project areas, it has been assumed that the landowners or residents at these locations support the proposed renewable energy development and would not view the project in a negative light.
- Based on the project description provided by the Proponent, visual analysis for the Facility is based on a worst-case scenario where the highest structure associated with the Facility (Air Separation Unit) is assumed to be 40m.
- Visual analysis in respect of the powerlines is based on a worst-case scenario where power line tower heights are assumed to be 35m.
- Due to the varying scales and sources of information; maps may have minor inaccuracies. Terrain data for this area, derived from the National Geo-Spatial Information (NGI)'s 25m Digital Elevation Model (DEM), is fairly coarse and somewhat inconsistent and as such, localised topographic variations in the landscape may not be reflected on the DEM used to generate the viewshed(s) and visibility analysis conducted in respect of the proposed development.
- In addition, the viewshed / visibility analysis does not consider any existing vegetation cover or built infrastructure which may screen views of the proposed development. This analysis should therefore be seen as a conceptual representation or a worst-case scenario.
- No feedback regarding the visual environment has been received from the public participation process to date. Any feedback from the public during the review period of the Draft EIA Report (DEIR) for the Facility and OHL infrastructure will however be incorporated into further drafts of this report, if relevant.

- At the time of undertaking the visual study no details were available regarding the type and intensity of lighting that will be required for the proposed Facility and therefore the potential impact of lighting at night has not been assessed at a detailed level. General measures to mitigate the impact of additional light sources on the ambiance of the nightscape have however been provided.
- In the light of the fact that green hydrogen facilities are still relatively new in South Africa, this report is based on assumptions as to the likely generic impacts associated with the proposed development.
- This study includes an assessment of the potential cumulative impacts of other renewable energy and infrastructural / mining developments on the existing landscape character and on the identified sensitive receptors. This assessment is based on the information available at the time of writing the report and where information has not been available, broad assumptions have been made as to the likely impacts of these developments.
- It should be noted that the fieldwork for this study was undertaken in mid-September 2019, during late winter which is characterised by low levels of rainfall and reduced vegetation cover. In these conditions, increased levels of visual impact will be experienced from receptor locations in the surrounding area.
- The overall weather conditions in the study area have certain visual implications and are expected to affect the visual impact of the proposed development to some degree. In clear weather conditions, the Facility and powerlines would present a greater contrast with the surrounding environment than they would on an overcast day. Although the field investigation was conducted during clear weather conditions, localised pollution in the study area resulted in relatively hazy skies which would reduce the visibility of the Facility.

Heritage and Palaeontology

The following limitations are associated with the heritage study:

- The authors acknowledge that the brief literature review is not exhaustive on the literature of the area.
- Due to the nature of heritage resources and pedestrian surveys, the possibility exists that some features or artefacts may not have been discovered/recorded and the possible occurrence of graves and other cultural material cannot be excluded.
- The discrepancy between Google Earth, handheld GPS and GIS projections could cause some deviation on actual locations of sites and should be verified.
- The EAP must also confirm if all the project components have been addressed during this study.
- This report only deals with the footprint area of the proposed development and consisted of non-intrusive surface surveys focussing on tangible heritage along the project footprint.
- The corridors were assessed on desktop level only. This study did not assess the impact on medicinal plants and intangible heritage as it is assumed that these components would have been highlighted through the public consultation process if relevant.
- It is possible that new information could come to light in future, which might change the results of this Impact Assessment.

Noise

The following assumptions and limitations are associated with the acoustic assessment study.

These constraints and limitations are discussed below and could include:

- Seasonal changes in the surrounding environment can influence typical ambient sound levels, as many faunal species are more active during warmer periods than the colder periods. As an example, cicada is usually only active during warmer periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals;
- Defining ambient sound levels using the result of one 10-minute measurement may be very inaccurate (very low confidence level in the results) relating to the reasons mentioned above, and measurements over a longer-term period is critical;

The assumptions include the following:

- It is technically difficult and time-consuming to improve the measurement of spectral distribution of large equipment in an industrial setting. This is due to the many correction factors that need to be considered (e.g., other noise sources active in the area, adequacy of average time setting, surrounding field non-uniformity etc.19 as per SANS 9614-3:2005);

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would likely be over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor, nor the potential effect of the modulation of amplitude of the noise;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (DEM) data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify

Due to the uncertainties highlighted above, modelling generally could be out with as much as +10 dBA (the potential noise level is over-modelled), although realistic values ranging from 3 dBA to less than 5 dBA are more common in practice.

Air Quality

Activity data (i.e. storage tank specifications, forecasted throughputs, etc.) was provided by Enertrag SA. Any errors, limitations or assumptions inherent in this data extend to the air quality assessment.

Desktop Geotechnical

The following assumptions and limitations are associated with the desktop geotechnical study

- The interpretation of the overall geotechnical conditions across the site is based on a review of available information on the project area.
- Subsurface and geotechnical conditions have been inferred at a desktop level from the available information, past experience in the project area and professional judgement.
- The information and interpretations are given as a guideline only and there is no guarantee that the information given is totally representative of the entire area in every respect.
- The information must be verified by the undertaking of a detailed geotechnical site investigation.

Bats

As with any environmental study, there are certain assumptions and limitations that exist around the current knowledge we possess regarding bats and their behaviour, movements and distribution. Some important points are discussed briefly below:

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.
- The migratory paths of bats are largely unknown, thus some uncertainty in this regard will remain until the end of operational monitoring of at least 2 years.
- The sensitivity map is based partially on satellite imagery and from detailed site visits, although given the large extent of the site, there is always the possibility that what has been mapped may differ slightly to what is on the ground.

Traffic

The traffic impact assessment assumptions associated with the construction phase with the are as follows:

- This study is based on the project information provided by the client.
- According to the Eskom Specifications for Power Transformers (Eskom Power Series, Volume 5: Theory, Design, Maintenance and Life Management of Power Transformers), the following dimensional limitations

need to be kept when transporting the transformer 3 total maximum height 5 000mm, total maximum width 4 300mm and total maximum length 10 500mm.

- It is envisaged that for this project, the inverter, transformer, and switchgear will be transported to site in containers on a low bed truck and trailer. A mobile crane and the transformer transport are the only abnormal load envisaged for the site. The crane will be utilised for offloading equipment, such as the transformers.
- Maximum vertical height clearances along the haulage route are 5.2m for abnormal loads.
- If any elements are manufactured within South Africa, these will be transported from their respective manufacturing centres, which would be either in the greater Cape Town area, Johannesburg, or possibly Pinetown/Durban.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
- Material for the construction of internal access roads will be sourced locally as far as possible.
- Abnormal loads expected as summarised below:

  Water Treatment Unit (to be delivered to site in modular units)

  Electrolyser Unit (to be delivered to site in modular units)

  Air Separation Unit (to be delivered to site in modular units)

  Ammonia Processing Unit (to be delivered to site in modular units)

  Liquid Air Storage System (LAES) (to be delivered to site in modular units)

  Liquid Ammonia Storage Tank (to be delivered to site in modular units)

  Hydrogen Storage Tank (to be delivered to site in modular units)
- Port of entry is envisaged to be the Port of Richards Bay.
- The construction period is estimated at 24 months.

Groundwater

Notwithstanding these assumptions and limitations, it is the view of WSP that this EIR provides a good description of the issues associated with the project, and a reasonable plan of study for this EIA phase.

2 GOVERNANCE FRAMEWORK

2.1 NATIONAL ENVIRONMENTAL LEGAL FRAMEWORK

The South African regulatory framework establishes well-defined requirements and standards for environmental and social management of industrial and civil infrastructure developments. Different authorities at both national and regional levels carry out environmental protection functions. The applicable legislation and policies are shown in **Table 2-1**.

Table 2-1: Applicable National Legislation[1]

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
The Constitution of South Africa (No. 108 of 1996)	The Constitution cannot manage environmental resources as a stand-alone piece of legislation hence additional legislation has been promulgated in order to manage the various spheres of both the social and natural environment. Each promulgated Act and associated Regulations are designed to focus on various industries or components of the environment to ensure that the objectives of the Constitution are effectively implemented and upheld in an on-going basis throughout the country. In terms of Section 7, a positive obligation is placed on the State to give effect to the environmental rights.
National Environmental Management Act (No. 107 of 1998)	In terms of Section 24(2) of the NEMA, the Minister may identify activities, which may not commence without prior authorisation. The Minister thus published GNR 983 (as amended) (Listing Notice 1), GNR 984 (as amended) (Listing Notice 2) and GNR 985 (as amended) (Listing Notice 3) listing activities that may not commence prior to authorisation. The regulations outlining the procedures required for authorisation are published in the EIA Regulations of 2014 (GNR 982) (as amended). Listing Notice 1 identifies activities that require a BA process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. Listing Notice 2 identifies activities that require an S&EIR process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. Listing Notice 3 identifies activities within specific areas that require a BA process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. WSP undertook a legal review of the listed activities according to the proposed project description to conclude that the activities listed in in this section are considered applicable to the development: A S&EIR process must be followed. An EA is required and will be applied for with the MDARDLEA.
Listing Notice 1: GNR 983	***Activity 9(i)*** *The development of infrastructure exceeding 1 000 metres in length for the bulk transportation of water or storm water—* *(i) with an internal diameter of 0,36 metres or more; or* *(ii) with a peak throughput of 120 litres per second or more;* *excluding where—* *(a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve or railway line reserve; or* *(b) where such development will occur within an urban area.* **Description**:

[1] It should be noted that all dimensions outlined in relation to Listing Notice 1, 2 and 3 are provisional and are subject to final design.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	The Facility is located outside an urban area and will require, depending on the water source and water quality obtained, an above or below ground water supply pipeline exceeding 1 000 metres in length, of internal diameter in excess of 0,36m towards feed water supply of the Facility. The exact pipeline specifications will be confirmed once final designs have been provided.
	Activity 10(i) *The development and related operation of infrastructure exceeding 1 000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes –* *(i) with an internal diameter of 0,36 metres or more; or* *(ii) with a peak throughput of 120 litres per second or more;* *excluding where—* *(a) such infrastructure is for the bulk transportation of sewage, effluent, process* *water, waste water, return water, industrial discharge or slimes inside a road reserve or railway line reserve; or* *(b) where such development will occur within an urban area.* **Description**: The Facility is located outside an urban area and road/railway line reserve, and will require infrastructure exceeding 1000m in length for the bulk transportation of effluent/process water of internal diameter in excess of 0,36m for crystallisation, associated with the Reverse Osmosis plant. The exact pipeline specifications will be confirmed once final designs have been provided.
	Activity 11(i) *The development of facilities or infrastructure for the transmission and distribution of electricity—* *(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or* *(ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more;* **Description**: The Facility is located outside urban areas and will be supplied with electricity by a single up to 132kV overhead or underground power line from a common Collector Substation. In addition, electrical substation infrastructure associated with the Facility is rated at 33/132kV whilst being located outside urban areas or industrial complexes.
	Activity 12(ii)(a)(c) *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; **Description**: The physical footprint of access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed $100m^2$ within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site. The exact footprint will be confirmed once final designs have been provided.
	Activity 16 *The development and related operation of facilities for the desalination of water with a design capacity to produce more than 100 cubic metres of treated water per day.* **Description**: The Facility's Reverse Osmosis (RO) infrastructure (with a design capacity to produce ~3182 m^3 purified/treated water per day) will be required to supply the electrolysis process with sufficient quality feed water.
	Activity 19 *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;* **Description**: Access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will collectively require the excavation, infilling or removal of soil exceeding $10m^3$ from delineated watercourses on site. The exact values will be confirmed once final designs have been provided.
	Activity 24(ii) *The development of a road—* *(i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or* *(ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres;* **Description**: Internal and access roads required by the Facility will be between 5m and 6m wide, and exceed 1km in length in a rural area. Where required for turning circle/bypass areas, however, access or internal roads may be up to 20m to allow for larger component transport. The exact values will be confirmed once final designs have been provided.
	Activity 25 *The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	Description: Depending on the water source and water quality obtained, an evaporator / crystalliser for the treatment of more than 2 000m^3 effluent at any one time will be constructed and operated as part of the Facility.
	Activity 27 *The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation* **Description**: The power lines, water pipelines and access/internal roads related to the Facility are considered linear activities and therefore is excluded from this activity. However, the respective infrastructure components related to the Facility individually require in excess of 1 ha but not more than 20ha of indigenous vegetation clearance each. The exact values will be confirmed once final designs have been provided.
	Activity 28(ii) *Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development:* *(i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;* **Description**: The Facility development footprint is collectively approximately 30ha (subject to finalisation based on technical and environmental requirements). As part of this buildable area, infrastructure such as the individual components will have footprints of between 1 ha and 12ha, all located outside an urban area and which is currently used for agriculture.
	Activity 30 *Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).* **Description:** The Facility and associated infrastructure is located within, and will require vegetation clearance or disturbance of Eastern Highveld Grassland this ecosystem is listed in the National List of Ecosystems That Are Threated And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
	Activity 48(i)(a)(c) *The expansion of—* *(i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; or* *(ii) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 100 square metres or more;* *where such expansion occurs—*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(a) within a watercourse; *(b) in front of a development setback; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;* **Description**: Transport of large infrastructure components related to the Facility will require the expansion of existing access and/or internal roads, culverts or similar drainage crossing infrastructure collectively exceeding $100m^2$ or more beyond existing road or road reserves located within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site. The exact values will be confirmed once final designs have been provided.
	Activity 56(i)(ii) *The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre—* *(i) where the existing reserve is wider than 13,5 meters; or* *(ii) where no reserve exists, where the existing road is wider than 8 metres;* **Description**: The Facility is located within a rural area. Transport of large infrastructure components related to the facility will require the widening of existing access and/or internal roads where no reserve exists and where such road is wider than 8 metres.
Listing Notice 2: GNR 984	***Activity 4*** *The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.* **Description**: Dangerous goods product stores related to the operation of the Facility include Nitrogen, Oxygen, Hydrogen and Ammonia storage tanks (of varying sizes, pressures and temperatures) in excess of $500m^3$. In addition, fuel, cement, transformer oil and other chemicals will be stored onsite. Collectively all storage and handling of dangerous goods on site will exceed $500m^3$.
	Activity 6 *The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent,* *excluding—* *(i) activities which are identified and included in Listing Notice 1 of 2014;* *(ii) activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies;* *(iii) the development of facilities or infrastructure for the treatment of effluent, polluted water, wastewater or sewage where such facilities have a daily throughput capacity of 2 000 cubic metres or less; or*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(iv) where the development is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will not exceed 50 cubic metres per day. **Description**: The Facility will produce up to 100,000 tons per annum of liquid ammonia and therefore potentially requires licensing in terms of the NEM: AQA (specifically Category 7, subcategory 7.1: "Production and or Use in Manufacturing of Ammonia, Fluorine, Fluorine Compounds, Chlorine, and Hydrogen Cyanide", with a threshold trigger value of greater than 100 tons per annum). The activity identified in the NEM: AQA however relates to the production of Ammonia, regardless of the nature of the process undertaken in production. During operation of the Facility, gases purged are: — Not altered in the process; — Not considered ambient pollutants; and — Not regulated by the Minimum Emissions Standards (MES); The applicant is therefore seeking exemption from Atmospheric Emissions Licensing (AEL) requirements. However, should the AELA consider an AEL required under the NEM:AQA regulations for this project, this activity will be triggered and is therefore applied for.
	Activity 7 (ii) *The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods—* *(i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day;* *(ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 50 cubic metres per day; or* *(iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day.* **Description**: Liquid ammonia of up to ~402 m^3 per day will be produced by the Facility, which will be transported within the Facility as a liquid in pipelines exceeding 1000m in length. In addition, up to 800 m^3 per day of liquid hydrogen will be produced by the Facility, which will be transported within the Facility as a liquid in pipelines exceeding 1000m in length. Both Hydrogen and Ammonia are substances listed in SANS10234.
	Activity 15 *The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for—* *(i) the undertaking of a linear activity; or* *(ii) maintenance purposes undertaken in accordance with a maintenance management plan.* **Description**: The non-linear infrastructure components of the development footprint (buildable area) is approximately 25ha (subject to finalisation based on technical, final design and environmental requirements), within areas containing indigenous vegetation.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
Listing Notice 3: GNR 985	***Activity 4(f)(i)(cc)(ee)*** *The development of a road wider than 4 metres with a reserve less than 13,5 metres.* *f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding disturbed areas;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(dd) Sites or areas identified in terms of an international convention;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(ff) Core areas in biosphere reserves; or* *(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas, where such areas comprise indigenous vegetation; or* *ii. Inside urban areas:* *(aa) Areas zoned for use as public open space; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.* **Description:** Internal and access roads required by the Facility will be between 5m and 6m wide, and exceed 1km in length in a rural area. Where required for turning circle/bypass areas, however, access or internal roads may be up to 20m to allow for larger component transport. The exact values will be confirmed once final designs have been provided. Furthermore, roads required for the Facility will be located within, and will require vegetation clearance or disturbance of, Eastern Highveld Grassland, this ecosystem is listed in the National List of Ecosystems That Are Threatened And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). Similarly, roads required for the Facility will be located within, and will require vegetation clearance or disturbance within Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA).
	Activity 10(f)(i)(bb)(cc)(ee)(hh) *The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.* *f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(dd) Sites or areas identified in terms of an international convention;*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; *(ff) Core areas in biosphere reserves;* *(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, where such areas comprise indigenous vegetation; or* *(hh) Areas within a watercourse or wetland, or within 100 metres of a watercourse or wetland;* **Description:** Dangerous goods product stores related to the operation of the Facility include Nitrogen, Oxygen, Hydrogen and Ammonia storage tanks (of varying sizes, pressures and temperatures) in excess of 500m3. In addition, fuel, cement, transformer oil and other chemicals will be stored onsite. Collectively all storage and handling of dangerous goods on site will exceed 500m3, however individual component capacities may be between 30 - 80m3. Furthermore, storage contemplated above will be located within, and will require vegetation clearance or disturbance of, Eastern Highveld Grassland, this ecosystem is listed in the National List of Ecosystems That Are Threated And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). Similarly, storage contemplated above will be located within, and will require vegetation clearance or disturbance within CBA and ESA as well as being located within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site. The exact footprint will be confirmed once final designs have been provided.
	Activity 12(f)(i)(ii) *The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *f. Mpumalanga* *i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;* *ii. Within critical biodiversity areas identified in bioregional plans; or* **Description**: The clearance required for the Facility will be up to approximately 30ha (subject to finalisation based on technical, final design and environmental requirements) of indigenous vegetation. Such clearance will therefore be in excess of 300m2 and be partly located within Eastern Highveld Grassland, this ecosystem is listed in the National List of Ecosystems That Are Threated And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). Similarly, vegetation clearance required for the Facility and associated infrastructure will be located within CBA and ESA, in excess of 300m^2. The exact values will be confirmed once final designs have been provided.
	Activity 14(ii)(a)(c)(f)(i)(bb)(dd)(ff) *The development of—*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or *(ii) infrastructure or structures with a Physical footprint of 10 Square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;* *f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) World Heritage Sites;* *(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(ee) Sites or areas identified in terms of an international convention;* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(gg) Core areas in biosphere reserves; or* *(hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation;* **Description:** The physical footprint of internal and access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed 10m^2 within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site. Furthermore, the physical footprint of internal and access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed 10m^2 within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site, which infrastructure will be located within Eastern Highveld Grassland, this ecosystem is listed in the National List of Ecosystems That Are Threated And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). Finally, the physical footprint of internal and access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed 10m^2 within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site, located within CBA and ESA. The exact footprint will be confirmed once final designs have been provided.
	Activity 18(f)(i)(bb)(cc)(ee) *The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.* *f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	(bb) National Protected Area Expansion Strategy Focus areas; *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(dd) Sites or areas identified in terms of an international convention;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(ff) Core areas in biosphere reserves; or* *(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation;* **Description:** Transport of large infrastructure components related to the Facility will require the widening of existing access and/or internal roads by more than 4 metres or in excess of 1km within the Mpumalanga Province and outside urban areas. Furthermore, such widening will occur within Eastern Highveld Grassland, this ecosystem is listed in the National List of Ecosystems That Are Threated And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). Finally, such widening will be located within CBA and ESA. The exact footprint will be confirmed once final designs have been provided.
	Activity 23(ii)(a)(c)(f)(i)(bb)(cc)(ee) *The expansion of—* *(i) dams or weirs where the dam or weir is expanded by 10 square metres or more; or* *(ii) infrastructure or structures where the physical footprint is expanded by 10 square metres or more;* *where such expansion occurs —* *(a) within a watercourse;* *(b) in front of a development Setback adopted in the prescribed manner; or* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;* *f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(dd) Sites or areas identified in terms of an international convention;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(ff) Core areas in biosphere reserves;* *(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation;*

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	Description: The physical footprint of internal and access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed 10m2 within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site. Furthermore, the physical footprint of internal and access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed 10m2 within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site, which infrastructure will be located within Eastern Highveld Grassland, this ecosystem is listed in the National List of Ecosystems That Are Threated And In Need of Protection (GNR 1002 of 9 December 2011), and subsequently listed in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). Finally, the physical footprint of internal and access roads, stormwater control infrastructure, electrical cabling and water supply pipelines related to the Facility will exceed 10m2 within delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site, located within Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA). The exact footprint will be confirmed once final designs have been provided.
National Environmental Management: Waste Act (59 of 2008) (NEM:WA)	This Act provides for regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation. The Act also provides for the licensing and control of waste management activities through GNR. 921 (2013): List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment. The water treatment process is associated with the generation of concentrated wastes removed from the water, such as brine salt. Liquid brine can be made into a solid through several available technologies such as, settlement tanks, cooling water circuits, and forced crystallization. Given the proposed brine treatment and Zero Liquid Discharge system, as well as the use of a third-party contractor for the treatment and disposal of the produced salt cake, and the relatively small temporary storage facility envisaged and regular removal (< 80m3 at any one point in time), it is understood that no waste activities are triggered for either the treatment or storage of waste. It is however noted that the proponent will be required to comply with the general duties provided for at section 16 of NEM:WA relating to the management of waste as well as the legal requirements relating to the storage of waste as provided for at sections 21 and 22 respectively. The proposed project (Hendrina GH&A Facility) does not constitute a Listed Activity requiring a Waste Management Licence (WML) as defined in GNR 921. The contents of this Scoping Report will include reasonable measures for the prevention of pollution and good international industry practice (GIIP).
National Environmental Management: Air Quality Act (Act 39 of 2004) (NEM:AQA)	Until 2004, South Africa's approach to air pollution control was driven by the Atmospheric Pollution Prevention Act 45 of 1965 (APPA) which was repealed with the promulgation of NEM:AQA . NEM:AQA represents a shift in South Africa's approach to air quality management, from source-based control to integrated effects-based management. The objectives of NEM:AQA are to: — Protect the environment by providing reasonable measures for: — The protection and enhancement of air quality; — The prevention of air pollution and ecological degradation; — Securing ecologically sustainable development while promoting justifiable economic and social development; and — Give effect to everyone's right "to an environment that is not harmful to their health and well-being" Significant functions detailed in NEM:AQA include:

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	— The National Framework for Air Quality Management ; — Institutional planning matters, including: — The establishment of a National Air Quality Advisory Committee; — The appointment of Air Quality Officers (AQOs) at each level of government; and — The development, implementation and reporting of Air Quality Management Plans (AQMP) at national, provincial and municipal levels; — Air quality management measures including: — The declaration of Priority Areas where ambient air quality standards are being, or may be, exceeded; — The listing of activities that result in atmospheric emissions and which have the potential to impact negatively on the environment and the licensing thereof through an Atmospheric Emissions License (AEL); — The declaration of Controlled Emitters; — The declaration of Controlled Fuels; — Procedures to enforce Pollution Prevention Plans or Atmospheric Impact Reporting for the control and inventory of atmospheric pollutants of concern; and — Requirements for addressing dust and offensive odours Ammonia (NH3) production in excess of 100 tons per annum triggers listed activity Subcategory 7.1: Production and or use in Manufacturing of Ammonia, Fluorine, Fluorine Compounds, Chlorine and Hydrogen Cyanide of Government Notice Regulation 893 of 20131, promulgated in line with Section 21 of the National Environmental Management: Air Quality Act (Act 39 of 2004) (NEM:AQA). As per Section 22 of NEM:AQA, all activities listed require an AEL. An Atmospheric Impact Report (AIR) is required as a prerequisite for the application for an AEL. WSP was appointed to compile the AIR, assessing the ambient air quality impacts of the proposed facility. In line with the Regulations Regarding Air Dispersion Modelling (hereafter referred to as 'the Modelling Regulations') a Plan of Study was submitted to the licensing authority (in this case, the Environmental Management Unit for Nkangala District Municipality (NDM)) on 19 January 2022. The Plan of Study and the case specific limitations around quantitative assessment at this time (as detailed herein) were presented to the NDM atmospheric licensing officers on 11 March 2022. It was agreed that this AIR will thus comprise a qualitative impact assessment with further quantitative assessment conducted when operational information and site monitoring data is available to do so and will form part of the Provisional Atmospheric Emissions License (PAEL) review process. .
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) was promulgated in June 2004 within the framework of NEMA to provide for the management and conservation of national biodiversity. The NEMBA's primary aims are for the protection of species and ecosystems that warrant national protection, the sustainable use of indigenous biological resources, the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources. In addition, the NEMBA provides for the establishment and functions of a South African National Biodiversity Institute (SANBI). SANBI was established by the NEMBA with the primary purpose of reporting on the status of the country's biodiversity and conservation status of all listed threatened or protected species and ecosystems. The biodiversity assessment identifies CBAs which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives. The following areas were identified at a scoping level by the specialist study (**Appendix H-3**): — CBA: Optimal: Various drainage lines and its associated grassland areas in the project area are within a "CBA: Optimal" area. — Other Natural Areas (ONA): There are patches throughout the site mapped as ONA. — Heavily or moderately modified: Remaining areas on site, associated primarily with cultivation.

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	According to the description for the MBSP Terrestrial Assessment categories, CBAs are areas that are required to meet biodiversity targets (for biodiversity pattern and ecological process features). The policy is that they should remain in a natural state. CBAs are areas of high biodiversity value which are usually at risk of being lost and usually identified as important in meeting biodiversity targets, except for Critically Endangered Ecosystems or Critical Linkages. CBAs in the Province can be divided into two sub-categories: — Irreplaceable (parts of the site are within this sub-category), and — Optimal (northern parts of the site are within this sub-category). Supplementary baseline terrestrial ecology studies will be undertaken during the EIA phase to inform the assessment of impacts and will include flora and faunal surveys of the project footprint to determine the presence of flora and fauna species of concern (SoC). The Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA) Regulations with regards to alien and invasive species have been superseded by the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. Specific management measures for the control of alien and invasive plants will be included in the Environmental Management Programme (EMPr).
The National Water Act (No. 36 Of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) (NWA) provides the framework to protect water resources against over exploitation and to ensure that there is water for social and economic development, human needs and to meet the needs of the aquatic environment. The Act defines water source to include watercourses, surface water, estuary or aquifer. A watercourse is defined in the Act as a river or spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which or from which water flows, and any collection of water that the Minister may declare a watercourse. Section 21 of the Act outlines a number of categories that require a water user to apply for a Water Use License (WUL) and Section 22 requires water users to apply for a General Authorisation (GA) with the Department of Water and Sanitation (DWS) if they are under certain thresholds or meet certain criteria. The list of water uses applicable to the proposed Project include: *a) Taking water from a water resource;* *c) Impeding or diverting the flow of water in a watercourse;* *g) Disposing of waste in a manner which may detrimentally impact on a water resource;* *i) Altering the bed, banks, course or characteristics of a watercourse;* The DWS will make the final decision on water uses that are applicable to the project through a pre-application meeting after which a Water Use Authorisation Application (WUA) as determined by the risk assessment will be undertaken in compliance with procedural regulations published by the DWS within General Notice 267 (GN267). These regulations specify required information per water use and the reporting structure of required supporting technical information.
The National Heritage Resources Act (No. 25 Of 1999)	The National Heritage Resource Act (Act No. 25 of 1999) (NHRA) serves to protect national and provincial heritage resources across South Africa. The NHRA provides for the protection of all archaeological and palaeontological sites, the conservation and care of cemeteries and graves by the South African Heritage Resources Agency (SAHRA), and lists activities that require any person who intends to undertake to notify the responsible heritage resources agency and furnish details regarding the location, nature, and extent of the proposed development. Part 2 of the NHRA details specific activities that require a Heritage Impact Assessment (HIA) that will need to be approved by SAHRA. Parts of Section 35, 36 and 38 apply to the proposed project, principally: — Section 35 (4) - No person may, without a permit issued by the responsible heritage resources authority-

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	— destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite; — destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite. — Section 38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as- — any development or other activity which will change the character of a site— (i) exceeding 5 000 m^2 in extent, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. In terms of Section 38(8), approval from the heritage authority is not required if an evaluation of the impact of such development on heritage resources is required in terms of any other legislation (such as NEMA), provided that the consenting authority ensures that the evaluation of impacts fulfils the requirements of the relevant heritage resources authority in terms of Section 38(3) and any comments and recommendations of the relevant resources authority with regard to such development have been taken into account prior to the granting of the consent. However, should heritage resources of significance be affected by the proposed Hendrina GH&A Facility, a permit is required to be obtained prior to disturbing or destroying such resources as per the requirements of Section 48 of the NHRA, and the SAHRA Permit Regulations (GN R668). A Heritage Impact Assessment Report (**Appendix H-6**) has been carried out by a suitably qualified specialist, revealing: — The Project area is characterised by extensive cultivated fields and is considered to be of low archaeological potential. This was confirmed during the field survey and no archaeological sites of significance were noted and finds were limited to the ephemeral remains of demolished dwellings and burial sites. — The recorded ruins' potential to contribute to aesthetic, historic, scientific, and social aspects are non-existent, and it is therefore of low heritage significance unless associated with burial sites (e.g., still born graves) in which case the burial sites are of high social significance. The graves are of high significance and should be avoided. — Based on the current lay out the ruins at Waypoint 067 – 071 will be directly impact on by Option 1 and although of low significance the possible presence of graves is a risk, and the impact is high. Option 3 is from a heritage point of view not a preferred option due to the occurrence of ruins (based on aerial photographs and Topographical maps) of the Weltevreden Farmstead. This option is not preferred from a heritage point of view as the associated water pipeline will also have a high impact on the burial site at Waypoint 088 — According to the SAHRA Paleontological sensitivity map the study area is of very high paleontological significance and an independent study was conducted for this aspect. — Bamford (2022) concluded that it is extremely unlikely that any fossils would be preserved in the loose soils and sands of the Quaternary. There is a very small chance that fossils may occur in the shales and siltstones of the early Permian Vryheid Formation, but only more than 5m below the surface, therefore, a Fossil Chance Find Protocol should be added to the EMPr — The impact to heritage resources can be mitigated to an acceptable level provided that the recommendations in this report are adhered to, based on the South African Heritage Resource Authority (SAHRA) 's approval The proposed project has been loaded onto the SAHRIS portal for comment by SAHRA. Interim comments were received on 13 January 2023.
Mineral and Petroleum Resources Development Act (No. 28 of 2002)	The aim of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources. Section 53(1) of the MPRDA provides that any person who intends to use the surface of any land in any way that may be contrary to any object of the MPRDA, or which is likely to impede any such object, must apply to the Minister of Mineral Resources (the Minister) for approval. Section 53 of the MPRDA provides a mechanism for ensuring that, inter alia, the mining of mineral

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	resources is not detrimentally affected through the use of the surface of land and which may, for example, result in the sterilisation of a mineral resource. A Section 53 approval will be required due to the fact that the project is located on various mining right areas.
Noise Control Regulations in terms of the Environmental Conservation, 1989 (Act 73 of 1989)	In South Africa, environmental noise control has been in place for three decades, beginning in the 1980s with codes of practice issued by the South African National Standards (formerly the South African Bureau of Standards, SABS) to address noise pollution in various sectors of the country. Under the previous generation of environmental legislation, specifically the Environmental Conservation Act 73 of 1989 (ECA), provisions were made to control noise from a National level in the form of the Noise Control Regulations (GNR 154 of January 1992). In later years, the ECA was replaced by the National Environmental Management Act 107 of 1998 (NEMA) as amended. The National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA) was published in line with NEMA and contains noise control provisions under Section 34: *(1) The minister may prescribe essential national standards –* *(a) for the control of noise, either in general or by specific machinery or activities or in specified places or areas; or* *(b) for determining –* *(i) a definition of noise; and* *(ii) the maximum levels of noise.* *(2) When controlling noise, the provincial and local spheres of government are bound by any prescribed national standards.* Under NEMAQA, the Noise Control Regulations were updated and are to be applied to all provinces in South Africa. The Noise Control Regulations give all the responsibilities of enforcement to the Local Provincial Authority, where location specific by-laws can be created and applied to the locations with approval of Provincial Government. Where province-specific regulations have not been promulgated, acoustic impact assessments must follow the Noise Control Regulations. Furthermore, NEMAQA prescribes that the Minister must publish maximum allowable noise levels for different districts and national noise standards. These have not yet been accomplished and as a result all monitoring and assessments are done in accordance with the South African National Standards (SANS) 10103:2008 and 10328:2008.
Conservation of Agricultural Resources Act (No. 43 of 1983)	The Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) provides for the implementation of control measures for soil conservation works as well as alien and invasive plant species in and outside of urban areas. In terms of the amendments to the regulations under the CARA, landowners are legally responsible for the control of alien species on their properties. Various Acts administered by the DFFE and the DWS, as well as other laws (including local by-laws), spell out the fines, terms of imprisonment and other penalties for contravening the law. Although no fines have yet been placed against landowners who do not remove invasive species, the authorities may clear their land of invasive alien plants and other alien species entirely at the landowners' cost and risk. The CARA Regulations with regards to alien and invasive species have been superseded by NEMBA Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014.
Civil Aviation Act (No. 13 of 2009)	Civil aviation in South Africa is governed by the Civil Aviation Act (Act 13 of 2009). This Act provides for the establishment of a stand-alone authority mandated with controlling, promoting, regulating, supporting, developing, enforcing and continuously improving levels of safety and security throughout the civil aviation industry. This mandate is fulfilled by South African Civil Aviation Authority (SACAA) as an agency of the Department of Transport (DoT). SACAA achieves the objectives set out in the Act by complying with the Standards and Recommended Practices (SARPs) of the International Civil Aviation Organisation (ICAO), while considering the local context when issuing the South African Civil Aviation Regulations (SA CARs).

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	The DEA Screening Tool Report identified Civil Aviation as having low sensitivity for the proposed Hendrina GH&A Facility, and as being located between 8 and 15km of other civil aviation aerodrome. SACAA and ATNS have been included on the project stakeholder database. They will be informed of the proposed Project, and comment will be sought from these authorities as applicable.
Occupational Health and Safety Act (No. 85 of 1993)	The National Occupational Health and Safety Act (No. 85 of 1993) (OHSA) and the relevant regulations under the Act are applicable to the proposed project. This includes the Construction Regulations promulgated in 2014 under Section 43 of the Act. Adherence to South Africa's OHSA and its relevant Regulations is essential. The ammonia and hydrogen facilities as well as oxygen facilities will likely be Major Hazard Installations (MHI) and will require a fill quantitative risk assessment (QRA) and emergency response plan (ERP). Under the current MHI Regulations notification of various authorities and the public is required. Should the proposed new MHI Regulations be promulgated prior to commencement of construction of this facility it is possible that in addition to a QRA and ERP, the hydrogen, ammonia and oxygen facilities will necessitate an application for a Licence to Operate from the Department of Employment and Labour. There will likely be a requirement for implementation of a Process Safety Management Systems and submission of a Safety Report providing evidence of the effectiveness of this management system.

2.2 POLICIES AND PLANS

Table 2-2 summarised key policies and plans as an outline of the governance framework for the project.

Table 2-2: Applicable Regional Policies and Plans

APPLICABLE POLICY	DESCRIPTION OF POLICY
National Development Plan	The National Development Plan aims to eliminate poverty and reduce inequality by 2030. The NDP identifies a number of enabling milestones. Of relevance to the proposed development the NDP refers to the need to produce sufficient energy to support industry at competitive prices and ensure access for poor households, while reducing carbon emissions per unit of power by about one-third. In this regard the infrastructure is not just essential for faster economic growth and higher employment. It also promotes inclusive growth, providing citizens with the means to improve their own lives and boost their incomes. Infrastructure is essential to development. Chapter 3, Economy and Employment, identifies some of the structural challenges specific to South Africa, including an energy constraint that will act as a cap on growth and on options for industrialisation. The NDP notes that from an environmental perspective South Africa faces several related challenges. The reduction of greenhouse gas emissions and shift to a green low-carbon economy, is one of these challenges. In terms of implementation the NDP identifies three phases. The first two are of specific relevance to the proposed project. The first phase (2012–2017) notes that ensuring the supply of energy and water is reliable and sufficient for a growing economy. The second phase (2018–2023) involves building on the first phase to lay the foundations for more intensive improvements in productivity. The provision of affordable and reliable energy is a key requirement for this to take place. Chapter 4, Economic infrastructure, notes that economic infrastructure provides the foundation for social and economic development. In this regard South Africa must invest in a strong network of economic infrastructure designed to support the country's medium-

APPLICABLE POLICY	DESCRIPTION OF POLICY
	and long-term economic and social objectives. The plan envisages that, by 2030, South Africa will have an energy sector that promotes: — Economic growth and development through adequate investment in energy infrastructure. The sector should provide reliable and efficient energy service at competitive rates, while supporting economic growth through job creation. — Environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change. More specifically, South Africa should have adequate supply security in electricity and in liquid fuels, such that economic activity, transport, and welfare are not disrupted. The plan sets out steps that aim to ensure that, in 20 years, South Africa's energy system looks very different to the current situation. In this regard coal will contribute proportionately less to primary-energy needs, while gas and renewable energy resources, will play a much larger role.
Integrated Resource Plan 2010 – 2030	The IRP is an electricity capacity plan which aims to provide an indication of the country's electricity demand, how this demand will be supplied and what it will cost. On 6 May 2011, the then Department of Energy (DoE) released the Integrated Resource Plan 2010-2030 (IRP 2010) in respect of South Africa's forecast energy demand for the 20-year period from 2010 to 2030. The promulgated IRP 2010–2030 identified the preferred generation technology required to meet expected demand growth up to 2030. It incorporated government objectives such as affordable electricity, reduced greenhouse gas (GHG) emissions, reduced water consumption, diversified electricity generation sources, localisation and regional development. The IRP recognises that the green hydrogen economy presents an opportunity to diversify the electricity mix and to utilise renewable electricity to further boost the economy in terms of clean hydrogen and ammonia production . Renewable technologies also present huge potential for the creation of new industries, job creation and localisation across the value chain.
New Growth Path	Government released the New Economic Growth Path Framework on 23 November 2010. The aim of the framework is to enhance growth, employment creation and equity. The policy's principal target is to create five million jobs over the next 10 years and reflects government's commitment to prioritising employment creation in all economic policies. The framework identifies strategies that will enable South Africa to grow in a more equitable and inclusive manner while attaining South Africa's developmental agenda. Central to the New Growth Path is a massive investment in infrastructure as a critical driver of jobs across the economy. In this regard the framework identifies investments in five key areas namely: energy, transport, communication, water, and housing.
National Infrastructure Plan	The South African Government adopted a National Infrastructure Plan (NIP) in 2012. The NIP aims to transform the South African economic landscape while simultaneously creating significant numbers of new jobs and strengthening the delivery of basic services. It outlines the challenges and enablers which needs to be addressed in the building and developing of infrastructure. The Presidential Infrastructure Coordinating Commission (PICC) was established by the Cabinet to integrate and coordinate the long-term infrastructure build. The plan also supports the integration of African economies. In terms of the plan Government will invest R827 billion over the next three years to build new and upgrade existing infrastructure. The aim of the investments is to improve access by South Africans to healthcare facilities, schools, water, sanitation, housing and electrification. The plan also notes that investment in the construction of ports, roads, railway systems, ***electricity plants***, hospitals, schools and dams will contribute to improved economic growth.
Integrated Energy Plan	The development of a National IEP was envisaged in the White Paper on the Energy Policy of the Republic of South Africa of 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and, on an annual basis, review and publish the IEP in the Government Gazette. The purpose of the

APPLICABLE POLICY	DESCRIPTION OF POLICY
	IEP is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development. The IEP notes that South Africa needs to grow its energy supply to support economic expansion and in so doing, alleviate supply bottlenecks and supply-demand deficits. In addition, it is essential that all citizens are provided with clean and modern forms of energy at an affordable price. As part of the Integrated Energy Planning process, eight key objectives are identified, namely: — Objective 1: Ensure security of supply. — Objective 2: Minimise the cost of energy. — Objective 3: Promote the creation of jobs and localisation. — Objective 4: Minimise negative environmental impacts from the energy sector. — Objective 5: Promote the conservation of water. — Objective 6: Diversify supply sources and primary sources of energy. — Objective 7: Promote energy efficiency in the economy. — Objective 8: Increase access to modern energy. The IEP provides an assessment of current energy consumption trends within different sectors of the economy (i.e., agriculture, commerce, industry, residential and transport) and uses this information to identify future energy requirements, based on different scenarios. The scenarios are informed by different assumptions on economic development and the structure of the economy and also take into account the impact of key policies such as environmental policies, energy efficiency policies, transport policies and industrial policies, amongst others. Based on this information the IEP then determines the optimal mix of energy sources and technologies to meet those energy needs in the most cost-effective manner for each of the scenarios. The associated environmental impacts, socio-economic benefits and macroeconomic impacts are also analysed. The IEP is therefore focused on determining the long-term energy pathway for South Africa, taking into account a multitude of factors which are embedded in the eight objectives. As part of the analysis four key scenarios were developed, namely the Base Case, Environmental Awareness, Resource Constrained and Green Shoots scenarios: — The Base Case Scenario assumes that existing policies are implemented and will continue to shape the energy sector landscape going forward. It assumes moderate economic growth in the medium to long term. — The Environmental Awareness Scenario is characterised by more stringent emission limits and a more environmentally aware society, where a higher cost is placed on externalities caused by the supply of energy. — The Resource Constrained Scenario in which global energy commodity prices (i.e. coal, crude oil and natural gas) are high due to limited supply. — The Green Shoots Scenario describes an economy in which the targets for high economic growth and structural changes to the economy, as set out in the National Development Plan (NDP), are met. The IEP notes that South Africa should continue to pursue a diversified energy mix which reduces reliance on a single or a few primary energy sources. In terms of existing electricity generation capacity, the IEP indicates that existing capacity starts to decline notably from 2025, with significant plant retirement occurring in 2031, 2041 and 2048. By 2050 only 20% of the current electricity generation capacity remains. As a result, large investments are required in the electricity sector in order to maintain an adequate supply in support of economic growth. By 2020, various import options become available, and some new coal capacity is added along with new wind, solar and gas capacity. The mix of generation capacity technologies by 2050 is considerably more diverse than the current energy mix, across all scenarios. The main differentiating factors between the scenarios are the level of demand, constraints on emission limits and the carbon dioxide externality costs. In all scenarios the energy mix for electricity generation becomes more diverse over the period to 2050, with

APPLICABLE POLICY	DESCRIPTION OF POLICY
	coal reducing its share from about 85% in 2015 to 15–20% in 2050 (depending on the scenario). Solar, wind, nuclear, gas and electricity imports increase their share. The Environmental Awareness and Green Shoots scenarios take on higher levels of renewable energy. An assessment of each scenario against the eight objectives with reference to renewable energy notes while all scenarios seek to ensure that costs are minimised within the constraints and parameters of each scenario, the Base Case Scenario presents the least cost followed by the Environmental Awareness, Resource Constrained and Green Shoots scenarios respectively when total energy system costs are considered. In terms of promoting job creation and localisation potential the Base Case Scenario presents the greatest job creation potential, followed by the Resource Constrained, Environmental Awareness and Green Shoots scenarios respectively. In all scenarios, approximately 85% of total jobs are localisable. For electricity generation, most jobs result from solar technologies followed by nuclear and wind, with natural gas and coal making a smaller contribution. The Environmental Awareness Scenario, due to its stringent emission constraints, shows the lowest level of total emissions over the planning horizon. This is followed by the Green Shoots, Resource Constrained and Base Case scenarios. These trends are similar when emissions are considered cumulatively and individually by type.
National Protected Area Expansion Strategy, 2010	The National Protected Area Expansion Strategy 2010 (NPAES) areas were identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine scale planning which may identify a range of different priority sites based on local requirements, constraints and opportunities (NPAES, 2010). According to the NPAES, there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**.

2.3 PROVINCIAL AND MUNICIPAL LEGAL AND REGULATORY FRAMEWORK

Table 2-3: Provincial Plans

APPLICABLE PLAN	DESCRIPTION OF PLAN
Mpumalanga Growth and Development Path	The primary objective of the Mpumalanga Economic Growth and Development Path (MEGDP) (2011) is to foster economic growth that creates jobs, reduce poverty and inequality in the Province. The MEGDP identifies supporting the development of clean forms of energy such as wind and hydro power generation opportunities, as well as opportunities including gas production from landfill and organic waste, as one of the key interventions to facilitate growth and job creation in the manufacturing sector. A focal point of the MEGDP is massive investments in infrastructure as a key driver of job creation across the economy, with alternative energy production identified as one of the key opportunities in the Mpumalanga Economic sectors.
Mpumalanga Spatial Development Framework (MSDF), 2019	The Mpumalanga Spatial Development Framework (SDF) (2019) identifies that tourism is an important economic sector and has emerged as a robust driver of growth for emerging economies. The SDF also notes that a significant portion of Mpumalanga's land area is classified as Moderate to High-Very High agricultural potential which can be utilised for agricultural production. However, there are other factors affecting the agricultural sector including loss of agricultural land to other activities, availability of water, contamination of

APPLICABLE PLAN	DESCRIPTION OF PLAN
	the water used for irrigation by other economic activities, and access to the market. The SDF further notes that mining is the largest economic sector in the province and has assisted other sectors such as manufacturing and power generation, to grow in the province. However, the mining sector has posed some key challenges, including soil and water contamination and environmental pollution, development of mines on good agricultural soil thus threatening food security, restriction of animal movement due to open cast mining thus affecting the ecosystem etc. It also notes that Mpumalanga's manufacturing plants and coal fired power plants are the key polluters of air, with climate change also identified as a key challenge in the province. Therefore, the province must carefully design interventions that provide a gradual shift from mining oriented sectors to the sustainable economic sectors to maintain sustained growth of the provincial economy. The SDF notes that a significant amount of the country's electricity comes from coal-fired stations in Mpumalanga. It also observes that there is a steady increase in the demand for electricity in the province, mostly attributed to residential, commercial and industrial development, including mining and heavy industry. The Provincial SDF also notes that the abundance of coal has led to the development of many coal-fired power stations in the province, however these coalfields are depleting, therefore making it necessary to consider renewable power sources in Mpumalanga. The SDF also recognises that Mpumalanga's Coal Mining and Coal Fired Power Plant region (mainly the Highveld area) will be under immense pressure for environmental considerations and as a result, the region will witness a possible decline in demand of coal and large-scale employment. The SDF proposes to diversify the regional economy and facilitate the gradual transition of economic activities in the region. The green economy aims to further contribute to this plan via job creation, skills development and energy production diversification on all projects. According to the SDF, power stations using renewable sources (such as wind and solar) can be developed on the unused fallow lands.
Mpumalanga Industrial Development Plan	In terms of industry, the purpose of the Mpumalanga Industrial Development Plan (MIDP) (2016) is to promote the establishment of new industries and promote growth of existing industries in the province. It is however noted that the Nkangala Municipality (within which the project falls under) is not directly impacted by the 2025 MIDP and its proposed priority hubs.
Mpumalanga Conservation Act (No. 10 of 1998)	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project: — Various species are protected; — The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. The Act provides lists of protected species for the Province. According to the Mpumalanga Nature Conservation Act, a permit is required for the removal of any species on this list.

Table 2-4: District and Local Municipality Plans

APPLICABLE PLAN	DESCRIPTION OF PLAN
Nkangala Municipality Integrated Development Plan (IDP)	According to the Municipal Systems Act (Act 32 of 2000) (MSA), all municipalities have to undertake an Integrated Development Plan (IDP) process. The IDP is a legislative requirement thus it has legal status and supersedes all other plans that guide development at local government level.

APPLICABLE PLAN	DESCRIPTION OF PLAN
	The Nkangala District Municipality (NDM) IDP Final IDP (2020/2021) has identified the following development priorities: — An economy that will create more jobs — Improving infrastructure — Transition to a low-carbon economy — An inclusive and integrated rural economy — Reversing the spatial effect of apartheid — Improving quality of education, training and innovation — Quality health care for all — Social protection — Building safer communities — Reforming the public service — Fighting corruption — Transforming society and uniting the country The main goal and strategic objective of the Basic Service Delivery and Infrastructure Development priority is a reliable and sustainable service. One of the main strategic objectives for reaching the goal is the provision of basic services such as water and electricity to an approved minimum level of standards in a sustainable manner; as per the national guidelines.
Steve Tshwete Local Municipality IDP	The Steve Tshwete Local Municipality Revised IDP (2022) has identified the following key Municipal priorities: — Water, electricity and sanitation and Housing — Clean environment — Employment — Safety and security — Recreation and leisure — Safe and reliable public transport — Quality education and skills development — Quality health care — Social protection — Adequate nutrition One of the main strategic objectives for the access to basic services priority is to provide sustainable and reliable services to communities. Most of the basic services are rendered within the municipality, however some rural areas are still faced with some challenges in the provision water, sanitation and electricity. The Municipality, through the IDP, aims to facilitate the provision of electricity, with a number of key projects planned to be implemented over the period of five years linked to the Municipal IDP.
Steve Tshwete Spatial Development Framework	The Steve Tshwete SDF is informed by a number of spatial objectives, including: — Sustainable land use; — Improved environmental management; — Integrated development; and — Efficient land development. The provision of space of the diversification of the local economy is of specific relevance to the proposed development.

2.4 INTERNATIONAL ENVIRONMENTAL AND SOCIAL STANDARDS

2.4.1 IFC PERFORMANCE STANDARDS

The International Finance Corporation (IFC) is an international financial institution that offers investment, advisory, and asset management services to encourage private sector development in developing countries. The IFC is a member of the World Bank Group (WBG) and is headquartered in Washington, D.C., United States. It was established in 1956 as the private sector arm of the WBG to advance economic development by investing in strictly for-profit and commercial projects that purport to reduce poverty and promote development.

The IFC's stated aim is to create opportunities for people to escape poverty and achieve better living standards by mobilizing financial resources for private enterprise, promoting accessible and competitive markets, supporting businesses and other private sector entities, and creating jobs and delivering necessary services to those who are poverty-stricken or otherwise vulnerable. Since 2009, the IFC has focused on a set of development goals that its projects are expected to target. Its goals are to increase sustainable agriculture opportunities, improve health and education, increase access to financing for microfinance and business clients, advance infrastructure, help small businesses grow revenues, and invest in climate health.

The IFC is owned and governed by its member countries but has its own executive leadership and staff that conduct its normal business operations. It is a corporation whose shareholders are member governments that provide paid-in capital and which have the right to vote on its matters. Originally more financially integrated with the WBG, the IFC was established separately and eventually became authorized to operate as a financially autonomous entity and make independent investment decisions. It offers an array of debt and equity financing services and helps companies face their risk exposures, while refraining from participating in a management capacity. The corporation also offers advice to companies on making decisions, evaluating their impact on the environment and society, and being responsible. It advises governments on building infrastructure and partnerships to further support private sector development.

The IFC’s Sustainability Framework articulates the Corporation’s strategic commitment to sustainable development and is an integral part of IFC’s approach to risk management. The Sustainability Framework comprises IFC’s Policy and Performance Standards on Environmental and Social Sustainability, and IFC’s Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC’s commitments, roles, and responsibilities related to environmental and social sustainability. IFC’s Access to Information Policy reflects IFC’s commitment to transparency and good governance on its operations and outlines the Corporation’s institutional disclosure obligations regarding its investment and advisory services. The Performance Standards (PSs) are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the PSs to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation to achieve its overall development objectives. The PSs may also be applied by other financial institutions (FIs).

The Project is considered a Category B project in terms of the IFC Policy on E&S Sustainability (2012), having the potential to cause limited adverse environmental or social risks and/or impacts that are few in number, generally site specific, largely reversible, and readily addressed through mitigation measures.

The objectives and applicability of the eight PSs are outlined in **Table 2-5**.

Table 2-5: IFC Performance Standards Applicability to the Project

<table>
<tr><th>REFERENCE</th><th colspan="2">REQUIREMENTS</th><th>PROJECT SPECIFIC APPLICABILITY</th></tr>
<tr><td colspan="4">Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts</td></tr>
<tr><td>Overview</td><td colspan="3">Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.</td></tr>
<tr><td>Objectives</td><td colspan="3">— To identify and evaluate environmental and social risks and impacts of the project.
— To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.
— To promote improved environmental and social performance of clients through the effective use of management systems.
— To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.
— To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.</td></tr>
<tr><td rowspan="9">Aspects</td><td>1.1</td><td>Policy</td><td rowspan="9">The IFC Standards state under PS 1 (Guidance Note 23) that "the breadth, depth and type of analysis included in an ESIA must be proportionate to the nature and scale of the proposed project's potential impacts as identified during the course of the assessment process." This document is the draft EIR deliverable from the Scoping and EIA process undertaken for the proposed Project. The impact assessment comprehensively assesses the key environmental and social impacts and complies with the requirements of the South African EIA Regulations. In addition, an EMPr (Appendix I) has been compiled during the EIA phase of the project. A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlines in the EMPr will serve as the basis for an ESMS for the proposed Project.</td></tr>
<tr><td>1.2</td><td>Identification of Risks and Impacts</td></tr>
<tr><td>1.3</td><td>Management Programmes</td></tr>
<tr><td>1.4</td><td>Organisational Capacity and Competency</td></tr>
<tr><td>1.5</td><td>Emergency Preparedness and Response</td></tr>
<tr><td>1.6</td><td>Monitoring and Review</td></tr>
<tr><td>1.7</td><td>Stakeholder Engagement</td></tr>
<tr><td>1.8</td><td>External Communication and Grievance Mechanism</td></tr>
<tr><td>1.9</td><td>Ongoing Reporting to Affected Communities</td></tr>
<tr><td colspan="4">Performance Standard 2: Labour and Working Conditions;</td></tr>
<tr><td>Overview</td><td colspan="3">Performance Standard 2 recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.</td></tr>
<tr><td>Objectives</td><td colspan="3">— To promote the fair treatment, non-discrimination, and equal opportunity of workers.
— To establish, maintain, and improve the worker-management relationship.
— To promote compliance with national employment and labour laws.
— To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.
— To promote safe and healthy working conditions, and the health of workers.
— To avoid the use of forced labour.</td></tr>
</table>

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
Aspects	2.1	— Working Conditions and Management of Worker Relationship — Human Resources Policy and Management — Working Conditions and terms of Engagement — Workers organisation — Non- Discrimination and Equal Opportunity — Retrenchment — Grievance Mechanism	The construction activities will require contractors for completion. A safe working environment and fair contractual agreements must be in place. The operational phase will have permanent employees for day-to-day activities as well as contractors who will all need a safe working environment and fair contractual agreements. Whilst PS2 will be applicable to the Project, it is not intended to be addressed in detail at this stage. Recommendations are provided concerning development of a detailed Human Resources (HR) and Occupational Health and Safety (OHS) system by the developer and its partners as the Project moves towards implementation. In addition, measures to address the Interim Advice for IFC Clients on Supporting Workers in the Context of COVID-19 are referenced. The EMPr (**Appendix I)** has incorporated the requirements for compliance with local and international Labour and Working legislation and good practice on the part of the contractors.
	2.2	— Protecting the Workforce — Child Labour — Forced Labour	
	2.3	Occupational health and Safety	
	2.4	Workers Engaged by Third Parties	
	2.5	Supply Chain	
Performance Standard 3: Resource Efficiency and Pollution Prevention			
Overview	Performance Standard 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world.		
Objectives	— To avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities. — To promote more sustainable use of resources, including energy and water. — To reduce project related GHG emissions.		
Aspects	3.1	— Policy Resource Efficiency — Greenhouse Gases — Water Consumption	PS3-related impacts, such as the management of construction waste, hazardous substances, and stormwater are assessed in **Section 8** of this report. There are no material resource efficiency issues associated with the Project. The EMPr includes general resource efficiency measures. The project is not GHG emissions intensive and a climate resilience study or a GHG emissions-related assessment is not deemed necessary for a project of this nature. However, the Hendrina GH&A Facility seeks to facilitate resource efficiency and pollution prevention by contributing to the South African green economy. Dust air pollution in the construction phase has been addressed in the **Section 6** of the EMPr (**Appendix I**). The Project will not result in the release of industrial effluents. Potential pollution associated with sanitary wastewater is low and mitigation measures have been included in **Section 6** the EMPr (**Appendix I**).
	3.2	— Pollution Prevention — Air Emissions — Stormwater — Waste Management — Hazardous Materials Management — Pesticide use and Management	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
			Land contamination of the site from historical land use (i.e. low intensity agricultural / grazing) is not considered to be a cause for concern. The waste generation profile of the project is not complex. Waste mitigation and management measures have been included in **Section 7.1** of the EMPr (**Appendix I**). The ammonia and hydrogen facilities as well as oxygen facilities will likely be Major Hazard Installations and will require a full quantitative risk assessment (QRA) that complies with SANS 1461: MHI QRA as well as an emergency response plan (ERP) that complies with SANS 1514: MHI Emergency Response Planning. Under the current MHI Regulations notification of various authorities and the public is required. The EMPr (**Appendix I**) has taken this into account and recommend relevant mitigation and management measures in **Section 6** of the EMPr.
Performance Standard 4: Community Health, Safety, and Security			
Overview	Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.		
Objectives	— To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. — To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.		
Aspects	4.1	— Community Health and Safety — Infrastructure and Equipment Design and Safety — Hazardous Materials Management and Safety — Ecosystem Services — Community Exposure to Disease — Emergency Preparedness and Response	The requirements included in PS 4 has been addressed in this S&EIA process and the development of the EMPr. During the construction phase there will be an increase in vehicular traffic along public roads, largely due to the need for importation of construction material. Pedestrian and road safety risks have been qualitatively evaluated in this S&EIA process and the clients' standard safety and security measures, as well as potential additional measures recommended by WSP, is detailed in **Section 6** of the EMPr (**Appendix I**).
	4.2	Security Personnel	
Performance Standard 5: Land Acquisition and Involuntary Resettlement			
Overview	Performance Standard 5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use.		
Objectives	— To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs. — To avoid forced eviction. — To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. — To improve, or restore, the livelihoods and standards of living of displaced persons.		

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
	— To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.		
Aspects	5.1	— Displacement — Physical Displacement — Economic Displacement — Private Sector Responsibilities under Government Managed Resettlement	PS5 is not applicable to the proposed Hendrina GH&A Facility as no physical or economic displacement or livelihood restoration will be required. The proposed Hendrina GH&A Facility is located on privately owned land that is utilised for agriculture by the landowners. The impact of the proposed development on the agricultural production capability of the site has been assessed by the Agriculture Specialist as being acceptable
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources			
Overview	Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.		
Objectives	— To protect and conserve biodiversity. — To maintain the benefits from ecosystem services. — To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.		
Aspects	6.1	Protection and Conservation of Biodiversity	The Project Area falls within CBAs (Irreplaceable and Optimal) and wetland areas. A Biodiversity Impact Assessment (**Appendix H-3**) as well as an Avifaunal Impact Assessment (**Appendix H-2**) and Freshwater Ecology Impact Assessment (**Appendix H-4**) have been included in the proposed scope. The methodologies for the specialist assessments include a combination of literature review, in-field surveys and sensitivity mapping. This substantively complies with the PS 6 general requirements for baseline and impact assessment for determination of biodiversity and ecosystem services issues. The determination of habitat sensitivity was undertaken within the legal and best practice reference framework for South Africa. The prevalence of invasive alien species has been determined, and mitigation and management measures have been included in **Section 7.2** of the EMPr (**Appendix I**).
Performance Standard 7: Indigenous People			
Overview	Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded.		
Objectives	— To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. — To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. — To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. — To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. — To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. — To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.		

REFERENCE		REQUIREMENTS	PROJECT SPECIFIC APPLICABILITY
Aspects	7.1	General — Avoidance of Adverse Impacts — Participation and Consent	As per the international instruments under the United Nations (UN) Human Rights Conventions, no indigenous peoples are present within the study area. The Project does not involve displacement. PS7 will not be triggered.
	7.2	Circumstances Requiring Free, Prior, and Informed Consent — Impacts on Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use — Critical Cultural Heritage — Relocation of Indigenous Peoples from Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use	
	7.3	Mitigation and Development Benefits	
	7.4	Private Sector Responsibilities Where Government is Responsible for Managing Indigenous Peoples Issues	
Performance Standard 8: Cultural Heritage			
Overview	Performance Standard 8 recognizes the importance of cultural heritage for current and future generations.		
Objectives	— To protect cultural heritage from the adverse impacts of project activities and support its preservation. — To promote the equitable sharing of benefits from the use of cultural heritage.		
Aspects	8.1	Protection of Cultural Heritage in Project Design and Execution	A Heritage impact assessment Report (**Appendix H-6**) has been carried out by a suitably qualified specialist, revealing that archaeological sites (Stone Age and Historic Archaeological), cultural heritage sites, burial grounds or isolated artifacts are unlikely to be present on the affected landscape. A Chance Find Procedure is included in **Section 7.14.1** of the EMPr (**Appendix I**)

2.4.2 WORLD BANK GROUP ENVIRONMENTAL HEALTH AND SAFETY GUIDELINES

In support of the Performance Standards, the World Bank Group (WBG) has published a number of Environmental Health and Safety (EHS) Guidelines. The EHS Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to PS3: Pollution Prevention and Abatement, as well as certain aspects of occupational and community health and safety.

Where host country regulations differ from the levels and measures presented in the EHS Guidelines, projects seeking international funding may be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

The following IFC / WBG EHS Guidelines have been generally consulted during the preparation of the EIA in order to aid the identification of EHS aspects applicable to the project:

- *Electric Power Transmission and Distribution (2007)* **-** information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas;
- *General EHS Guidelines* – this includes a section on a range of environmental, occupational health and safety, community health and safety, and construction activities that would apply to the project. The guideline also contains recommended guidelines adopted form the World Health Organisation (WHO) for ambient air and water quality, which are referred to in the relevant impact assessment sections in the ESIA report.
- *Section 1.1* **-** *Air Emissions and Ambient Air Quality* **-** This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards.
- *Section 1.5* **-** *Hazardous Materials Management* **-** These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazmats can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances. Guidance on the transport of hazardous materials is covered in Section 8 of this document. The ammonia and hydrogen facilities as well as oxygen facilities will likely be Major Hazard Installations and will require a full quantitative risk assessment (QRA) that complies with SANS 1461: MHI QRA as well as an emergency response plan (ERP) that complies with SANS 1514: MHI Emergency Response Planning. Under the current MHI Regulations notification of various authorities and the public is required. The EMPr will take these anticipated hazardous materials into account and recommend relevant mitigation and management measures.
- *Section 2* **-** *Occupational Health and Safety* **-** Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. This section provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction and decommissioning activities.
- *Section 3.5* **-** *Community Health and Safety* – Transport of Hazardous Materials **-** This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis.

2.4.3 EQUATOR PRINCIPLES

The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing, and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making.

The EPs apply globally to all industry sectors and to five financial products 1) Project Finance Advisory Services, 2) Project Finance, 3) Project-Related Corporate Loans, 4) Bridge Loans and 5) Project-Related Refinance and Project-Related Acquisition Finance. The relevant thresholds and criteria for application is described in detail in the Scope section of the EP. Currently 125 Equator Principles Financial Institutions (EPFIs) in 37 countries have officially adopted the EPs, covering the majority of international project finance debt within developed and emerging markets. EPFIs commit to implementing the EPs in their internal environmental and social policies, procedures and standards for financing projects and will not provide Project

Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the EPs.

While the EPs are not intended to be applied retroactively, EPFIs apply them to the expansion or upgrade of an existing project where changes in scale or scope may create significant environmental and social risks and impacts, or significantly change the nature or degree of an existing impact. The EPs have greatly increased the attention and focus on social/community standards and responsibility, including robust standards for indigenous peoples, labour standards, and consultation with locally affected communities within the Project Finance market.

The EPs have also helped spur the development of other responsible environmental and social management practices in the financial sector and banking industry and have supported member banks in developing their own Environmental and Social Risk Management Systems.

The requirements and applicability of the EPs are outlined in **Table 2-6**.

It should be noted that Principles 8 and 10 relate to a borrower's code of conduct and are therefore not considered relevant to the S&EIA process and have not been included in this discussion.

Table 2-6: Requirements and Applicability of the Equator Principles

<table>
<tr><th colspan="2">REQUIREMENT</th><th>PROJECT SPECIFIC APPLICABILITY</th></tr>
<tr><td colspan="3">Principle 1: Review and Categorisation</td></tr>
<tr><td>Overview</td><td>When a project is proposed for financing, the EPFI will, as part of its internal social and environmental review and due diligence, categorise such project based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the IFC.

Using categorisation, the EPFI's environmental and social due diligence is commensurate with the nature, scale, and stage of the Project, and with the level of environmental and social risks and impacts.

The categories are:
— Category A: Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;
— Category B: Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and
— Category C: Projects with minimal or no adverse environmental and social risks and/or impacts.</td><td>Based upon the significance and scale of the Project's environmental and social impacts, the proposed project is regarded as a Category B project i.e. a project with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.</td></tr>
<tr><td colspan="3">Principle 2: Environmental and Social Assessment</td></tr>
<tr><td>Overview</td><td>For all Category A and Category B Projects, the EPFI will require the client to conduct an appropriate Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and scale of impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimise, mitigate, and where residual impacts remain, to compensate/ offset/ remedy for risks and impacts to Workers, Affected Communities, and the environment, in a manner relevant and appropriate to the nature and scale of the proposed Project.

The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether</td><td>This document is the third deliverable (i.e. EIR) from the S&EIA process undertaken for the proposed Project. The assessment appropriately and comprehensively assessed the key environmental and social impacts and complies with the requirements of the South African EIA Regulations and this principle. In addition, an EMPr has been compiled and is included in Appendix I. A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlined in the EMPr will serve as the basis for an ESMS for the proposed Project.</td></tr>
</table>

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
	prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. For other Category B and potentially C Projects, a limited or focused environmental or social assessment may be appropriate, applying applicable risk management standards relevant to the risks or impacts identified during the categorisation process. The client is expected to include assessments of potential adverse Human Rights impacts and climate change risks as part of the ESIA or other Assessment, with these included in the Assessment Documentation.	
Principle 3: Applicable Environmental and Social Standards		
Overview	The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. The EPFI's due diligence will include, for all Category A and Category B Projects globally, review and confirmation by the EPFI of how the Project and transaction meet each of the Principles. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC PS and WBG EHS Guidelines. For Projects located in Designated Countries, compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.	As South Africa has been identified as a non-designated country, the reference framework for environmental and social assessment is based on the IFC PS. In addition, this S&EIA process has been undertaken in accordance with NEMA (the host country's relevant legislation).
Principle 4: Environmental and Social Management System and Equator Principles Action Plan		
Overview	For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree on an Equator Principles Action Plan (EPAP). The EPAP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.	A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlines in the EMPr will serve as the basis for an ESMS for the proposed Project.
Principle 5: Stakeholder Engagement		
Overview	EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities Workers and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. To accomplish this, the appropriate assessment documentation, or non-technical summaries thereof, will be made available to the public by the borrower for a reasonable minimum period in the relevant local language and in a culturally appropriate manner. The borrower will take	The S&EIA process includes an extensive stakeholder engagement process which complies with the South African EIA Regulations. The process includes consultations with local communities, nearby businesses, and a range of government sector stakeholders (state owned enterprises, national, provincial and local departments). The stakeholder engagement process solicits interest from potentially interested parties through the placement of site notices and

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
	account of and document the process and results of the consultation, including any actions agreed resulting from the consultation. Disclosure of environmental or social risks and adverse impacts should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis. All Projects affecting Indigenous Peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for Indigenous Peoples contained in relevant national law, including those laws implementing host country obligations under international law.	newspaper advertisements as well as written and telephonic communication. The stakeholder engagement process is detailed in **Section 4.3.**
Principle 6: Grievance Mechanism		
Overview	For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish effective grievance mechanisms which are designed for use by Affected Communities and Workers, as appropriate, to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The borrower will inform the Affected Communities and Workers about the grievance mechanism in the course of the stakeholder engagement process and ensure that the mechanism addresses concerns promptly and transparently, in a culturally appropriate manner, and is readily accessible, at no cost, and without retribution to the party that originates the issue or concern.	The EMPr (**Appendix I**) includes a *Grievance Mechanism Process for Public Complaints and Issues* (**Section 7.16)**. This procedure effectively allows for external communications with members of the public to be undertaken in a transparent and structured manner.
Principle 7: Independent Review		
Overview	For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.	This principle will only become applicable in the event that that the project is developed in the future necessitating Independent Review.
Principle 9: Independent Monitoring and Reporting		
Overview	To assess Project compliance with the Equator Principles after Financial Close and over the life of the loan, the EPFI will require independent monitoring and reporting for all Category A, and as appropriate, Category B projects. Monitoring and reporting should be provided by an Independent Environmental and Social Consultant; alternatively, the EPFI will require that the client retain qualified and experienced external experts to verify its monitoring information, which will be shared with the EPFI in accordance with the frequency required.	This principle will only become applicable in the event that the project is developed in the future necessitating independent monitoring and reporting.

3 SCOPING PHASE SUMMARY

3.1 PROCEDURAL PROCESS

The application form was compiled and submitted to the MDARDLEA on **23 November 2022**. The MDARDLEA reference number allocated to this application is 1/3/1/16/1N-347. This reference number will appear on all official correspondence with the authorities and the public regarding the Proposed Project.

The DSR was initially placed on public review for a period of 30 days from **25 November 2022 to 16 January 2022**, at the Proposed Site. The report was also made available on the WSP website (https://www.wsp.com/en-ZA/services/public-documents)

The comprehensive FSR including all comments received was submitted on the **25 January 2023**.

All registered stakeholders and authorising/commenting state departments were notified of the public review period as well as the locations of the FSRs via email and bulk SMS. The abovementioned plan, for notification and provision of reports, will also be utilised for the review of the FSR as well as the EIAR once the EIAR Phase has commenced.

The approval of the Final Scoping Report (FSR) and the plan of study for the environmental impact assessment was received on 15 March 2023 (dated **14 March 2023**) and is included in **Appendix G**.

3.2 AUTHORITY CONSULTATION

A pre-application meeting was held on 16 August 2022 with the MDARDLEA in order to discuss the proposed project. The minutes of this meeting are included in **Appendix K**. In addition, WSP notified a number of commenting authorities of the Proposed Project via a notification letter, these included:

- DMRE;
- DFFE: Biodiversity and Conservation;
- DFFE: Protected Areas;
- MDARDLEA;
- DWS;
- Vaal WMA Authority;
- SAHRA;
- MHRA;
- MTPA;
- CAA;
- ATNS;
- DD (SA Army);
- AMA;
- SAWS;
- SANRAL;
- Nkangala District Municipality;
- Steve Tshwete Local Municipality; and

WSP received comments on the DSR from the MDARDLEA on **2 December 2022**. The comments and responses have been outlined in **Table 3-1** and included in the SER **(Appendix D)**. The responses to the MDARDLEA comments were applicable as at the time of final scoping submission and based on the project description included in the final scoping report. Lastly, **Table 3-2** shows the comments on the FSR received from MDARDLEA on the 15 March 2023.

Table 3-1: Comments received from the MDARDLEA regarding the DSR

COMMENT	RESPONSE
The Department confirms having received the application form for environmental authorisation of the abovementioned project on the 24 November 2022.	**EAP:** This comment is acknowledged.
The application has been assigned the reference number 1/3/16/1N-347. Kindly quote this reference number in any future correspondence in respect of the application. The responsible officer is Dineo Tswai and all correspondence must be directed to: Environmental Impact Management, Nkangala District Office, marked for the attention of the responsible officer.	**EAP:** This comment is acknowledged. WSP can confirm that Ms Dineo Tswai will be forwarded all future correspondence regarding this project. Furthermore, all future documents relating to the project will have the reference number 1/3/16/1N-347.
Please note that you must. within 44 days from the 24 November 2022, submit to this office a Final Scoping Report inclusive of specialist reports and an EMPr which has already been subjected to a public participation process, and was provided to interested and affected parties for a period of 30 days for comments, and which reflects the incorporation of any comments received, including any comments from this office. In this regard you are referred to the requirements of Regulation 40(3).	**EAP:** This comment is acknowledged. WSP can confirm that the final scoping report will be submitted within 44 days of the 24 November 2022. Thereafter the Draft EIA report will be compiled and will include the various detailed specialist reports as well as the draft EMPr. The Draft EIA Report and associated Appendices will be subjected to a public participation process, which will provide interested and affected parties 30 days for review and comment.
Please take note in terms of the provisions of regulation 45, the application will lapse, and this office will deem the application to have lapsed, if the applicant fails to submit the Final Scoping Report within the timeframe specified above.	**EAP:** This comment is acknowledged. WSP can confirm that the final scoping report will be submitted within 44 days of the 24 November 2022.
Please draw the applicant's attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department. Your cooperation will be highly appreciated.	**EAP:** This comment is acknowledged. The applicant is aware that no construction activity may commence without the Environmental Authorisation being granted.

Table 3-2: Comments received from the MDARDLEA regarding the FSR

COMMENT	RESPONSE
The Department has received the Final Scoping Report and Plan of Study for the above-mentioned project on 02 February 2023 and has been accepted. Based on the information supplied, this Department has no objections at this stage to the proposed development. You may proceed with the submission of the draft EIR with the consideration of the comments below;-	**EAP:** This comment is acknowledged.
Applicable licenses must be obtained before the commencement of the activity.	**EAP:** This comment is acknowledged.

COMMENT	RESPONSE
	The applicant is aware of the applicable licences to be obtained for the project
Applicable municipal By-Laws must be considered and adhered to at all times throughout the planning and the lifespan of the project.	**EAP:** This comment is acknowledged.
All recommendations, key findings and conditions made in the specialist studies must be adhered to.	**EAP:** This comment is acknowledged. WSP can confirm that all specialist recommendations have been added to the EMPr (**Appendix I**) to ensure compliance during the stages of development.
MTPA comments must be sourced and recommendations thereof must inform the site layout and protection of any identified endangered species.	**EAP:** This comment is acknowledged. WSP can confirm that the MTPA has provided comment on this project, which has been added to the SER **(Appendix D)**
Complaints received from the public must be attended to as soon as possible and addressed to the satisfaction of all concerned.	**EAP:** This comment is acknowledged. It has been recommended by various specialists that a complaints register be implemented and maintained from the construction phase to the operational phase of the project, this has been added to the EMPr (**Appendix I**) to ensure that it is complied with.
The applicant is responsible for the compliance with the provisions for "Duty of Care" and remediation of damage contained in Section 28 of the National Environmental Management Act, (Act 107 of 1998)	**EAP:** This comment is acknowledged. The applicant is aware that the responsibility of compliance with the provisions for "Duty of Care" and remediation of damage contained in Section 28 of the National Environmental Management Act, (Act 107 of 1998), is
Please draw the applicant's attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department.	**EAP:** This comment is acknowledged. The applicant is aware that no construction activity may commence without the Environmental Authorisation being granted.

3.3 STAKEHOLDER CONSULTATION

Section 41 of the 2017 EIA Regulations states that written notices must be given to identified stakeholders. Refer to the Stakeholder Engagement Report (SER) in **Appendix D** for proof of notification. Relevant authorities (Organs of State) have been automatically registered as I&APs. In accordance with the EIA Regulations, 2014 (as amended), all other persons must request in writing to be placed on the register, submit written comments or attend meetings in order to be registered as stakeholders and included in future communication regarding the project.

Stakeholder engagement comprises a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the S&EIR process. Effective stakeholder engagement requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the proposed project.

The objectives of the stakeholder engagement process can be summarised as follows:

- Identify relevant individuals, organisations and communities who may be interested in or affected by the Proposed Project;
- Clearly outline the scope of the Proposed Project, including the scale and nature of the existing and proposed activities;
- Identify viable proposed project alternatives that will assist the relevant authorities in making an informed decision;
- Identify shortcomings and gaps in existing information;
- Identify key concerns, raised by Stakeholders that should be addressed in the subsequent specialist studies;
- Highlight the potential for environmental impacts, whether positive or negative; and
- To inform and provide the public with information and an understanding of the proposed project, issues and solutions.

In accordance with the NEMA, GNR 326, Chapter 6, the following activities have taken place or are proposed to take place within the DSR review period or beyond.

Stakeholders were identified and will continue to be identified through several mechanisms. These include:

- Utilising existing databases from other projects in the area;
- Networking with local business owners, non-governmental agencies, community based organisations, and local council representatives;
- Field work in and around the project area;
- Advertising in the press;
- Placement of community notices;
- Completed comment sheets; and
- Attendance registers at meetings.

All Stakeholders identified to date have been registered on the project stakeholder database. The EAP endeavoured to ensure that individuals/organisations from referrals and networking were notified of the Proposed Project. Stakeholders were identified at the horizontal (geographical) and vertical extent (organisations level).

A list of stakeholders captured in the project database is included in Appendix A of the SER (**Appendix D**).

All concerns, comments, viewpoints and questions (collectively referred to as 'issues') received to date have been documented and responded to in a SER included in **Appendix D**. The following key issues were highlighted during the scoping phase:

- Impacts on the biodiversity of the area with specific reference to Critical Biodiversity
- Impacts on heritage and burial sites in the project area

3.3.1 STAKEHOLDER NOTIFICATION

DIRECT NOTIFICATION

Notification of the proposed Project was issued to potential Stakeholders, via direct correspondence (i.e., site notices and e-mail) on **25 February 2022**. The notification letter circulated is included in Appendix B-3 of the SER (**Appendix D**). Proof of notification is included in the SER (i.e. **Appendix D**).

NEWSPAPER ADVERTISEMENTS

In accordance with the requirements of GNR 982, as amended, the proposed project was advertised in two local newspapers. The purpose of the advertisement was to notify the public about the proposed project and to invite them to register as stakeholders. A copy of the advertisements are included in Appendix B-1 of the SER (**Appendix D)**. The relevant scoping phase advertisement dates are listed in **Table 3-3**.

Table 3-3: Dates on which the Adverts were published

NEWSPAPER	PUBLICATION DATE	LANGUAGE
Middelburg Herald	25 November 2022	English and Zulu
Middelburg Observer	25 November 2022	Afrikaans

SITE NOTICES

The official site notices were erected as per GNR 982, as amended, on the boundary fence of the proposed site. In addition, general project notices, announcing the Proposed Project and inviting stakeholders to register, were be placed at various locations in and around the project area. A copy of the site notice is included in Appendix B-2 of the SER (**Appendix D**).

3.4 SCOPING STUDY FINDINGS

The scoping phase identified a number of impacts associated with the proposed Hendrina GH&A Facility. The findings of the preliminary significance ratings undertaken during the scoping phase for the construction phase, operational phase and initial cumulative impacts are included in **Table 3-4**, **Table 3-5** and **Table 3-6** respectfully.

Table 3-4: Construction Phase Impacts

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Air Quality	Dust Emissions	Negative	3	1	**Low**	**Yes**
Noise emissions	Noise and Vibration from construction activities	Negative	3	1	**Low**	**Yes**
Topography, & Geology	Risk of soil erosion is increased resulting in the prevention of infiltration of rainwater thereby increasing surface run-off	Negative	4	3	**High**	**No**
Soils, Land Capability and Agricultural Potential	Loss of agricultural potential by soil degradation	Negative	3	3	**Medium**	**Yes**
	Loss of agricultural potential by occupation of land	Negative	3	3	**Medium**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Surface water	Deterioration of surface water quality due to an increase in sediment or other pollutants, from Grading, vegetation clearing and soil stripping	Negative	3	3	**Medium**	**Yes**
	Deterioration of surface water quality due to poor management of hazardous materials.	Negative	3	3	**Medium**	
Groundwater	Soil clearing and construction of infrastructure	Negative	3	2	**Medium**	**No**
	Water use- Over abstraction of groundwater can result in aquifer depletion and loss of resource for farmers.	Negative	3	2	**Medium**	
Hazardous Substances and Pollutants	Soil, groundwater and surface water contamination	Negative	4	3	**High**	**Yes**
Waste Generation	Generation of General Waste	Negative	3	2	**Medium**	**No**
	Generation of Hazardous Waste	Negative	3	2	**Medium**	
	Sanitation Waste	Negative	3	2	**Medium**	
Terrestrial Ecology	Loss and Fragmentation of Vegetation and Habitat	Negative	4	3	**High**	**Yes**
	Impacts on CBAs and broad-scale ecological processes	Negative	4	3	**High**	
	Loss and Displacement of Fauna	Negative	4	3	**High**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Proliferation of alien invasive plant species	Negative	4	3	**High**	
Avifauna	Displacement of SCC due to habitat transformation associated with the construction of the facility.	Negative	1	3	**Low**	**Yes**
	Displacement of SCC due to disturbance of breeding birds associated with the construction of the facility.	Negative	1	2	**Very low**	
	Displacement due to habitat transformation associated with the construction of the 132kV grid connection power line.	Negative	1	1	**Very low**	
	Displacement due to disturbance associated with the construction of the 132Kv grid connection power line.	Negative	2	2	**Low**	
Bats	Loss of foraging habitat by clearing of vegetation.	Negative	4	1	**Medium**	**Yes**
	Roost destruction during earthworks	Negative	2	3	**Medium**	
Visual and Landscape	Potential visual intrusion resulting from large construction vehicles and equipment	Negative	3	2	**Medium**	**Yes**
	Potential visual effect of construction laydown areas and material stockpiles.	Negative	3	2	**Medium**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Potential impacts of increased dust emissions from construction activities and related traffic	Negative	3	2	**Medium**	
	Potential visual scarring of the landscape as a result of site clearance and earthworks	Negative	3	2	**Medium**	
	Potential visual pollution resulting from littering on the construction site	Negative	3	1	**Low**	
Heritage and Cultural Resources	Clearing, levelling and construction activities resulting in Disturbance to known Cultural Resources	Negative	4	2	**High**	**Yes**
	Destruction of ruins	Negative	4	2	**High**	
	Clearing, levelling and construction activities will permanently destroy heritage features.	Negative	3	1	**Low**	
Palaeontology	Chance Find of Palaeontological resources	Negative	3	2	**Medium**	**Yes**
Traffic	Increased traffic generation around the study area by construction vehicles	Negative	4	2	**Medium**	**Yes**
	Deterioration of the surrounding road network due to an increase of traffic around the site	Negative	4	2	**Medium**	
	Transportation of abnormal loads during the construction phase	Negative	4	2	**Medium**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Socio-Economic	Temporary increase in the GDP and production of the national and local economies during construction	Positive	4	3	**High**	**Yes**
	Temporary increase employment in the national and local economies	Positive	3	2	**Medium**	
	Contribution to skills development in the country and local economy	Positive	3	3	**Medium**	
	Temporary increase in household earnings	Positive	3	3	**Medium**	
	Temporary increase in government revenue	Positive	3	1	**Low**	
	Negative changes to the sense of place	Negative	3	3	**Medium**	
	Impact on the agriculture operations	Negative	3	1	**Low**	
	Temporary increase in social conflicts	Negative	3	3	**Medium**	
	Impact on economic and social infrastructure	Negative	3	2	**Medium**	
	Impact on property and land value in the immediately affected area during construction	Negative	2	2	**Low**	
Climate Change	Greenhouse Gas Emissions	Negative	2	1	**Very Low**	**No**
	Climate Risks & Vulnerabilities	Negative	2	1	**Very Low**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
SHE Risk	Human Health chronic exposure to toxic chemical or biological agents	Negative	3	2	**Medium**	**Yes**
	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Negative	4	3	**High**	
	Fires, explosions, noxious smoke, large spills, traffic accidents, equipment/structural collapse. Inadequate emergency response to small event leads to escalation. Consequences - Injuries turn to fatalities, small losses become extended down time.	Negative	3	2	**Medium**	

Table 3-5: Operational Phase Impacts

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Air Quality	Potential degradation of ambient air quality due to NH_3 emissions	Negative	1	1	**Very Low**	**Yes**
Noise emissions	Noise Emissions from operating GH&A facility	Negative	3	1	**Low**	**Yes**
Traffic	Increased traffic generation around the study area by construction vehicles	Negative	2	2	**Low**	**Yes**
	Deterioration of the surrounding road network due to an increase of traffic around the site	Negative	2	2	**Low**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Transportation of abnormal loads during the construction phase	Negative	2	2	**Low**	
Soils, Land Capability and Agricultural Potential	Permanent loss of agricultural land	Negative	4	3	**Medium**	**Yes**
Surface Water	Deterioration of surface water due to contact with Brine or Ammonia produced at the facility	Negative	3	3	**Medium**	**Yes**
	Increased sedimentation due to increased erosion in concreted or compacted surfaces.	Negative	3	3	**Medium**	
Groundwater	Production, storage and disposal of the brine waste pose potential groundwater contamination	Negative	4	3	**High**	**No**
Hazardous Substances and Pollutants	Soil, groundwater and surface water contamination	Negative	3	3	**Medium**	**No**
	Major Hazardous Installation	Negative	3	3	**Medium**	**Yes**
Waste Generation	Generation of General Waste	Negative	3	2	**Medium**	**Yes**
	Generation of Hazardous Waste	Negative	3	3	**Medium**	
	Sanitation Waste	Negative	3	2	**Medium**	
Terrestrial ecology	Proliferation of alien invasive plant species	Negative	3	3	**Medium**	**Yes**
Avifauna	Mortality of priority species due to collisions with 132kV grid connection power line.	Negative	3	2	**Medium**	**Yes**

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Bats	Increased bat mortalities due to light attraction and habitat creation.	Negative	4	3	**High**	**Yes**
Visual	Potential alteration of the visual character of the area;	Negative	3	3	**Medium**	**Yes**
	Potential visual intrusion resulting from the various components of the Facility	Negative	3	3	**Medium**	
	Potential visual clutter caused by substation and other associated infrastructure on-site	Negative	3	3	**Medium**	
	Potential visual effect on surrounding farmsteads	Negative	3	3	**Medium**	
	Potential alteration of the night-time visual environment	Negative	3	3	**Medium**	
	Potential visual effect of OHL	Negative	3	1	**Low**	
Social	Sustainable increase in the GDP and production of the national and local economies	Positive	4	3	**High**	**Yes**
	Creation of sustainable employment positions nationally and locally	Positive	3	3	**Medium**	
	Skills development of permanently employed workers	Positive	3	3	**Medium**	
	Improved standards of living for benefiting households	Positive	4	3	**High**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Sustainable increase in national and local government revenue	Negative	4	3	**High**	
	Local economic and social development benefits derived from the project's operations	Negative	3	3	**Medium**	
	Sustainable rental revenue for farms where the facility is located	Negative	3	3	**Medium**	
	Sustainable increase in hydrogen and ammonia available for the local region and South Africa	Positive	4	3	**High**	
	Negative changes to the sense of place	Negative	3	2	**Medium**	
	Impact on the agriculture operations	Negative	3	1	**Low**	
Climate Change	Reduced GHG Emissions	Positive	4	3	**High**	**No**
SHE Risk	Human Health chronic exposure to toxic chemical or biological agents	Negative	3	2	**Medium**	**Yes**
	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Negative	4	3	**High**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Fires, explosions, noxious smoke, large spills, traffic accidents, equipment/structural collapse. Inadequate emergency response to small event leads to escalation. Consequences - Injuries turn to fatalities, small losses become extended down time.	Negative	3	2	**Medium**	

Table 3-6: Initial Cumulative Impacts

RECEPTOR	DESCRIPTION	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Noise and Vibrations	Cumulative Noise Emissions	Negative	3	3	**Medium**	**Yes**
Soils, Land Capability and Agricultural Potential	Cumulative Agricultural Impacts	Negative	4	3	**High**	**Yes**
Terrestrial Ecology	Cumulative impacts on biodiversity	Negative	4	3	**High**	**Yes**
Avifauna	Displacement of SCC due to disturbance of breeding birds associated with the decommissioning of the facility	Negative	1	3	**Medium**	**Yes**
	Cumulative collision Impacts	Negative	4	3	**Medium**	

RECEPTOR	DESCRIPTION	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Visual	Combined visual impacts from mining, industrial, infrastructural and renewable energy development in the broader area could potentially alter the sense of place and visual character of the area	Negative	3	3	**Medium**	**Yes**
	Combined visual impacts from mining, industrial, infrastructural and renewable energy development in the broader area could potentially exacerbate visual impacts on visual receptors	Negative	3	3	**Medium**	
Social	Cumulative impact on sense of place	Negative	4	3	**High**	**Yes**
Bats	Loss of foraging habitat by clearing of vegetation.	Negative	4	1	**Medium**	**Yes**
	Roost destruction during earthworks.	Negative	2	2	**Low**	
	Increased bat mortalities due to light attraction and habitat creation.	Negative	4	3	**High**	

3.5 SCOPING RECOMMENDATIONS

The scoping report identified and evaluated the feasibility of a range of site options. **Table 3-7** provides a summary of the scoping phase alternatives assessment.

Table 3-7: Alternatives Summary

ALTERNATIVE CATEGORY	ALTERNATIVE IDENTIFIED IN SCOPING	ASSESSMENT IN EIA PHASE (YES / NO)
Project Alternatives	**Site Alternative 1** is located on Portion 3 of the Farm Dunbar 189IS, at the site of an old abandoned farmyard and has three powerline options from the associated	Yes

ALTERNATIVE CATEGORY	ALTERNATIVE IDENTIFIED IN SCOPING	ASSESSMENT IN EIA PHASE (YES / NO)
	Hendrina North and South Wind Energy Facilities ("WEF") as follows: — Powerline option 1 is up to 2km in length, to the Hendrina North WEF substation Option 1 on Portion 1 of the Farm Dunbar 189IS; — Powerline option 2 is up to 7km in length, to the Hendrina North WEF substation Option 2 on Portion 3 of the Farm Hartebeestkuil 185IS; — Powerline option 3 is up to 1.5km in length, to the Hendrina South WEF substation on Portion 3 of the Farm Dunbar 189IS. — Water supply to the Site: constructing a new pipeline (up to 16km) from the Komati Power Station	
	Site Alternative 2 is located on Portion 3 of the Farm Dunbar 189IS and Portion 18 of the Farm Weltevreden 193IS, adjacent to the proposed Hendrina South WEF substation and has three powerline options from the associated wind farms as follows: — Powerline option 1 is up to 3km in length to the Hendrina North WEF Option 1 substation on Portion 1 of the Farm Dunbar 189IS; — Powerline option 2 is up to 8km in length to the Hendrina North WEF substation Option 2 on Portion 3 of the Farm Hartebeestkuil 185IS; — Powerline option 3 is up to 0.5km in length to the Hendrina South WEF substation on Portion 3 of the Farm Dunbar 189IS; — Water supply to the Site: constructing a new pipeline (up to 16km) from the Komati Power Station	Yes
	Site Alternative 3 is located on Portions 14 and 15 of the Farm Weltevreden 193IS and has three powerline options from the associated wind farms as follows: — Powerline option 1 is up to 5km in length to the Hendrina North WEF Option 1 substation on Portion 1 of the Farm Dunbar 189IS; — Powerline option 2 is up to 5km in length to the Hendrina North WEF substation Option 2 on Portion 3 of the Farm Hartebeestkuil 185IS; — Powerline option 3 is up to 7km in length to the Hendrina South WEF substation on Portion 3 of the Farm Dunbar 189IS. — Water supply to the Site: constructing a new pipeline (up to 16km) from the Komati Power Station	Yes

4 EIA METHODOLOGY

The EIA process was initiated in accordance with Appendix 3 of GNR 982 pertaining to applications subject to an S&EIR process.

4.1 DETAILED ENVIRONMENTAL ASSESSMENT

4.1.1 SPECIALIST STUDIES

Table 4-1 provides a list of the Specialist Studies that have been undertaken. The Specialist Declarations are included in **Appendix C**.

Table 4-1: Details of the Specialists

SPECIALIST STUDY	SPECIALIST	COMPANY	APPENDIX
Agriculture	Johann Lanz	Independent consultant	**Appendix H-1**
Avifauna	Chris van Rooyen	Chris van Rooyen Consulting	**Appendix H-2**
Terrestrial, Plant and Animal Ecology	David Hoare	David Hoare Consulting (Pty) Ltd	**Appendix H-3** **Appendix H-14** **Appendix H-13**
Aquatic	Stephen Burton	Independent	**Appendix H-4**
Bats	Werner Marais,	Animalia Consultants	**Appendix H-5**
Heritage	Jaco van der Walt	Beyond Heritage	**Appendix H-6**
Palaeontology	Marion Bamford	Beyond Heritage	**Appendix H-6**
Socio-economic	Pierre van Jaarsveld	Urban-Econ Development Economists	**Appendix H-7**
Traffic	Avheani Ramawa	JG Afrika (Pty) Ltd	**Appendix H-8**
Visual	Kerry Schwartz	SLR Consulting (Pty) Ltd	**Appendix H-9**
Noise	Morné de Jager	Enviro-Acoustic Research cc	**Appendix H-10**
Air Quality	Kirsten Collet	WSP Group Africa (Pty) Ltd	**Appendix H-11**
SHE Risk	Debra Mitchel	Ishecon cc	**Appendix H-12**
Desktop Geotechnical	Muhammad Osman	SLR Consulting (South Africa) (Pty) Ltd	**Appendix H-15**
Groundwater	Ockie Scholtz	Shangoni Management Services (Pty) Ltd	**Appendix H-16**

4.1.2 CUMULATIVE ASSESSMENT

The specialist assessments include a detailed cumulative environmental impact statement. The cumulative impact statement is provided in **Section 10**.

4.2 IMPACT ASSESSMENT METHODOLOGY

The EIR uses a methodological framework developed by WSP to meet the combined requirements of international best practice and NEMA, Environmental Impact Assessment Regulations, 2014, as amended (GN No. 326) (the "EIA Regulations").

As required by the EIA Regulations (2014) as amended, the determination and assessment of impacts will be based on the following criteria:

- Nature of the Impact
- Significance of the Impact
- Consequence of the Impact
- Extent of the impact
- Duration of the Impact
- Probability if the impact
- Degree to which the impact:
  - can be reversed;
  - may cause irreplaceable loss of resources; and
  - can be avoided, managed or mitigated.

Following international best practice, additional criteria have been included to determine the significant effects. These include the consideration of the following:

- Magnitude: to what extent environmental resources are going to be affected;
- Sensitivity of the resource or receptor (rated as high, medium and low) by considering the importance of the receiving environment (international, national, regional, district and local), rarity of the receiving environment, benefits or services provided by the environmental resources and perception of the resource or receptor);
- Severity of the impact, measured by the importance of the consequences of change (high, medium, low, negligible) by considering inter alia magnitude, duration, intensity, likelihood, frequency and reversibility of the change.

It should be noted that the definitions given are for guidance only, and not all the definitions will apply to all of the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

4.2.1 METHODOLOGY

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct, indirect, secondary as well as cumulative impacts. A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e., residual impact). The significance of environmental aspects is determined and ranked by considering the criteria presented in **Table 4-2**.

Table 4-2: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

4.2.2 IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan. The mitigation sequence/hierarchy is shown in **Figure 4-1** below.

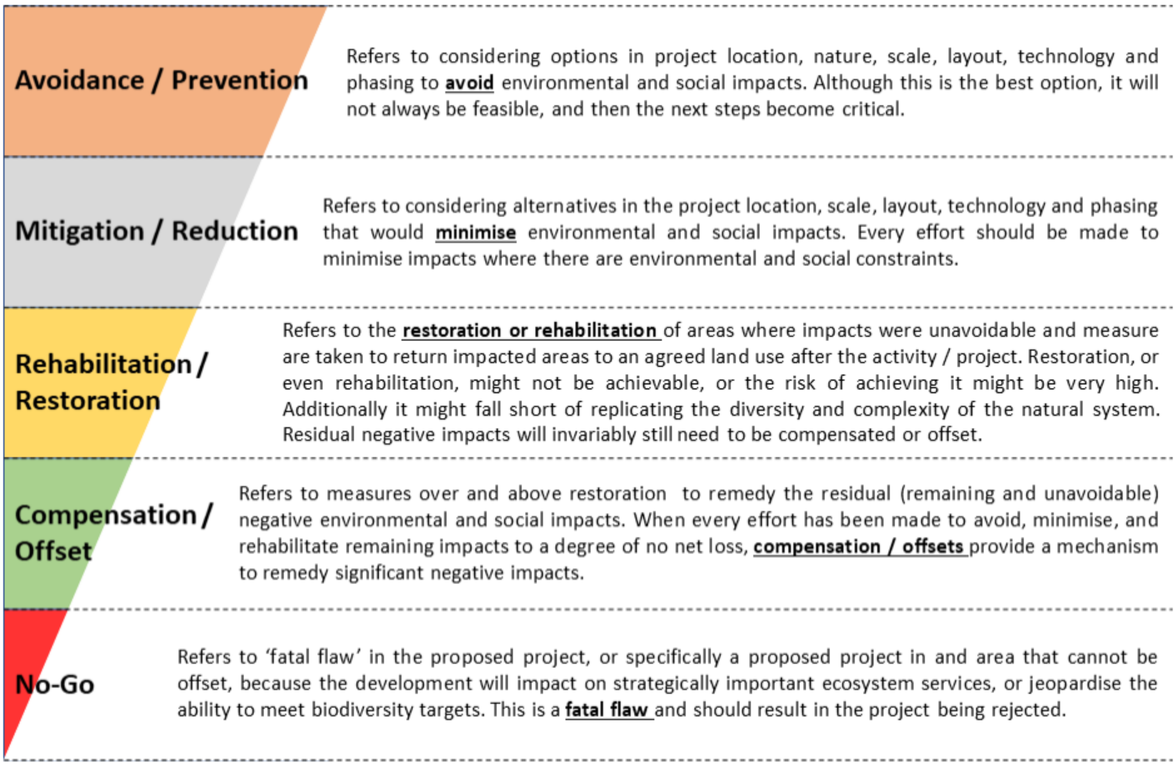


Figure 4-1: Mitigation hierarchy

4.3 STAKEHOLDER ENGAGEMENT

Stakeholder engagement (public participation) is a requirement of the S&EIA process. It consists of a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the S&EIA decision-making process. Effective engagement requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the proposed project. The objectives of the stakeholder engagement process can be summarised as follows:

- Identify relevant individuals, organisations and communities who may be interested in or affected by the proposed project;
- Clearly outline the scope of the proposed project, including the scale and nature of the existing and proposed activities;
- Identify viable proposed project alternatives that will assist the relevant authorities in making an informed decision;
- Identify shortcomings and gaps in existing information;
- Identify key concerns, raised by Stakeholders that should be addressed in the specialist studies;
- Highlight the potential for environmental impacts, whether positive or negative; and

— To inform and provide the public with information and an understanding of the proposed project, issues, and solutions.

A SER (**Appendix D**) has been compiled and included in the draft_EIAr detailing the projects' compliance with Chapter 6 of the NEMA EIA Regulations 2014, as amended.

4.3.1 STAKEHOLDER AND AUTHORITY CONSULTATION

There will continue to be ongoing communication between WSP and stakeholders throughout the S&EIR process. These interactions include the following:

— Interactions with stakeholders will be recorded in the comment and response report;
— Feedback to stakeholders will take place both individually and collectively;
— Written responses (email, faxes or letters) will be provided to stakeholders acknowledging issues and providing information requested (dependent on availability) and
— A letter will sent out to all registered stakeholders notifying them of the outcome of the environmental authorisation process

As per the GNR 982, particular attention will be paid to landowners, and neighbouring communities, specifically where literacy levels and language barriers may be an issue.

4.3.2 PUBLIC REVIEW

This draft EIAr will be placed on public review for a period of 30 days from **8 May 2023 to 7 June 2023** at the following public places:

— Gerard Sekoto Library;
— Hendrina Public Library;
— Steve Tshwete Local Municipality Office;
— Nkangala District Municipality office
— WSP website (https://www.wsp.com/en-ZA/services/public-documents); and
— Datafree Website (https://wsp-engage.com/).

All registered stakeholders and authorising/commenting state departments will be notified of the public review period as well as the locations of the draft EIR via email and SMS.

4.3.3 COMMENT AND RESPONSE REPORT

All concerns, comments, viewpoints and questions (collectively referred to as 'issues') will continue to be documented and responded to adequately in the Comment and Response Report. The Comment and Response Report records the following:

— List of all issues raised;
— Record of who raised the issues;
— Record of where the issues were raised;
— Record of the date on which the issue was raised; and
— Response to the issues.

The updated Comment and Response Report has been included in the SER in **Appendix D**.

4.3.4 SUBMISSION AND DECISION MAKING

The EAP must submit the final EIR to the competent authority within 106 days of the acceptance of the scoping report. A request for extension to the submission deadline of the FEIR was submitted to the MDARDLEA in terms of EIA Regulation 3(7). The final EIR is due to the MDARDLEA by latest **04 July 2023**. Once submitted, the delegated competent authority (i.e. the MDARDLEA) will be allocated 107 days to review the final EIR in order to either grant or refuse and environmental authorisation.

The final EIR will be placed on stakeholder review for a reasonable time period during the MDARDLEA's final review and decision-making process. All comments on the Final EIR should be submitted directly to MDARDLEA. The delegated competent authority must issue their decision within this specified timeframe. It must be noted that the final reports will not be open to further comment and the commenting period as regulated will have closed by then, but that comments can be forwarded to the case relevant officer.

4.3.5 NOTIFICATION OF ENVIRONMENTAL AUTHORISATION

All stakeholders will receive a letter at the end of the process notifying them of the authority's decision, thanking them for their contributions, and explaining the appeals procedure as outlined in the national Appeal Regulations, 2014 (GNR 993 of 2014).

4.4 DFFE WEB-BASED ENVIRONMENTAL SCREENING TOOL

DFFE has developed the National Web-based Environmental Screening Tool in order to flag areas of potential environmental sensitivity related to a site as well as a development footprint and produces the screening report required in terms of regulation 16 (1)(v) of the EIA Regulations (2014, as amended). The *Notice of the requirement to submit a report generated by the national web-based environmental screening tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended* (GN 960 of July 2019) states that the submission of a report generated from the national web-based environmental screening tool, as contemplated in Regulation 16(1)(b)(v) of the EIA Regulations, 2014, published under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, is compulsory when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the EIA Regulations, 2014 as of 04 October 2019.

The Screening Report generated by the National Web-based Environmental Screening Tool contains a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmentally sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected.

Screening reports for the proposed Hendrina GH&A facility was generated on 1 & 2 August 2022 and is attached as **Appendix F**. The Screening Report for the project identified various sensitivities for the site. The report also generated a list of specialist assessments that should form part of the S&EIA based on the development type and the environmental sensitivity of the site. Assessment Protocols in the report provide minimum information to be included in a specialist report to facilitate decision-making.

Table 4-3 below provides a summary of the sensitivities identified for the development footprint.

Table 4-3: Sensitivities identified in the screening report

THEME	VERY HIGH SENSITIVITY	HIGH SENSITIVITY	MEDIUM SENSITIVITY	LOW SENSITIVIY
Agricultural Theme		✓		
Animal Species Theme			✓	
Aquatic Biodiversity Theme	✓			
Archaeological and Cultural Heritage Theme				✓

THEME	VERY HIGH SENSITIVITY	HIGH SENSITIVITY	MEDIUM SENSITIVITY	LOW SENSITIVIY
Civil Aviation Theme		✓	✓	
Defence Theme				✓
Palaeontology Theme	✓			
Plant Species Theme			✓	
Terrestrial Biodiversity Theme	✓			

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report as determined by the screening tool (please refer to Section 4.4.1 below for the EAP motivation applicable to this list):

- Agricultural Impact Assessment
- Archaeological and Cultural Heritage Impact Assessment
- Palaeontology Impact Assessment
- Landscape/Visual Impact Assessment
- Terrestrial Biodiversity Impact Assessment
- Freshwater Impact Assessment
- Avifauna Impact Assessment
- Social Impact Assessment
- A Geotechnical Assessment
- Plant Species Assessment
- Animal Species Assessment

4.4.1 MOTIVATION FOR SPECIALIST STUDIES

The report recognises that "it is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the footprint situation."

As summarised in **Table 4-3** above, the following specialist assessments have been commissioned for the project based on the environmental sensitivities identified by the Screening Report:

- Soils and Agricultural Potential Assessment;
- Archaeological and Cultural Heritage Assessment;
- Palaeontology Impact Assessment;
- Visual Impact Assessment;
- Biodiversity Impact Assessment (inclusive of terrestrial biodiversity, plant species and animal species);
- Freshwater/Aquatic Assessment;
- Avifauna Impact Assessment;
- Environmental Acoustic (Noise) Impact Assessment;
- Social Impact Assessment;
- Qualitative Risk Assessment;
- Desktop Geotechnical Assessment;

— Traffic Assessment.

Three of the identified specialist studies will not be undertaken as part of the S&EIA process for the proposed Hendrina GH&A facility. Motivation for the exclusion of these specialist studies is provided below:

— **Detailed Geotechnical**

  A desktop Geotechnical Assessment has been commissioned and has been incorporated into this report (**Section 7.1.4** and **Appendix H-15**). No geotechnical fatal flaws were identified. However, a detailed Geotechnical Assessment will not be undertaken as part of the S&EIA Process as this will be undertaken during the detailed design phase.

— **Civil Aviation**

  According to the DFFE Screening Tool Report, civil aviation is regarded as having high and medium sensitivity.. The proposed development site is located between 8 and 15 km of civil aviation aerodromes. A formal Civil Aviation Assessment will not be undertaken as part of the S&EIA Process. Nevertheless, the relevant Authorities will be included on the project stakeholder database. The relevant Authorities have been included on the project stakeholder database. As of the 1st of February 2022, ATNS has been appointed as the new Obstacle application Service Provider. An Obstacle application will be submitted to ATNS for the project and the required permits will be obtained prior to the development of the project. The SACAA has also been included on the project stakeholder database.

— **Defence**

  According to the DFFE Screening Tool Report, defence is regarded as having low sensitivity. A compliance statement is therefore not required. The Department of Defence has been included on the project stakeholder database. They have been informed of the proposed Project and provided comment. (Refer to Stakeholder engagement report **Appendix D**)

5 NEED AND JUSTIFICATION

In October 2021, at the second Sustainable Infrastructure Development Symposium, President Cyril Ramaphosa said that green energy had the potential to drive industrialisation and establish a whole new industrial reality. Furthermore, the President stated that "We stand ready to be a major exporter in this market, to use hydrogen to rapidly decarbonise our existing industries, and attract industrial investment from across the globe seeking to meet new standards of green power in the production process".

The proposed development of the Hendrina GH&A Facility directly addresses the President's statements and the need to implement renewable energy technologies and green fuels and/or products in Mpumalanga.

Renewable energy development is regarded as an important contribution to meeting international and national targets of reducing reliance on fossil fuels, such as coal, which contribute towards greenhouse gas emissions and resultant climate change. The need and desirability of proposed Hendrina GH&A facility has been considered from an international, national and regional perspective.

5.1.1 WHAT IS GREEN HDROGEN AND AMMNOIA PRODUCTION

Green hydrogen is hydrogen fuel that is created using renewable energy instead of fossil fuels. It has the potential to provide clean power for manufacturing, transportation, and more and its only by-product is water.

Hydrogen energy is very versatile, as it can be used in gas or liquid form, be converted into electricity or fuel, and there are many ways of producing it. Approximately 70 million metric tons of hydrogen are already produced globally every year for use in oil refining, ammonia production, steel manufacturing, chemical and fertilizer production, food processing, metallurgy, and more.

Hydrogen is the most abundant chemical in the universe. Two atoms of hydrogen paired with an atom of oxygen creates water. Alone, though, hydrogen is an odourless and tasteless gas, and highly combustible.

There are three types of Hydrogen, namely brown, grey, and green hydrogen. These are named based on the process used to make them, and the emissions each process emits:

— **Brown hydrogen** requires the burning of fossil fuels (coal) in order to complete the gasification process. This process releases vast greenhouse gases (GHG) emissions into the atmosphere.
— **Grey hydrogen** is extracted from natural gases through a process known as steam reforming. This process also releases GHG emissions into the atmosphere.
— **Green hydrogen and ammonia production** differs from traditional production technologies in that the process relies exclusively on renewable resources (renewable energy) and for input air and water (feedstock), to produce commercially usable green hydrogen and ammonia. This method has **no associated GHG emissions.**

WHAT ARE HYDROGEN AND AMMONIA USED FOR?

Commercially, hydrogen is used as a fuel for transport in hydrogen fuel cells. Alternatively, hydrogen is used for welding and in the production of other chemicals such as methanol and hydrochloric acid and also has other commercial uses like the filling of balloons. It is also a primary input to the production of ammonia. Ammonia in turn is primarily used in the production of ammonium nitrate (fertiliser) and is also used as refrigerant gas and the manufacture of plastics, explosives, textiles, pesticides and other chemicals. Ammonia can also be used as a stable 'carrier' of hydrogen, allowing hydrogen to be readily stored and transported.

ADVANTAGES AND DISADVANTAGES OF GREEN HYDROGEN[2]

The green hydrogen energy source has advantages and disadvantages that we must be aware of. The most notable advantages include:

[2] https://www.iberdrola.com/sustainability/green-hydrogen

- **100 % sustainable:** green hydrogen does not emit polluting gases either during combustion or during production.
- **Storable**: hydrogen is easy to store, which allows it to be used subsequently for other purposes and at times other than immediately after its production.
- **Versatile:** green hydrogen can be transformed into electricity or synthetic gas and used for domestic, commercial, industrial or mobility purposes.
- **Transportable:** it can be mixed with natural gas at ratios of up to 20 % and travel through the same gas pipes and infrastructure **-** increasing this percentage would require changing different elements in the existing gas networks to make them compatible.

However, green hydrogen also has negative aspects, including:

- **High cost**: energy from renewable sources, which are key to generating green hydrogen through electrolysis, is more expensive to generate, which in turn makes hydrogen more expensive to obtain.
- **High energy consumption**: the production of hydrogen in general and green hydrogen in particular requires more energy than other fuels.
- **Safety issues**: hydrogen is a highly volatile and flammable element and extensive safety measures are therefore required.

5.1.2 GREEN ECONOMY

THE PARIS AGREEMENT

Climate change is a global emergency that goes beyond national borders. It is an issue that requires international cooperation and coordinated solutions at all levels. To tackle climate change and its negative impacts, world leaders at the UN Climate Change Conference (COP21) in Paris reached a breakthrough on 12 December 2015: the historic Paris Agreement.

The Agreement sets long-term goals to guide all nations:

- substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 degrees Celsius while pursuing efforts to limit the increase even further to 1.5 degrees;
- review countries' commitments every five years;
- provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts.

The Agreement is a legally binding international treaty. It entered into force on 4 November 2016. Today, 192 Parties (191 countries plus the European Union) have joined the Paris Agreement.

The Agreement includes commitments from all countries to reduce their emissions and work together to adapt to the impacts of climate change, and calls on countries to strengthen their commitments over time. The Agreement provides a pathway for developed nations to assist developing nations in their climate mitigation and adaptation efforts while creating a framework for the transparent monitoring and reporting of countries' climate goals.

The Paris Agreement provides a durable framework guiding the global effort for decades to come. It marks the beginning of a shift towards a net-zero emissions world. Implementation of the Agreement is also essential for the achievement of the Sustainable Development Goals.

Most experts agree that green hydrogen will be essential to meeting the goals of the Paris Agreement, since there are certain portions of the economy whose emissions are difficult to eliminate such as transportation, electricity generation and industry.

NATIONAL PERSPECTIVE

The Project will aid in the increase of exports from South Africa through the production of green hydrogen that has become popular globally. Hydrogen has become one of the latest buzzes for meeting the world's growing energy needs and a vital component for meeting the global decarbonization goals. Hydrogen is a clean fuel; however, the manufacturing of hydrogen fuel is energy-intensive and traditionally uses fossil fuels to power the production plant. There are four types of hydrogen and are classified in the manufacturing process. These types are brown, blue, grey and green hydrogen. Brown hydrogen is created through coal gasification, blue hydrogen uses carbon capture and storage for the greenhouse gases produced in the creation of grey hydrogen, producing grey hydrogen from natural gas produces carbon waste, and green hydrogen production uses renewable energy to create hydrogen fuel without carbon input.

The Project will produce green hydrogen of which can be used for various purposes and products which include fertilizers, shipping fuel, aviation fuel, and green steel. The Project can help contribute towards South Africa's exports and tap into the emerging multi-billion market, which is predicted to grow exponentially over the next few decades. The production of green hydrogen also requires a large solar and wind power input (both at the Project site). It is estimated that with the growth of the green hydrogen industry half a million jobs in the solar and wind industry will be created. Furthermore, in South Africa, green hydrogen has been identified by the Presidency as the first of the five "Big Frontier' strategic investment opportunities and will be involved in the finalization of the much anticipated 'Hydrogen Strategy and investor Roadmap'. It has been estimated that the green hydrogen industry in South Arica will be producing more than 3.8-million tonnes per Anum and reducing the countries greenhouse gas emissions by 75%- by 2050 and could support the creation of around 370 000 additional direct and indirect jobs.

Studies have shown that the manufacturing and use of hydrogen, using the available low-carbon technologies, will substantially support South Africa to progress to deeper decarbonization than current policies envisage. The production of green hydrogen will support greater domestic decarbonization and allow the country to meet its international obligations by (not limited to):

- Reforming carbon dioxide emissions in coal- and gas-to-liquids synthetic fuels refineries in Mossel Bay and Secunda and potentially supporting the use of biogenic, non-fossil, or direct-air-capture sources of CO_2 to be used to source sustainable synthetic fuels;
- Replacing the use of coking and other coal in steel production;
- Displacing the existing unabated gas use for chemicals and refinery hydrogen;
- Supporting the roll-out of fuel cells for remote and heavy-duty vehicles where battery solutions are not viable; and
- Fuelling industrial processes where electrification cannot meet the specific combustion or heat needs.

With South Africa being ranked in the top ten globally for its wind and solar potential- there is high potential for green hydrogen production. South Africa has excellent resources of land, wind, and sun that are fundamental to the large-scale development of renewable electricity— and are also the key inputs for green hydrogen. Based on having these key resources allowing for the construction of the hydrogen facility will ensure the country is taking the right steps towards the Presidency 2050 aspirations. This Project will serve as one of the anchor or foundation projects to the establishment of the South African green hydrogen industry

5.1.3 DESIRABILITY OF THE SITE

ENVIRONMENT

The environment is a key factor when it comes to the development of its projects. It is critical to ensure that its projects are developed in a sustainable manner. All the environmental factors were considered in the area when potential sites were being considered. After a thorough evaluation of the regional farms, the specific farms were selected because they were already heavily disturbed by agricultural and coal mining activities. Thus, it was concluded that the development of these farms would have a minimal impact on the region's flora, fauna and water resources.

TOPOGRAPHY AND SITE ACCESS

The surrounding landscape has a rolling hill topography which is suitable for the development of a GH&A facility. The Project site can be accessed via the tarred N11, R542 and R35 roads which run along the North-Eastern and western boundaries of the site. There is an existing road that goes through the land parcels to allow for direct access to the project development area. The site is also situated close to the renewable energy projects that are being proposed in parallel with this facility and therefore, the GH&A facility will be close to a reliable source of electricity.

LAND AVAILABILITY

With this region being home to some of the biggest coal power stations in the country (Komati and Camden among many others), most land parcels have been given mining rights for coal beneficiation to provide fuel stock supply these power stations. Thus, there is very limited land available for the development of the GH&A facility. However, sufficient land has been secured for the development of the proposed project with landowners within the respective cadastral portions comprising the development footprint indicating their support and willingness for the project to proceed to development via entering into agreement with the developer.

5.1.4 NEED AND DESIRABILITY FOR GREEN HYDROGEN AND AMMONIA

Sustainable energy conversion requires zero emissions of greenhouse gases and criteria pollutants using primary energy sources that the earth naturally replenishes quickly, like renewable resources. Solar and wind power conversion technologies have become cost effective recently, but challenges remain to manage electrical grid dynamics and to meet end-use requirements for energy dense fuels and chemicals.

Renewable hydrogen provides the best opportunity for a zero emissions fuel and is the best feedstock for production of zero emission liquid fuels and some chemical and heat end-uses. Renewable hydrogen can be made at very high efficiency using electrolysis systems that are dynamically operated to complement renewable wind and solar power dynamics.

Hydrogen can be stored within the existing natural gas system to provide low-cost massive storage capacity that (1) could be sufficient to enable a 100% zero emissions grid; (2) has sufficient energy density for end-uses including heavy duty transport; (3) is a building block for zero emissions fertilizer and chemicals; and (4) enables sustainable primary energy in all sectors of the economy.

5.1.5 NEED AND DESIRABILITY FOR RENEWABLE ENERGY

As the Hendrina GH&A facility will be powered by renewable energy, the need and desirability of renewable energy is therefore linked to the project as a whole. The GH&A Facility will serve to support these proposed neighbouring renewable facilities through guaranteed off-take.

Renewable energy development is regarded as an important contribution to meeting international and national targets of reducing reliance on fossil fuels, such as coal, which contribute towards greenhouse gas emissions and resultant climate change. The need and desirability of proposed Hendrina GH&A Facility has been considered from an international, national and regional perspective.

INTERNATIONAL PERSPECTIVE

The proposed project will align with internationally recognised and adopted agreements, protocols and conventions. This includes the Kyoto Protocol (1997) which calls for countries internationally to reduce their greenhouse gas emissions through cutting down on their reliance on fossil fuels and investing in renewable energy technologies for electricity generation.

The project will also greatly contribute to the countries' efforts to reduce their carbon emissions and play their role as part of the Paris Climate Accord. The Paris Agreement is a legally binding international treaty signed by 196 countries at the COP 21 in Paris, on the 12th of December 2015 to combat climate change. The goal of the Paris Accord is to limit global warming to well below 2 degrees Celsius, compared to industrial levels to avoid catastrophic natural disasters which are driven by the global temperature increase. Therefore, to achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate-neutral world by 2050.

The authorization of the Project will further align with South Africa's National Climate Response White Paper which outlines the countries efforts to manage the impacts of climate change and to contribute to the global efforts to stabilize the Greenhouse gases concentrations in the atmosphere.

NATIONAL PERSPECTIVE

The South African Government, through the IRP, has set a target to secure 17 800 MW of renewable energy by 2030. This is an effort to diversify the country's energy mix in response to the growing electricity demand and promote access to clean sources of energy.

The National Development Plan (NDP) is aimed at reducing and eliminating poverty in South Africa by 2030. The NDP also outlines the need to increase electricity production by 2030, with 20 000 MW of electricity capacity generated from renewable sources in order to move to less carbon-intensive electricity production. The Plan also envisages that South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates, while supporting economic growth through job creation.

The authorisation of the Hendrina GH&A Facility will further align with South Africa's National Climate Response White Paper which outlines the countries efforts to manage the impacts of climate change and to contribute to the global efforts to stabilize the greenhouse gases concentrations in the atmosphere.

The proposed Hendrina Renewable Energy Complex, which includes the Hendrina GH&A Facility, will pave the way for the Just Energy Transition (JET)[3] in South Africa and promote the transition from a fossil fuel-based economy to a low carbon economy. The proposed Hendrina Renewable Energy Complex aims towards the aforementioned national energy targets of diversification of energy supply and the promotion of clean energy. Wind and solar energy developments contribute to reduced emissions and subsequently climate change whilst promoting industrial development and job creation.

In addition, the Council for Scientific and Industrial Research (CSIR) reported that renewable energy assisted in relieving pressure on the constrained South African power system during load shedding in the first quarter of 2019. This indicates that renewable energy is a key factor in ensuring that the country does not face further load shedding in the future.

REGIONAL AND LOCAL PERSPECTIVE

JUST ENERGY TRANSITION

Coal power stations and the coal mining industry play a vital component in the economic and social components of the local Mpumalanga economy. Shifting to a low carbon economy will thus need to offset or exceed the benefits being realized by fossil fuels in the province. Thus, a key factor to ensuring the success of the Just Energy Transition is not only to focus on the transition from fossil fuels to renewable energy resources but to simultaneously ensure the Just Transition of jobs and skills.

The transition towards renewable energy will improve the socio-economic conditions of the Nkangala District Municipality. The Nkangala District Municipality recorded an unemployment rate of 34.3% in 2019 with the majority of its employed in the trade and community services sectors. The Project will aid in solving two of the leading challenges faced by the Nkangala District Municipality, namely the cost of electricity and lack of adequate employment opportunities. As various career opportunities are presented by the wind industry, and these are divided into four pillars that are aligned with the value chain. These four pillars are project development, component manufacturing, construction, and operation & maintenance as shown in **Figure 5-1**

[3] The Just Transition is described as the transition towards a low-carbon and climate-resilient economy that maximizes the benefits of climate action while simultaneously improving the welfare of the workers and their communities.

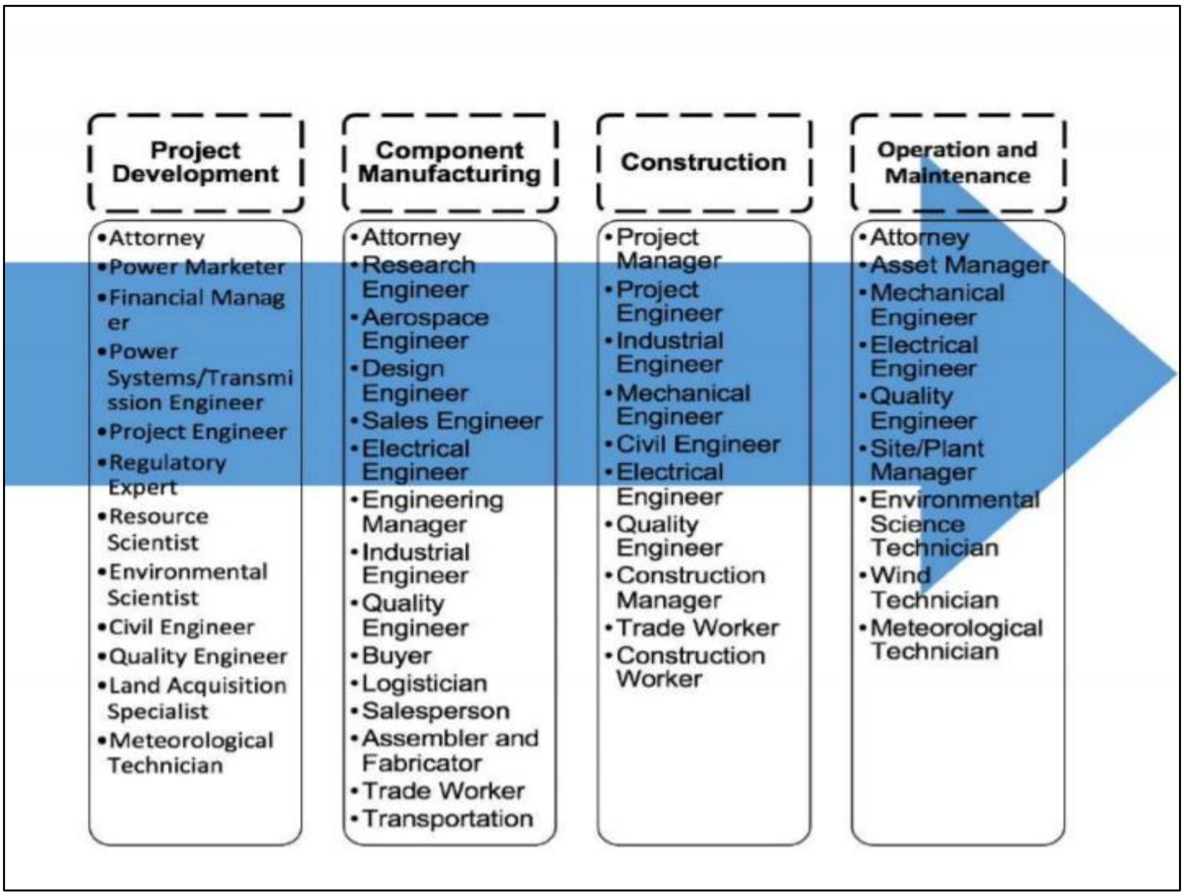


Figure 5-1: Career Opportunities presented by the Wind Industry (Source: https://www.res4africa.org/wp-content/uploads/2020/09/RES4Africa-Foundation-A-Just-Energy-Transition-in-South-Africa.pdf)

Figure 5-1 shows that the wind industry will create job opportunities throughout the supply chain. The wind industry will contribute to the Just transition in South Africa to ensure that there are no job losses but rather job transfers and skill exchange. For these opportunities to arise, renewable energy projects need to be approved in Mpumalanga to ensure that the transition from fossil fuels to renewable energy happens gradually and takes off effectively.

6 PROJECT DESCRIPTION

6.1 SITE LOCATION

The proposed Hendrina GH&A Facility will be developed in an area of approximately 25 hectares (ha), 17km west of Hendrina, in Mpumalanga. The proposed Hendrina GH&A Facility falls within the Steve Tshwete Local Municipality of the Nkangala District Municipality.

The five projects of the Hendrina Renewable Energy Complex are located within the same geographical area and are inevitably linked and integrated. As such, the overall locality of the Hendrina Renewable Energy Complex is included in **Figure 6-1**. The Hendrina GH&A Facility (project under consideration for this EIAr) project site, including associated alternatives, is indicated in **Figure 6-2**.

It must be noted that that the linear features (pipeline most importantly) are assessed in corridors of 500m wide so as to allow for micro siting and minor modification withing the corridor to fit sensitives and on-site conditions.

The details of the properties associated with the proposed Hendrina GH&A Facility, including the 21-digit Surveyor General (SG) codes for the cadastral land parcels are outlined in **Table 6-1**, **Table 6-2, Table 6-3, Table 6-4** and **Table 6-5** below.

Each site option has three powerline options and one water supply option associated with it. The properties associated with the powerline and water supply pipeline alternatives are outlined in **Table 6-2, Table 6-3, Table 6-4** and **Table 6-5**

Table 6-1: Hendrina GH&A Affected Farm Portion

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Site Alternative 1	
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Site Alternative 2 (Preferred)	
Portion 18 of Weltevreden Farm No. 193IS	T0IS00000000019300018
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Site Alternative 3	
Portion 14 of Weltevreden Farm No. 193IS	T0IS00000000019300014
Portion 15 of Weltevreden Farm No. 193IS	T0IS00000000019300015

Table 6-2: Site 1 Powerline Alternatives

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Powerline Alternative 1 for Site 1 (Preferred)- 2km	
Portion 1 of Dunbar Farm No. 189IS	T0IS00000000018900001
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Powerline Alternative 2 for Site 1 -7km	
Portion 1 of Dunbar Farm No. 189IS	T0IS00000000018900001
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Portion 0 of Dunbar Farm No. 189IS	T0IS00000000018900000
Portion 3 of Hartebeestkuil Farm No. 185IS	T0IS00000000018500003
Powerline Alternative 3 for Site 1- 1.5km	
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003

Table 6-3: Site 2 Powerline Alternatives

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Powerline Alternative 1 for Site 2 (Preferred)- 3km	
Portion 1 of Dunbar Farm No. 189IS	T0IS00000000018900001
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Powerline Alternative 2 for Site 2 -8km	
Portion 1 of Dunbar Farm No. 189IS	T0IS00000000018900001
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Portion 0 of Dunbar Farm No. 189IS	T0IS00000000018900000
Portion 3 of Hartebeestkuil Farm No. 185IS	T0IS00000000018500003
Powerline Alternative 3 for Site 2- 0.5km	
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003

Table 6-4: Site 3 Powerline Alternatives

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Powerline Alternative 1 for Site 3 (Preferred)- 5km	
Portion 15 of Weltevreden Farm No. 193IS	T0IS00000000019300015
Portion 0 of Dunbar Farm No. 189IS	T0IS00000000018900000
Portion 1 of Dunbar Farm No. 189IS	T0IS00000000018900001
Powerline Alternative 2 for Site 3 -5km	
Portion 15 of Weltevreden Farm No. 193IS	T0IS00000000019300015
Portion 0 of Dunbar Farm No. 189IS	T0IS00000000018900000
Portion 3 of Hartebeestkuil Farm No. 185IS	T0IS00000000018500003
Powerline Alternative 3 for Site 3- 7km	
Portion 3 of Dunbar Farm No. 189IS	T0IS00000000018900003
Portion 15 of Weltevreden Farm No. 193IS	T0IS00000000019300015
Portion 0 of Dunbar Farm No. 189IS	T0IS00000000018900000
Portion 1 of Dunbar Farm No. 189IS	T0IS00000000018900001
Portion 6 of Dunbar Farm No. 189IS	T0IS00000000018900006

Table 6-5: Water pipeline alternative affected farm portions

It should be noted that these pipelines are within corridors for assessment of 500m wide for the purposes of micro siting, the same applies for proposed 132kV grids lines – line is indicative but can be located anywhere in the assessment corridor pending walkdowns and micro-siting.

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Water Pipeline Alternative for site 1	
Portion 1 of Bultfontein Farm No. 187IS	T0IS00000000018700001
Portion 2 of Bultfontein Farm No.87IS	T0IS00000000018700002
Portion 3 of Bultfontein Farm No.187IS	T0IS00000000018700003

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Portion 4 of Bultfontein Farm No.187IS	T0IS00000000018700004
Portion 6 of Bultfontein Farm No. 187IS	T0IS00000000018700006
Portion 10 Bultfontein Farm No.187IS	T0IS00000000018700010
Portion 14 Bultfontein Farm No.187IS	T0IS00000000018700014
Portion 0 Dunbar Farm No.189IS	T0IS00000000018900000
Portion 1 Dunbar Farm No.189IS	T0IS00000000018900001
Portion 2 Dunbar Farm No.189IS	T0IS00000000018900002
Portion 4 Dunbar Farm No.189IS	T0IS00000000018900004
Portion 5 Dunbar Farm No.189IS	T0IS00000000018900005
Portion 6 Dunbar Farm No.189IS	T0IS00000000018900006
Portion 7 Dunbar Farm No.189IS	T0IS00000000018900007
Portion 6 Geluk Farm No.26IS	T0IS00000000002600006
Portion 7 Geluk Farm No.26IS	T0IS00000000002600007
Portion 3 Hartebeestkuil Farm No.185IS	T0IS00000000018500003
Portion 0 Komati Power Station Farm No.56IS	T0IS00000000005600000
Portion 1 Wilmansrust Farm No.47IS	T0IS00000000004700001
Portion 3 Wilmansrust Farm No.7IS	T0IS00000000004700003
Portion 9 Wilmansrust Farm No.47IS	T0IS00000000004700009
Water Pipeline Alternative for site 2 (Preferred)	
Same portions as above	
Water Pipeline Alternative for site 3	
Portion 1 of Bultfontein Farm No. 187IS	T0IS0000000018700001
Portion 2 of Bultfontein Farm No.87IS	T0IS0000000018700002

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Portion 3 of Bultfontein Farm No.187IS	T0IS00000000018700003
Portion 4 of Bultfontein Farm No.187IS	T0IS00000000018700004
Portion 6 of Bultfontein Farm No. 187IS	T0IS00000000018700006
Portion 10 Bultfontein Farm No.187IS	T0IS00000000018700010
Portion 14 Bultfontein Farm No.187IS	T0IS00000000018700014
Portion 0 Dunbar Farm No.189IS	T0IS00000000018900000
Portion 1 Dunbar Farm No.189IS	T0IS00000000018900001
Portion 2 Dunbar Farm No.189IS	T0IS00000000018900002
Portion 4 Dunbar Farm No.189IS	T0IS00000000018900004
Portion 5 Dunbar Farm No.189IS	T0IS00000000018900005
Portion 6 Dunbar Farm No.189IS	T0IS00000000018900006
Portion 7 Dunbar Farm No.189IS	T0IS00000000018900007
Portion 6 Geluk Farm No.26IS	T0IS00000000002600006
Portion 7 Geluk Farm No.26IS	T0IS00000000002600007
Portion 3 Hartebeestkuil Farm No.185IS	T0IS00000000018500003
Portion 0 Komati Power Station Farm No.56IS	T0IS00000000005600000
Portion 1 Wilmansrust Farm No.47IS	T0IS00000000004700001
Portion 3 Wilmansrust Farm No.7IS	T0IS00000000004700003
Portion 15 of Weltevreden Farm No. 193IS	T0IS00000000019300015

It should be noted that that the proposed pipelines are within corridors of 500m wide for assessment for the purposes of micro siting, the same is applied for the proposed 132kV grid lines – line is indicative but it can be located anywhere in the assessment corridor pending walkdowns and micro-siting.

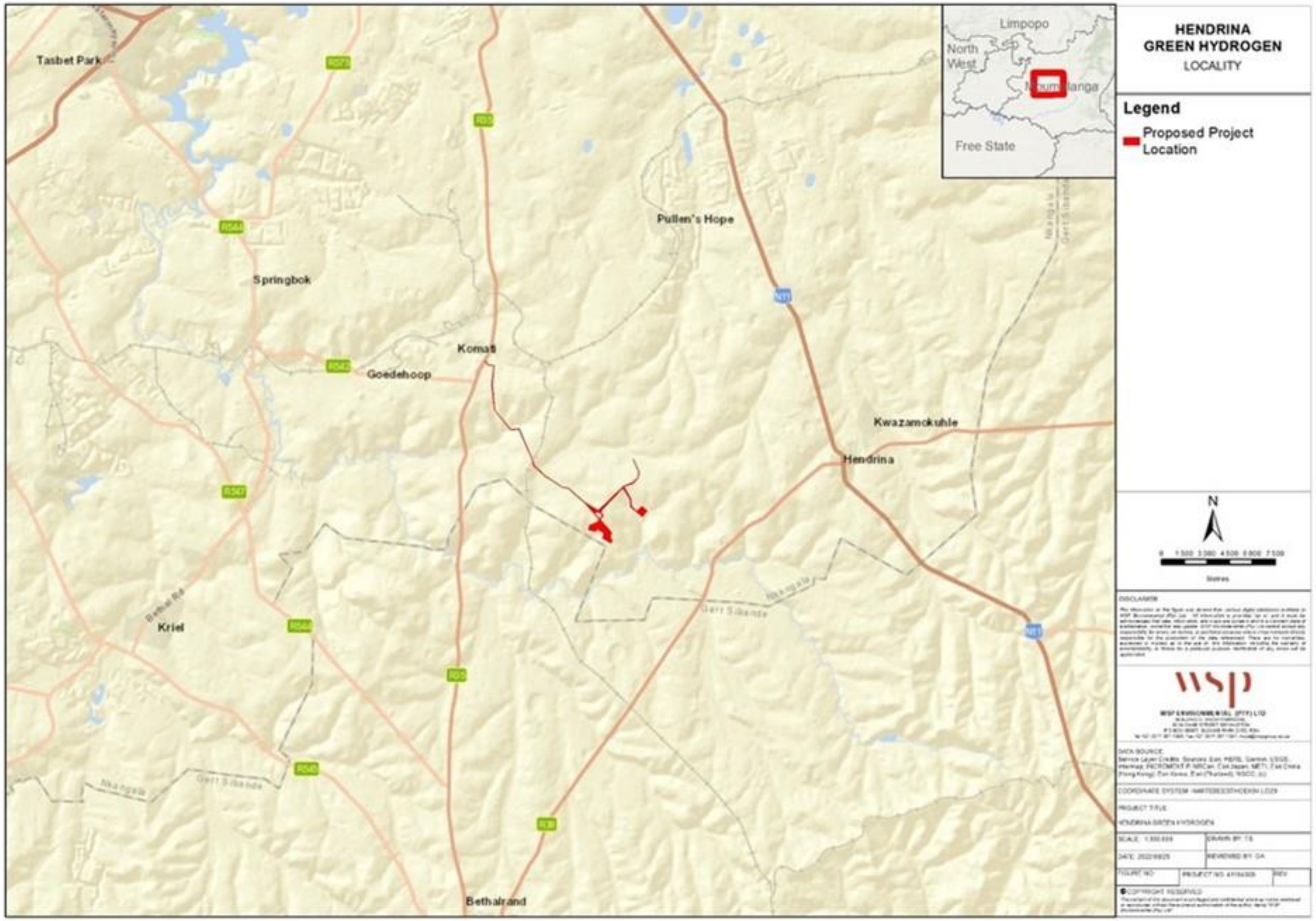


Figure 6-1: Locality map for the proposed Hendrina Green Hydrogen and Ammonia facility, near Hendrina, Mpumalanga Province

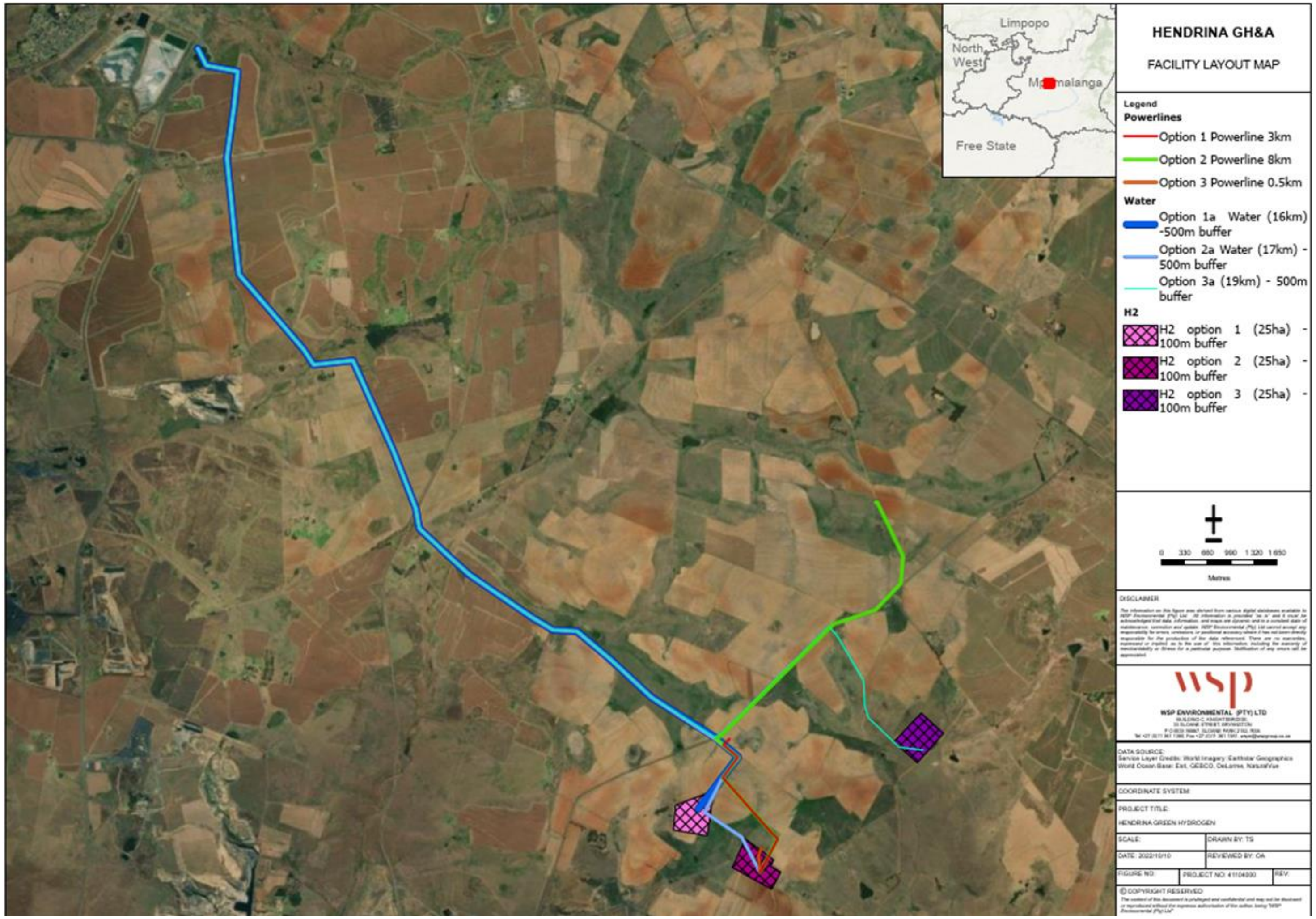


Figure 6-2: Proposed Hendrina GH&A Facility and associated main components

6.2 GREEN HYDROGEN AND AMMONIA PROCESS

ENERTRAG developed its first green hydrogen facility, Hybridkraftwerk, in Germany which is powered by wind energy. The Hybridkraftwerk was commissioned in October 2011 and produces 94 tons of hydrogen per year (**Figure 6-3** and **Figure 6-4**).

ENERTRAG SA, is proposing the development of up to 150MW green hydrogen and ammonia facility (‘Facility’). The Facility will encompass approximately 25 hectares of land (three alternative locations being assessed), and the affected land parcels are shown in **Figure 6-3.**

Figure 6-3: Enertrag Germany’s Hybridkraftwerk

Figure 6-4: Closer View of Electrolyser Housing and Storage Tanks

‘Green Ammonia’ is ammonia (NH_3) made using renewable energy, air and water (**Figure 6-5**). The process uses electrolysis (direct electric current to drive an otherwise non-spontaneous chemical reaction) and air separation to split water and air into its primary components i.e. hydrogen (H) and oxygen (O_2) from water, and nitrogen (N) and oxygen from air. NH_3 is then synthesised from the separated components using the Haber-Bosch method (the standard industrial process used to make ammonia). The Haber-Bosch process combines stoichiometric amounts of hydrogen and nitrogen in a moderate temperature (~ 400 – 500 °C), high pressure (100 barg) reactor. The process requires a catalyst (usually iron-based) promoting NH_3 mixture equilibrium. The NH_3 gas generated is rapidly cooled to form anhydrous (liquid) NH_3 for easy and safe storage and transport. Any unreacted nitrogen and hydrogen is recycled back into the reactor.

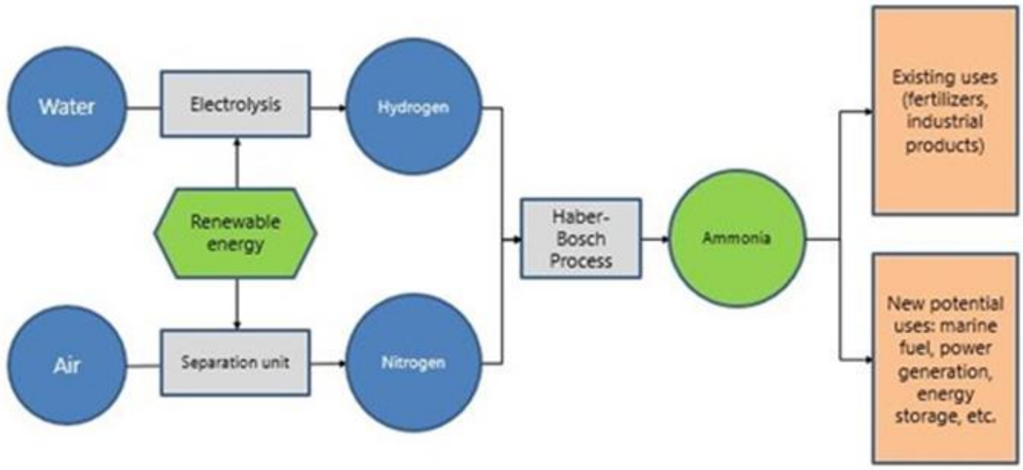


Figure 6-5: Green ammonia production and end uses

Anhydrous NH_3 is easily stored in bulk tanks and used widely as an agricultural fertilizer as well as in industrial processes. When powered by renewable energy sources (i.e. wind or solar generated electricity) the production process is 100% carbon-free. NH_3 can also be used as a fuel in combustion engines (releasing nitrogen and water vapour as opposed to harmful emissions associated with the combustion of fossil fuels) or it can be cracked back into its components and the separated hydrogen used in other applications e.g. a fuel cell for charging battery powered electric vehicles. Hydrogen derived from renewable sources is also a viable substitute for fossil fuels, however, is difficult to store and transport in bulk. NH_3 is an effective and safe storage medium for hydrogen. Green Ammonia as a hydrogen carrier, thus presents an opportunity to capture renewable energy in a form that can be stored, safely transported and used in multiple applications.

The only solid waste stream is the production of brine from the water treatment plant. Ammonia spillages may occur however these will be accidental and mitigation measures will be developed and implemented, including amongst others suitable containment related to storage and emergency response measures.

A gaseous ‘waste’ (oxygen) is generated from the electrolyses process. Another source of gaseous ‘wastes’ is from the Air Separation Unit. This is where nitrogen is removed from the air and the other natural gases as expelled back to the environment.

A simplified flow process diagram is shown in **Figure 6-6** and **Figure 6-7**

The production, storage and transport of hydrogen and ammonia is an industry undergoing in-depth research and developments. Consequently, technological solutions are constantly being improved and changing. Thus, the below Facility description is based on available technological solutions, however, the underlying fundamentals will remain.

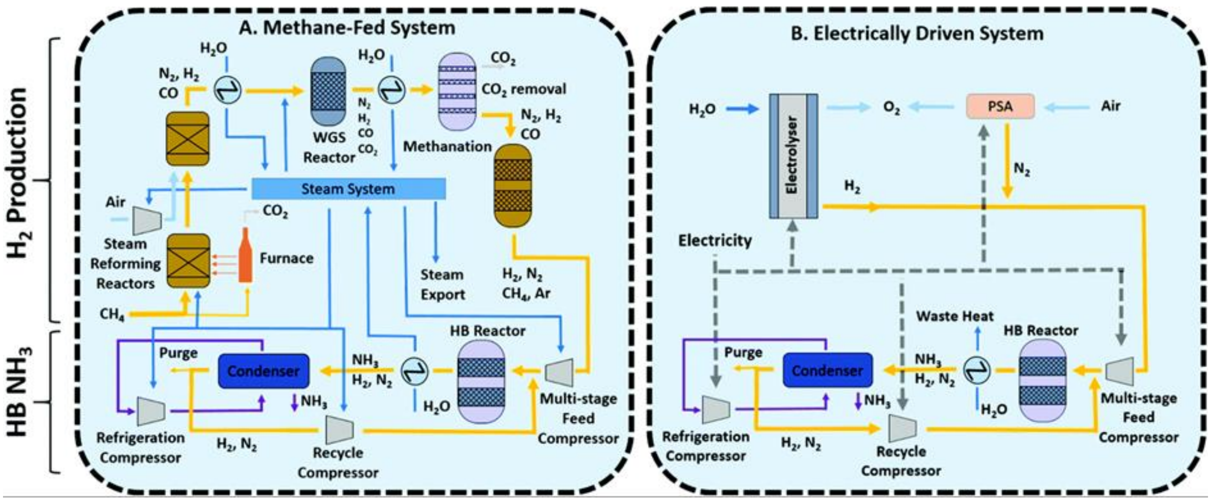


Figure 6-6: Simplified process flow diagram- traditional ammonia vs green ammonia production

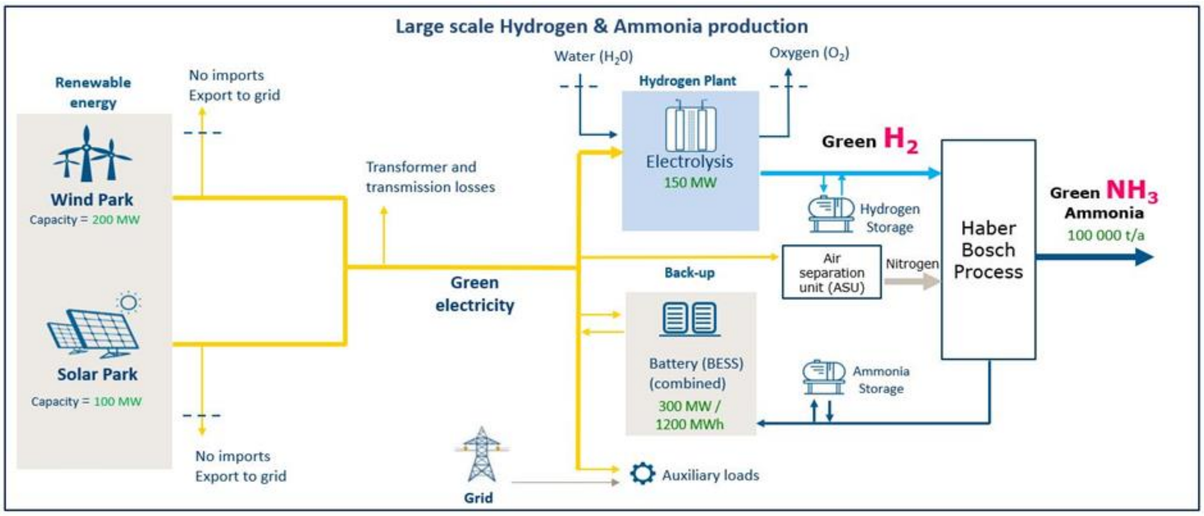


Figure 6-7: Simplified green hydrogen and ammonia production life cycle example

6.3 PROJECT INFRASTRUCTURE

The facility comprises the following components as summarised in **Table 6-6**, where the footprint and capacities are presented. An indicative block layout of the GH&A Facility is illustrated in **Figure 6-8**.

These parameters on based on the assumption that an up to 150MW electrolyser is installed (maximum). These components are detailed further below, but comprise the following general components:

— Water treatment.
— Electrolyser.
— Air separator.
— Ammonia processing unit.
— Liquid air energy system (LAES) for nitrogen storage.
— Feedstock and product storage.
— Utilities.
— Gantry and loading bay.

— Up to 132kV overhead powerline from the substation to the facility

Associated infrastructure further includes:

- Temporary and permanent laydown areas required for temporary storage and assembly of components and materials.
- Access road/s to the site and internal roads between project components, with a width of up to up to 8m wide respectively.
- A temporary concrete batching plant (if necessary).
- Temporary staff accommodation.
- Fencing and lighting.
- Lightning protection.
- Telecommunication infrastructure.
- Stormwater channels.
- Water pipelines.
- Offices.
- Operational control centre.
- Operation and Maintenance Area / Warehouse / workshop.
- Ablution facilities.
- A gate house.
- Control centre, offices, warehouses.
- Security building.

Access to the site is possible primarily via an unnamed gravel road immediately off the R542 (North-West from the town of Hendrina). Existing roads will be used where feasible and practical.

Table 6-6: Summary of Facility Components

NO.	COMPONENT	APPROXIMATE FOOTPRINT (HA)	STORAGE CAPACITY (M^3 / TONS)	MAXIMUM THROUGHPUT (M^3 / TONS PER ANNUM)	NOTE
1	Water Reservoir	2	6 800 / 6 800	800 / 800	Process and utilities water
2	Water Treatment Unit	1.5	N/A	192 000 / 192 000	Process and utilities water
3	Electrolyser Unit	1	N/A	(1 239 157 – 301 932 367) / 20 000	Hydrogen Output Oxygen Output
4	Air Separation Unit	0.5	N/A	92 905 405 / 110 000	Nitrogen Input
5	Ammonia Processing Unit	2	N/A	149 253 / 100 000	Ammonia Output
6	Liquid Air Storage System (LAES)	1	3 983/ 3 505	460 227 / 405 000	Nitrogen Storage
7	Liquid Ammonia Storage Tank	2	2 273/ 1 523	261 194 / 175 000	

NO.	COMPONENT	APPROXIMATE FOOTPRINT (HA)	STORAGE CAPACITY (M^3 / TONS)	MAXIMUM THROUGHPUT (M^3 / TONS PER ANNUM)	NOTE
8	Hydrogen and Oxygen Storage Tank Farm	12	59 566/ 800	5 576 208 / 90 000	Hydrogen and Oxygen storage (combined tank farm), i.e. feedstock storage
9	Ancillary infrastructure	3	n/a	n/a	Includes temporary and permanent laydown areas, parking, offices and other related infrastructure.
	Total Footprint	~ 25			

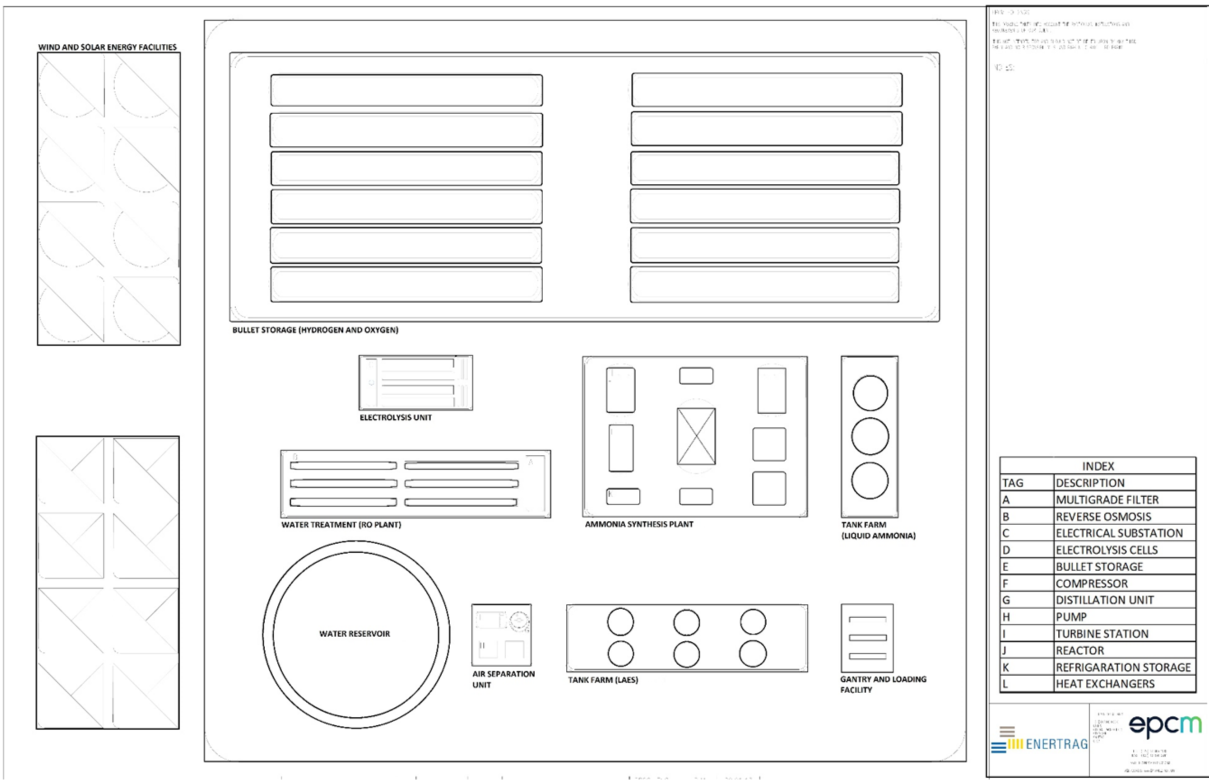


Figure 6-8: Indicative block layout of the proposed hydrogen and ammonia plant

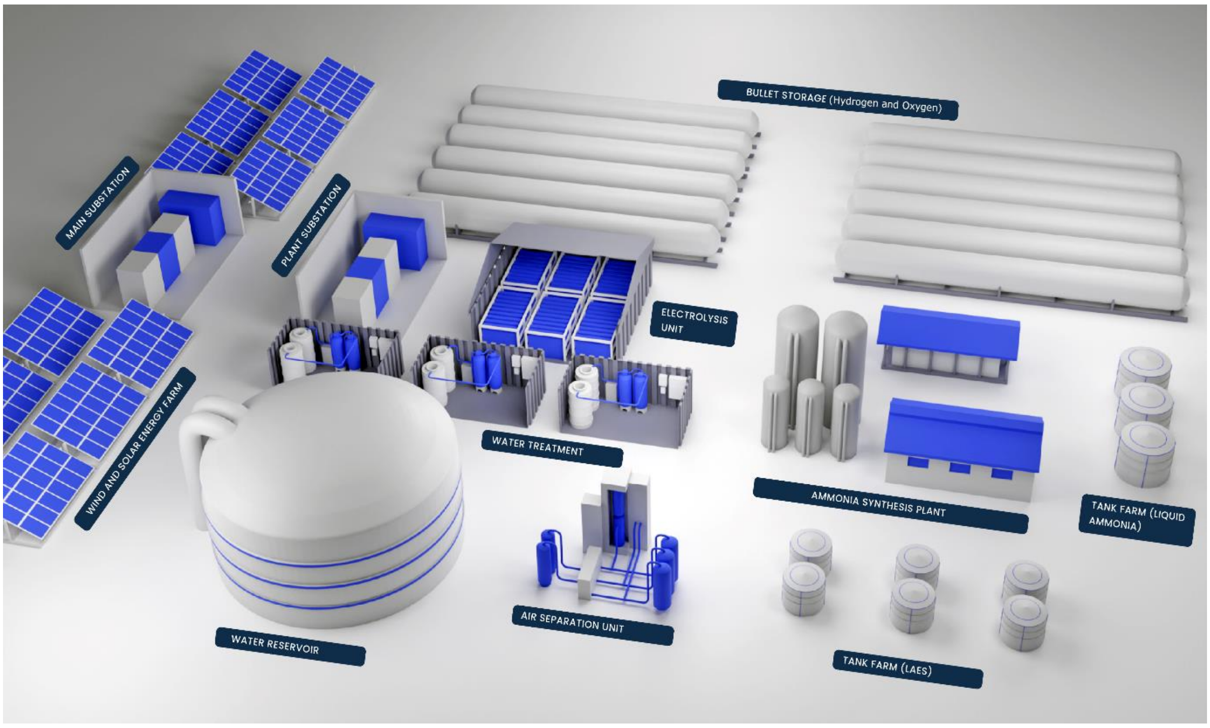


Figure 6-9: Possible Green Hydrogen and Ammonia plant layout

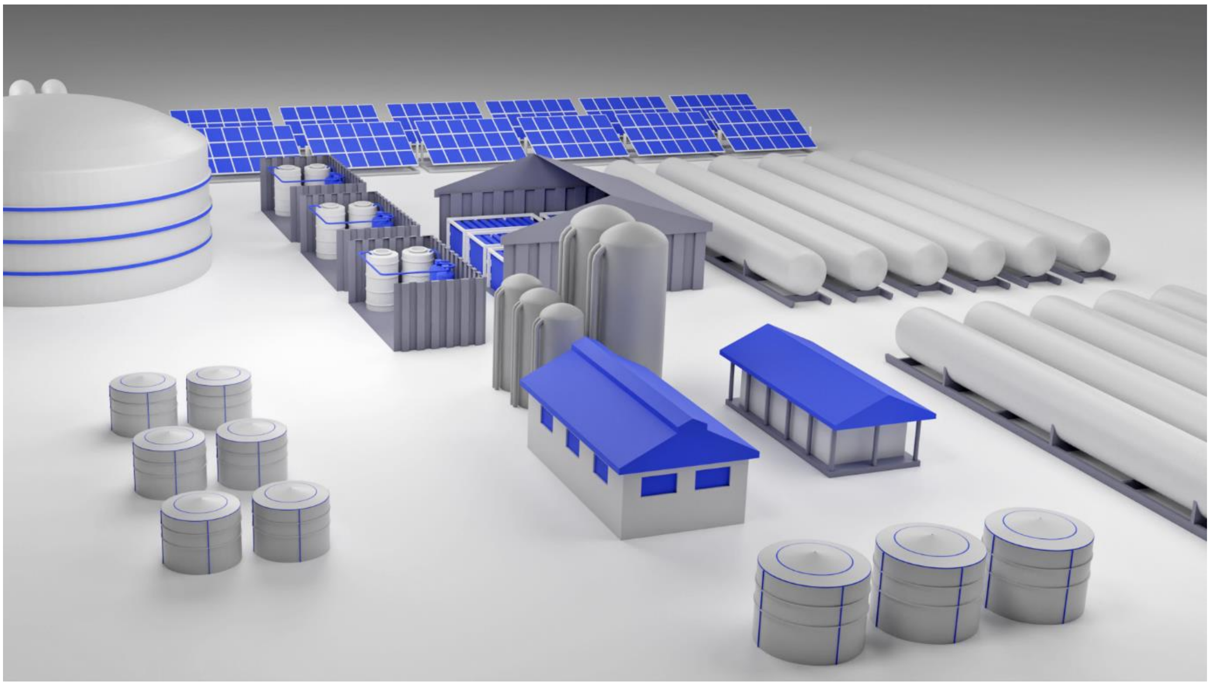


Figure 6-10: Possible Green Hydrogen and Ammonia plant layout

6.3.1 WATER RESERVOIR

Water is required for the production of hydrogen and for heating and cooling purposes. Feedstock water will be stored in a water reservoir with a footprint of up to 1.5ha and a capacity of approximately 6800 m^3. It is proposed that three water reservoirs will be located on site. Each reservoir will have a diameter of up to 25m and a height of 6m (maximum height up to 15m), pending detailed design. The water reservoirs will consist of either reinforced concrete or steel cylindrical tanks (**Figure 6-11**). The precise design will be determined during the detailed design engineering phase.

A variety of water sources are being investigated for the broader development, and include the following:

- **Komati Power Station** (technical preferred option): Bulk water infrastructure from the Usuthu Water Scheme currently feeding the surrounding coal mines and power stations (specifically Eskom Komati Power Station) may be utilised for construction and operational water. Initial water results indicate good quality supply in sufficient quantities is available. This option is the preferred water sourcing for the development due to excess water being available at the Power Station's water reservoirs.
- **Groundwater:** Various boreholes may be utilised across the project site for extraction of construction and operational water requirements. The volumes will be dependent on the available groundwater and the quality thereof, which has not yet been determined.
- **Purified wastewater:** Wastewater from nearby commercial or mining facilities could be sourced to provide the facility with water. This would depend on availability of suitable quality wastewater and agreements with the respective entities involved. It is possible that water may be sourced from existing surrounding mining operations that are experiencing or anticipating mine water decant from their operations. Using this water in the green hydrogen and ammonia facility is potentially beneficial.

Figure 6-11: Typical water reservoir (left - concrete, right – steel)

WATER PIPELINE

As mentioned above, the preferred water source will be to connect to the Usutu Pipeline. Therefore, an above or below ground water pipeline will be constructed for the continuous or intermittent supply of water to the GH&A facility.

The pipeline will comprise a concrete pressure pipe, ductile iron pipe, galvanised iron or steel pipe, GRP/GRE pipe, Poly Vinyl Chloride Pipes, High Density Polyethylene pipes or other suitable material as required by the detailed design phase, situated (where buried) within a trench of up to 3m wide and up to 2m deep. The pipe will carry up to 928 880m^3 per annum at a throughput of ~40 litres per second (usage requirements varying between the construction and operational phases). The pipeline inner diameter will be up to 300mm. Major components will include:

- Pipeline segments comprising pipeline length of up to 9.5km.
- Concrete supports (where pipeline is located above ground)
- Pumps (including pump, electrical or oil engine and panel board) housed in pump house for security and safety
- Mains and sumps (if needed)
- Manholes for inspection, with concrete covers. To be spaced no further than 100 metres apart.
- Valves (various, for example sluice, air, scour etc.) as required
- Water and flow meters
- Pipe fitting pieces, joints, clamps, adaptors and couplings as needed
- Bedding material as needed (concrete, sand, tamped down soil) where trenched
- Electrical source for pumps

— Protection systems (pipeline inner liner and outer coating), cathodic protection, pressure meters).

Three water supply pipeline alternatives are being considered, as follows:

— Alternative 1: Alternate Site to Usuthu Water Scheme (~16km);
— Alternative 2: Preferred Site to Usuthu Water Scheme (~17km);
— Alternative 3: Alternate Site to Usuthu Water Scheme (~19km);

The surface area required for the trenching, assuming a 3m wide trench for the full length of the entire pipeline will be up to 3 ha.

6.3.2 WATER TREATMENT

Water required for the electrolysis must first be purified to acceptable standards for the electrolysis process. This purification is achieved through a Closed Circuit Reverse Osmosis (CCRO) process, including a forced-crystallisation unit. The reverse osmosis operation comprises of high pressure applied in order to drive water through semipermeable membranes that reject salt ions.

CCRO systems further work by recirculating pressurized feedwater until a desired recovery level is reached. Brine is replaced with fresh feed without stopping the flow of pressurized feed or permeate. CCRO systems achieve recovery by recirculation, not with multiple membrane elements and stages in series, and can therefore reach any desired recovery percentage in a single stage. CCRO technology has process has demonstrated recovery rates of up to 98% whilst saving more water and reducing more waste than traditional one-, two- and three-stage reverse osmosis systems. The RO system consumes between 10 - 16 litres of water per kg - of hydrogen.

Two by-products are produced by the RO process – brine and permeate. The permeate (purified water) must be of ASTM Type II quality, defined as having a resistivity of >1 MΩ-cm, a conductivity of <1 µS/cm and <50 ppb of TOCs. In contrast, the brine produced contains all rejected concentrated minerals which was separated through the RO process, which then acts as feedwater for the forced crystallisation unit forming part of the RO plant.

The water treatment facility is estimated to consume up to 192 000 tons per annum (tpa) of water per annum, with an additional estimated 2 000 tpa for utilities related to general running of the plant. This may increase, depending on the water source and qualities obtained, to approximately 320 000 tons per annum.

Purified water from the water treatment facility is the main input to the next step in the process, namely the electrolyser.

BRINE HANDLING

Water treatment is associated with the generation of concentrated wastes removed from the water, such as brine salt. The quantity of brine produced is directly related to the quality of the feedwater and efficiency of the RO process. Based on standard tap water, it can be assumed that for every 10 litres of purified water there will be 4 litres of bine produced. Liquid brine can be made into a solid through several available technologies such as, settlement tanks, cooling water circuits, and forced crystallization.

Based on the water samples taken to date and the quality of the Usutu pipeline feedwater, a total dissolved solids content of around 200mg/l is anticipated. Should the plant consume up to 192 000 tons of water, this would result in a maximum of 38 tons of sold salt being created per year (~105kg per day) assuming all salts are removed. This represents the worst-case scenario. This may increase, depending on the water source and qualities obtained, to approximately 320 000 tons per annum.

Liquid brine can be dewatered to recycle water and reduce the need for new input water. This dewatered, solid brine can be stored onsite in waste skips and can be readily disposed at the nearest suitably licenced waste disposal facility.

Alternatively, the wastewater can be used for irrigation water for the local famers by diluting the concentrated liquid brine with additional fresh water, or where possible re-used process water from the RO plant.

In addition, should sufficient quantities of feed water be available, brine can be diluted with fresh feedwater and used for dust suppression or similar use.

CRYSTALLIZATION

Crystallization is the production of a solid (crystal or precipitate) formed from a homogeneous, liquid which is concentrated to supersaturation levels (concentration > solubility) at that temperature. The crystallization processes utilised has not been selected and will be determined at detailed designed phase based on likely permeate constituents and concentration levels, however, may comprise any of the following:

- Supersaturation by cooling the solution with trivial evaporation;
- Supersaturation by evaporation of the solvent with little cooling;
- Evaporation by a combination of cooling and evaporation in adiabatic evaporators (vacuum crystallizers).

In addition, various crystaliser technologies may be utilised including steam driven, thermocompression driven, vapour compression cycling and calandria crystallisers, amongst others, depending on the final design.

Crystallisation essentially comprises three broad steps:

- Pre-concentration: Electrical, concentration-gradient or temperature gradient driven permeable membrane concentration step, which increases the TDS of the feedwater.
- Evaporation: Flash evaporation, multiple distillation or increased vapor pressure condensation of the concentrated brine to reduce the water content of the brine.
- Crystallization: achieving and promoting crystal development in the brine via heating or spray drying the until supersaturation is achieved.

Crystallisers typically comprise various interconnected modules placed on contained skid systems, which house heaters, vaporators, vapor washers, compressors, motors and zero liquid discharge packages. Ancillary equipment include pumps, platforms and decking, instrumentation, control panels, insulation, valving, electrical systems and wiring, piping, and starter motors (if required). **Figure 6-12** and **Figure 6-13** provide a 3D rendering and simplified flow diagram of a typical Zero Liquid Discharge system respectively.

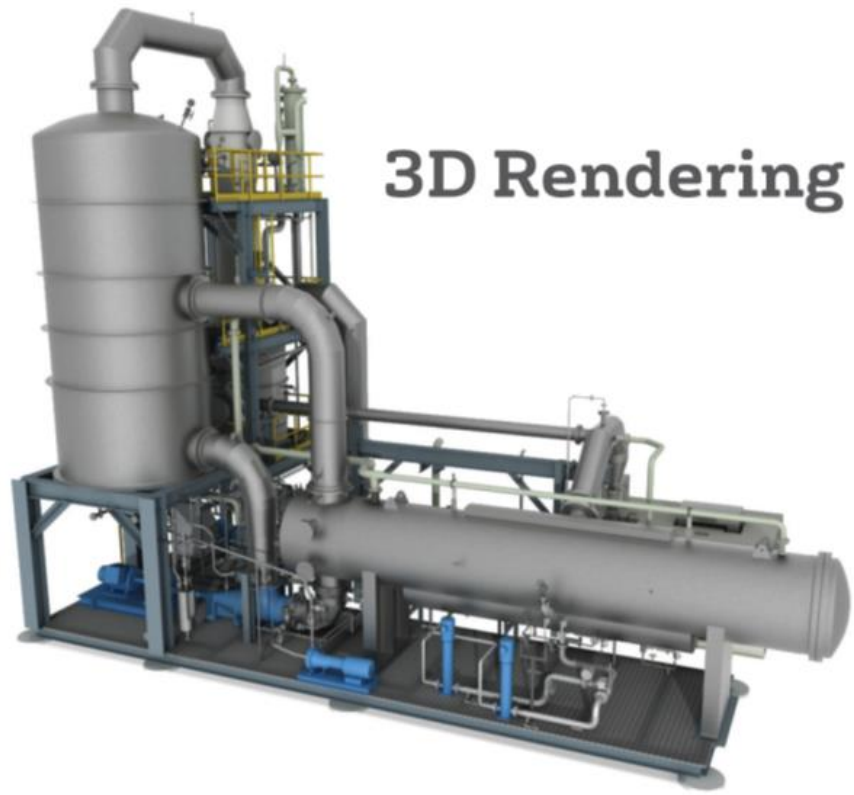


Figure 6-12: 3D Rendering of a typical Crystalliser (Source: Veolia)

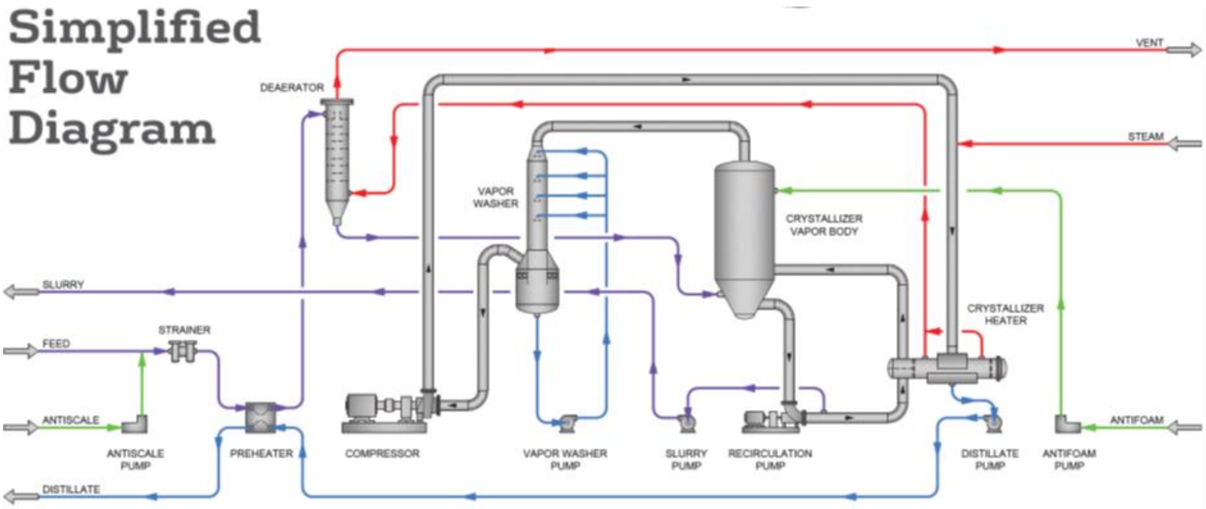


Figure 6-13: Simplified Flow Diagram of a typical Crystalliser (Source: Veolia)

The product of this zero liquid discharge (ZLD) crystallisation process is a salt 'cake' (i.e. solid block of typically mixed minerals and trace metals crystals of various sizes). The resulting cake is typically about 10% moisture. This can be somewhat controlled by adjusting the filtering and drying cycle times, reducing moisture content down to approximately 5%.

The resulting salt cake is then temporarily stored in a hazardous waste skip within a bund on-site which is then removed at regular intervals (no longer than two-weekly) by a third-party waste management company. This third-party waste management company will be suitably licenced for disposal and treatment of both general and hazardous waste. The waste contractor will take the necessary steps to treat the salt cake should it be required, prior to disposal. The third-party waste management company will provide a disposal certificate from a licenced landfill site that is authorised to accept and dispose of such waste.

6.3.3 ELECTROLYSER (UP TO 150MW)

The up to 150MW electrolyser will be housed in a warehouse building and will have a footprint of up to 1ha.

Purified water from the treatment plant will be fed through the electrolyser using electric current (renewable energy provided from the WEF) to separate water molecules ($2H_2O$) through a reduction-oxidation process, into hydrogen gas ($2H_2$ on that cathode side) and oxygen gas (O_2 on the anode side). Electrolysers are modular and currently range in size from 5MW – 20MW. It is proposed that 15 sets of 10 MW electrolysers (150 MW in total) be installed with the capacity to produce 20,000 tonnes per annum (tpa) of 'green' hydrogen and 100,000 tpa of 'green' ammonia. Each electrolyser unit will be powered through its own set of transformers and rectifiers. Oxygen will either be released to atmosphere or stored and sold as a by-product. Hydrogen will either be directed to the ammonia production plant or sold directly to interested parties

Two electrolysis technologies may be considered, namely alkaline- and polymer electrolyte membrane electrolysis ('PEM') (**Figure 6-14**). The most likely technology to be used in the PEM, however this will only be confirmed once detailed engineering design has been completed and EPC contractual arrangements concluded.

Figure 6-14: Example of an Electrolyser Unit (Nel Proton PEM)

6.3.4 AIR SEPARATOR UNIT

The air separation until will occupy a footprint of up to 0.5ha and the intake tower will have a maximum height of up to 40m (due to the height of the 'cold box' – the tallest vertical component of the air separation unit) (**Figure 6-15**).

Air from the atmosphere (approximately 78% nitrogen, 21% oxygen and 1% trace gases) is separated into mainly nitrogen and oxygen using cryogenics (air compression and temperature manipulation), pressure swing adsorption (pressure control) and membrane separation. The air separation unit will have a capacity of 110,000 tpa.

Alternative technologies exist (including Pressure Swing Adsorption (PSA) and Membrane Separation Technologies) and are being evaluated; the most efficient process will be implemented in the final project design.

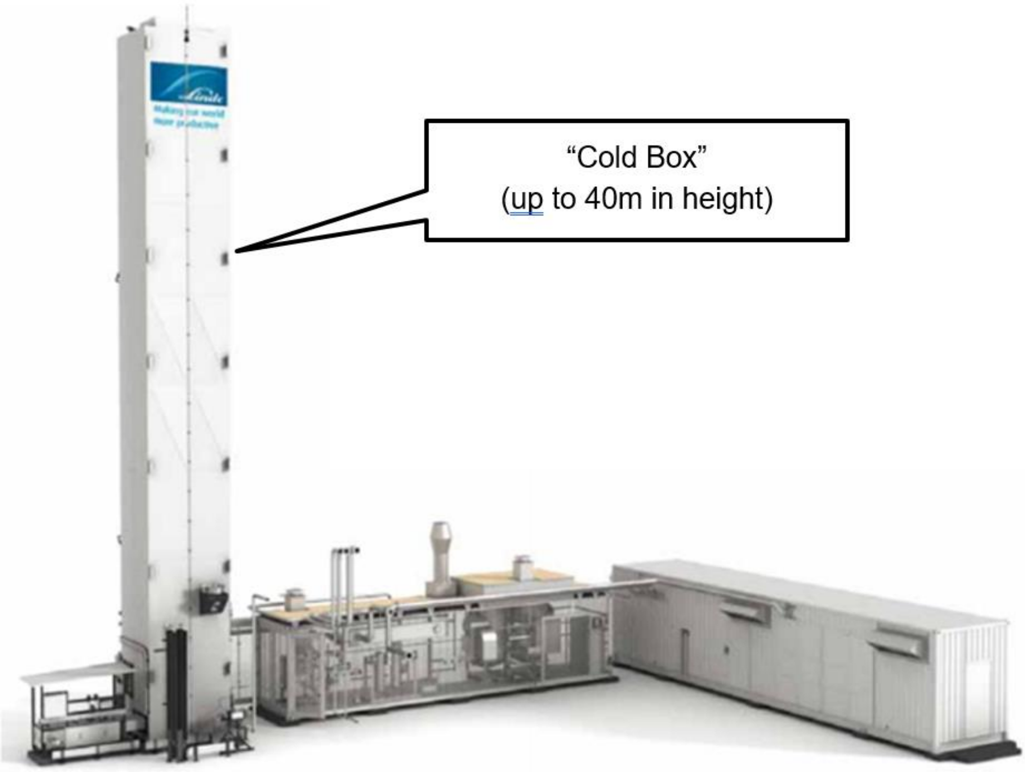


Figure 6-15: Example of an Air Separation Unit (Linde ECOGAN Containerized System)

6.3.5 LIQUID AIR ENERGY SYSTEM (LAES) FOR NITROGEN PRODUCTION

Liquid air energy will be used to liquefy nitrogen for storage, energy and feedstock requirements. Liquid air energy is the use of liquefied air, nitrogen, oxygen and even hydrogen to store Energy. LAES consists of three main stages:

- cooling and separation of the air,
- storage (usually in insulated vessels at low pressure) and
- expanded for energy and/or production.

The first stage is the cooling of the air which is done by the air separation unit, the second stage is storage (usually in insulated vessel at low pressure) and the third stage is when extra energy is needed (the liquefied air is pumped and superheated to evaporate at atmospheric temperature). The change in pressure is used to turn gas turbines. These gas turbines produce electricity via the rotation of the generator shaft (mechanical energy is converted to electrical energy).

Components in the LAES include compressors, ambient and cryogenic heat exchangers, expansion valves, storage vessels, pumps, small turbines and generators.

6.3.6 AMMONIA PROCESSING UNIT

Nitrogen from the air separation unit and hydrogen from the electrolyser will be reacted over a bed of catalyst to form ammonia – as per the standard Haber-Bosch method. This is where stoichiometric amounts of nitrogen and hydrogen are reacted to produce ammonia. The conversion is typically achieved at 100 barg and between 400 - 500 °C to favour the formation of ammonia at equilibrium. A catalyst is also used to favour the production of ammonia.

The ammonia gas will be rapidly cooled to form anhydrous ammonia. Unreacted nitrogen and hydrogen will be recycled back to the reactor. If the full 20,000 tpa of green hydrogen generated by the electrolyser is directed to this process, this will produce up to 100,000 tpa of liquid, green ammonia for market.

Typical components of an ammonia production plant include compressors, filters, reactor chamber and beds, heat exchangers, water storage vessels, condensers, separators, circulators, absorbers and gas release valves (**Figure 6-16**).

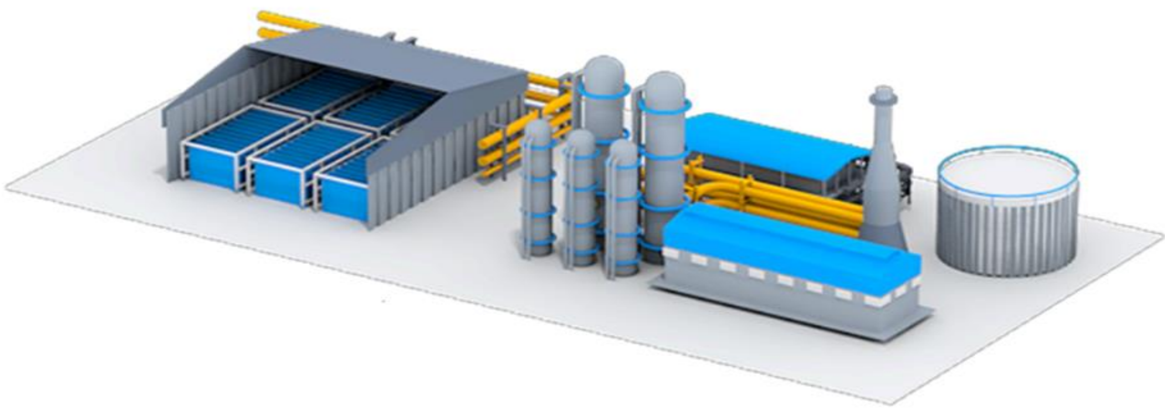


Figure 6-16: Example of integrated hydrogen and ammonia complex (ThyssenKrupp)

6.3.7 STORAGE TANKS -GENERAL

Storage Tanks can be stored in pressurised as or gas in liquid form through the utilisation of a variety of specialised tanks. There are different kinds of storage tanks designs to store anhydrous ammonia, these include but are not limited to:

— *Fixed roof tanks:* Fixed roof storage tanks are cylindrical storage containers that have flat or conical roofs joined to the shell. These storage tanks are often used to store large quantities of petroleum distillates, petrochemicals, and other liquid chemicals at atmospheric pressure. When the level of fluid in the tank rises and falls, air and vapor are pushed out and drawn into the tank headspace. Consequently, the vapor is lost into the atmosphere during the process of emptying the tank. A double-walled tank is designed to provide secondary containment by enhancing the protection against tank failure. It can be customized by adding ultrasonic level indicators, leak detectors, and tank ladder assemblies to identify and monitor in case of any leakage. Below are examples of fixed roof storage tanks

— *Floating roof tanks*: The roof of floating roof tanks floats above the liquid stored at atmospheric pressure. The roof rises and falls as the fluid does. Consequently, floating roof tanks reduce vapor loss, fire, and tank collapse hazards of fixed roof storage tanks.

— *Low-temperature storage tanks*: Low-pressure storage tanks are insulated tanks. These kinds of tanks are more suitable to store volatile liquids for atmospheric storage. They are often used to store ammonia, and liquified gases such as butane at a pressure set by their vapor pressure at the working temperature.

— *Pressure tanks:* Pressure tanks are horizontal-welded pressure vessels with elliptical or hemispherical heads known as bullet tanks (**Figure 6-17**). A bullet tank is a storage container that stores natural gas liquids. Bullet tanks are used for high-pressure fluids. Pressure tanks also include spherical pressure tanks known as Horton Spheres and are used to store large quantities of high-pressure fluids.

Figure 6-17: Bullet storage tank (ammonia/hydrogen storage)

6.3.8 STORAGE REQUIREMENTS FOR THE DEVELOPMENT

NITROGEN

Nitrogen will be stored (7-14 days) as a liquid with in large cylindrical cryogenic storage tanks with a combine volume of approximately 4 100 tons of nitrogen. A storage tank is usually considered to have 85% usable capacity, this is to allow 15% vapor space to allow for expansion. It is proposed that the facility will house up to two cylindrical cryogenic storage tanks. Each tank will have a diameter of up to 14m and a height of up to 15m with a capacity of up to 2032 tons.

AMMONIA

Green ammonia will be stored as anhydrous liquid ammonia, using similar storage equipment as that utilised for storage of Liquid Natural Gas (LNG), i.e. in a storage tank farm (**Figure 6-18**). Ammonia storage tanks are containers used to store ammonia as liquid or compressed gases. Anhydrous ammonia (gas or liquid) is a colourless gas with a sharp smell under atmospheric conditions. The temperature of anhydrous ammonia increases with the increase of surrounding temperature resulting in the vapor pressure in the tank to increase. Thus, it is important to store anhydrous ammonia in containers that can withstand the physical and chemical properties of the liquid form.

Figure 6-18: An example of a Liquid Ammonia Storage System (Source: Energas)

Anhydrous ammonia will be stored within large cylindrical cryogenic storage tanks with a combined volume of 3 750 tons of ammonia. A storage tank is usually considered to have 85% usable capacity, this is to allow 15% vapor space to allow for expansion.

It is proposed that the facility will house up to three cylindrical cryogenic storage tanks. Each tank will have a diameter of up to 14m and a height of up to 15m with a capacity of up to 1250 tons each.

HYDROGEN

Hydrogen is stored in vertical or horizontal storage bullets **(Figure 6-19**). Compressed hydrogen can be storage as a gas or in liquid form. Compressed hydrogen can be stored at ambient temperature. Up to 800 tons of hydrogen will be stored at the facility, in conjunction with that of the oxygen stored on site, in a tank farm of up to 12 ha. The facility will house up to 20 horizontal pressure bullets for the storage of hydrogen. Each bullet will have a diameter of up to 4m and a length of up to 15m.

Figure 6-19: Example of a compressed Hydrogen Storage – horizontal tank

OXYGEN

Oxygen will be stored in vertical or horizontal storage bullets and stored under high-pressures. The tanks have a vacuum-insulated double wall consisting of two concentric vessels, a steel inner tank and an outer jacket in carbon steel. Up to 800 tons of oxygen will be stored at the facility, in conjunction with that of the hydrogen stored on site, in a tank farm of up to 12 ha. It is proposed that the facility will house up to 16 vertical cryogenic storage bullets for the storage of oxygen. Each bullet will have a diameter of up to 4m and a length of up to 15m.

6.3.9 GANTRY AND LOADING BAY

Ammonia is easily transported by truck and rail as a pressurized liquid. Three loading gantries were assumed where international organisation for standardisation (ISO) containers can be filled with anhydrous ammonia and trucked to an export port location, or similar consumer or off-take point (for example nearby railroad sidings). The following equipment forms part of these gantries:

— Custody transfer metering.
— Loading arm with coupling.
— Control valve.
— Control unit.

6.3.10 UP TO 132KV POWERLINE

The proposed project will comprise the following key components:

— 1 x up to 132kV transmission line (either single or double circuit) between the Hendrina Green Hydrogen Facility and the onsite substation.
— The length of the preferred up to 132kV powerline is approximately 2m, 7m and 1.5m for the site alternatives.
— The servitude width for 1x up to 132kVA transmission line is 32m.
— For up to 132kV structures, concrete foundation sizes may vary depending on design type up to $80m^2$ (10m by 8m), with depths reaching up to 3.5m typically in a rectangular 'pad' shape. The actual number of structures required will vary according to the final route alignment determined. A working area of approximately 100m x 100m.

6.4 GENERAL CONSTRUCTION ACTIVITIES

The construction process will follow industry standard methods and techniques. Key activities associated with the construction phase are described in **Table 6-7.**

Table 6-7: Construction Activities

ACTIVITY	DESCRIPTION
Site preparation and establishment	Site establishment will include clearing of vegetation and topsoil at the authorised site, including laydown area and access routes. The temporary laydown area will be constructed, including establishment of the construction camp (temporary offices, storage containers, concrete batching plant etc). Site establishment will also entail the installation and/or connection of services (sanitation, electricity etc).
Transport of components and equipment to site	Bulk materials (aggregate, steel etc.), infrastructure components, lifting and construction equipment (excavators, trucks, compaction equipment etc.) will be sourced and transported to site via suitable National and provincial routes and designated access roads. The infrastructure components may be defined as abnormal loads in terms of the Road Traffic Act (Act 29 of 1989) due to their large size and abnormal lengths and loads for transportation. A permit may be required for the transportation of these loads on public roads.

ACTIVITY	DESCRIPTION
Excavation and earthworks	Subject to the determination of founding specifications, earthworks will be required. This is likely to entail: — Excavation necessary for concrete foundations — Levelling of the plant area, construction camp area, substation area, and O&M building area, and excavation of foundations prior to construction. — Excavation of trenches for the installation of underground cables and material pipelines as needed.
Construction of GH&A facility	A large lifting crane will be required to lift the various components into place. The lifting crane/s will be brought on site.
Establishment of ancillary infrastructure	Ancillary infrastructure will include construction site office, temporary laydown area and workshop area for contractor’s equipment.
Rehabilitation	Once all construction is completed on site and all equipment and machinery has been removed from the site, the site will be rehabilitated.

6.5 ALTERNATIVES

The EIA Regulations of 2014 (as amended) require that the S&EIA process must identify and describe alternatives to the proposed activity that were considered, or motivation for not considering alternatives. Different types or categories of alternatives could be considered including different locations, technology types, and project layouts. At the scoping level the evaluation of alternatives is provided at a high level in the absence of detailed environmental comparators for each alternatives; due to the two-staged nature of the S& EIA process it is more suitable to identify and describe the potential alternatives on a high level basis within scoping, and to perform a more detailed analysis of alternatives (with environmental comparators) in the EIA phase of the project. As such, the S&EIA will holistically assess the impacts and risks of each alternative in a comparative way, as suggested by Appendix 2 of the EIA Regulations of 2014 (as amended).

6.5.1 SITE ALTERNATIVES

There are three site alternatives for the Hendrina GH&A Facility within the Hendrina project area (**Figure 6-20**). All three sites will be investigated in this EIA phase. The corner co-ordinates for the preferred site are outlined in **Table 6-8**.

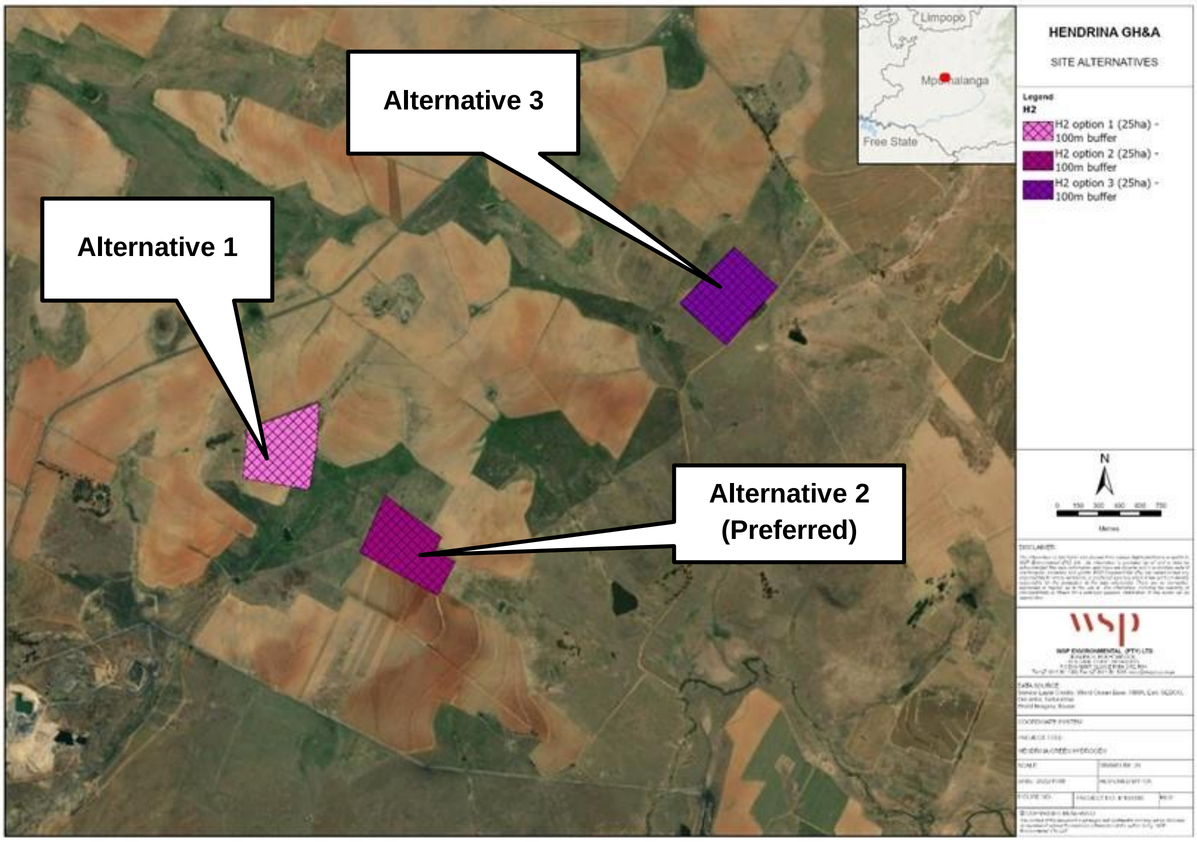


Figure 6-20: Hendrina GH&A Alternative Sites

Table 6-8: Hendrina GH&A Alternative Site – Co-ordinates

POINT	LATITUDE	LONGITUDE
Site Alternative 1		
		
A1-A	26°11'41.88"S	29°33'16.03"E
A1-B	26°11'48.25"S	29°32'57.42"E

POINT	LATITUDE	LONGITUDE
A1-C	26°11'59.83"S	29°32'56.24"E
A1-D	26°12'2.38"S	29°33'13.52"E
A-1-E	26°11'51.52"S	29°33'15.50"E
Alternative 2 - Preferred		
		
A2-A	26°12'3.74"S	29°33'33.37"E
A2-B	26°12'17.06"S	29°33'26.78"E
A2-C	26°12'27.16"S	29°33'47.13"E
A2-D	26°12'19.30"S	29°33'51.76"E
A2-E	26°12'16.45"S	29°33'46.51"E
A2-F	26°12'13.49"S	29°33'48.09"E
Alternative 3		
		

POINT	LATITUDE	LONGITUDE
A3-A	26°11'18.18"S	29°34'50.02"E
A3-B	26°11'27.92"S	29°35'2.04"E
A3-C	26°11'14.12"S	29°35'15.49"E
A3-D	26°11'4.84"S	29°35'4.02"E

6.5.2 LINEAR ALTERNATIVES

There is one water pipeline being considered for the supply of water to the three proposed Hendrina GH&A Facility sites (**Figure 6-21**). The alternatives being considered are as follows:

— Alternative 1: Alternate Site to Usutu Scour 2 (~16km);
— Alternative 2: Preferred Site to Usutu Scour 2 (~17km) (Preferred Alignment);
— Alternative 3: Alternate Site to Usutu Scour 2 (~19km);

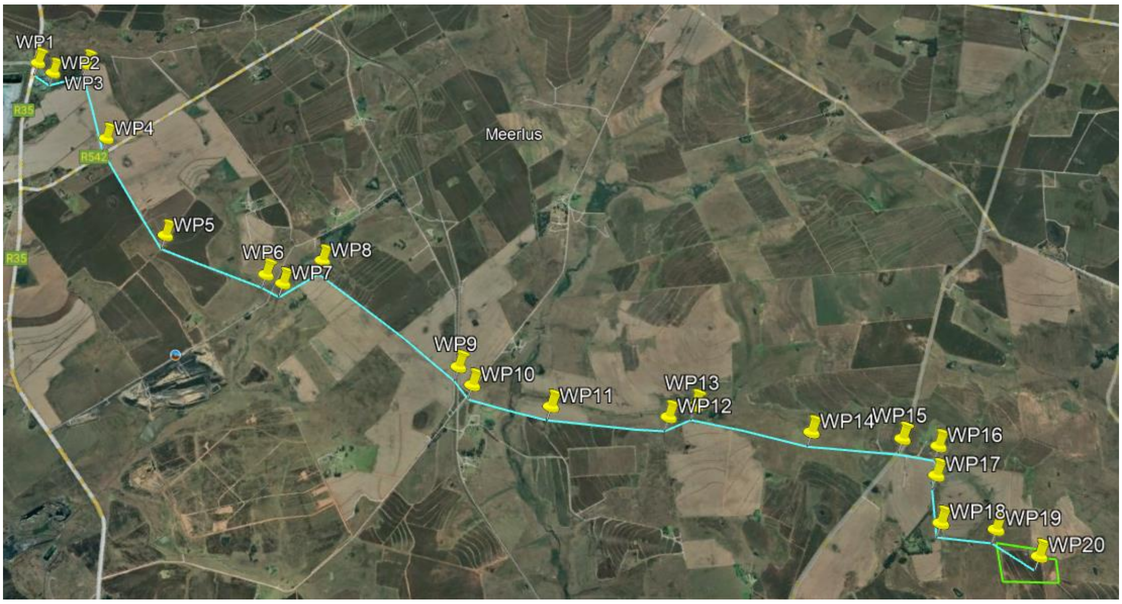
All three alignments have been investigated in the EIA phase. The co-ordinates for the alignments are outlined in **Table 6-9**

Figure 6-21: Hendrina GH&A Water Pipeline Alternative Alignments

Table 6-9: Hendrina Water Supply Pipeline Alternative Sites – Co-ordinates

POINT	LATITUDE	LONGITUDE
Water Pipe Alternative for Site 1		

WP1	26° 5'56.52"S	29°28'49.09"E
WP2	26° 6'4.43"S	29°28'53.68"E
WP3	26° 6'7.11"S	29°29'9.59"E
WP4	26° 6'47.00"S	29°29'4.29"E
WP5	26° 7'41.63"S	29°29'11.03"E
WP6	26° 8'16.65"S	29°29'44.31"E
WP7	26° 8'23.47"S	29°29'49.43"E
WP8	26° 8'21.50"S	29°30'9.72"E
WP9	26° 9'30.08"S	29°30'42.55"E
WP10	26° 9'39.44"S	29°30'44.32"E
WP11	26°10'1.52"S	29°31'10.46"E
WP12	26°10'26.67"S	29°31'53.50"E
WP13	26°10'27.37"S	29°32'6.03"E

POINT	LATITUDE	LONGITUDE
WP14	26°10'57.84"S	29°32'44.66"E
WP15	26°11'16.52"S	29°33'17.58"E
WP16	26°11'25.49"S	29°33'29.50"E
WP17	26°11'49.99"S	29°33'9.05"E
Water Pipe Alternative for Site Alternative 2 (Preferred)		
		
WP1	26° 5'56.52"S	29°28'49.09"E
WP2	26° 6'4.43"S	29°28'53.68"E
WP3	26° 6'7.11"S	29°29'9.59"E
WP4	26° 6'47.00"S	29°29'4.29"E
WP5	26° 7'41.63"S	29°29'11.03"E
WP6	26° 8'16.65"S	29°29'44.31"E
WP12	26° 8'23.47"S	29°29'49.43"E
WP13	26° 8'21.50"S	29°30'9.72"E
WP14	26° 9'30.08"S	29°30'42.55"E
WP15	26° 9'39.44"S	29°30'44.32"E

POINT	LATITUDE	LONGITUDE
WP16	26°10'1.52"S	29°31'10.46"E
WP17	26°11'35.01"S	29°33'21.75"E
WP18	26°11'51.57"S	29°33'12.35"E
WP19	26°12'3.26"S	29°33'31.43"E
WP20	26°12'19.33"S	29°33'41.05"E
Water Pipe Alternative for Site Alternative 3		
		
WP1	26° 5'56.52"S	29°28'49.09"E
WP2	26° 6'4.43"S	29°28'53.68"E
WP3	26° 6'7.11"S	29°29'9.59"E
WP4	26° 6'47.00"S	29°29'4.29"E
WP5	26° 7'41.63"S	29°29'11.03"E
WP6	26° 8'16.65"S	29°29'44.31"E
WP7	26° 8'23.47"S	29°29'49.43"E
WP8	26° 8'21.50"S	29°30'9.72"E

POINT	LATITUDE	LONGITUDE
WP9	26° 9'30.08"S	29°30'42.55"E
WP10	26° 5'56.52"S	29°28'49.09"E
WP11	26° 6'4.43"S	29°28'53.68"E
WP12	26° 6'7.11"S	29°29'9.59"E
WP13	26° 6'47.00"S	29°29'4.29"E
WP14	26° 7'41.63"S	29°29'11.03"E
WP15	26°11'16.47"S	29°33'17.42"E
WP16	26°10'24.31"S	29°34'16.28"E
WP17	26°10'29.47"S	29°34'20.65"E
WP18	26°10'50.18"S	29°34'34.17"E
WP19	26°11'1.53"S	29°34'34.87"E
WP20	26°11'7.07"S	29°34'36.77"E
WP21	26°11'20.78"S	29°34'52.73"E
WP22	26°11'22.05"S	29°35'4.99"E

6.5.3 132KV POWERLINE ALTERNATIVES

There are three powerline alternatives for each proposed site being considered for the supply of electricity to the Hendrina GH&A Facility sites (**Figure 6-22**). A up to 132kV transmission line (either single or double circuit) between the Facility and the onsite substation.

The alternatives being considered are as follows:

Site 1

- Alternative Powerline 1: Approximately 2km
- Alternative Powerline 2: Approximately 7km
- Alternative Powerline 3: Approximately 1.5km

Figure 6-22: Site Alternative 1 powerline options

All these alignments will be investigated in this EIA phase. The co-ordinates for the alignments are outlined in **Table 6-10, Table 6-11** and **Table 6-12** below.

Table 6-10: Powerline Alternatives for Site 1

POINT	LATITUDE	LONGITUDE
Site 1- Powerline Alternative 1 (Preferred)- Approx.2km		
		

POINT	LATITUDE	LONGITUDE
PL1-A	26°11'49.93"S	29°33'8.97"E
PL1-B	26°11'25.68"S	29°33'29.36"E
PL1-C	26°11'20.21"S	29°33'21.93"E
PL1-D	26°11'17.48"S	29°33'24.93"E
Site 1- Powerline Alternative 2- Approx.7km		

PL2-A	26°11'49.93"S	29°33'8.97"E
PL2-B	26°11'25.68"S	29°33'29.36"E
PL2-C	26°11'17.25"S	29°33'18.26"E
PL2-D	26°11'15.50"S	29°33'21.13"E
PL2-E	26°10'23.44"S	29°34'18.65"E
PL2-F	26°10'17.00"S	29°34'40.19"E
PL2-G	26°10'4.20"S	29°34'53.15"E
PL2-H	26° 9'51.75"S	29°34'54.34"E
PL2-I	26° 9'26.71"S	29°34'40.93"E
PL2-J	26° 9'26.75"S	29°34'40.01"E

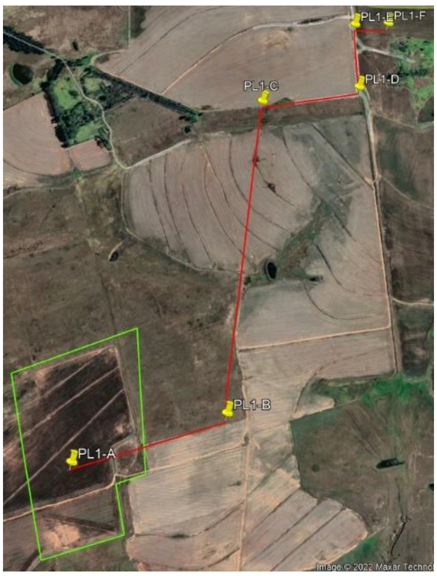
POINT	LATITUDE	LONGITUDE
Site 1- Powerline Alternative 3- Approx. 1.5km		
		
PL2-A	26°11'49.93"S	29°33'8.97"E
PL2-B	26°12'7.48"S	29°33'39.62"E

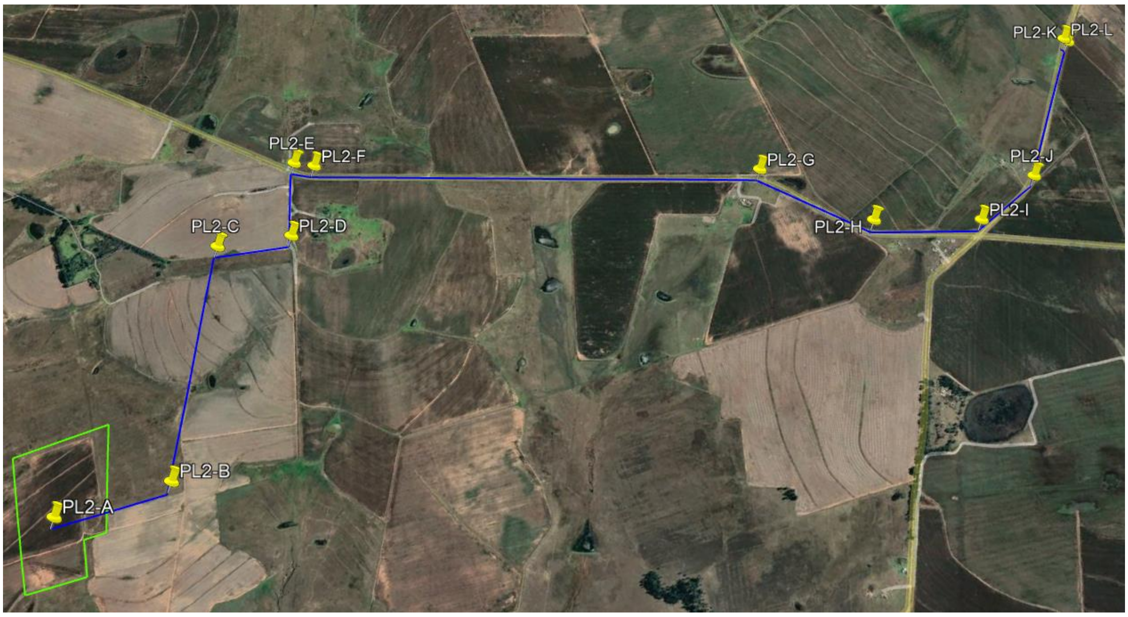
Site 2

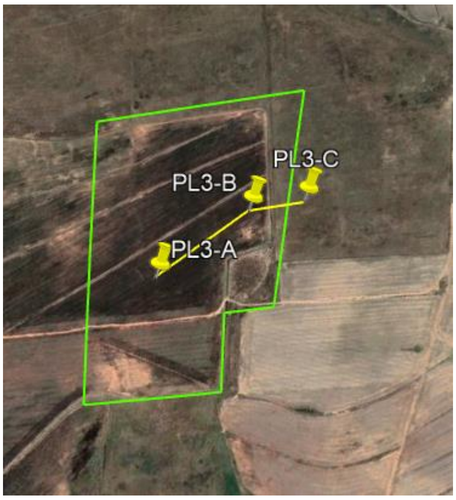
— Alternative Powerline 1: Approximately 3km
— Alternative Powerline 2: Approximately 8km
— Alternative Powerline 3: Approximately 0.5km

Figure 6-23: Site Alternative 2 Powerline Options

Table 6-11: Powerline Alternatives for Site 2

<table>
<tr><th>POINT</th><th>LATITUDE</th><th>LONGITUDE</th></tr>
<tr><td colspan="3">Site 2- Powerline Alternative 1 (Preferred)- Approx.3km</td></tr>
<tr><td colspan="3">
</td></tr>
</table>

POINT	LATITUDE	LONGITUDE
PL1-A	26°12'19.20"S	29°33'41.35"E
PL1-B	26°12'3.63"S	29°33'49.99"E
PL1-C	26°11'35.49"S	29°33'21.66"E
PL1-D	26°11'25.87"S	29°33'29.33"E
PL1-E	26°11'20.24"S	29°33'21.94"E
PL1-F	26°11'17.23"S	29°33'25.04"E
Site 2- Powerline Alternative 2- Approx.8km		
		
PL2-A	26°12'19.20"S	29°33'41.35"E
PL2-B	26°12'3.63"S	29°33'49.99"E
PL2-C	26°11'35.49"S	29°33'21.66"E
PL2-D	26°11'25.87"S	29°33'29.33"E
PL2-E	26°11'17.29"S	29°33'18.17"E
PL2-F	26°11'15.28"S	29°33'21.24"E
PL2-G	26°10'23.42"S	29°34'18.70"E

POINT	LATITUDE	LONGITUDE
PL2-H	26°10'16.91"S	29°34'39.86"E
PL2-I	26°10'4.27"S	29°34'53.25"E
PL2-J	26° 9'51.75"S	29°34'54.34"E
PL2-K	26° 9'26.71"S	29°34'40.93"E
PL2-L	26° 9'26.75"S	29°34'40.01"E
Site 2- Powerline Alternative 3- Approx. 0.5km		
		
PL3-A	26°12'19.20"S	29°33'41.35"E
PL3-B	26°12'11.56"S	29°33'40.30"E
PL3-C	26°12'8.02"S	29°33'41.93"E

Site 3

— Alternative Powerline 1: Approximately 5km
— Alternative Powerline 2: Approximately 5km
— Alternative Powerline 3: Approximately 7km

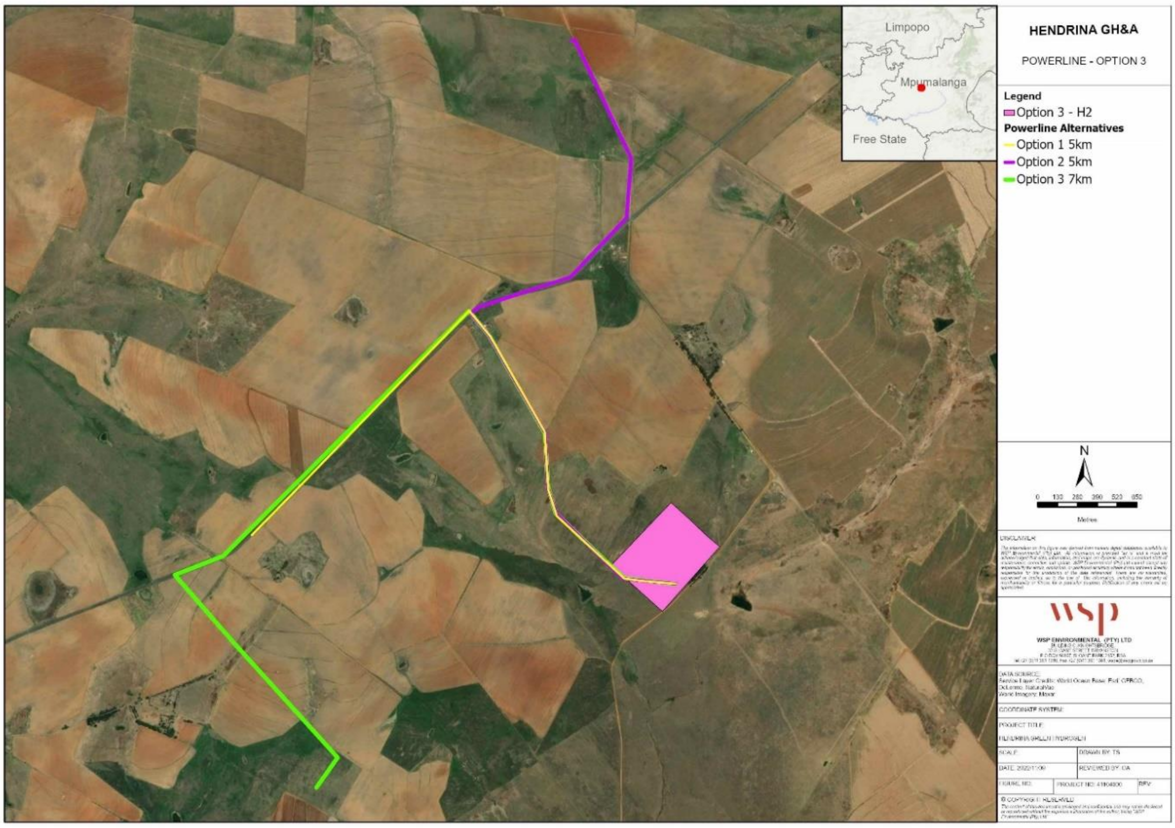
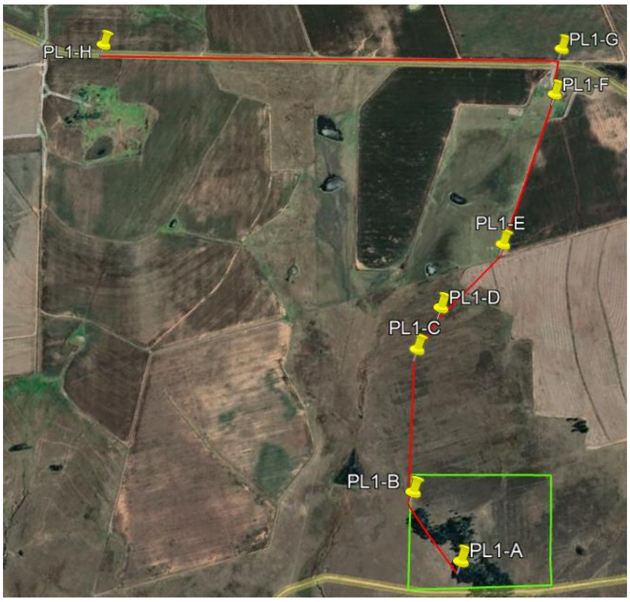


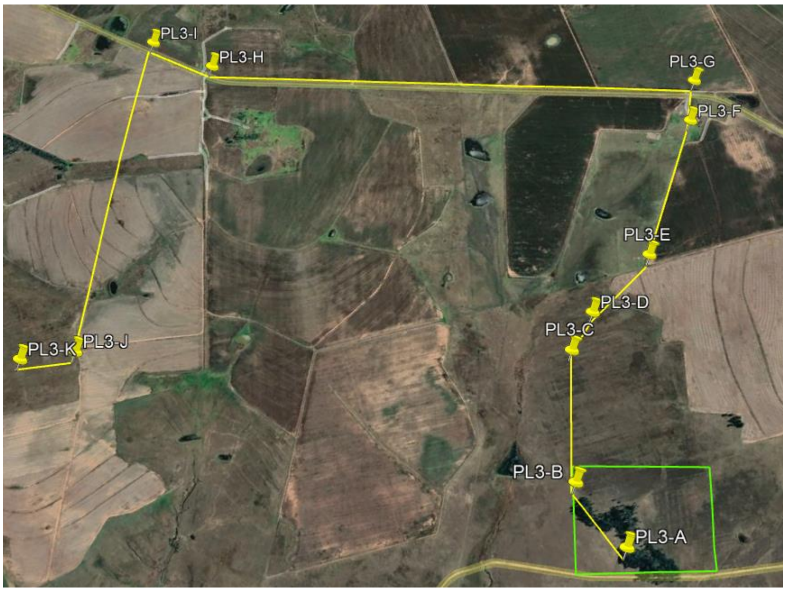
Figure 6-24: Site Alternative 3 Powerline Options

Table 6-12: Powerline Alternatives for Site 3

POINT	LATITUDE	LONGITUDE
Site 3- Powerline Alternative 1 (Preferred)-Approx.5km		
		

POINT	LATITUDE	LONGITUDE
PL1-A	26°11'22.15"S	29°35'5.24"E
PL1-B	26°11'20.95"S	29°34'53.12"E
PL1-C	26°11'8.21"S	29°34'37.43"E
PL1-D	26°11'2.07"S	29°34'35.02"E
PL1-E	26°10'49.97"S	29°34'34.06"E
PL1-F	26°10'29.77"S	29°34'21.24"E
PL1-G	26°10'24.28"S	29°34'16.19"E
PL1-H	26°11'12.17"S	29°33'25.23"E
Site 3- Powerline Alternative 2- Approx.5km		

PL2-A	26°11'22.15"S	29°35'5.24"E
PL2-B	26°11'20.95"S	29°34'53.12"E
PL2-C	26°11'8.21"S	29°34'37.43"E
PL2-D	26°11'2.07"S	29°34'35.02"E
PL2-E	26°10'49.97"S	29°34'34.06"E

POINT	LATITUDE	LONGITUDE
PL2-F	26°10'29.77"S	29°34'21.24"E
PL2-G	26°10'24.28"S	29°34'16.19"E
PL2-H	26°10'16.91"S	29°34'39.86"E
PL2-I	26°10'16.60"	29°34'39.91"E
PL2-J	26°10'4.31"S	29°34'53.29"E
PL2-K	26° 9'51.50"S	29°34'54.07"E
PL2-L	26° 9'26.64"S	29°34'40.80"E
PL2-M	26° 9'26.70"S	29°34'39.98"E
Site 3- Powerline Alternative 3- Approx.7km		
		
PL3-A	26°11'22.15"S	29°35'5.24"E
PL3-B	26°11'20.95"S	29°34'53.12"E
PL3-C	26°11'8.21"S	29°34'37.43"E
PL3-D	26°11'2.07"S	29°34'35.02"E
PL3-E	26°10'49.97"S	29°34'34.06"E
PL3-F	26°10'29.77"S	29°34'21.24"E

POINT	LATITUDE	LONGITUDE
PL3-G	26°10'24.28"S	29°34'16.19"E
PL3-H	26°11'16.62"S	29°33'18.41"E
PL3-I	26°11'20.59"S	29°33'7.49"E
PL3-J	26°11'59.33"S	29°33'45.78"E
PL3-K	26°12'5.64"S	29°33'41.06"E

6.5.4 TECHNOLOGY ALTERNATIVES

The project is being developed on the basis that a GH&A facility will be established on this site. Therefore, no technology alternatives are being considered for this project. The motivation behind the development of this facility is outlined in **Section 5:Need and Justification.**

ENVIRONMENT

The environment is a key factor when it comes to the development of its projects. It is critical to ensure that its projects are developed in a sustainable manner. All the environmental factors were considered in the area when potential sites were being considered. After a thorough evaluation of the regional farms, the specific farms were selected because they were already heavily disturbed by agricultural and coal mining activities. Thus, it was concluded that the development of these farms would have a minimal impact on the region's flora, fauna and water resources.

TOPOGRAPHY AND SITE ACCESS

The surrounding landscape has a rolling hill topography which is suitable for the development of a GH&A facility. The Project site can be accessed easily via either the tarred N2 and N11 national roads which run along the eastern and western boundaries of the site. There is an existing road that goes through the land parcels to allow for direct access to the project development area. The site is also situated close to the renewable energy projects that are being proposed in parallel with this facility and therefore, the GH&A facility will be close to a reliable source of renewable electricity.

LAND AVAILABILITY

With this region being home to some of the biggest coal power stations in the country (Komati and Camden among many others), most land parcels have been given mining rights for coal beneficiation to provide fuel stock supply these power stations. Thus, there is very limited land available for the development of the GH&A facility. However, sufficient land has been secured for the development of the proposed project with landowners within the respective cadastral portions comprising the development footprint indicating their support and willingness for the project to proceed to development via entering into agreement with the developer.

WATER SUPPLY ALTERNATIVES

A variety of water sources are being investigated for the broader development, and include the following options:

Komati Power Station (technical preferred option): Bulk water infrastructure from the Usuthu Water Scheme currently feeding the surrounding coal mines and power stations (specifically Eskom Komati Power Station) may be utilised for construction and operational water. Initial water results indicate good quality supply in sufficient quantities is available. This option is the preferred water sourcing for the development due to excess water being available at the Power Station’s water reservoirs. Little or no impacts are associated with this option.

Groundwater: Various boreholes may be utilised across the project site for extraction of construction and operational water requirements. The volumes will be dependent on the available groundwater and the quality thereof, which has not yet been determined. Large quantities of water are needed for the project and one option is to utilise groundwater from a multitude of scattered boreholes or from wellfields designed for this purpose. A groundwater quantity impact is mainly associated with this option.

Purified wastewater: Wastewater from nearby commercial or mining facilities could be sourced to provide the facility with water. This would depend on availability of suitable quality wastewater and agreements with the respective entities involved. It is possible that water may be sourced from existing surrounding mining operations that are experiencing or anticipating mine water decant from their operations. A groundwater quality impact is mainly associated with this option.

6.5.5 LAYOUT ALTERNATIVES

Three conceptual site layouts of the Hendrina GH&A Facility have been compiled and is included in **Figure 6-20** above. These layouts are likely to be updated and refined as the project engineering progresses and depending on the sensitivity and technical inputs from the specialists during this EIA phase. The developed site layouts of the Hendrina GH&A Facility will only be finalised during detailed engineering design. Outlined below are the proposed layouts/sites alternatives for the facility and its associated infrastructure:

Alternative 1:

Site Alternative 1 is located on Portion 3 of the Farm Dunbar 189IS, at the site of an old abandoned farmyard and has three powerline options from the associated Hendrina North and South Wind Energy Facilities ("WEF") as follows:

- Powerline option 1 is up to 2km in length, to the Hendrina North WEF substation Option 1 on Portion 1 of the Farm Dunbar 189IS;
- Powerline option 2 is up to 7km in length, to the Hendrina North WEF substation Option 2 on Portion 3 of the Farm Hartebeestkuil 185IS;
- Powerline option 3 is up to 1.5km in length, to the Hendrina South WEF substation on Portion 3 of the Farm Dunbar 189IS.
- Water supply to the Site: constructing a new pipeline (up to 16km) from the Komati Power Station

Alternative 2 (Preferred):

Site Alternative 2 is located on Portion 3 of the Farm Dunbar 189IS and Portion 18 of the Farm Weltevreden 193IS, adjacent to the proposed Hendrina South WEF substation and has three powerline options from the associated wind farms as follows:

- Powerline option 1 is up to 3km in length to the Hendrina North WEF Option 1 substation on Portion 1 of the Farm Dunbar 189IS;
- Powerline option 2 is up to 8km in length to the Hendrina North WEF substation Option 2 on Portion 3 of the Farm Hartebeestkuil 185IS;
- —Powerline option 3 is up to 0.5km in length to the Hendrina South WEF substation on Portion 3 of the Farm Dunbar 189IS;
- Water supply to the Site: constructing a new pipeline (up to 16km) from the Komati Power Station

Alternative 3:

Site Alternative 3 is located on Portions 14 and 15 of the Farm Weltevreden 193IS and has three powerline options from the associated wind farms as follows:

- Powerline option 1 is up to 5km in length to the Hendrina North WEF Option 1 substation on Portion 1 of the Farm Dunbar 189IS;
- Powerline option 2 is up to 5km in length to the Hendrina North WEF substation Option 2 on Portion 3 of the Farm Hartebeestkuil 185IS;
- Powerline option 3 is up to 7km in length to the Hendrina South WEF substation on Portion 3 of the Farm Dunbar 189IS.
- Water supply to the Site: constructing a new pipeline (up to 16km) from the Komati Power Station

Table 6-13 below shows the advantages and disadvantages of the proposed layouts in relation to the surrounding environment.

Table 6-13: Advantages and Disadvantages of layout alternatives

ADVANTAGES	DISADVANTAGES
Facility layout Alternative 1	
— Least impact on wetland and aquatic biodiversity, together with OHL layout 3 being the shortest route. — Preferred from a terrestrial animal and plant perspective because does not impact on natural habitats, therefore unlikely to affect SCC — This site is located on a highly transformed habitat, therefore preferred from an avifaunal perspective, as there is less likely to house SCC	— From a SHE risk assessment point of view, where there is a choice of location that is further from public roads, water courses, isolated farmhouses or existing infrastructure, this would be preferred. This site alternative location for the facility is closer to the tar access road for the area as well as existing farmhouses. — All three powerlines and water supply pipeline options will impact on burial sites at HD002 and GA004. — This site alternative intrudes on to the highly sensitive area associated with Bats
Facility layout Alternative 2 -Preferred	
— Preferred from a terrestrial animal perspective because no impact on natural habitats — This site location is slightly more isolated and is therefore slightly preferred from a SHE risk perspective. — This site is located on a highly transformed habitat, therefore preferred from an avifaunal perspective, as there is less likely to house SCC — This site is preferred from a heritage perspective as there are the least amount of Heritage finds in close proximity. — Preferred from a Bat impact assessment perspective, as it is situated in a low sensitivity area	— All three powerlines and water supply pipeline options will impact on burial sites at HD002 and GA004.
Facility layout Alternative 3	
— No advantages have been identified	— Most impact on wetland and aquatic biodiversity identified as it is located in close proximity to the site — Located near and partial on natural Grassland habitat (CBA Irreplaceable) — All OHL and water pipeline options for this site will traverse natural grassland habitat. — This site is the closest to farmsteads at less than 300m (north) from the site and the closest water course less than 250m (east), from a SHE risk perspective this is not deemed suitable. — This site alternative is closest to potential noise receptors — This site is least preferred from an Avifaunal perspective because there are still areas of natural grassland, and the stand of alien trees could potentially be used by used certain SCC for breeding and roosting. — All three powerlines and water supply pipeline options will impact on burial sites at HD002 and GA004. — This site alternative intrudes on to the highly sensitive area associated with Bats

6.5.6 'NO PROJECT' ALTERNATIVE

In the "no project" alternative, the Hendrina GH&A Facility project will not be developed. In this scenario, there could be a missed opportunity to address the need for the green production of hydrogen and ammonia for commercial use in an effort to mitigate against concerns of climate change and exploitation of non-renewable resources. The no-go alternative would not assist in responding to the global call to reduce GHG emissions in the industrial sector. Conversely, negative environmental impacts of the project (as outlined in **Section 8)** associated with the development of the Hendrina GH&A Facility would be avoided.

The "no project" alternative is considered in this EIA phase as a baseline against which the impacts of the Hendrina GH&A Facility project is assessed.

7 DESCRIPTION OF BASELINE ENVIRONMENT

7.1 PHYSICAL ENVIRONMENT

7.1.1 CLIMATE AND METEOROLOGY

LOCAL METEOROLOGY OVERVIEW

According to the Köppen-Geiger Classification, the Hendrina area is defined as having a temperate climate with warm summers and dry winters. Meteorological variables, including hourly temperature, rainfall, humidity, wind speed and wind direction, were obtained from the nearest ambient air quality monitoring station (AQMS)27. The Hendrina AQMS (approximately 17 km to the east-northeast of the study site, **Figure 7-1**) is owned and managed by SAWS and was analysed for the period January 2018 **-** December 2020 (i.e. three calendar years as required by the Modelling Regulations). Station details and data recovery for the Hendrina AQMS is given in **Table 7-1.**

Although this station is at distance from the study site, the local topography is not complex and thus the meteorological data is considered representative of regional weather conditions that would prevail at the proposed development sites.

Table 7-1 Details of the Hendrina AAQMI station

STATION NAME	LATITUDE (°S)	LONGITUDE (°E)	ALTITUDE (M)	DATA RECOVERY		
				Temperature	Rainfall	Wind field
Hendrina	-26.151200°	29.716484°	1,675	97%	97%	97%

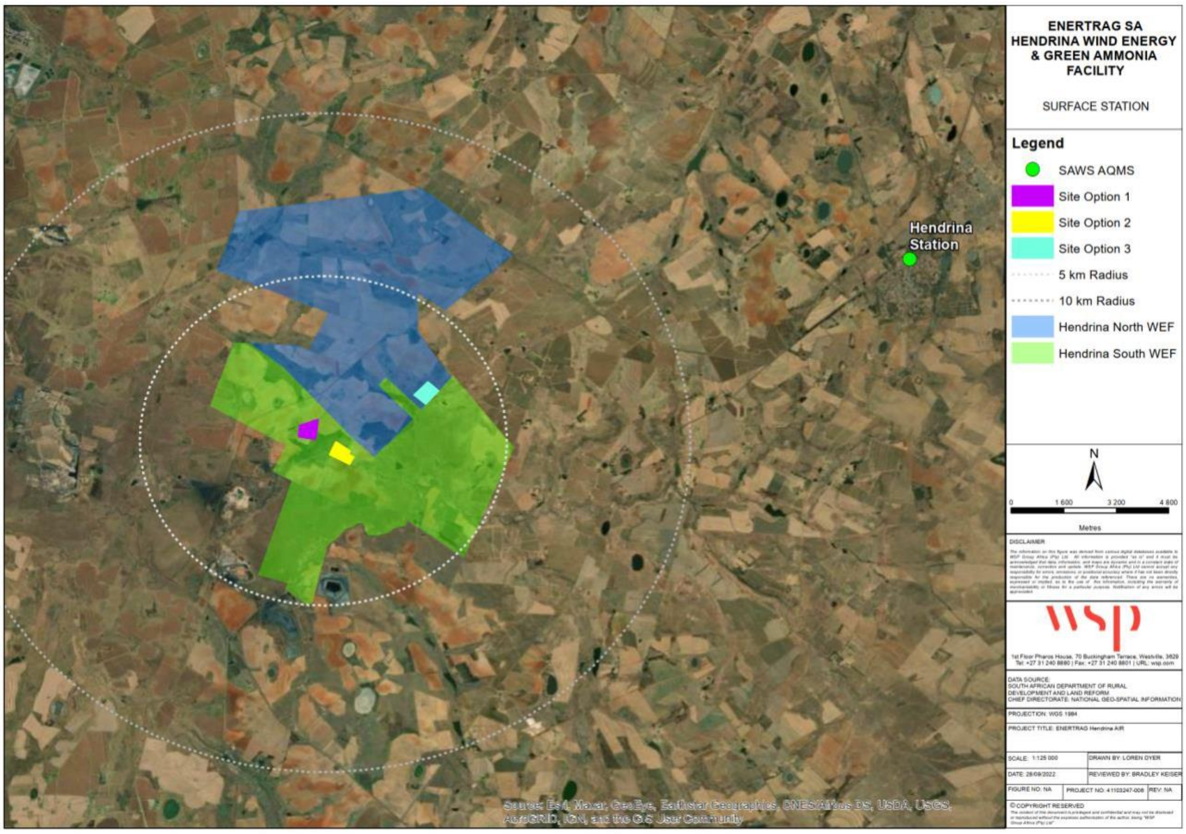


Figure 7-1: Surface station proximity to the study site

TEMPERATURE AND RAINFALL

Ambient air temperature influences plume buoyancy as the higher the plume temperature is above the ambient air temperature, the higher the plume will rise. Further, the rate of change of atmospheric temperature with height influences vertical stability (i.e. formation of mixing or inversion layers). Rainfall is an effective removal mechanism of atmospheric pollutants and thus also relevant in the assessment of pollution potential.

Figure 7-2 presents the average monthly temperature range, humidity and rainfall recorded at the Hendrina station. Higher rainfall occurs during the warmer, summer months (December, January and February) with drier conditions during the cooler, winter months (June, July and August). Summer temperatures for the region average at 19.5°C while winter temperatures average at 11.1°C. Hendrina received on average 570 mm of rainfall each year, with approximately 49% of that during the summer months (December, January and February) and only 3% during winter (June, July and August).

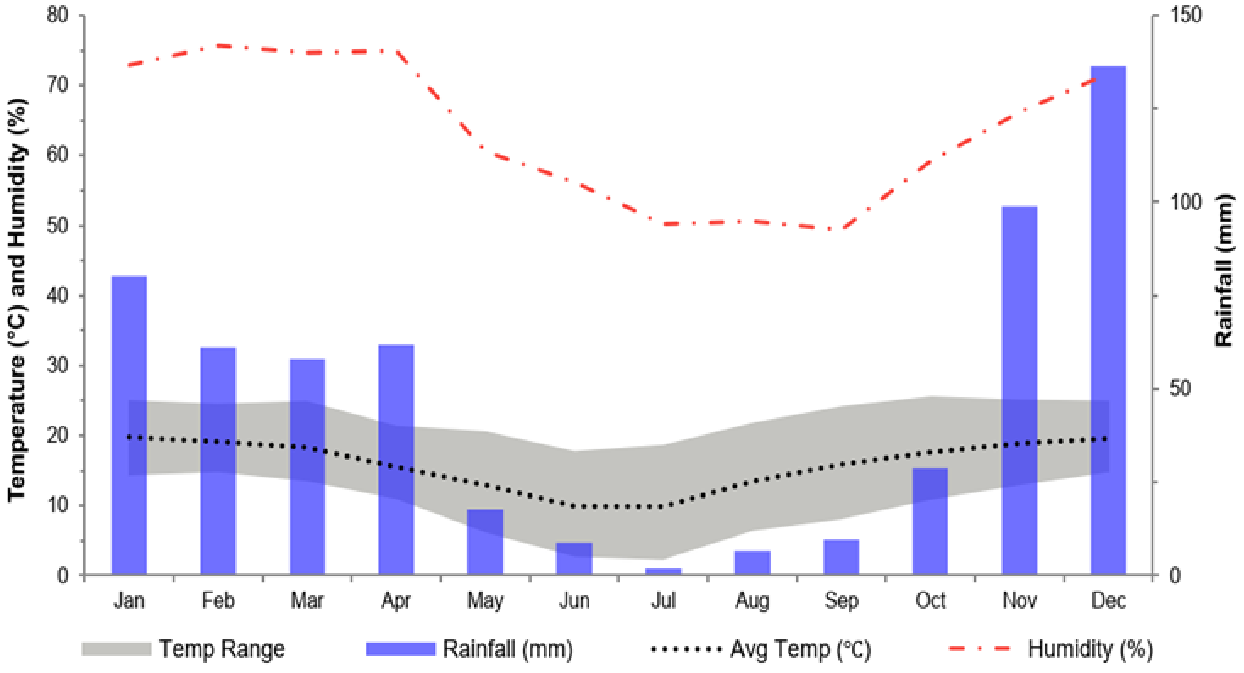


Figure 7-2 Meteorological summary for Hendrina (January 2018 - December 2020)

WIND

Wind roses (**Figure 7-3**) summarize wind speed and directional frequency at a location. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of colour, representative of different wind speeds. Calm conditions are defined by the Beaufort Wind Force Scale as wind speeds less than 0.5 m/s.

Typical wind fields have been analysed using Lakes Environmental WRPlot Freeware (Version 7.0.0) for the full period (January 2018 – December 2020); diurnally for early morning (00h00 – 06h00), morning (06h00 – 12h00), afternoon (12h00 – 18h00) and night (18h00 – 00h00); and seasonally for summer (December, January and February), autumn (March, April and May), winter (June, July and August) and spring (September, October and November):

- Calm conditions (wind speeds <0.5 m/s) occurred 29.9% of the time.
- Light to fresh easterlies prevailed in the region.
- Peak wind speeds occurred from the east-northeast (11.2 m/s) and highest average wind speeds occurred from the east (3.0 m/s).
- Easterly winds prevailed during the early morning (00h00-06h00), morning (06h00-12h00) and night-time (18h00-00h00) hours.
- Winds from the west-northwest prevailed in the afternoon (12h00-18h00).
- Diurnal peak (10.3 m/s) and highest average (2.0 m/s) wind speeds occurred during the afternoon.
- Winds from the east prevailed during the spring, summer and autumn months.
- Higher directional variability in the wind field is observed during winter.
- Seasonal peak (10.4 m/s) wind speeds occur during spring and highest average (1.6 m/s) wind speeds occur during both summer and spring.

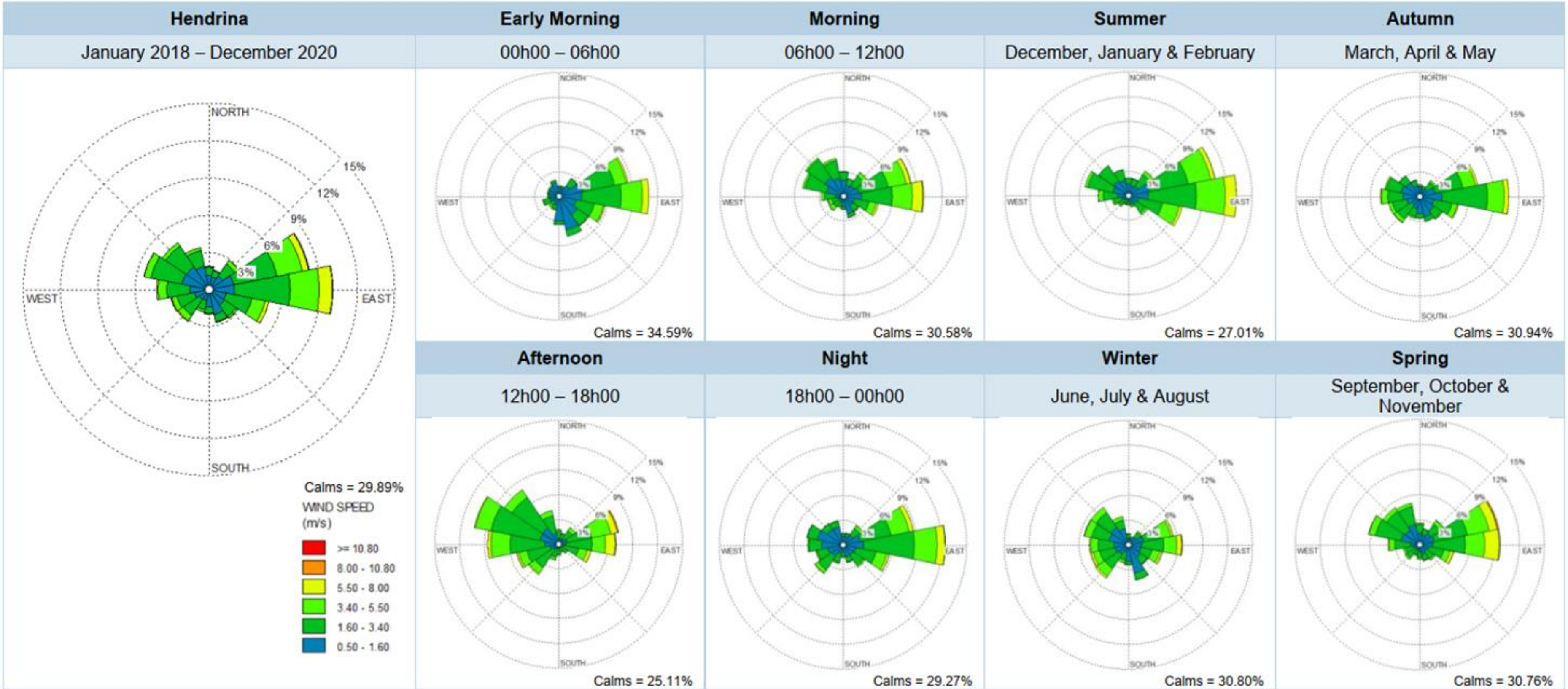


Figure 7-3: Local Wind Conditions at Hendrina

7.1.2 BACKGROUND AIR QUALITY

An evaluation of the existing air pollution situation provides an understanding of the potential risk for health impacts. The Department of Forestry, Fisheries and Environment (DFFE) has identified District and Metropolitan Municipalities of concern with respect to air quality based on the prevalence of sources of emissions for each source category. The National Framework for Air Quality Management in the Republic of South Africa (hereafter referred to as 'The National Framework') has rated the Nkangala District, as having "poor" air quality. The district area is thus identified as being in either the upper range of prevalence for one or more emission source categories or middle range in two or more categories relative to other Districts. Municipalities that are classified as having poor air quality require priority attention in terms of air quality management planning.

The Air Quality Management Plan (AQMP) for the HPA identifies the Steve Tshwete Local Municipality as one of the HPA's nine air quality hot spot areas. This classification is based on atmospheric dispersion modelling outputs verified by ambient air quality monitoring data. The Hendrina area is identified in the AQMP for modelled SO_2 exceedances and measured O_3 exceedances. Elevated O^3 concentrations is attributed to secondary chemical formation resulting from the presence of NOx and volatile organic compounds (VOC), which is noted by the assessment as being a 'regional scale phenomenon'. It is highlighted that the HPA AQMP's assessment is limited to criteria pollutants (specifically, SO_2, NO_2, PM10 and O_3) none of which are relevant to the proposed ENERTRAG renewable energy complex. The only mention of NH_3 emissions in the AQMP is reference to trace amounts (not quantified) associated with biomass burning, with some agricultural burning for field clearing recognised as relevant in the Steve Tshwete area.

The nearest AQMS to the study site is the Hendrina station owned and managed by SAWS (**Figure 7-1**), approximately 17 km to the east-northeast of the study site. Pollutants measured by this station include PM10, PM2.5, CO, NO_2, SO_2 and O_3. None of these pollutants are relevant to the proposed ENERTRAG renewable energy complex. Since the Hendrina monitoring station does not measure NH_3 and is located too far away for ambient air quality measurements to be considered representative of ambient pollution concentrations at site, this data is not considered further.

The site for the proposed Green Ammonia processing facility is approximately 17 km west-southwest of the town of Hendrina. Proximate land uses (within 10 km) include coal mining activities at varying distances from the southeast through to the northwest (**Figure 7-4**). Notable mining activity includes:

— The Weltevreden colliery 3.4 km to the southeast with mineral conveyor and transfer points linking to the Halfgewonnen colliery 3.6 km to the southwest.
— The Overlooked colliery, 4.7 km to the south-southwest.
— The Forzando North colliery and mine dump 4.9 km to the south.
— The Middelkraal colliery 8.3 km to the west.
— The Bultfontein colliery 9.7 km to the northwest.
— The Kleinfontein colliery 9.9 km to the west-northwest.

The remaining land is either under cultivation or is open veld (potentially earmarked for future mining prospects).

There are no known industrial sources of NH_3 within the assessment area. Localised and transient increases in ambient NH_3 concentrations may be expected from intermittent agricultural activities, such as crop spraying and burning for field clearing.

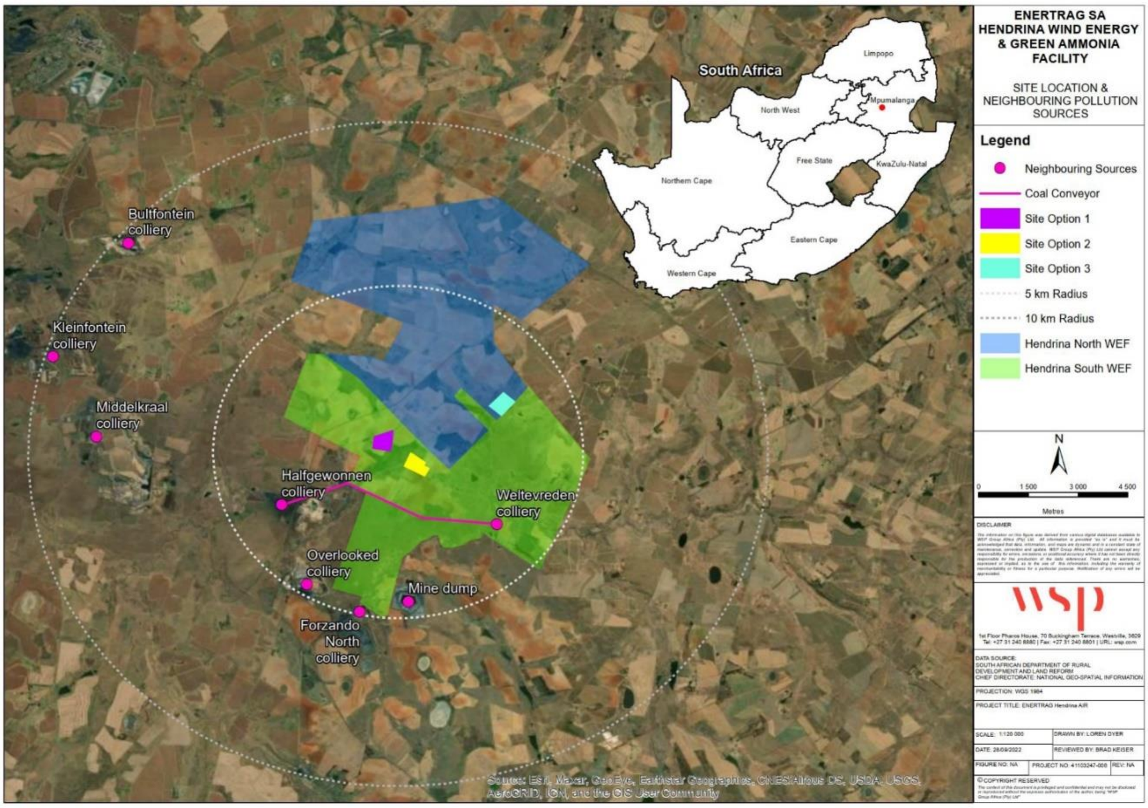


Figure 7-4: Site location and neighbouring emission sources

SENSITIVE RECEPTORS

This area falls within one of South Africa's key air quality regions known as the Highveld Priority Area (HPA). The highveld area is associated with poor air quality and elevated concentrations of criteria pollutants due to the high volume of both industrial and non-industrial emission sources. Most of the remaining land is either under cultivation or is open veld (potentially earmarked for future mining prospects). There are no known industrial sources of NH_3 within the assessment area. Localised and transient increases in ambient NH_3 concentrations may be expected from intermittent agricultural activities, such as crop spraying and burning for field clearing.

The three site alternatives are under consideration for the proposed Green NH_3 processing facility, are at an approximate elevation of 1,665 m above mean seal level and up to 0.2 km^2 in extent. Elevations within the surrounding landscape gently undulate within 100 m of this and thus the local topography is considered flat.

Sensitive receptors (i.e. places where sensitive individuals may be impacted, such as residences) identified within a 5 km radius of the general study site are listed in

Table 7-2 and presented in **Figure 7-5.**

Table 7-2: Sensitive Receptors

ID	RECEPTOR NAME	RECEPTOR TYPE	DISTANCE (KM) FROM SITE			CARDINAL DIRECTION			LATITUDE (ºS)	LONGITUDE (ºE)
			Site option 1	Site option 2	Site option 3	Site option 1	Site option 2	Site option 3		
1	Halfgewonnen Office	Commercial	1.4	2.3	4.7	WSW	W	WSW	26.201068	29.538816
2	Residence 1	Residential	4.2	4.0	1.4	NE	NE	NNE	26.175948	29.586500

ID	RECEPTOR NAME	RECEPTOR TYPE	DISTANCE (KM) FROM SITE			CARDINAL DIRECTION			LATITUDE (°S)	LONGITUDE (°E)
3	Residence 2	Residential	2.7	1.6	3.6	SE	SSE	SSW	26.217541	29.568418
4	Residence 3	Residential	4.9	3.8	2.5	ESE	E	SE	26.206837	29.599529
5	Residence 4	Residential	3.3	3.5	2.0	NE	NNE	NW	26.174362	29.572278
6	Residence 5	Residential	2.1	3.3	5.2	WNW	NW	W	26.192119	29.531528
7	Residence 6	Residential	4.3	4.5	7.4	SW	WSW	SW	26.228052	29.524666

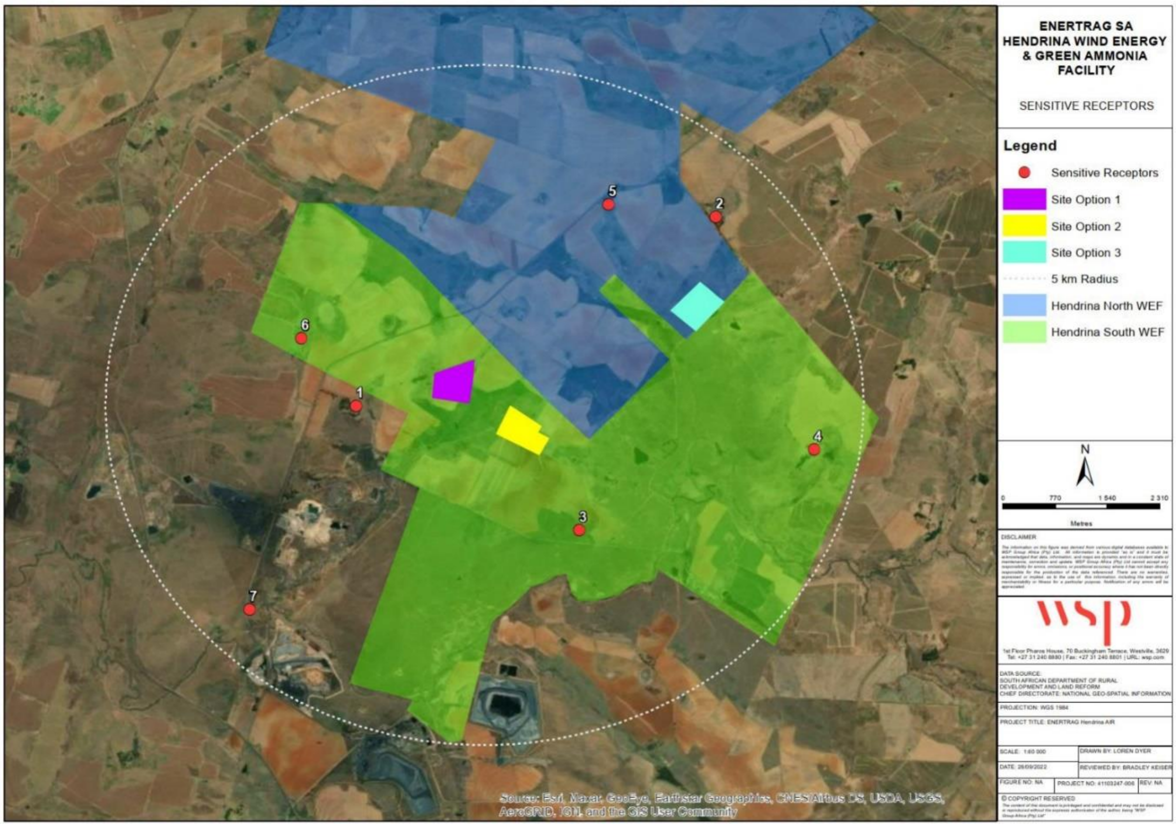


Figure 7-5: Sensitive receptors within 5 km

7.1.3 TOPOGRAPHY

The proposed project is located in an area largely characterised by a mix of flat to undulating plains (**Figure 7-6**) and greater relief in the form of slightly higher-lying plateaus intersected by river valleys.

Figure 7-6: View from the R542 Main Road across the study area showing flat to gently undulating terrain

Mining activity in parts of the study area has altered the natural topography significantly with mine dumps forming prominent features in the landscape. Slopes across the study area are relatively gentle to moderate, with steeper slopes being largely associated with the more incised river valleys. The main water course in the study area is the Olifants River which traverses the study area in a west-east direction.

The topography and slopes within and in the immediate vicinity of the Hendrina GH&A Facility area are indicated in **Figure 7-7** and **Figure 7-8** respectively.

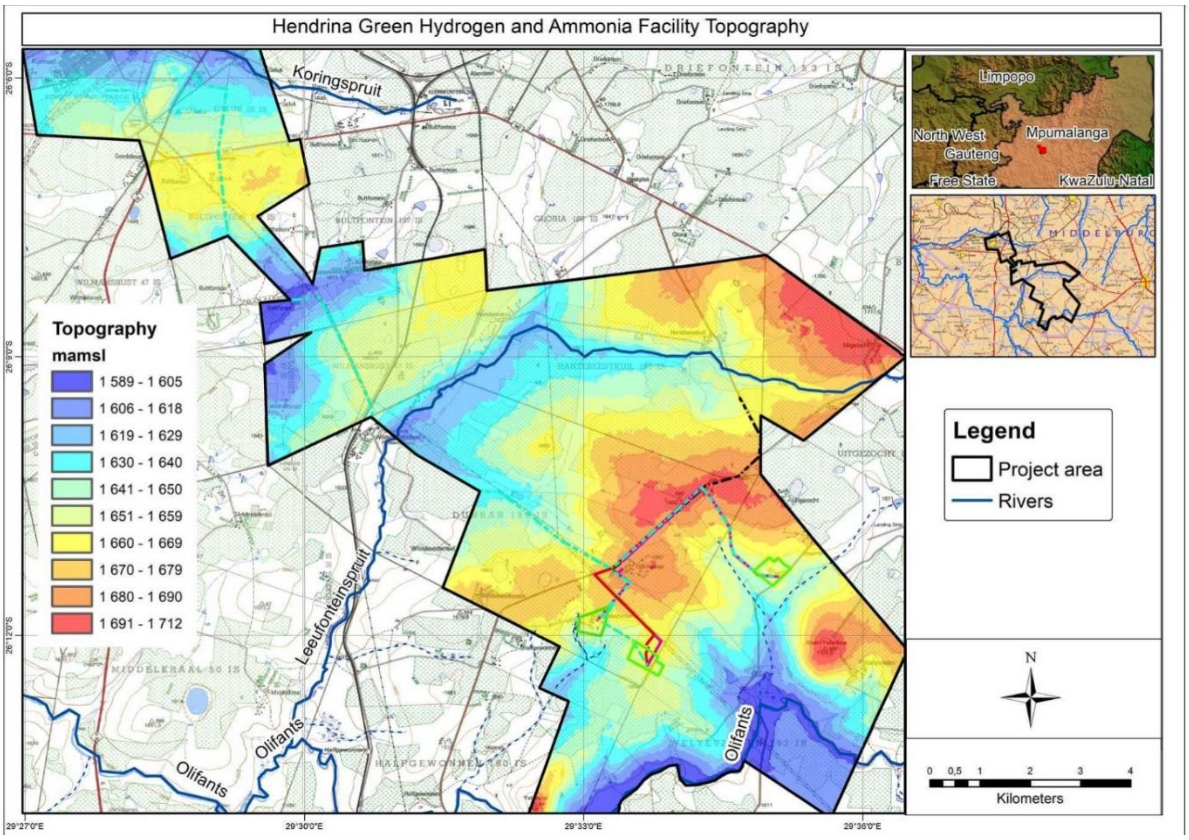


Figure 7-7: Topographical Map of Project Area (Shangoni, 2023)

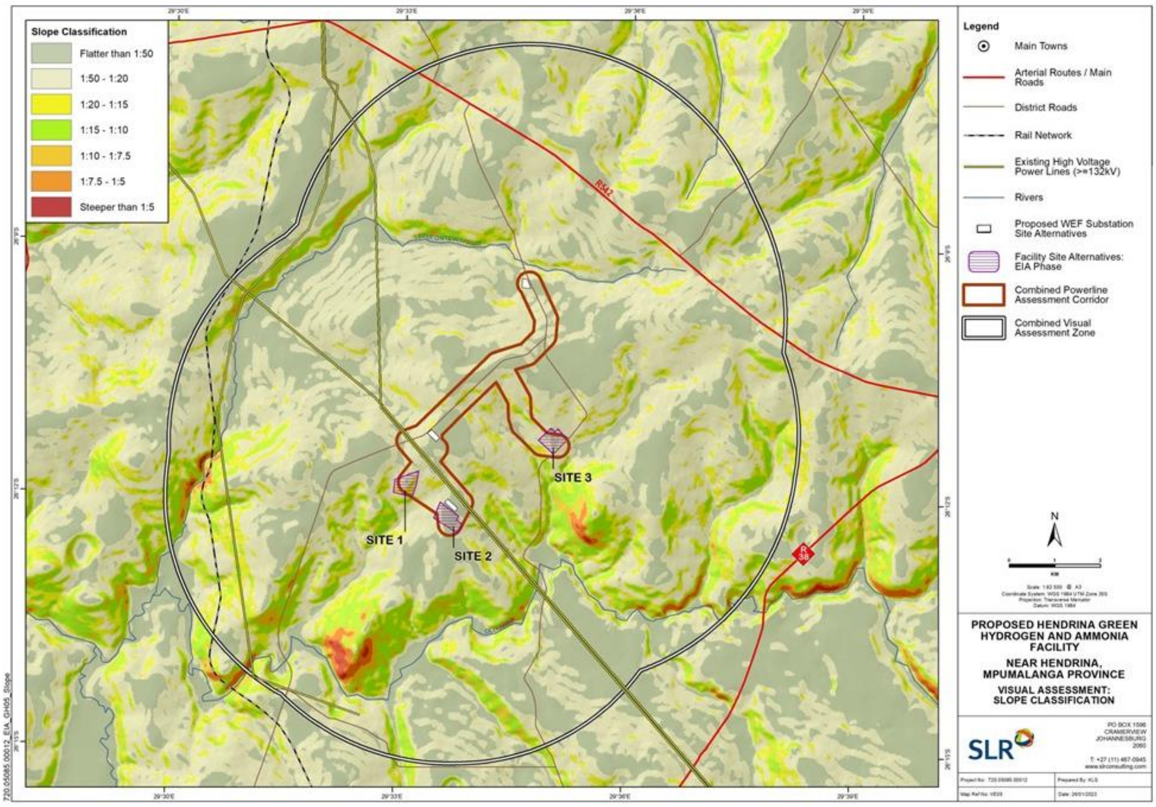


Figure 7-8: Slope classification of Project Area (SLR, 2023)

7.1.4 GEOLOGY

A desktop review of the geology of the proposed development area indicates that site is predominantly underlain by lithological units of the Ecca Group (**Figure 7-9**) which is represented by sandstones, shales and coal seams of the Vryheid Formation, all deposited in a shallow marine environment. The Vryheid Formation has been extensively intruded by Jurassic aged dolerite, becoming relatively more prevalent further south of the proposed study area.

Sandstones comprise a larger portion of the Karoo sediments and are generally closely intercalated with mudrocks, resulting in alternating bands of arenaceous and argillaceous sediments. The Vryheid Formation sandstones may typically occur as arkosic to greywacke, ranging from a generally coarse grained, poorly sorted material to a fine grained, well sorted material, with an abrupt upward transition.

Of significant economic importance is the presence of coal seams located stratigraphically between the sandstone and mudrock bedding partings, at the base of the Vryheid Formation. The lower coal seams attain thicknesses of approximately 18 m which progressively diminishes upwards through the formation, due to various depositional and post-depositional factors (Brink, 1983).

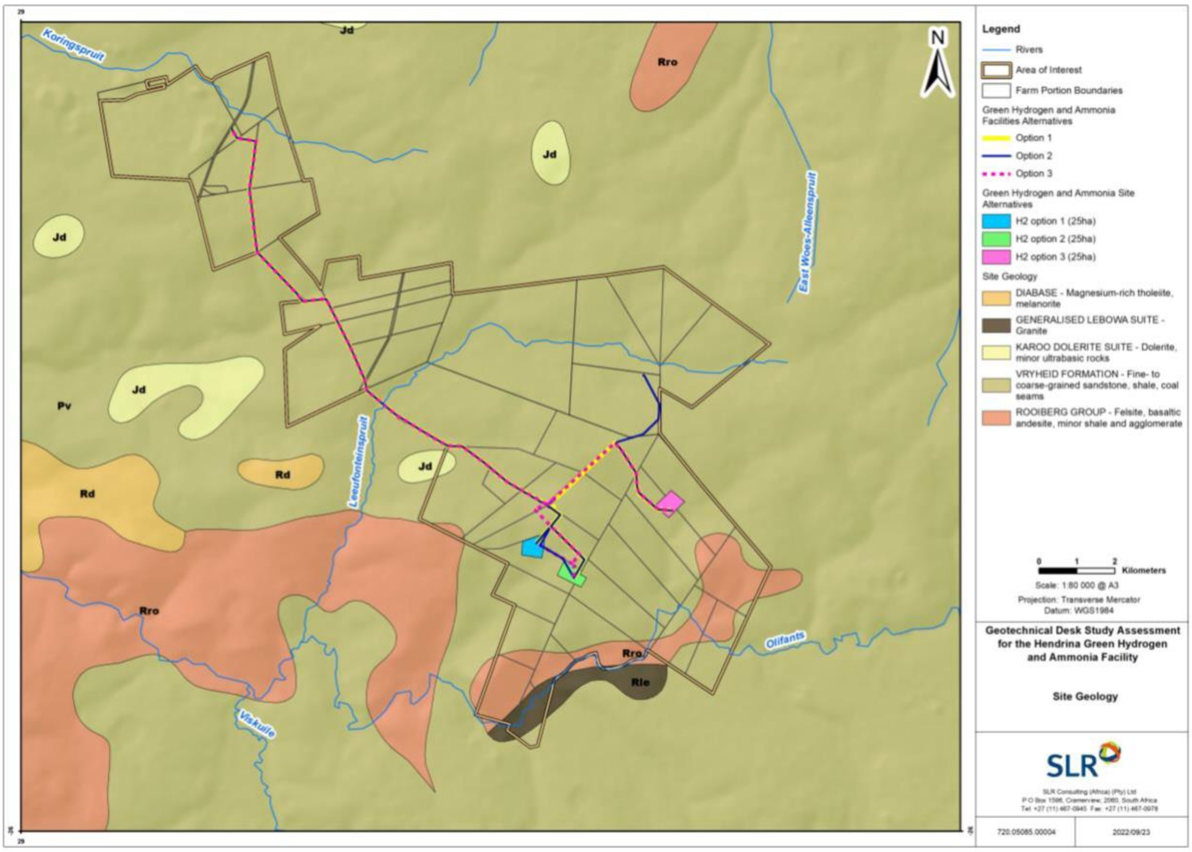


Figure 7-9: Geological Map of the Proposed Development Area (SLR, 2022)

In respect of sourcing construction materials for roads and laydown areas consideration could be given to natural gravely or crushed sandstone bedrock. Selective usage must be exercised to avoid using sandstone containing excessive pyrite and muscovite, which can cause distress when used as basecourse (Brink, 1983).

In addition, where chemical stabilization is required the clay matrix of sandstones make them suitable for stabilization with lime (Brink, 1983). The occurrence, nature, material quality and quantity of sandstone and other potential construction materials will have to be assessed during the detailed geotechnical investigation. It is recommended that provision be made to procure aggregates for use in upper pavement layer works construction and the manufacture of concrete from commercial sources.

On the contrary, mudrocks such as siltstone, mudstone and "mud-shales" are not considered suitable for use as construction materials, due to their swelling characteristics, excessive absorption of water and poor engineering performance. Slope stability issues can arise in areas where closely intercalated sandstones and mudrock co-exist. When mudrocks slake or disintegrate the exposed sandstone layers are undercut, which can result in rockfalls (Brink, 1983).

7.1.5 SOILS AND AGRICULTURAL POTENTIAL

All three alternative locations fall within one land type, Bb4. The geology is predominantly shale and sandstone of the Ecca Group of the Karoo Supergroup and includes dolerite. The land type includes a fairly high proportion of deep, red and yellow, reasonably drained, loamy soils of the Avalon, Hutton and Glencoe soil forms that are good for crop production. It also includes other soils that have various limitations for crop production, which are predominantly the result of poor drainage or limited depth due to underlying clay or bedrock. These soils are of the Mispah and Glenrosa soil forms (shallow bedrock) and the Westleigh, Longlands, Rensburg, Estcourt, and Katspruit soil forms (poor drainage and underlying clay).

The development is in grain and cattle farming agricultural regions, but the soils vary in their suitability for crop production. Crops in the area include mainly maize and soya beans. Farmers generally utilise all suitable soil as cropland. Only soil that is not suitable for crop production is used for grazing of cattle and sheep. Limitations that render the soil unsuitable for crop production are poor drainage and depth limitations due to rock or dense clay in the subsoil.

Alternatives 1 and 2 are on cropland while alternative 3 is on land not used for crops and therefore presumed to be unsuitable. Coal-fired electricity generation and mining take place in the surrounding area.

Because of the favourable climate and suitable soils on the croplands, crop yields are fairly high with average maize yields of around 7 to 8 tons per hectare according to the farmers on site. The long-term grazing capacity of the area is fairly high at 5 hectares per large stock unit (DAFF, 2018).

The only impact of this development is the loss of 25 hectares of agricultural land on the site of the facility. The proposed pipeline, because it is linear infrastructure and runs only between and on the edges of croplands, instead of through them, has minimal agricultural impact. The proposed overhead power lines have negligible agricultural impact, regardless of their route and design and the agricultural potential of the land they traverse. All agricultural activities can continue completely unhindered underneath the power lines. This is because their direct, permanent, physical footprint that has any potential to interfere with agriculture (pylon bases), is insignificantly small and the pylons can easily be located on the edges of cropland where they do not interfere with it. There will therefore be no reduction in future agricultural production potential underneath the power lines.

A satellite image map of the alternative agricultural footprints of the facility is shown in **Figure 7-10**. A satellite map showing the pipeline route is shown in **Figure 7-11.**

Figure 7-10: Satellite image map of the three alternative sites for the proposed facility, showing all cropland shaded green. Alternatives 1 to 3 are located in numerical order from west to east.

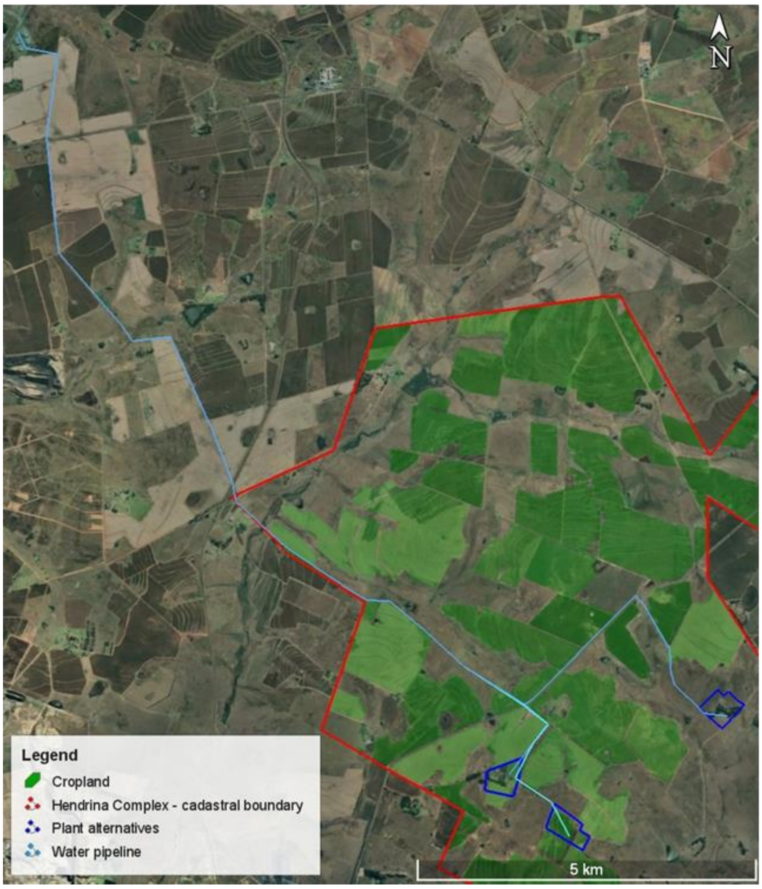


Figure 7-11: Satellite image map of the proposed pipelines to the alternative facility sites.

7.1.6 SURFACE WATER

HYDROLOGICAL CACHMENT

The Olifants River is the main receiving surface water body of the catchment. Several tributaries consisting of perennial and nonperennial streams bisect the project area and eventually connects to the two main streams (Leeuwfonteinspruit and Koringspruit) that drain into the Olifants River. The Olifants River runs in a western direction along the southern boundary of the project area.

The Hendrina Green Hydrogen and Ammonia Project falls within the Upper Olifants of the Olifants Water Management Area and within the B11A quaternary drainage regions but the project area also include B11B catchment (**Figure 7-12**).

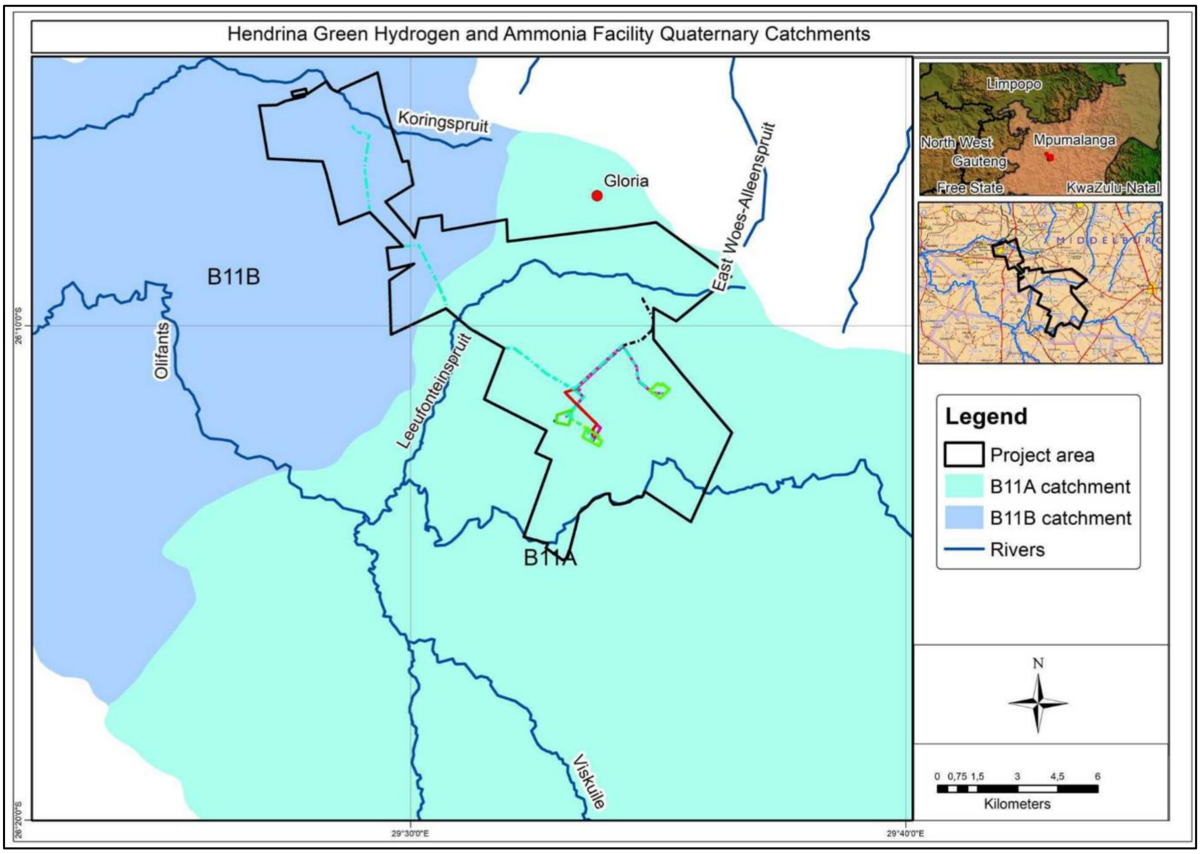


Figure 7-12: Quaternary catchments within the Project Area (Shangoni, 2023)

LOCAL AQUATIC FEATURES

During the desktop and field assessment, 1722.32 ha of wetlands were identified and delineated within the Project Area using the approved methodology by the Department of Water Affairs and Forestry (2005). Thirty-six (36) HGM units were identified and categorized based on terrain units. These include hillslope seep wetlands (Seeps), unchanneled valley bottom wetlands (UVBs), and channelled valley bottom wetlands (CVBs). Land use activities and in-field studies have shown that some of the systems are similar from a catchment management perspective as they would be subject to similar overall land uses impacts. Therefore, it was considered practical to group the HGM units by systems that have similar land use and impacts to calculate more accurate PES and EIS scores. Seven HGM units were identified and assessed. The extent of the combined HGM units are indicated in **Table 7-3** below:

Table 7-3: Combined HGM units

NUMBER	NAME	ACRONYM	AREAS (HA)
1	Channelled Valley Bottoms	CVBs	168.87
2	Channelled Valley Bottoms (fragmented)	CVBs Fragmented	107.71
3	Unchanneled Valley Bottoms	UVBs	635.99
4	Unchanneled Valley Bottoms (fragmented)	UVBs Fragmented	352.70
5	Hillslope Seep (Agriculture)	HS Agriculture	324.93
6	Hillslope Seep (Fragmented)	HS Fragmented	45.98
7	Hillslope Seep (Unimpacted)	HS Unimpacted	86.14
Total wetlands			**1722.32**

Figure 7-13: An unimpacted wetland

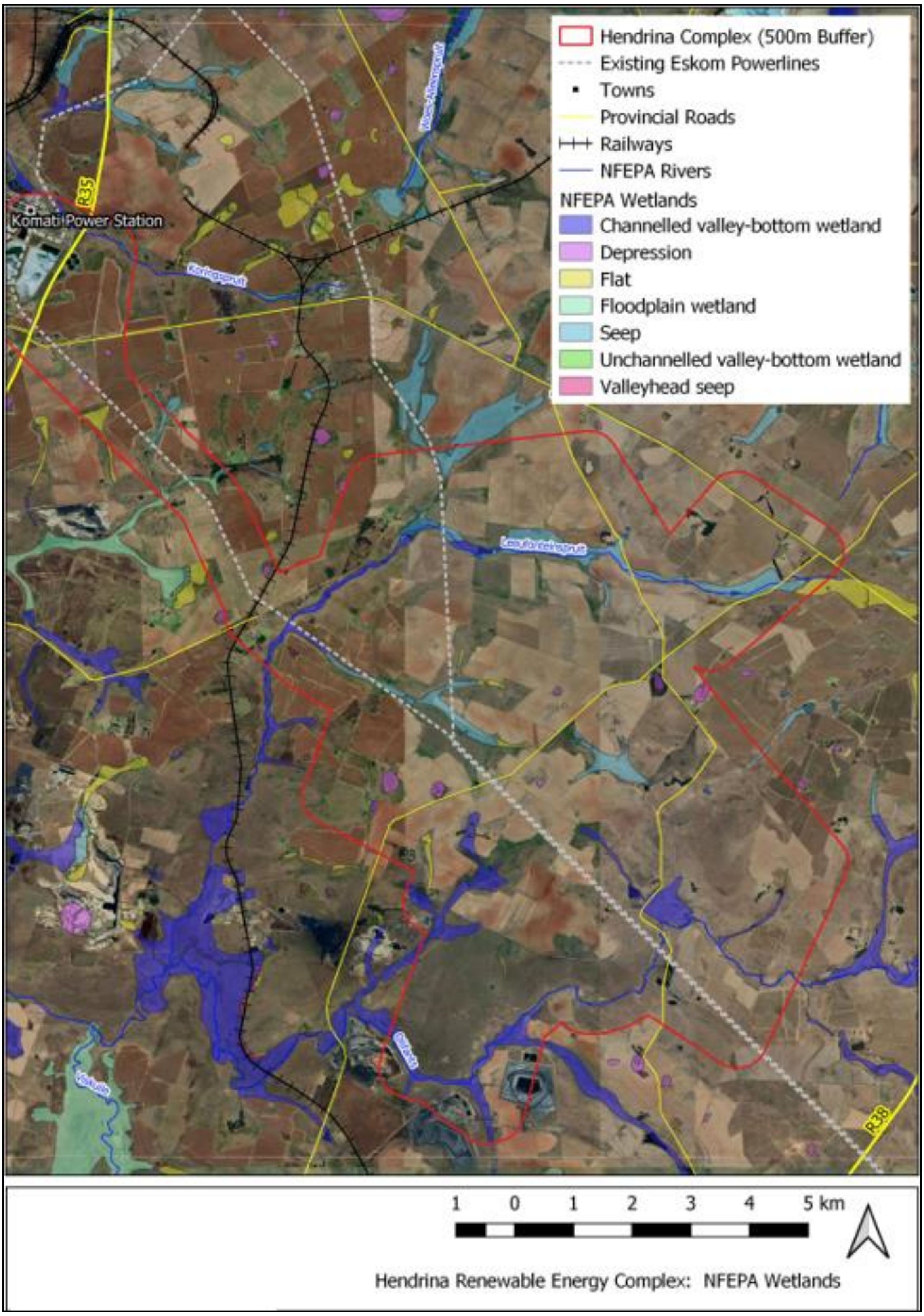


Figure 7-14: NFEPA Wetlands within Project footprint based

PRESENT ECOLOGICAL STATE AND CONSERVATION IMPORTANCE

The Present Ecological State (PES) of a river, watercourse or wetland represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

The PES scores have been revised for the country and based on the new models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014). The new PES system incorporates Ecological Importance (EI) and Ecological Sensitivity (ES) separately as opposed to Ecological Importance and Sensitivity (EIS) in the old model, although the new model is still heavily centred on rating rivers using broad fish, invertebrate, riparian vegetation, and water quality indicators. The Recommended Ecological Category (REC) is still contained within the new models, with the default REC being B, when little or no information is available to assess the system or when only one of the above-mentioned parameters are assessed or the overall PES is rated between a C or D.

All of the systems assessed by DWS (2014) on a Sub quaternary level within the study area were rated as PES = C or Moderately Modified and PES = D or Largely Modified.

The PES of the seven HGM units were rated to have an ecological state of 'Moderately Modified' to 'Largely Modified'. According to the integrity (health) method described by Kotze et al. (2007):

A category C wetland has Moderate changes to its ecosystem processes, and loss of natural habitat has taken place; however, the natural habitat remains predominantly intact.

A category D wetland has Large modifications to the natural ecosystem processes and loss of natural habitat and biota.

Each HGM unit, PES score, and its health; hydrological, vegetation, and geomorphological health are shown below (**Table 7-4**) whereas the validations for the PES values are discussed below.

Table 7-4: Combined HGM units

NUMBER	HGM UNIT GROUP	HYDROLOGY	GEOMORPHOLOGY	VEGETATION	COMBINED PES	PES CATEGORY
1	CVBs	7.0	1.4	5.9	5.1	D
2	CVBs Fragmented	4.0	4.0	5.4	4.4	D
3	UVBs	2.0	0.5	6.2	2.8	C
4	UVBs Fragmented	3.0	0.3	7.8	3.6	C
5	HS Agriculture	2.0	0.6	9.0	3.6	C
6	HS Fragmented	4.0	1.2	7.5	4.2	D
7	HS Unimpacted	1.0	0.2	7.0	2.5	C

SITE SENSITIVITY

Using the baseline description and field data while considering the current disturbances and site characteristics, the following features were identified, then categorised into one of a number of pre-determined sensitivity categories to provide protection and/or guide the layout planning and design processes of the Facility and respective grid assessment corridor. The full extent of the grid and water pipeline corridors were assessed to allow for micro siting therein.

Channelled Valley Bottoms (D) – The CVBs have mainly been impacted by agropastoral activities, including cattle grazing, dams, and cultivation. Large dams exist within the CVB, together with evidence of cattle trampling, erosion, and compaction. This impacted the natural hydrology, ground cover, and changes to the natural vegetation.

Channelled Valley Bottoms (fragmented) (D) – In addition to the above, some of the CVBs have been fragmented by linear infrastructure, including roads, conveyors, powerlines, and fence lines. Some systems have also been fragmented by agropastoral activities. Fragmentation of wetlands impacts the natural habitat, functionality, and health of a wetland. Linear infrastructure within wetlands is prone to creating erosion, channelling, drying out of wetlands, and increased Alien Invasive Plants.

Unchanneled Valley Bottoms (C) – The UVBs within the Project Area were dominantly used for cattle grazing. There were no clear signs of channelling, erosion, or extensive cattle trampling. The vegetation was stable with little changes to water inputs to the systems. The systems were in a stable condition, well-functioning, and creating habitat for various fauna and flora species.

Unchanneled Valley Bottoms (fragmented) (C) – Regardless of some of the UVBs being moderately impacted, some of the systems were fragmented by agropastoral and linear infrastructure. Dams were also indicated in some of the systems. The fragmentation of the UVBs changes the natural habitat and health of the systems.

Hillslope Seep (Agriculture) (C) – The majority of the Hillslope Seep wetlands were used for agropastoral activities, including commercial cultivation and cattle grazing. The soils within Hillslope Seep wetlands (Hutton, Clovelly) are typically used for cultivation due do the decent water-holding-capacity, fertility, and soil depth. However, cultivation changes the natural vegetation, hydrological functioning as well as the geomorphology by ploughing, ripping, and tillage.

Hillslope Seep (Fragmented) (D) – Regardless of some Hillslope Seeps being impacted by agropastoral activities, some of the seeps have been impacted by linear infrastructure, including roads, dams, and powerlines. Some sections of the seeps have almost completely been removed by these activities or completely separated and cut off from the rest of the system.

Hillslope Seep (Unimpacted) (C) – Unimpacted Hillslope Seep wetlands were recorded within the Project Area. These wetlands were mainly used for cattle grazing, however, was well regulated and little erosion and impacts on the vegetation and geomorphology were noted.

Wetland Indicators

Wetlands in the crest and mid-slope were typically characterized as Seeps and UVBs. Wetlands in the middle slope, foot-slope, and bottomland typically identified as CVBs and UVB’s. Scattered dams and a large dam within the main CVB on the east of the Project Area were identified. These dams are typically used for non-commercial irrigation, cattle watering, and domestic use. Some of the wetlands were unimpacted by agricultural activities, whereas some wetlands were fragmented, or cultivated.

Stands of Eucalyptus grandis and Pinus patula were identified within the Project Area. Isolated areas of Acacia mearnsii were also observed. It is regarded as likely that these areas may have resulted in serious modifications to historically wet or moist grasslands, VBs, and seeps, thus influencing the wetland delineation at these points.

Soil indicators including soil forms and soil wetness, such as mottling and gleying of soils, were used extensively throughout the Project Area to identify and confirm wetlands. The wetlands are used for cattle grazing and perennial grasslands. These soils are somewhat limited for cultivation and highly mobile (high erosion probability).

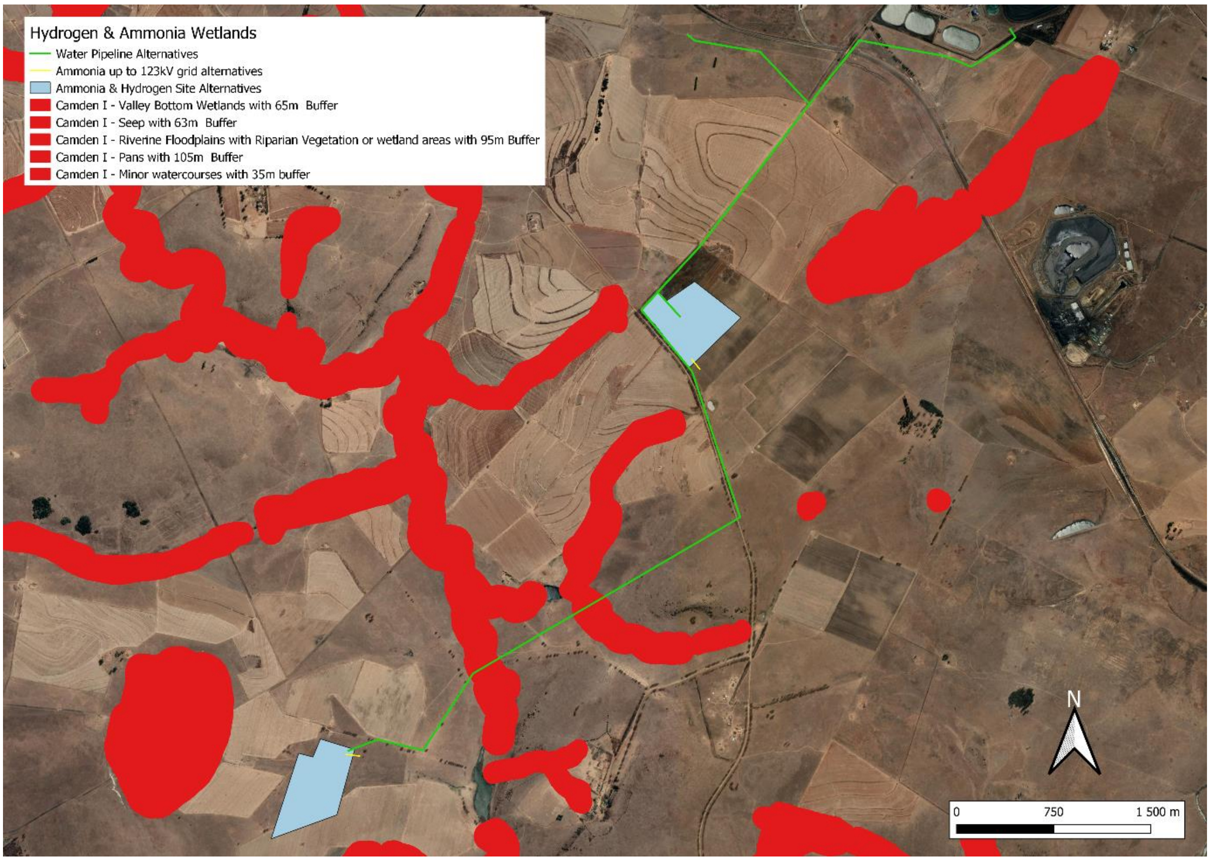


Figure 7-15: The delineated waterbodies inclusive of the respective buffer distances

7.1.7 GROUNDWATER

The topography is slightly undulating. Surface elevations range from 1589 meters above mean sea level ("mamsl") at the drainage lines to 1710 mamsl on the north-western border of the project area as shown in **Figure 7-7**. This indicates a generally flat and shallow sloped area dipping down towards the Olifants River to the south, Leeuwfontein Spruit to the west, and Koringspruit to the north-west.

The topographical contour lines in **Figure 7-7** show that surface water drainage will occur towards these drainage lines. The topography is usually a good first indication of the groundwater flow directions, and often hydraulic heads in a semi-confined aquifer mimics surface flow.

Depending on the prevailing gradient between groundwater in the shallow aquifer and the surface water stage in a river, groundwater will discharge into surface waters or vice versa. Groundwater sources are predominantly from rainfall recharge at an average of between 0.5 to 3% and discharges as baseflow into wetlands, rivers and streams, but this occurrence is mostly between the weathered aquifer and the natural surface water system. The main groundwater sources in the wider area of interest are:

— direct rainfall recharge of the shallow weathered aquifer with vertical leakage to the fractured aquifer.
— potential leakage from surface water courses and unlined dams.
— regional groundwater inflow.

The main groundwater sinks in the model domain are:

— groundwater seepage towards surface waters.
— regional groundwater outflow.
— shallow interflow and groundwater fed pans, wetlands and natural drainage systems.

Three distinct undisturbed saturated groundwater regions are potentially underlying the study area, and include:

— Perched aquifer, mostly associated within wetlands (unconfirmed).

— Weathered aquifer.
— Fractured aquifer.

Groundwater flow directions largely correlate with surface flow. It tends to follow relatively similar gradients and flow patterns compared to surface topography. Based on first principles, groundwater flow patterns are largely towards the major drainage systems, being the Olifants River and Leeuwfonteinspruit. Groundwater leaves the aquifer as discharge contributing to flow within the bases of these systems (groundwater contribution baseflow). A good correlation of 0.97 was achieved between static hydraulic heads and surface elevation. Groundwater flows from higher lying ground towards lower lying springs or valleys including surface water drainages (Olifants River and Leeuwfonteinspruit), where it 'daylights' or accumulates in the alluvial and hill wash deposits.

The groundwater levels within the weathered and fractured aquifer are relatively shallow being of semi-confined to confined nature. Ferricrete underly the study area at certain places (unconfirmed) and acts as a confining aquiclude or aquitard (in places) that separate the weathered aquifer from the fractured aquifer resulting in piezometric heads to form, some of which may be artesian. Sills are generally confined to specific horizons and will also act as a largely impermeable barrier for groundwater movement.

Several wetlands occur within the study area, which is largely disconnected from the fractured aquifer. Only the weathered and/ or perched aquifer is hydraulically connected to the wetlands.

A detailed Hydrogeological Map illustrating the aquifer types and borehole yielding potential across the study area is presented in **Figure 7-16** below.

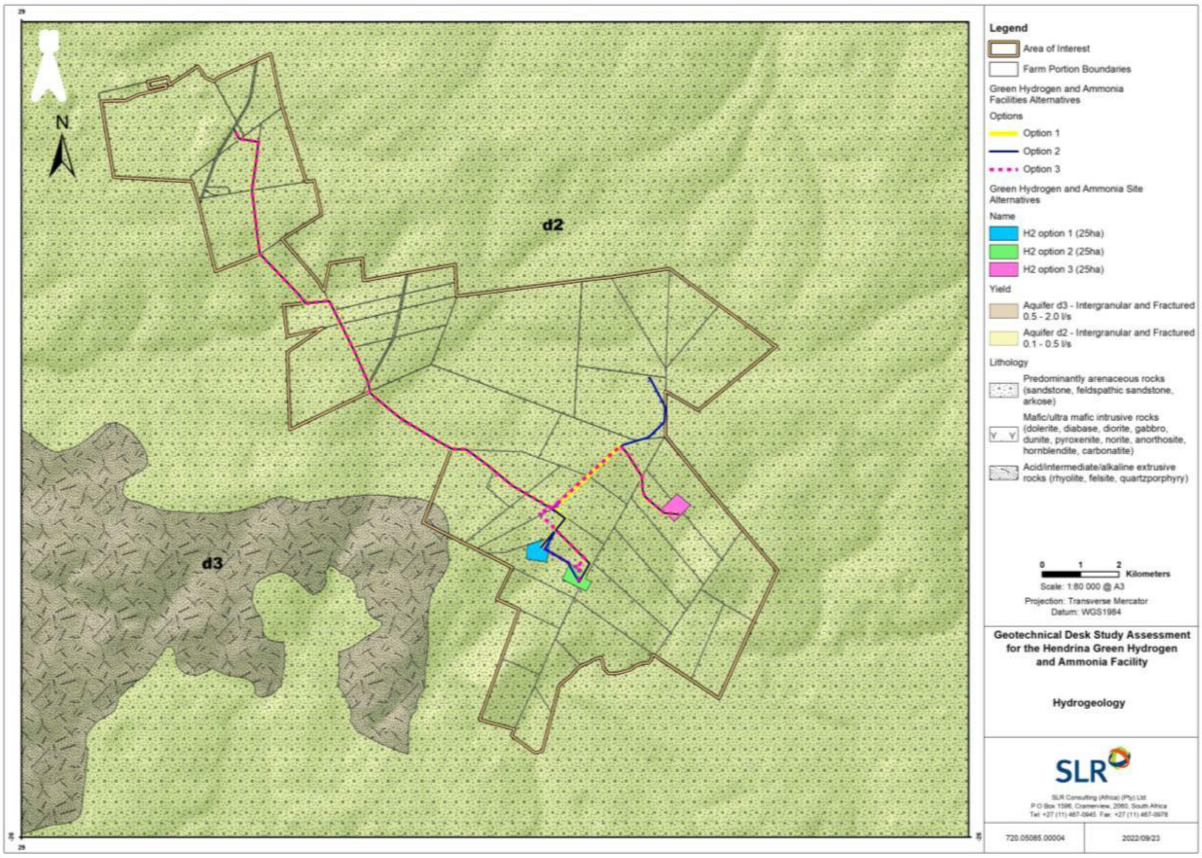


Figure 7-16: Hydrogeological Map of the Proposed Development Area (SLR, 2022)

According to the 1: 25 000 hydrogeological map (2526) for Johannesburg (map not shown) the study area is predominantly located in a d2 aquifer class region; the porphyritc rhyolite (Selons River Formation) being slightly more favourable compared to the Vryheid Formation sandstone and shale, but only constitute a very small area to the south.

The groundwater yield potential is classed as low on the basis that most of the boreholes on record in vicinity of the study area produce between 0.1 and 0.5 l/s, although larger yields (up to 5 l/s) can be obtained in weathered or fractured aquifers associated with dolerite intrusions

The occurring aquifer, in terms of the above definitions, is classified as a minor aquifer system. The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer is classified as medium.

Reasonable and sound groundwater protection measures are recommended to ensure that no cumulative pollution affects the aquifer, during short- and long-term. DWS's water quality management objectives are to protect human health and the environment.

Therefore, the significance of this aquifer classification is that if any potential risk exists, measures must be taken to limit the risk to the environment, which in this case is:

— The protection of the underlying weathered and fractured aquifers.
— Olifants River, Leeuwfonteinspruit and Koringspruit.

7.2 BIOLOGICAL ENVIRONMENT

7.2.1 REGIONAL VEGETATION

Based on the preliminary desktop and site-specific field study Terrestrial Plant species assessment Report (David Hoare Consulting, 2022) (**Appendix H-14**), there is one regional vegetation type occurring in the study area, namely Eastern Highveld Grassland (**Figure 7-17**). There is one additional unit that occurs in nearby areas, namely Eastern Temperate Freshwater Wetlands. It is probable that terrestrial vegetation patterns reflect the major vegetation type, namely Eastern Highveld Grassland The vegetation type description below is from Mucina & Rutherford (2006), extracted from the SANBI BGIS website (http://bgis.sanbi.org/vegmap).

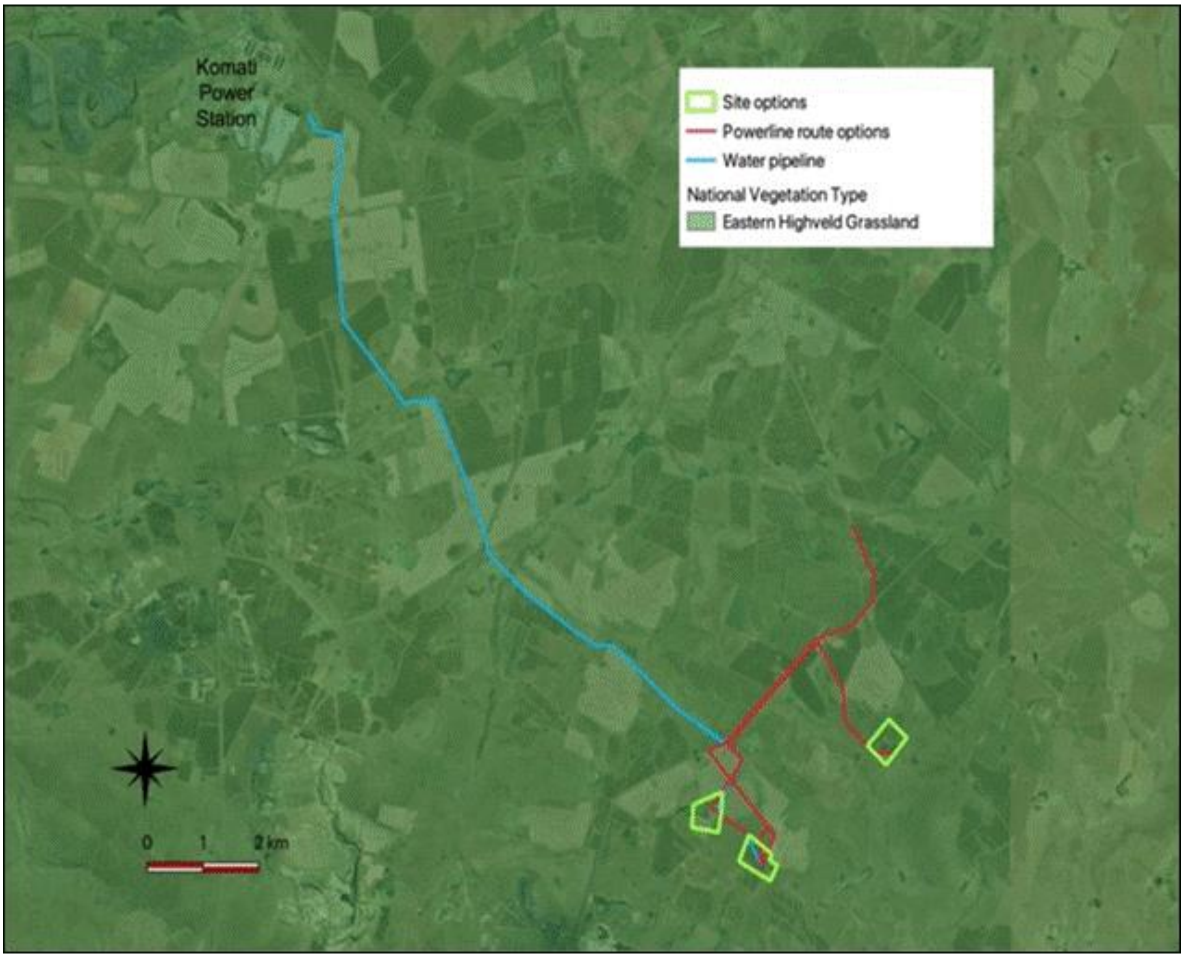


Figure 7-17: Regional Vegetation Types of the Study Area

EASTERN HIGHVELD GRASSLAND

DISTRIBUTION

Found in Mpumalanga and Gauteng Provinces, on the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. The vegetation type occurs at an altitude of between 1 520–1 780 m.

VEGETATION & LANDSCAPE FEATURES

The vegetation occurs on slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra*, *Celtis africana*, *Diospyros lycioides* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Searsia magalismontanum*).

GEOLOGY & SOILS

Red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup). Land types Bb (65%) and Ba (30%).

CLIMATE

Strongly seasonal summer rainfall, with very dry winters. MAP 650–900 mm (overall average: 726 mm), MAP relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidence of frost from 13–42 days, but higher at higher elevations.

IMPORTANT TAXA

Low Shrubs	*Anthospermum rigidum* subsp. *pumilum*, *Stoebe plumosa*..
Herbs	*Berkheya setifera* (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Pelargonium luridum* (d), *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops gilfillanii, E. transvaalensis* subsp. *setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum*, *H. oreophilum*, *H. rugulosum*, *Ipomoea crassipes*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Senecio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulata*.
Geophytic Herbs	*Gladiolus crassifolius*, *Haemanthus humilis* subsp. *hirsutus*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*.
Succulent Herbs	*Aloe ecklonis*
Graminoids	*Aristida aequiglumis* (d), *A. congesta* (d), *A. junciformis* subsp. *galpinii* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *E. sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *A. schirensis*, *Bewsia biflora*, *Ctenium concinnum*, *Diheteropogon amplectens*, *Eragrostis capensis*, *E. gummiflua*, *E. patentissima*, *Harpochloa falx*, *Panicum natalense*, *Rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*.

EASTERN TEMPERATE FRESHWATER WETLANDS

DISTRIBUTION

Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Eswatini: Around water bodies with stagnant water (lakes, pans, periodically flooded vleis, edges of calmly flowing rivers) and embedded within the Grassland Biome. Altitude ranging from 750–2 000 m.

VEGETATION & LANDSCAPE FEATURES

Flat landscape or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herb-lands.

GEOLOGY & SOILS

Found on younger Pleistocene to recent sediments overlying fine-grained sedimentary rocks of the Karoo Supergroup (on sediments of both Ecca and Beaufort Groups due to the large extent of the area of occurrence) as well as of the much older dolomites of the Malmani Subgroup of the Transvaal Supergroup in the northwest. Especially the areas built by Karoo Supergroup sediments are associated with the occurrence of Jurassic Karoo dolerite dykes having a profound influence on run-off. Soils are peaty (Champagne soil form) to vertic (Rensberg soil form). The vleis form where flow of water is impeded by impermeable soils and/or by erosion resistant features, such as dolerite intrusions. Many vleis and pans of this type of freshwater wetlands are inundated and/or saturated only during the summer rainfall season, and for some months after this into the middle of the dry winter season, but they may remain saturated all year round. Surface water inundation may be present at any point while the wetland is saturated and some plant species will be present only under inundated conditions, or under permanently saturated conditions. The presence of standing water should not be taken as a sign of permanent wet conditions.

CLIMATE

Exclusively summer-rainfall region (MAP range 421–915 mm). Cool-temperate pattern with MAT ranging between 12.6°C and 16.7°C. Due to high elevation, frost is a frequent phenomenon

IMPORTANT TAXA

Megagraminoids	*Cyperus congestus (d), Phragmites australis (d), Schoenoplectus corymbosus (d), Typha capensis (d), Cyperus immensus.*
Graminoids	*Agrostis lachnantha (d), Carex acutiformis (d), Eleocharis palustris (d), Eragrostis plana (d), E. planiculmis (d), Fuirena pubescens (d), Helictotrichon turgidulum (d), Hemarthria altissima (d), Imperata cylindrica (d), Leersia hexandra (d), Paspalum dilatatum (d), P. urvillei (d), Pennisetum thunbergii (d), Schoenoplectus decipiens (d), Scleria dieterlenii (d), Setaria sphacelata (d), Andropogon appendiculatus, A. eucomus, Aristida aequiglumis, Ascolepis capensis, Carex austro-africana, Carex cernua, C. schlechteri, Cyperus cyperoides, C. distans, C. longus, C. marginatus, Echinochloa holubii, Eragrostis micrantha, Ficinia acuminata, Fimbristylis complanata, F. ferruginea, Hyparrhenia dregeana, H. quarrei, Ischaemum fasciculatum, Kyllinga erecta, Panicum schinzii, Pennisetum sphacelatum, Pycreus macran¬thus, P. nitidus, Setaria pallide-fusca, Xyris gerrardii.*
Herbs	*Centella asiatica (d), Ranunculus multifidus (d), Berkheya radula, B. speciosa, Berula erecta subsp. thunbergii, Centella coriacea, Chironia palustris, Equisetum ramosissimum, Falckia oblonga, Haplocarpha lyrata, Helichrysum difficile, H. dregeanum, H. mundtii, Hydrocotyle sibthorpioides, H. verticillata, Lindernia conferta, Lobelia angolensis, L. flaccida, Marsilea farinosa subsp. farinosa, Mentha aquatica, Monopsis decipiens, Pulicaria scabra, Pycnostachys reticulata, Rorippa fluviatilis var. fluviatilis, Rumex lanceolatus, Senecio inornatus, S. microglossus, Sium repandum, Thelypteris confluens, Wahlenbergia banksiana.*
Carnivorous herb	*Utricularia inflexa.*
Geophytic Herbs	*Cordylogyne globosa, Crinum bulbispermum, Gladiolus papilio, Kniphofia ensifolia, K. fluviatilis, K. linearifolia, Neobolusia tysonii, Nerine gibsonii (only in Eastern Cape), Satyrium hallackii subsp. Hallackii*
Aquatic Herbs	*Aponogeton junceus, Ceratophyllum demersum, Lagarosiphon major, L. muscoides, Marsilea capensis, Myriophyllum spicatum, Nymphaea lotus, N. nouchali var. caerulea, Nymphoides thunbergiana, Potamogeton thunbergii.*

ENDEMIC TAXA

Herbs	*Disa zuluensis, Kniphofia flammula (northern KwaZulu-Natal), Nerine platy¬petala*
Succulent Herbs	*Crassula tuberella*

CONSERVATION STATUS OF THE REGIONAL VEGETATION TYPES

On the basis of a scientific approach used at national level by SANBI (Driver *et al*., 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in **Figure 7-18**, as determined by best available scientific approaches (Driver *et* *al*., 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al*., 2005).

According to scientific literature (Driver *et al*., 2005; Mucina *et al*., 2006), as shown in **Table 7-5**, Eastern Highveld Grassland is listed as Endangered and Eastern Temperate Freshwater Wetlands as Least Threatened.

Determining ecosystem status (Driver *et al*., 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

Figure 7-18: Ecosystem Status (Driver et al. 2005)

Table 7-5: Conservation status of different vegetation types occurring in the study area

VEGETATION TYPE	TARGET (%)	CONSERVED (%)	TRANSFORMED (%)	CONSERVATION STATUS	
				DRIVER *ET AL.* 2005; MUCINA *ET AL.*, 2006	NATIONAL ECOSYSTEM LIST (NEM:BA)
Eastern Highveld Grassland	24	0.3	44	Endangered	Vulnerable
Eastern Temperate Freshwater Wetlands	24	5	15	Least threatened	Vulnerable

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types, and other ecosystems defined in the Act, that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands are both listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011). Eastern Highveld Grassland covers the entire site (**Figure 7-17**).

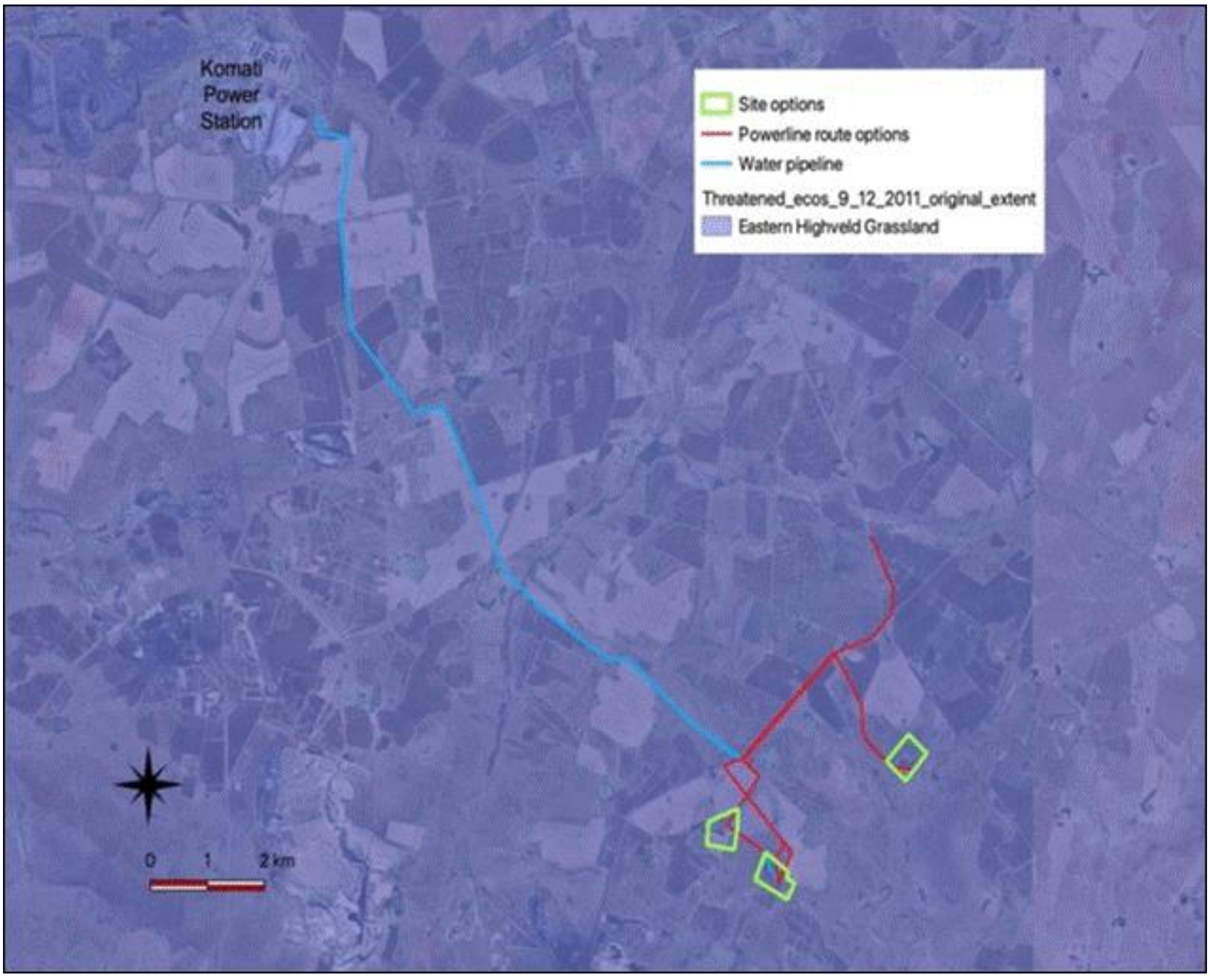


Figure 7-19: Threatened Ecosystems of the study area

7.2.2 BIODIVERSITY CONSERVATION PLANS

The Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Parks and Tourism Agency 2014) classifies the natural vegetation of the province according to the following categories:

— Protected Areas (sub-divided into three categories);
— Critical Biodiversity Areas (sub-divided into "Irreplaceable" and "Optimal");
— Other natural areas;
— Ecological Support Area (sub-divided into four categories); and
— Modified (sub-divided into Heavily or Moderately modified

Figure 7-20 shows the features in the study area within three of the classes listed above:

— Critical Biodiversity Areas (CBA): Irreplaceable: Significant portions of the eastern part of the site are within a "CBA: Irreplaceable" area. These categorized areas are associated with the Olifants River and a drainage valley leading into it, and all natural areas adjacent to these two areas.
— Critical Biodiversity Areas (CBA) Optimal : The entire grassland area in the southern part of the site is within a "CBA: Optimal" area, as well as other smaller patches adjacent to the CBA: Irreplaceable area.
— Other Natural Areas (ONA): There are patches in the western part of the site mapped as ONA.
— Ecological Support Area: There is a patch in the centre of the eastern half of the site that is mapped as ESA: Local Corridor
— Heavily or moderately modified: Remaining areas on site, associated primarily with cultivation.

According to the National Parks Area Expansion Strategy (NPAES), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**.

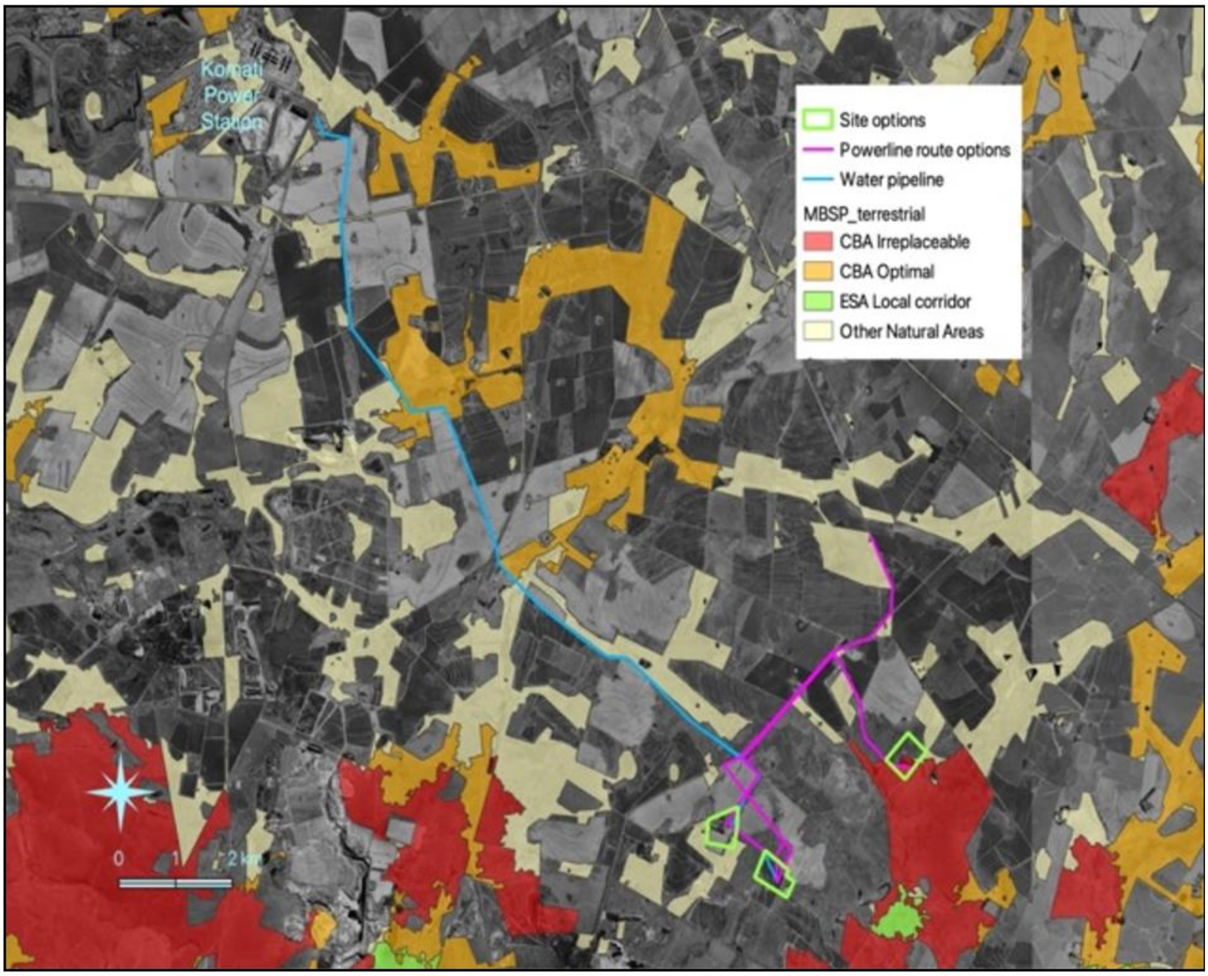


Figure 7-20: Biodiversity Map of the Project Area according to the MBSP (David Hoare Consulting, 2022)

7.2.3 PLANT SPECIES

Following the specialist study undertaken, none of the tree species protected under the National Forests Act (Appendix 1 of the Plant Species Assessment report, 2022) have been previously recorded in the area in which the site is located. A full list of plants that could occur on site, as well as those recorded, is given in Appendix 2 of the Plant Species Assessment report, 2022. (**Appendix H-14**)

There are some species that may occur on site that are protected under the Mpumalanga Nature Conservation Act No. 10 of 1998 (Appendix 3 of the Plant Species Assessment report, 2022) (**Appendix H-14**).

It is a legal requirement to obtain a permit from the provincial authorities for the destruction of any of these species. A comprehensive walk-through survey of the final footprint is required to compile a complete list of these protected species with pictures.

A database search identified additional plant species of conservation concern that could also occur on site that are not flagged in the Screening Tool output. These are included in the following **Table 7-6** :

Table 7-6: Additional listed plant species for the study area

TAXON	RED LIST STATUS	HABITAT AND DISTRIBUTION	FLOWERING TIME	PROBABILITY OF OCCURRENCE
Alepidea cordifolia APIACEAE	Endangered (SA)	Widespread and extremely common across the eastern highveld of Mpumalanga, the eastern Free State, and north-western KwaZulu-Natal. It occurs along the north and north-eastern borders of Lesotho and is also found in Eswatini, on the Eastern Highlands of Zimbabwe and the Chimanimani Mountains of Mozambique. Forest margins, west and south facing mountain slopes and near drainage lines or islands within wetlands. Open grassland or on forest margins, often amongst rocks and/or along streams.	Summer, mostly February to March	**MODERATE** (within known overall distribution)
Alepidea longeciliata APIACEAE	Endangered	Between Breyten, Lothair, Middelburg and Stoffberg. Recorded from 2 neighbouring grids. Eastern Highveld Grassland. Grassland, Karoo Sandstone, above 1600 m. Possibly associated with edges of pans.	Summer	**MODERATE** (within known overall distribution)
Aspidoglossum xanthosphaerum APOCYNACEAE	Vulnerable	Mpumalanga, Groenvlei and Ermelo. Closest known record is from Breyten and just to the west of Ermelo. Montane grassland, marshy sites, 1800 m.	Unknown	**HIGH**
Bowiea volubilis subsp. volubilis HYACINTHACEAE	Vulnerable (national)	Eastern Cape to Limpopo Province. Widespread elsewhere in southern and eastern Africa. Low and medium altitudes, usually along mountain ranges and in thickly vegetated river valleys, often under bush clumps and in boulder screes, sometimes found scrambling at the margins of karroid, succulent bush in the Eastern Cape. Occurs in bushy kloofs at the coast and inland in KwaZulu-Natal. In Gauteng, Mpumalanga and North West Province it is often found in open woodland or on steep rocky hills usually in well-shaded situations. Tolerates wet and dry conditions, growing predominantly in summer rainfall areas with an annual rainfall of 200-800 mm.		LOW (site within gap in distribution, habitat not suitable)

TAXON	RED LIST STATUS	HABITAT AND DISTRIBUTION	FLOWERING TIME	PROBABILITY OF OCCURRENCE
Eucomis pallidiflora subsp. polevansii HYACINTHACEAE	Near Threatened	Pilgrim's Rest and Lydenburg to Eswatini to southern Mpumalanga. Wetlands in grassland, often in standing water up to 300 mm deep. Recorded at Ermelo in similar habitat as that found on site.		**HIGH** (wetlands)
Gladiolus robertsoniae IRIDACEAE	Near Threatened	South-eastern Gauteng, northern Free State and south-western Mpumalanga. Moist highveld grasslands, found in wet, rocky sites, mostly dolerite outcrops, wedged in rock crevices.		**HIGH**
Khadia carolinensis AIZOACEAE	Vulnerable	Carolina and Belfast. Eastern Highveld Grassland, Lydenburg Montane Grassland, Rand Highveld Grassland. Well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m.		**HIGH**
Kniphofia typhoides ASPHODELACEAE	Near Threatened	Gauteng, Limpopo, Mpumalanga, North West, Parys to Lydenburg to Paulpietersburg to Newcastle. Low lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands.		**MODERATE** (habitat may not be suitable)
Merwilla plumbea HYACINTHACEAE	Near Threatened	Widespread in eastern half of South Africa, Eswatini and Lesotho. Montane mistbelt and Ngongoni grassland, rocky areas on steep, well drained slopes. 300-2500 m.		**HIGH**

7.2.4 ANIMAL SPECIES

PROTECTED ANIMALS

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (see Appendix 3 of the Animal Species Assessment Report - **Appendix H-14**). According to this Act, "*a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7*". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed threatened or protected species*". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Those species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) that have a geographical distribution that includes the site are listed in Appendix 3 of the Animal Species Assessment Report (**Appendix H-14)**. This includes the following species:

- Black Wildebeest (doesn't occur on site);
- Oribi (unlikely to occur on site);
- White Rhinoceros (doesn't occur on site);
- Black-footed Cat;
- Serval;
- Leopard (probably does not occur on site);
- Cape Clawless Otter;
- Spotted-necked Otter;
- Cape Fox;
- Honey Badger;
- South African Hedgehog;
- Brown Hyena;
- Giant Bullfrog.

There are additional species protected under the Mpumalanga Nature Conservation Act (Act No. 10 of 1998) (see Appendix 2 of the Animal Species Assessment Report **- Appendix H-13**). These include the following that have a geographical distribution that includes the site:

- Giant Bullfrog;
- South African Hedgehog;
- Honey Badger;
- Aardwolf;
- Brown Hyaena;
- Mountain Reedbuck;
- Black Wildebeest;
- Klipspringer;
- Orbi;
- Steenbok;
- Eland;
- Cape Clawless Otter
- Spotted-necked Otter.

All species of reptiles, except the water leguaan, rock leguaan and all species of snakes, of which the following have a geographical distribution that includes the site:

- Marsh terrapin;
- Leopard tortoise;
- Common dwarf gecko;
- Spotted dwarf gecko;
- Van Son's gecko;
- Delalande's sandveld lizard;
- Burchell's sand lizard;
- (Spotted sand lizard);
- Coppery grass lizard;
- Cape grass lizard;
- Large-scaled grass lizard;
- Common girdled lizard;

- Common crag lizard;
- Yellow-throated plated lizard;
- Breyer's long-tailed seps;
- Short-headed legless skink;
- Thin-tailed legless skink;
- Wahlberg's snake-eyed skink;
- Cape skink;
- Red-sided skink;
- Speckled rock skink;
- Variable skink;
- Montane dwarf burrowing skink;
- Common flap-necked chameleon;
- Eastern ground agama;
- Southern rock agama.

Vertebrate species (mammals, reptiles, amphibians) with a geographical distribution that includes the study area are listed in Appendix 3 of the Animal Species Assessment Report (**Appendix H-13**). All threatened (Critically Endangered, Endangered or Vulnerable) or near threatened vertebrate animals that could occur in the study area and have habitat preference that includes habitats available in the study area, are discussed further below.

MAMMALS

Of the species currently listed as threatened or protected (see Appendix 2 of the Animal Species Assessment Report **- Appendix H-13** for list of protected species), eleven of those listed in **Table 7-7** are considered to have a medium to high probability of occurring on site and being potentially negatively affected by proposed activities associated with the proposed projects.

Grey Rhebok

The Grey Rhebok (*Pelea capreolus*), listed as Near Threatened, is endemic to South Africa, Lesotho and parts of Eswatini. They are predominantly browsers, feeding on ground-hugging forbs, and largely water independent, obtaining most of their water requirements from their food. Local declines in their population have been attributed to increased densities of natural predators, such as Black-backed Jackal, Caracals and Leopards. It has not been recorded in the grid in which the site is located, but has been recorded in grids to the north-east and many grids further to the south, so the site is within the overall distribution range of the species. There is therefore a moderate likelihood that it could occur on site within any suitable habitat. However, it is a relatively mobile species and not necessarily dependent on any particular habitat. It is likely to move away from the path of any construction and development of parts of the study area.

Black-footed Cat

The Black-footed Cat (*Felis nigripes*), listed as Vulnerable, has been previously recorded in the grid in which the project is located, as well as in four surrounding grids. Its known distribution is on the inland part of most of South Africa, but seemingly not within the winter-rainfall part of the country. It also occurs in Botswana and Namibia. The current project area is towards the edge of the distribution range of the species but the species is highly likely to occur in the area. The species is nocturnal and carnivorous, favouring any vegetation cover that is low and not too dense. They make use of dens in the daytime, which can be abandoned termite mounds, or dens dug by other animals, such as aardvark, springhares or cape ground squirrels. Local declines in their population have been attributed to increased densities of natural predators, such as Black-backed Jackal, Caracals and Leopards. They are highly vulnerable to domestic carnivores. The study area is suited to this species and it probably occurs there.

Leopard

The Leopard (*Panthera pardus*), listed as Vulnerable, has a wide habitat tolerance, but with a preference for densely wooded areas and rocky areas. They have large home ranges, but do not migrate easily, males having ranges of about 100 km^2 and females 20 km^2. It has not been recorded in any of the adjacent or nearby grids and the overall distribution shows a gap in its distribution that includes the current study area. There is therefore a low probability of this species occurring on site, and if it did occur there it would probably be at very low densities.

Cape Clawless Otter

The Cape Clawless Otter (*Aonyx capensis*), listed as Near Threatened, is widely but patchily distributed throughout South Africa, and is also the most widely found otter in Africa. It is aquatic and seldom found far from permanent water, which needs to be fresh. The site is within the known distribution of this species and there are historical records for one adjacent grid to the north-east, although not from the current grid. There is potentially suitable habitat for this species on site, although water quality may be an issue. It is therefore considered possible that it occurs on site.

African Striped Weasel

The African Striped Weasel (*Poecilogale albinucha*), listed as Near Threatened, is found throughout most of South Africa, except for the arid interior, and into central Africa. It has not been recorded in the grid in which the site is located, but has been recorded in two adjacent grids, and the site is within the overall distribution range for the species. It is found primarily in moist grasslands and fynbos, where adequate numbers of prey may be found. It is considered likely that it could occur on site.

Brown Hyaena

The Brown Hyaena (*Parahyaena brunnea*), listed as Near Threatened, is found in a band running down the centre of the country, expanding into the entire northern parts of the country. There is a gap in the distribution around the current study area, but there is a possibility that vagrant individuals could extend into this area. The species is found in desert areas, particularly along the west coast, semi-desert, open scrub and open woodland savannah (Mills & Hes 1997). It is a solitary scavenger that travels vast distances every day in search of food. It has a medium chance of occurring in the study area since the distribution range includes the study area, however there are no historical records from nearby. It is a mobile animal that is likely to move away from the path of any construction and development of parts of the site is therefore highly unlikely to have any negative effect on the species. It is considered that there is a low likelihood of it occurring on site.

South African Hedgehog

The South African Hedgehog (*Atelerix frontalis*), listed as Near Threatened, is found in a large part of the central part of South Africa, extending down to the south-eastern coast, and is also found in Namibia, Botswana, Zimbabwe, Lesotho and Eswatini. It requires ample ground cover for cover, nesting and foraging and prefers dense vegetation and rocky outcrops. The site is well-within the known distribution of this species and there are historical records for nearby grids in all directions, and it has been recorded from the current grid. There is therefore a high probability of the study area being suitable for this species. It is considered likely that it could occur on site.

Swamp Musk Shrew

The Swamp Musk Shrew (*Crocidura mariquensis*), listed as Near Threatened, is found in a large part of the north-eastern part of South Africa, extending down to the south-eastern coast. It occurs in wetlands and waterlogged grasslands, predominantly in KwaZulu-Natal, Mpumalanga, Limpopo, Gauteng and eastern North West Provinces. The site is well-within the known distribution of this species and there are historical records for nearby grids in all directions, and it has been recorded from the current grid. There is therefore a high probability of the study area being suitable for this species. It is considered likely that it could occur on site.

Highveld Golden Mole

The Highveld Golden Mole (*Amblysomus septentrionalis*), listed as Near Threatened, is found across the Mpumalanga Highveld from Wakkerstroom northwards to Ermelo and Barberton and westwards through Standerton to north-eastern Free State. It occurs within meadows and edges of marshes in high-altitude grassland in Mpumalanga. They are restricted to friable soils in valleys and on mountainsides. The site is within the known distribution of this species, although higher densities of records occur further east. There are historical records for an adjacent grid to the south-west, but it has not been recorded from the current grid. There is therefore a medium probability of the study area being suitable for this species. It is considered possible that it could occur on site and individuals could be affected by construction activities, if suitable habitat is damaged.

White-tailed Rat

The White-tailed Rat (*Mystromys albicaudatus*), listed as Vulnerable, is endemic to South Africa and Lesotho, where it is found primarily in Highveld grasslands, but extending into adjacent Fynbos and Karoo areas. It is terrestrial, but never found in soft, sandy substrates, rocks, wetlands or river banks, and do not occur in transformed habitat. The study area is on the edge of the known distribution of this species, with most of Mpumalanga appearing to be a "hole" in the occurrence of the species. There is therefore a low probability of the study area being suitable for this species. It is considered unlikely that it would occur on site.

Vlei Rat

The Vlei Rat (Grassland-type) (*Otomys auratus*), listed as Near Threatened, is near-endemic to South Africa, occurring in the north-eastern half of the country, associated with mesic grasslands and wetlands within alpine, montane and sub-montane regions. It is likely to be associated with sedges and grasses in densely vegetated wetlands with wet soils. The study area is well within the known distribution of this species and there are historical records for the grid in which the study area is located, as well as two adjacent grids. There is therefore a high probability of the study area being suitable for this species. It is considered likely that it occurs on site and the proposed development could therefore affect this species.

Table 7-7: Mammal species of conservation concern with a likelihood of occurring on site

SCIENTIFIC NAME	COMMON NAME	STATUS	LIKELIHOOD OF OCCURRENCE
Ourebia ourebi	Oribi	Endangered	Low
Pelea capreolus	Grey Rhebok	Near Threatened, protected	Medium
Felis nigripes	Black-footed Cat	Vulnerable, protected	High
Panthera pardus	Leopard	Vulnerable, protected	Low
Dasymys robertsii	African Marsh Rat	Vulnerable	Low
Aonyx capensis	Cape Clawless Otter	Near Threatened, protected	Medium
Hydrictus maculicollis	Spotted-necked Otter	Vulnerable, protected	Medium
Poecilogale albinucha	African Striped Weasel	Near Threatened	Medium
Parahyaena brunnea	Brown hyaena	Near Threatened	Low
Atelerix frontalis	South African Hedgehog	Near Threatened, protected	High
Crocidura maquassiensis	Maquassie Musk Shrew	Vulnerable	Low
Crocidura mariquensis	Swamp Musk Shrew	Near Threatened	High
Amblysomus septentrionalis	Highveld Golden Mole	Near Threatened	Medium
Mystromys albicaudatus	White-tailed Rat	Vulnerable	Low
Otomys auratus	Vlei Rat	Near Threatened	High

REPTILES

Of the reptile species that could potentially occur in the study area, four have been listed in a threat category (**Table 7-8**). There are three reptile species of conservation concern that could potentially occur in the study area and that may therefore be affected by the proposed projects.

Coppery grass lizard

The Coppery Grass Lizard (*Chamaesaura aenea*), listed as Near Threatened, is endemic to South Africa, where it is found in western Eswatini, Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, north-eastern Free State and Eastern Cape. It is found on grassy slopes and plateau of the eastern escarpment and Highveld, where it probably shelters in the base of grass tussocks. The study area is within the known distribution of this species and there are historical records for two adjacent grids to the north and south, although not from the current grid. There is therefore a moderate probability of the study area being suitable for this species, including suitable habitat within the project area.

Large-scaled grass lizard

The Large-scaled Grass Lizard (*Chamaesaura macrolepis*), listed as Near Threatened, is endemic to South Africa, Eswatini and Zimbabwe. In South Africa it is found in Limpopo, Mpumalanga, and KwaZulu-Natal. It is found in grassland, especially rocky, grassy hillsides. Its main distribution is within the Indian Ocean Coastal Belt part of KwaZulu-Natal, but there are scattered records on the Highveld. The study area is marginally within the known distribution of this species in the sense that there are records in quarter degree grids up to Gauteng and there are historical records for one nearby grid to the north-east, although not from the current grid. There is therefore a moderate to low probability of the study area being suitable for this species, including suitable habitat within the project area. It is considered a low likelihood that it could occur on site.

Breyer's Long-tailed Seps

The Breyer's Long-tailed Seps (*Tetradactylus breyeri*), listed as Vulnerable, is endemic to South Africa, where it is found in Free State, Mpumalanga, and KwaZulu-Natal. It is found in montane and Highveld grassland. The study area is marginally within the known distribution of this species in the sense that there are records in quarter degree grids throughout the Highveld, extending from Blyde River Canyon to the Drakensberg, although not from the current grid or any nearby grids. There is therefore a low probability of the study area being suitable for this species, including suitable habitat within the project area. It is considered unlikely that it would occur on site.

Striped Harlequin Snake

The Striped Harlequin Snake (*Homoroselaps dorsalis*), listed as Near Threatened, is endemic to South Africa, where it is found in western Eswatini, Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, and Free State. It is partly fossorial and known to inhabit old termitaria in grassland habitat. Most of its range is at moderately high elevations, but it also occurs close to sea level in KwaZulu-Natal. The study area is within the known distribution of this species and there are historical records for one adjacent grid to the north, although not from the current grid. There is therefore a moderate probability of the study area being suitable for this species, including suitable habitat within the project area. It is considered likely that it could occur on site.

Table 7-8: Reptile species of conservation concern with a likelihood of occurring on site.

SCIENTIFIC NAME	COMMON NAME	STATUS	LIKELIHOOD OF OCCURRENCE
Chamaesaura aenea	Coppery grass lizard	Near Threatened	Medium
Chamaesaura macrolepis	Large-scaled Grass Lizard	Near Threatened	Low
Tetradactylus breyeri	Breyer's Long-tailed Seps	Vulnerable	Very Low
Homoroselaps dorsalis	Striped Harlequin Snake	Near Threatened	Medium to High

AMPHIBIANS

A total of 24 frog species have a geographical distribution that includes the general study area in which the project site is found (Du Preez & Carruthers 2009). Some of these species are only marginally present in the study area due to the fact that their distribution range ends close to the study area. Of the frog species that could potentially occur in the study area, none are listed in a threat category, but one species is listed as protected, according to National legislation, the Giant Bullfrog.

The Giant Bull Frog

The Giant Bull Frog (*Pyxicephalus adspersus*) previously listed as Near Threatened, is found in seasonal shallow grassy pans, vleis and other rain-filled depressions in open flat areas of grassland or savanna and, at the limits of its distribution, in Nama Karoo and thicket. For most of the year the species remains buried up to 1 m underground. They emerge only during the peak of the rainy season to forage and breed. If conditions are extremely dry, they may remain cocooned underground for several years. Long distances often separate suitable breeding sites. To breed, they require shallow, rain-filled depressions that retain water long enough for the tadpoles to metamorphose. Before and after breeding, bullfrogs forage in open grassland, feeding mostly on insects, but also on other frogs, lizards, snakes, small birds and rodents. After breeding males generally bury themselves within 100 m of the breeding site, but females may disperse up to 1 km away. Based on habitat requirements, there is a medium probability that this species occurs in the study area.

It is concluded that the site contains habitat that is suitable for various frog species, although only one species of conservation concern is likely to occur in the study area. One frog species of concern is therefore potentially likely to be affected by development in the study area, as shown in **Table 7-9**.

Table 7-9: Amphibian species of conservation concern with a likelihood of occurring on site.

SCIENTIFIC NAME	COMMON NAME	STATUS	LIKELIHOOD OF OCCURRENCE
Pyxicephalus adspersus	Giant Bullfrog	Protected	Medium

7.2.5 BATS

Most South African bats are insectivorous and are capable of consuming vast quantities of insects on a nightly basis (Taylor 2000, Tuttle and Hensley 2001) however, they have also been found to feed on amphibians, fruit, nectar and other invertebrates. As a result, insectivorous bats are the predominant predators of nocturnal flying insects in South Africa and contribute greatly to the suppression of these numbers. Their prey also includes agricultural pests such as moths and vectors for diseases such as mosquitoes (Rautenbach 1982, Taylor 2000).

Urban development and agricultural practices have contributed to the deterioration of bat populations on a global scale. Public participation and funding of bat conservation are often hindered by negative public perceptions and unawareness of the ecological importance of bats. Some species choose to roost in domestic residences, causing disturbance and thereby decreasing any esteem that bats may have established. Other species may occur in large communities in buildings, posing as a potential health hazard to residents in addition to their nuisance value. Unfortunately, the negative association with bats obscures their importance as an essential component of ecological systems and their value as natural pest control agents, which actually serves as an advantage to humans.

Many species of bats roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas may adversely impact individuals of different communities concurrently (Hester and Grenier 2005). Secondly, nativity rates of bats are much lower than those of most other small mammals. This is because, for the most part, only one or two pups are born per female per annum. Under natural circumstances, a population’s numbers may accumulate over long periods of time. This is due to the longevity of up to 30 years (O’Shea et al. 2003) and the relatively low predation of bats when compared to other small mammals. However, bat populations are not able to adequately recover after mass mortalities and major roost disturbances.

Currently there is no evidence of GH&A facilities posing a direct threat of fatality impact on bats during operation. However, roosting and foraging habitats may be destroyed during the construction phase. This is primarily due the fact that such facilities require areas of land to be cleared, and in some cases, earthworks are required for levelling purposes. This can result in habitat that is suitable for micro roosts, such as rocky outcrops, clumps of trees and certain vegetation being destroyed, which can also be fatal to bats residing in such roosts. Natural vegetation can support higher insect food quantities and diversity than cleared land, therefore foraging habitat can also be displaced.

The presence of security lights on and around these facilities creates significant light pollution that can impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light averse) species and favouring species that readily forage around insect-attracting lights. Additionally, if the buildings and associated infrastructure for these facilities are placed close to wind turbines, the light pollution at these buildings can attract photophilic bat species, thereby significantly increasing their chances of being killed by moving blades of turbines within close proximity.

Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and moderate sensitivities relating to bat species ecology and habitat preferences, where high sensitivities are no-go zones for certain GHA infrastructure. **Figure 7-21** depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

Shaded red = high sensitivity; Red line = 200m high sensitivity buffer; Shaded orange = medium sensitivity; Orange line = 150m medium sensitivity buffer. The three options for the GHA facility are indicated in green.

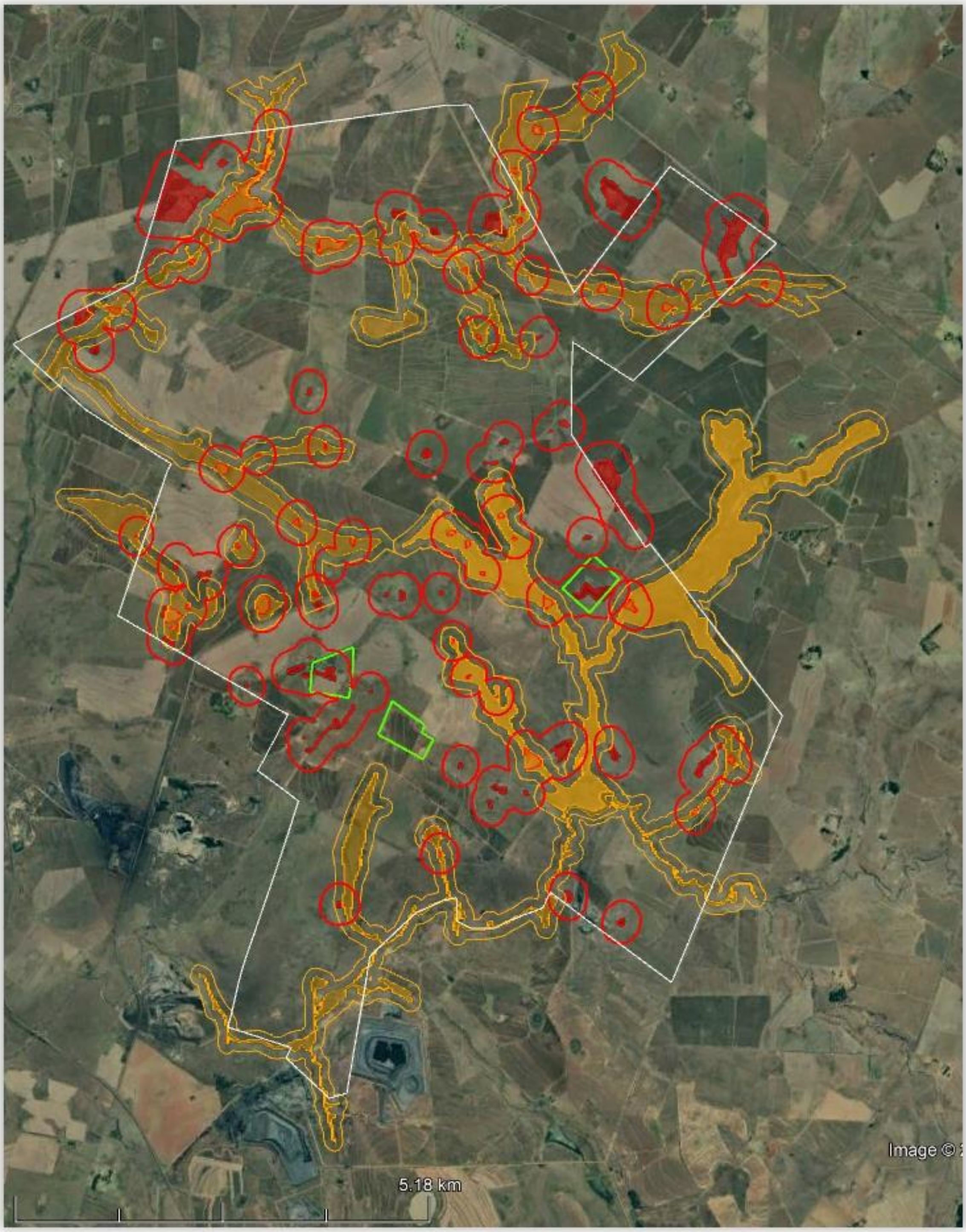


Figure 7-21: Bat Site Sensitivity of the area (Animalia, 2022)

Table 7-10 below indicates the species of bat which have been confirmed to occur on site, those unconfirmed species which may potentially occur on site, as well as those occurring in the broader area of the site based on literature review. For each species, the risk of impact by wind energy infrastructure was assigned by MacEwan et al. (2020) based on their distributions, altitudes at which they fly, and foraging ecology. The predicted risk of impact incurred by substations is inferred by literature-based foraging ecology for each species.

Table 7-10: Species currently confirmed on site, previously recorded in the area, or potentially occurring. Roosting and foraging habitats in the study area, conservation status and risk of impact are also briefly described per species (Monadjem et al. 2020).

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT IN THE LARGER AREA OF THE SITE	POSSIBLE FORAGING HABITAT IN THE LARGER AREA OF THE SITE	RISK OF IMPACT FOR GHA
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.	Medium to Low (GHA)
Sauromys petrophilus	Robert's flat-headed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Crevices in rocks, expansion joints in bridges and crevices in buildings.	Open air forager that will forage over grassland and other open terrain on site.	Medium to Low (GHA)
Mops midas	Midas free-tailed bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.	Medium to Low (GHA)
Laephotis (Neoromicia) capensis	Cape serotine	Confirmed on site	Least Concern (2016 Regional Listing)	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. But is predominantly a medium height clutter edge forager on site.	High (GHA)
Laephotis zuluensis	Zulu serotine	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Predominantly a medium height clutter edge forager on site.	Medium to Low (GHA)
Pipistrellus hesperidus	Dusky pipistrelle	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Prefers vegetation edges and clutter with open water sources.	Medium to Low (GHA)

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT IN THE LARGER AREA OF THE SITE	POSSIBLE FORAGING HABITAT IN THE LARGER AREA OF THE SITE	RISK OF IMPACT FOR GHA
Pipistrellus rusticus	Rusty pipistrelle	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Prefers vegetation edges and clutter with open water sources.	Medium to Low (GHA)
Miniopterus natalensis	Natal long-fingered bat	Confirmed on site	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium (GHA)
Miniopterus fraterculus	Lesser long-fingered bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium (GHA)
Eptesicus hottentotus	Long-tailed serotine	Confirmed on site	Least Concern (2016 Regional Listing)	It is a crevice dweller roosting in rock crevices in the larger area, as well as other crevices in buildings.	It generally seems to prefer woodland habitats, and forages on the clutter edge. But may still forage over open terrain occasionally.	Medium to Low (GHA)
Myotis tricolor	Temmink's myotis	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium (GHA)
Myotis welwitschii	Welwitsch's myotis	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager, unlikely on site due to preference for mountains/hillsides.	Medium (GHA)
Taphozous mauritianus	Mauritian tomb bat	Confirmed in	Least Concern (2016 Regional Listing)	Roost against the walls of buildings under roof overhangs or on large tree trunks. Often vigilant and conspicuous during daytime.	Open terrain forager may forage over open grasslands on site.	Medium (GHA)

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT IN THE LARGER AREA OF THE SITE	POSSIBLE FORAGING HABITAT IN THE LARGER AREA OF THE SITE	RISK OF IMPACT FOR GHA
		100km radius				
Rhinolophus blasii	Blasius's horseshoe bat	Confirmed in 100km radius	Near Threatened (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	Medium (GHA)
Rhinolophus clivosus	Geoffroy's horseshoe bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	Medium (GHA)
Rhinolophus swinnyi	Swinny's horseshoe bat	Confirmed in 100km radius	Vulnerable (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	Medium (GHA)
Rhinolophus simulator	Bushveld horseshoe bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	Medium (GHA)
Scotophilus dinganii	Yellow-bellied house bat	Confirmed on site	Least Concern (2016 Regional Listing)	Roofs of buildings and other suitable hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium to Low (GHA)
Nycteris thebaica	Egyptian slit-faced bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Suitable hollows such as culverts under roads, vacant buildings and hollow tree trunks.	Vegetation clutter forager, clumps of trees on site.	High (GHA)

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT IN THE LARGER AREA OF THE SITE	POSSIBLE FORAGING HABITAT IN THE LARGER AREA OF THE SITE	RISK OF IMPACT FOR GHA
Cloeotis percivali	Percival's short-eared trident bat	Confirmed in 100km radius	Endangered (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	High (GHA)
Hipposideros caffer	Sundevall's leaf-nosed bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area. Possibly hollows such as road culverts.	Vegetation clutter forager, clumps of trees on site.	High (GHA)
Epomophorus wahlbergi	Wahlberg's epauletted fruit bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts in dense foliage of large, leafy trees in the larger area, and may travel several kilometres each night to reach fruiting trees.	Feeds on fruit, nectar, pollen and flowers. If and where available on or near site.	Low (GHA)

7.2.6 HABITATS

A map of habitats within the study area is provided below in **Figure 7-22**. The site is within an area of natural grassland but degraded (from heavily to light). The grassland contains variation due to changes in topography, slope inclination, surface rockiness and the influence of water-flow and water retention in the landscape. A broad classification of the natural habitat units on site, which also reflects relatively uniform plant species compositional units, is as follows:

Natural habitats:

— Natural grassland (open grassland on undulating plains – the condition is not indicated in the habitat map although there is a gradient from heavily grazed poor condition to moderate condition);
— Wetlands (permanent and seasonal wetlands in drainage valleys, including channels, where they occur);

Transformed and degraded areas:

— Old lands (secondary grasslands on previously cultivated areas);
— Exotic trees (stands of exotic trees);
— Degraded areas (disturbed areas with bare ground, weeds or waste ground).
— Current cultivation (areas currently cultivated and fallow lands);
— Transformed (areas such as roads and buildings where there is no vegetation).

It is important to note that the mapping of any wetland-related habitats on site is based on vegetation characteristics and plant species composition and is not a wetland delineation according to the soil-based methodology required according to the National Water Act.

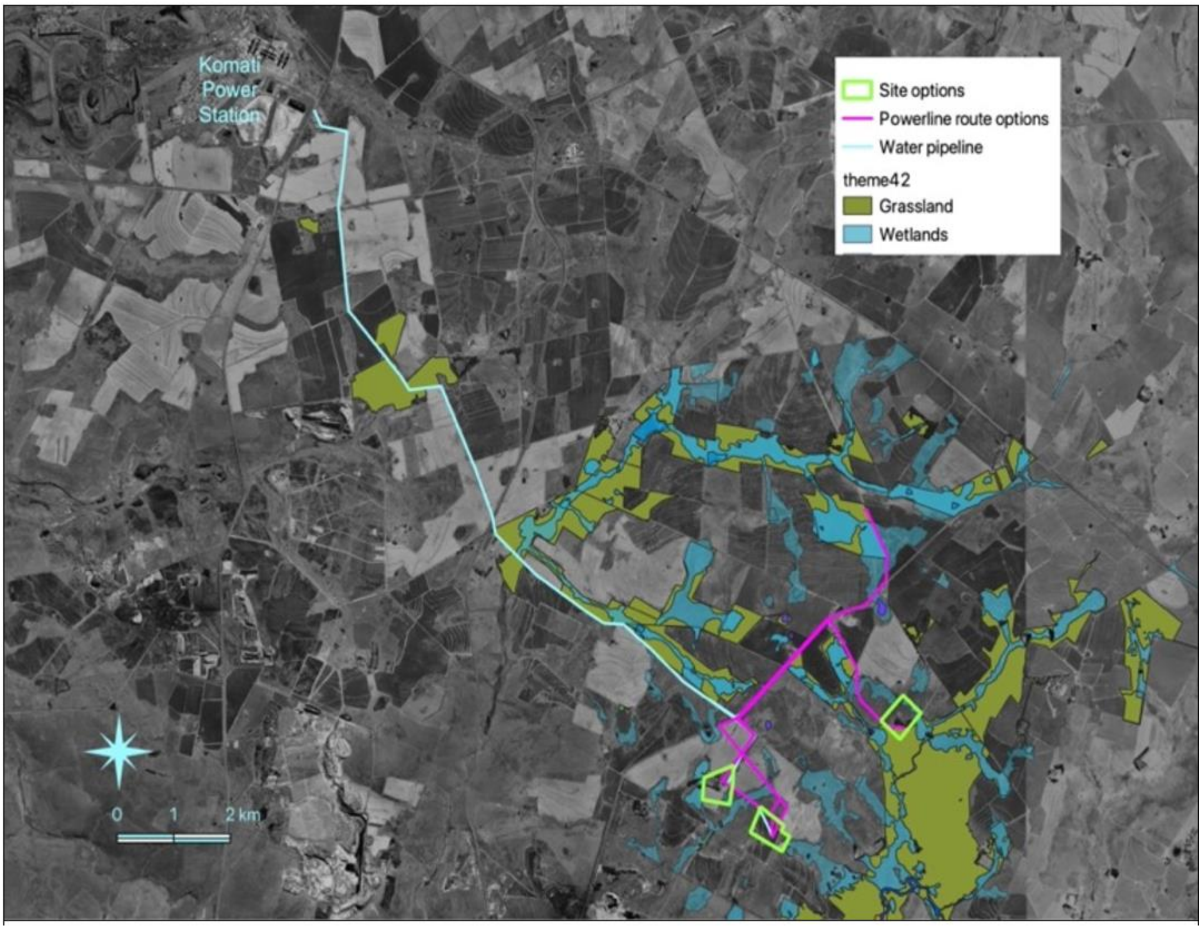


Figure 7-22: Main habitats of the study area (David Hoare Consulting, 2022)

To determine ecological sensitivity in the study area, site-specific, local and regional factors were taken into account. There are some habitats in the study area that have been described as sensitive in their own right, irrespective of regional assessments. This includes primarily the stream beds and associated riparian zones and adjacent floodplains. A detailed assessment and delineation of these areas was undertaken by an aquatic specialist and they are only considered here in terms of being important habitat for flora and fauna.

At a regional level, the CBA map for Mpumalanga indicates various parts of the study area as being important for conservation. The CBA map therefore corresponds with the distribution of remaining natural habitat on site. However, no parts of the site fall within CBAs (see **Figure 7-20**)

In terms of other species of concern, including both plants and animals, the preferred habitat of each of these can be determined or has been described. They are, however, distributed amongst different habitats on site, which means that no single habitat is primarily important as habitat for species of concern.

A summary of sensitivities that occur on site and that may be vulnerable to damage from the proposed project are as follows:

— **CBA "Irreplaceable" areas**: The Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Parks and Tourism Agency 2014) shows areas on site within various conservation planning categories, including areas designated as "CBA: Irreplaceable". These are areas that are required to meet biodiversity targets (for biodiversity pattern and ecological process features), the implication being that there are no other areas that meet the biodiversity criteria for meeting these conservation planning objectives. The Provincial policy is that they should remain in a natural state. Where possible, impacts on these areas should be minimised.
— **Wetlands**: These are described here only in terms of being a unique botanical habitat and not in the sense of a formal wetland delineation, which is normally assessed in a separate specialist study. The wetlands must be delineated according to "DWAF, 2003: A Practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Restrictions in terms of infrastructure within these areas should be according to the National Water Act (Act 36 of 1998), except where the wetlands fall within a CBA "Irreplaceable" area, in which case they should be considered to be "No-Go" areas.
— **Listed ecosystems**: Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands are both listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011). All remaining natural habitat on site falls within one of these two listed ecosystems.
— **Grasslands**: Grassland vegetation, in a general sense has been identified as threatened nationally as a habitat type. Indications are that loss of any grassland habitat is permanent in an ecological and biodiversity sense, and it is not possible to restore grassland to a natural state after they have been disturbed. They should therefore be treated as sensitive and all efforts made to minimize impacts on any area of grassland. If possible, the footprint of any proposed infrastructure should be kept to a minimum within any natural grasslands, especially those in a moderate to good condition.

Grassland

The natural vegetation of the study area is characterized by an open grassland on undulating hills and plains. It is generally a short to moderate height tussock grassland with closed canopy cover. The soil depth varies, as does the amount of surface rock cover. This was the most widespread vegetation community on site, occurring on all the relatively flat plains areas. These plains are also the area that has been most subject to cultivation.

The general floristic character of this vegetation on site is fairly uniform across wide areas, often dominated by the same suite of species, including the grasses: *Alloteropsis semialata, Aristida diffusa, Aristida junciformis, Bewsia biflora, Brachiaria serrata, Diheteropogon amplectens, Elionurus muticus, Eragrostis capensis, Eragrostis chloromelas, Eragrostis plana, Eragrostis racemosa, Harpochloa falx, Heteropogon contortus, Microchloa caffra, Panicum natalense, Setaria sphacelata var. torta, Themeda triandra, and Tristachya leucothrix, and the forbs: Acalypha angustata, Anthospermum rigidum subsp. rigidum, Berkheya setifera, Chaetacanthus costatus, Commelina africana, Crabbea acaulis, Cucumis hirsutus, Cucumis zeyheri, Cyanotis speciosa, Gerbera viridifolia, Haplocarpha scaposa, Helichrysum rugulosum, Hemizygia pretoriae, Hermannia transvaalensis, Hibiscus aethiopicus, Hypoxis obtusa, Hypoxis rigidula, Indigofera comosa, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Ledebouria ovatifolia, Monsonia attenuata, Nidorella hottentotta, Pentanisia angustifolia, Pollichia campestris, Scabiosa columbaria, Selago densiflora, Seriphium plumosum, Vernonia galpinii, Vernonia oligocephala, and Zornia milneana.*

Overall diversity in this habitat is high and includes a full list of over 100 species. Local species richness is also high at 56 species per 400m^2 sampling area. This rivals the local richness of some of the most species-rich grasslands anywhere in the country.

The main grassland areas on site are important faunal habitat. The areas in the south of the site linked to the Olifants River floodplain are foraging habitat for the African Grass Owl. It is the most likely habitat for the Maquassie Musk Shrew. There are a number of other species that could potentially occur within the grasslands on site.

Secondary grassland on site has the structural appearance of primary grassland, but a fraction of the species richness, usually dominated by a small number of perennial grasses, as well as various weedy species. It provides habitat for animals, but the diverse structure and composition limits the value for some animal species.

Wetlands

There are various valley bottom wetlands in the study area. Valley bottom wetlands in this general area around Hendrina are generally dominated by a variety of grasses, sedges and herbaceous plants, including the graminoids, *Kyllinga erecta, Leersia hexandra, Agrostis lachnantha, Andropogon appendiculatus, Helictotrichon turgidulum, Scirpoides burkei, Cyperus teneristolon, Cyperus macranthus, Typha capensis, Agrostis erianthe, Hemarthria altissima, Panicum schinzii, Cyperus rigidifolius and Arundinella nepalensis, the herbs, Centella asiatica, Senecio polyodon, Senecio erubescens, Haplocarpha scaposa, Pelargonium luridum, Commelina africana, Lobelia flaccida, Monopsis decipiens, and Helichrysum aureonitens*. The species composition depends on the hydrological characteristics of the site, with a greater number of obligate wetland species occurring in more permanently damp areas, whereas dryer areas resemble more closely the terrestrial grassland in species composition.

The drainage areas are important habitat for animals, providing refuge and shelter, water, when it is available, palatable vegetation, when surrounding areas are in drought, and softer and deeper soils for burrowing animals. The habitat is also an important flood-attenuation component of the landscape, and a reservoir for soil water. If it occurs on site, this is the habitat in which the protected Giant Bullfrog would be found.

The wetlands are potential habitat for the African Grass Owl. The margins of wetlands are also potential habitat for the Maquassie Musk Shrew, flagged for the site.

Secondary wetlands occur in areas where the original wetlands have been ploughed. They often return to a functional state with time that sometimes has similar species composition to the original wetlands. The exception is in seepage areas, where specialized plant communities are often permanently lost.

Transformed and degraded areas

Degraded and disturbed areas, as well as completely transformed areas, no longer have vegetation cover. This includes cultivated areas. Areas with alien trees are usually monospecific stands with virtually no plant biodiversity, but sometimes provide important cover and/or roosting habitat.

As per the Species Environmental Assessment Guidelines (SANBI 2020), Site Ecological Importance (SEI) is calculated as a function of the Biodiversity Importance (BI) of the receptor and its resilience to impacts (SEI = BI + RR). The Biodiversity Importance (BI) in turn is a function of Conservation Importance (CI) and Functional Integrity (FI), i.e. BI = CI + FI. This is outlined in **Table 7-11** below.

Table 7-11: Site ecological importance for habitats found on site

HABITAT	CONSERVATION IMPORTANCE	FUNCTIONAL INTEGRITY	RECEPTOR RESILIENCE	SITE ECOLOGICAL IMPORTANCE (BI)
Natural grassland	High Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type.	Medium Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.	Very low Habitat that is unable to recover from major impacts	High (BI = Medium)
Wetlands	High Any area of natural habitat of threatened ecosystem type with status of VU.	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore less than 50% of the original species composition and functionality	High (BI = Medium)
Old lands	Low No confirmed or highly likely populations of SCC or range-restricted species.	Very low Several major current negative ecological impacts.	High Habitat that can recover relatively quickly (5-10 years) to restore >75% to restore the original species composition and functionality	Very low (BI = Very low)
Current cultivation	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)
Exotic trees	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)
Degraded	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)

HABITAT	CONSERVATION IMPORTANCE	FUNCTIONAL INTEGRITY	RECEPTOR RESILIENCE	SITE ECOLOGICAL IMPORTANCE (BI)
Transformed	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)

The calculation of Site Ecological Importance matches the sensitivity classification given in the previous section of this report but includes an explicit recognition of the ability of each ecosystem to tolerate and recover from disturbance.

Guidelines for development activities within different importance levels are given in the **Table 7-12**.

Table 7-12: Guidelines for interpreting SEI in the context of the proposed development activities

SITE ECOLOGICAL IMPORTANCE	INTERPRETATION IN RELATION TO PROPOSED DEVELOPMENT ACTIVITIES
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/ not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

Based on this information, a map of habitat sensitivity on site is provided in **Figure 7-23**. This shows main habitat sensitivity classes on site, as follows:

- LOW for all transformed areas, including cultivated lands.
- MEDIUM-LOW for secondary grasslands in previously cultivated areas.
- MEDIUM for cultivated wetlands.
- MEDIUM-HIGH for secondary wetlands in previously cultivated areas, as well as for all remaining natural areas on site.
- HIGH for remaining natural habitat within “CBA: Irreplaceable” and “CBA: Optimal” areas.
- VERY HIGH for intact natural wetlands

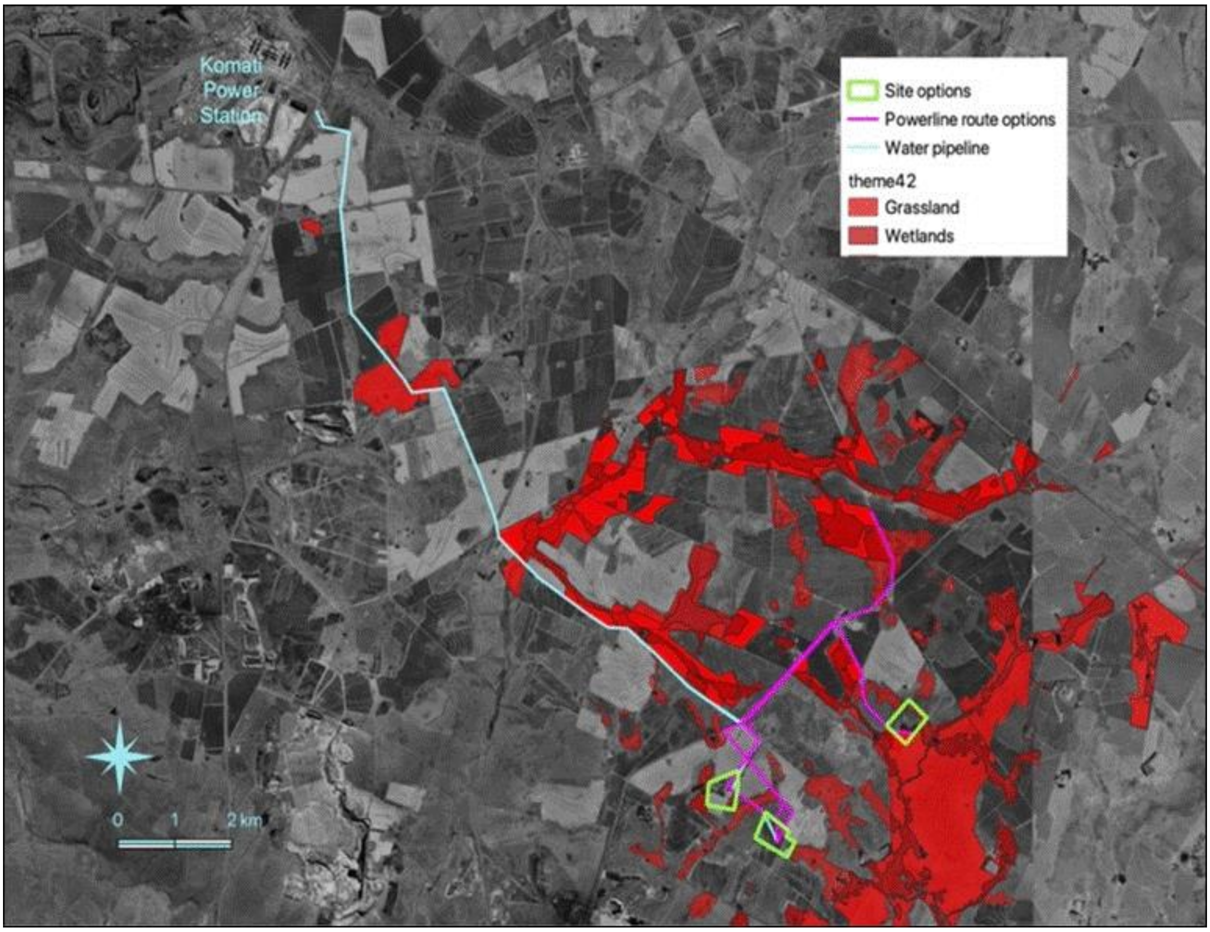


Figure 7-23: Habitat Sensitivity of the Study Area

Infrastructure locations relative to mapped sensitivities are shown in **Figure 7-23**. There are three possible Green Hydrogen and Ammonia Facility site alternatives. **Table 7-13** and **Table 7-14** below outlines the footprint of each alternative relative to the habitat it falls in. The proposed infrastructure includes the following:

— Alternative 2: the preferred site (PS) **-** in the north **-** this is within a cultivated land.

— Alternative 1: alternative site (AS) **-** in the south **-** this is within a grassland area.

Table 7-13: Amount of each type of habitat in the footprint of Alternative 1

HABITAT	STATUS	AREA IN HECTARES	PROPORTION OF TOTAL AREA
Grassland	Natural	15.29	71.2
Wetland	Natural	5.86	27.3
Current cultivation	Transformed	0.32	1.5
TOTAL		**21.47 ha**	**100.0%**

Table 7-14: Amount of each type of habitat in the footprint of Alternative 2 (Preferred):

HABITAT	STATUS	AREA IN HECTARES
Current cultivation	Transformed	18.16
TOTAL		**18.16 ha**
Habitat	**Status**	**Area in hectares**

Pipelines

Each ammonia facility requires a pipeline to obtain water. The two potential sources are at Camden Power Station Confluence, and at a second location nearer the Usutu bulk water supply pipeline. There are four pipeline route alternatives. The **Table 7-15** below outlines the footprint of each alternative relative to the habitat it falls in.

— Alternative 1: PS to Usutu Scour (preferred)
— Alternative 2: AS to Camden PS
— Alternative 3: AS to Usutu Scour
— Alternative 4: PS to Camden PS

Table 7-15: Distance of each type of habitat in the footprint of the water pipeline

HABITAT	STATUS	ALTERNATIVE 1 (PREFERRED)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
Grassland	Natural	422	2698	3120	
Wetland	Natural		200	200	
Exotic trees	Degraded		1437	1437	
Degraded areas	Degraded	86	1174	610	650
Old lands	Secondary	1236	1781	1440	1577
Current cultivation	Transformed	1521	2036	1657	1900
Road	Transformed		20	20	
TOTAL		3265 m	9346 m	8484 m	4127 m

7.2.7 AVIFAUNA

IMPORTANT BIRD AREAS

The project area is not located in an Important Bird Area (IBA). The closest IBA to the site is the Amersfoort-Bethal-Carolina IBA SA018, which is located approximately 3.5km to the east of the project area. The key species within this IBA is the globally threatened Botha's Lark, but the species was not recorded in the project area during four seasons of monitoring for the proposed wind energy facilities. However, due to the close proximity of the sites to the IBA, it is possible that some highly mobile target species which are also IBA trigger species, and which occur either permanently or sporadically in the IBA, might be impacted by the project when they leave to forage or breed beyond the borders of the IBA. Species that were recorded in the broader area and fall within this category are the following:

- Secretary bird — Sagittarius serpentarius
- Denham's Bustard — Neotis denhami
- Martial Eagle — Polemaetus bellicosus
- Black Harrier — Circus maurus
- African Grass Owl — Tyto capensis
- Lanner Falcon — Falco biarmicus
- Southern Bald Ibis — Geronticus calvus

BIRD HABITAT

Whilst much of the distribution and abundance of the bird species in the project area can be explained by the dominant biomes and vegetation types, it is also important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure. The target species for the project area is defined as the Species of Conservation Concern (SCC) together with the powerline sensitive species (susceptible to collisions or electrocutions).

The following bird habitat classes were identified in the project site.

GRASSLAND

The majority of the habitat in the project site comprises natural grassland. The grassland varies from dense stands of relatively high grass to areas of heavily grazed short grass. The priority species which could potentially use the natural grassland in the project site on a regular basis are the following:

- African Grass Owl (SCC)
- Denham's Bustard (SCC)
- Lanner Falcon (SCC)
- Secretary bird (SCC)
- Southern Bald Ibis (SCC)
- Blue Korhaan (SCC)
- Martial Eagle (SCC)
- African Harrier Hawk
- Amur Falcon
- Black-chested Snake Eagle
- Black-headed Heron
- Black-winged Kite
- Common Buzzard
- Greater Kestrel
- Helmeted Guineafowl
- Long-crested Eagle
- Marsh Owl
- Montagu's Harrier
- Pied Crow
- Rock Kestrel
- Spotted Eagle-Owl

- Western Barn Owl
- Western Cattle Egret
- White Stork

DRAINAGE AND WETLANDS

There are a number of wetlands in the project area, most of which are associated with drainage lines. The target species which could potentially use the wetlands in the project are the following:

- African Grass Owl (SCC)
- Grey Crowned Crane (SCC)
- African Black Duck
- African Sacred Ibis
- African Spoonbill
- African Swamphen
- Black-headed Heron
- Cape Shoveler
- Common Moorhen
- Egyptian Goose
- Glossy Ibis
- Great Egret
- Grey Heron
- Hadada Ibis
- Hamerkop
- Intermediate Egret
- Little Egret
- Marsh Owl
- Purple Heron
- Red-billed Teal
- Spur-winged Goose
- Squacco Heron
- White-faced Whistling Duck
- Yellow-billed Duck

AGRICULTURAL LANDS

The project area contains a patchwork of agricultural fields. Some fields are lying fallow or are in the process of being re-vegetated by grass. The target species which could potentially use the agricultural fields in the area are the following:

- Lanner Falcon (SCC)
- Southern Bald Ibis (SCC)
- Grey Crowned Crane (SCC)
- Martial Eagle (SCC)
- Amur Falcon
- Black-headed Heron
- Common Buzzard
- Egyptian Goose
- Hadada Ibis
- Helmeted Guineafowl
- Pied Crow
- Spur-winged Goose

- Western Barn Owl
- Western Cattle Egret

ALIEN TREES

The area contains few trees. Most trees are alien species, particularly Eucalyptus, Australian Acacia (Wattle), and Salix (Willow) species. Trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have trees growing in them. The target species which could potentially use the alien trees in the area are the following:

- Lanner Falcon (SCC)
- Secretary bird (SCC)
- Southern Bald Ibis (SCC)
- Grey Crowned Crane (SCC)
- Martial Eagle (SCC)
- African Fish Eagle
- African Harrier Hawk
- African Sacred Ibis
- African Spoonbill
- Amur Falcon
- Black Sparrowhawk
- Black-chested Snake Eagle
- Black-headed Heron
- Black-winged Kite
- Common Buzzard
- Greater Kestrel
- Grey Heron
- Hadada Ibis
- Helmeted Guineafowl
- Long-crested Eagle
- Pied Crow
- Rock Kestrel
- Spotted Eagle-Owl
- Western Cattle Egret
- White Stork
- White-breasted Cormorant

DAMS AND PANS

The project area contains many earth dams located in drainage lines. There are also a number of small pans which are a potential drawcard for many target species. Lesser and Greater Flamingos could use pans for foraging and roosting. Large raptors could use the dams and pans for bathing and drinking. The target species which could potentially use the pans and dams in the area are the following:

- Lanner Falcon (SCC)
- Secretary bird (SCC)
- Greater Flamingo
- Maccoa Duck
- Martial Eagle (SCC)
- Yellow-billed Stork
- African Black Duck
- African Darter
- African Fish Eagle

- African Spoonbill
- Black-chested Snake Eagle
- Black-necked Grebe
- Cape Shoveler
- Cape Teal
- Common Moorhen
- Egyptian Goose
- Goliath Heron
- Great Crested Grebe
- Great Egret
- Grey Heron
- Hamerkop
- Intermediate Egret
- Little Egret
- Little Grebe
- Long-crested Eagle
- Purple Heron
- Red-billed Teal
- Red-knobbed Coot
- Reed Cormorant
- South African Shelduck
- Southern Pochard
- Spur-winged Goose
- Squacco Heron
- White-backed Duck
- White-breasted Cormorant
- White-faced Whistling Duck
- Yellow-billed Duck

HIGH VOLTAGE LINES

The project areas are intersected by two high voltage transmission lines, i.e. Camden Duvha 1 400kV line and the Camden Komati 1 275kV, as well as several reticulation lines. The target species which could potentially perch, and roost on the transmission towers and powerlines in the project area are the following:

- Lanner Falcon (SCC)
- Southern Bald Ibis (SCC)
- Martial Eagle (SCC)
- Amur Falcon
- Black-chested Snake Eagle
- Black-headed Heron
- Black-winged Kite
- Common Buzzard
- Egyptian Goose
- Greater Kestrel
- Hadada Ibis
- Helmeted Guineafowl
- Long-crested Eagle
- Pied Crow

— Rock Kestrel
— White Stork

PRIORITY SPECIES

The South African Bird Atlas Project 2 (SABAP2) data indicates that a total of 173 bird species could potentially occur within the broader area. Appendix 1 of the Avifaunal Scoping report provides a comprehensive list of all the species. Of these, 63 species are classified as target species. Of the target species, 57 are likely to occur regularly in the project area (see **Table 7-16** and **Table 7-17** below).

Table 7-16 below lists all the SCC that could occur in the project area and the possible impact by the proposed hydrogen and ammonia facility.

The following abbreviations and acronyms are used:

— NT = Near threatened
— VU = Vulnerable
— EN = Endangered

Table 7-17 lists the same for the powerline sensitive species and the impacts that could be caused by the powerline. The following abbreviations and acronyms are used:

— NT = Near threatened
— VU = Vulnerable
— EN = Endangered

Table 7-16: Priority species potentially occurring at the development area

		Abundance and status				Occurrence in the Project area		Habitat						Potential impacts	
Species name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**	**Global status**	**Regional status**	**Recorded during monitoring**	**Likelihood of occurrence in the project area**	**Grassland**	**Agriculture**	**Alien trees**	**Pans and dams**	**Drainage lines and wetlands**	**High voltage lines**	**Displacement - habitat transformation: A & H Facility**	**Displacement - disturbance (breeding): A & H Facility**
African Grass Owl	*Tyto capensis*	0.0		-	VU		M	x				x		x	
Blue Korhaan	*Eupodotis caerulescens*	20.00	0.00	NT	LC	x	H	x						x	x
Denham's Bustard	*Neotis denhami*	4.00	3.03	NT	VU	x	H	x						x	
Greater Flamingo	*Phoenicopterus roseus*	22.67	3.03	-	NT	x	L				x				
Grey Crowned Crane	*Balearica regulorum*	0.00	3.03	EN	EN	x	L		x	x		x		x	
Lanner Falcon	*Falco biarmicus*	4.00	0.00	-	VU	x	M	x	x	x	x		x	x	x
Lesser Flamingo	*Phoeniconaias minor*	9.33	0.00	NT	NT	x	M								
Maccoa Duck	*Oxyura maccoa*	13.33	0.00	VU	NT		M				x				
Martial Eagle	*Polemaetus bellicosus*	1.33	0.00	EN	EN		L	x	x	x	x		x	x	
Secretarybird	*Sagittarius serpentarius*	8.00	0.00	EN	VU	x	H	x		x	x			x	x
Southern Bald Ibis	*Geronticus calvus*	2.67	0.00	VU	VU	x	M	x	x	x			x	x	
Yellow-billed Stork	*Mycteria ibis*	4.00	0.00	-	EN	x	M				x				

Table 7-17: Powerline sensitive species potentially occurring at the project area and potential impacts by the proposed 132kV grid connection on them

		Abundance and status				Occurrence in the project area		Habitat						Potential impacts		
Species name	Scientific name	SABAP 2 Full protocol reporting rate	SABAP 2 Ad hoc protocol reporting rate	Global status	Regional status	Recorded during monitoring	Likelihood of occurrence in the project area	Grassland	Agriculture	Alien trees	Pans and dams	Drainage lines and wetlands	High voltage lines	Displacement - habitat transformation: Powerline	Displacement - disturbance: Powerline	Collision mortality: Powerline
African Grass Owl	*Tyto capensis*	0.0		-	VU		M	x				x		x	x	x
Blue Korhaan	*Eupodotis caerulescens*	20.00	0.00	NT	LC	x	H	x						x	x	x
Denham's Bustard	*Neotis denhami*	4.00	3.03	NT	VU	x	H	x						x	x	x
Greater Flamingo	*Phoenicopterus roseus*	22.67	3.03	-	NT	x	L				x					x
Grey Crowned Crane	*Balearica regulorum*	0.00	3.03	EN	EN	x	L		x	x		x				x
Lanner Falcon	*Falco biarmicus*	4.00	0.00	-	VU	x	M	x	x	x	x		x		x	
Lesser Flamingo	*Phoeniconaias minor*	9.33	0.00	NT	NT	x	M									x
Maccoa Duck	*Oxyura maccoa*	13.33	0.00	VU	NT		M				x					x
Martial Eagle	*Polemaetus bellicosus*	1.33	0.00	EN	EN		L	x	x	x	x		x			
Secretarybird	*Sagittarius serpentarius*	8.00	0.00	EN	VU	x	H	x		x	x			x	x	x
Southern Bald Ibis	*Geronticus calvus*	2.67	0.00	VU	VU	x	M	x	x	x			x	x		x
Yellow-billed Stork	*Mycteria ibis*	4.00	0.00	-	EN	x	M				x					x
African Black Duck	*Anas sparsa*	1.33	3.03	-	-		L				x	x				x
African Darter	*Anhinga rufa*	26.67	6.06	-	-	x	M				x					x
African Fish Eagle	*Haliaeetus vocifer*	5.33	0.00	-	-	x	M			x	x					
African Harrier Hawk	*Polyboroides typus*	5.33	0.00	-	-	x	M	x		x						
African Sacred Ibis	*Threskiornis aethiopicus*	45.33	6.06	-	-	x	H			x		x				x
African Spoonbill	*Platalea alba*	32.00	21.21	-	-	x	H			x	x	x				x
African Swamphen	*Porphyrio madagascariensis*	4.00	0.00	-	-		M					x				x

Species name	Scientific name	Abundance and status				Occurrence in the project area		Habitat						Potential impacts		
		SABAP 2 Full protocol reporting rate	SABAP 2 Ad hoc protocol reporting rate	Global status	Regional status	Recorded during monitoring	Likelihood of occurrence in the project area	Grassland	Agriculture	Alien trees	Pans and dams	Drainage lines and wetlands	High voltage lines	Displacement - habitat transformation: Powerline	Displacement - disturbance: Powerline	Collision mortality: Powerline
Amur Falcon	*Falco amurensis*	5.33	0.00	-	-	x	M	x	x	x			x			
Black Sparrowhawk	*Accipiter melanoleucus*	12.00	0.00	-	-	x	M			x						
Black-chested Snake Eagle	*Circaetus pectoralis*	6.67	0.00	-	-	x	M	x		x	x		x			
Black-headed Heron	*Ardea melanocephala*	65.33	9.09	-	-	x	H	x	x	x		x	x			x
Black-necked Grebe	*Podiceps nigricollis*	9.33	0.00	-	-		M				x					x
Black-winged Kite	*Elanus caeruleus*	82.67	21.21	-	-	x	H	x		x			x			
Cape Shoveler	*Spatula smithii*	52.00	6.06	-	-	x	H				x	x				x
Cape Teal	*Anas capensis*	16.00	0.00	-	-		M				x					x
Common Buzzard	*Buteo buteo*	22.67	3.03	-	-	x	H	x	x	x			x			
Common Moorhen	*Gallinula chloropus*	21.33	6.06	-	-		H				x	x				
Egyptian Goose	*Alopochen aegyptiaca*	88.00	24.24	-	-	x	H		x		x	x	x			x
Glossy Ibis	*Plegadis falcinellus*	24.00	6.06	-	-	x	H					x				x
Goliath Heron	*Ardea goliath*	6.67	0.00	-	-		M				x					x
Great Crested Grebe	*Podiceps cristatus*	10.67	3.03	-	-	x	M				x					x
Great Egret	*Ardea alba*	5.33	3.03	-	-	x	M				x	x				x
Greater Kestrel	*Falco rupicoloides*	1.33	0.00	-	-	x	L	x		x			x		x	
Grey Heron	*Ardea cinerea*	36.0	9.1	-	-	x	H			x	x	x				x
Hadada Ibis	*Bostrychia hagedash*	86.67	15.15	-	-	x	H		x	x		x	x			x
Hamerkop	*Scopus umbretta*	9.33	6.06	-	-	x	M				x	x				x
Helmeted Guineafowl	*Numida meleagris*	54.67	15.15	-	-	x	H	x	x	x			x	x	x	
Intermediate Egret	*Ardea intermedia*	30.67	6.06	-	-	x	H				x	x				x

Species name	Scientific name	Abundance and status				Occurrence in the project area		Habitat						Potential impacts		
		SABAP 2 Full protocol reporting rate	SABAP 2 Ad hoc protocol reporting rate	Global status	Regional status	Recorded during monitoring	Likelihood of occurrence in the project area	Grassland	Agriculture	Alien trees	Pans and dams	Drainage lines and wetlands	High voltage lines	Displacement - habitat transformation: Powerline	Displacement - disturbance: Powerline	Collision mortality: Powerline
Little Egret	*Egretta garzetta*	17.33	6.06	-	-	x	M				x	x				x
Little Grebe	*Tachybaptus ruficollis*	61.33	15.15	-	-	x	H				x					x
Long-crested Eagle	*Lophaetus occipitalis*	4.00	3.03	-	-	x	M	x		x	x		x			
Marsh Owl	*Asio capensis*	20.00	0.00	-	-	x	H	x				x				x
Montagu's Harrier	*Circus pygargus*	1.33	0.00	-	-	x	M	x								
Pied Crow	*Corvus albus*	14.67	3.03	-	-	x	H	x	x	x			x		x	
Purple Heron	*Ardea purpurea*	13.33	9.09	-	-		M				x	x				x
Red-billed Teal	*Anas erythrorhyncha*	58.67	12.12	-	-	x	H				x	x				x
Red-knobbed Coot	*Fulica cristata*	78.67	27.27	-	-	x	H				x					x
Reed Cormorant	*Microcarbo africanus*	73.33	21.21	-	-	x	H				x					x
Rock Kestrel	*Falco rupicolus*	4.00	0.00	-	-	x	M	x		x			x		x	
South African Shelduck	*Tadorna cana*	10.67	0.00	-	-		M				x					x
Southern Pochard	*Netta erythrophthalma*	21.33	3.03	-	-	x	H				x					x
Spotted Eagle-Owl	*Bubo africanus*	2.67	0.00	-	-	x	M	x		x						x
Spur-winged Goose	*Plectropterus gambensis*	58.67	0.00	-	-	x	H		x		x	x				x
Squacco Heron	*Ardeola ralloides*	5.33	9.09	-	-		M				x	x				x
Western Barn Owl	*Tyto alba*	2.67	0.00	-	-		L	x	x							x
Western Cattle Egret	*Bubulcus ibis*	62.67	18.18	-	-	x	H	x	x	x						x
White Stork	*Ciconia ciconia*	5.33	0.00	-	-	x	H	x		x			x			x
White-backed Duck	*Thalassornis leuconotus*	8.00	3.03	-	-		M				x					x
White-breasted Cormorant	*Phalacrocorax lucidus*	26.67	15.15	-	-	x	M			x	x					x

Species name	Scientific name	Abundance and status				Occurrence in the project area		Habitat						Potential impacts		
		SABAP 2 Full protocol reporting rate	SABAP 2 Ad hoc protocol reporting rate	Global status	Regional status	Recorded during monitoring	Likelihood of occurrence in the project area	Grassland	Agriculture	Alien trees	Pans and dams	Drainage lines and wetlands	High voltage lines	Displacement - habitat transformation: Powerline	Displacement - disturbance: Powerline	Collision mortality: Powerline
White-faced Whistling Duck	*Dendrocygna viduata*	9.33	3.03	-	-	x	M				x	x				x
Yellow-billed Duck	*Anas undulata*	81.33	18.18	-	-	x	H				x	x				x

AVIFAUNA SENSITIVITY

- **100m all infrastructure exclusion zone (barring essential roads and grid line crossings) around drainage lines and associated wetlands.** Wetlands are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for African Grass Owl (SA status Vulnerable), Grey Crowned Crane (SA status Endangered).
- **No specific No-Go zones have been identified.**
- According to the Terrestrial Animal Species Protocol, confirmed habitat, or the presence SCC within the project area, triggers a High sensitivity classification. The classification should therefore be High sensitivity for the project area, based on actual conditions recorded on the ground during surveys at the proposed wind energy facilities, which included the area covered by the project area. The following SCC were recorded in the project area: Secretary bird (Globally Endangered, Locally Vulnerable), Southern Bald Ibis (Locally and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), Denham's Bustard (Globally Near-threatened, Regionally Vulnerable) Lanner Falcon (Regionally Vulnerable) and Lesser Flamingo (Globally and Regionally Near threatened).

The area where the avifaunal pre-construction monitoring for the Hendrina GH&A Facility are shown in **Figure 7-24.**

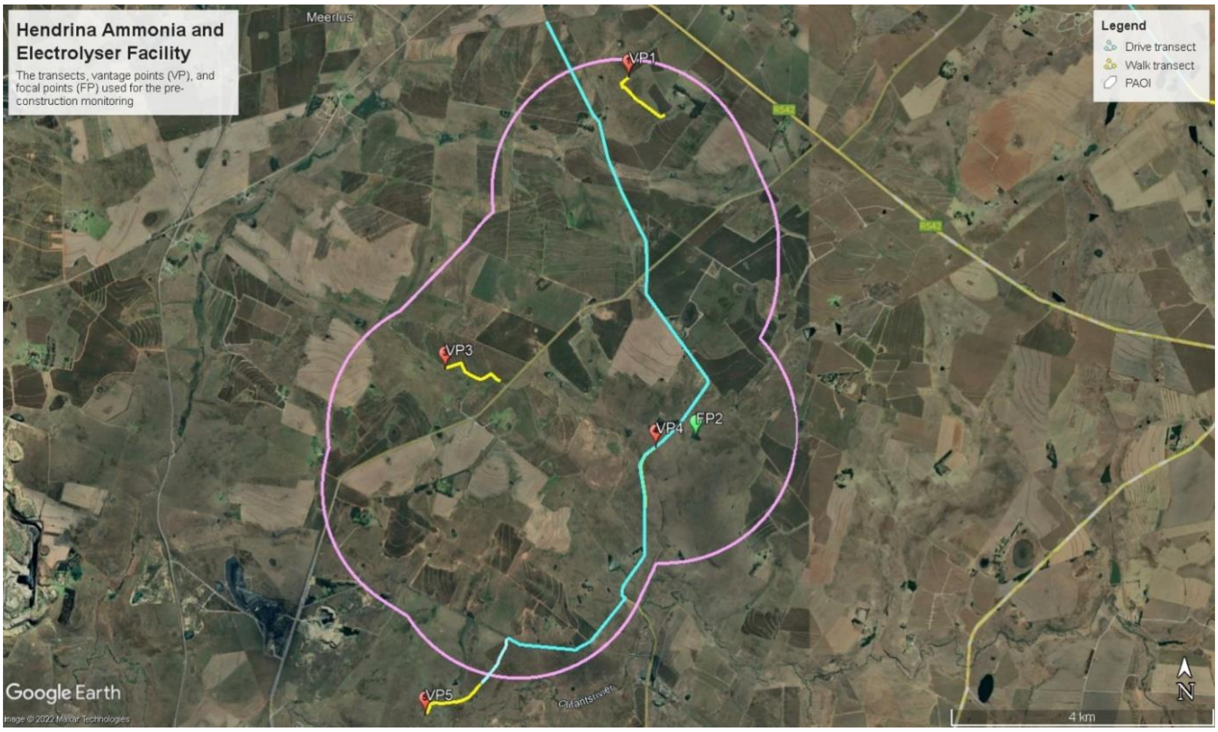


Figure 7-24: Area where monitoring is taking place, with position of Vantage points, focal points, drive transects, walk transects and the project area.

7.3 SOCIAL ENVIRONMENT

7.3.1 LAND USE

The development is located in a grain and cattle farming agricultural region, but the soils vary in their suitability for crop production. Crops in the area include mainly maize and soya beans. Farmers generally utilise all suitable soil as cropland. Only soil that is not suitable for crop production is used for grazing of cattle and sheep. Limitations that render the soil unsuitable for crop production are poor drainage and depth limitations due to rock or dense clay in the subsoil.

Alternatives 1 and 2 are on cropland while alternative 3 is on land not used for crops and therefore presumed to be unsuitable.

Coal-fired electricity generation and mining take place in the surrounding area.

Because of the favourable climate and suitable soils on the croplands, crop yields are fairly high with average maize yields of around 7 to 8 tons per hectare according to the farmers on site. The long-term grazing capacity of the area is fairly high at 5 hectares per large stock unit (DAFF, 2018).

The site is used for cultivation and for the grazing of both cattle and sheep. Cultivated crops include maize, soya beans and the fodder crop, weeping love grass, *Eragrostis curvula*.

In terms of the South African National Land Cover dataset, the site is classified as Grassland interspersed with cultivation areas, Small tracts of forested land and numerous water bodies are scattered throughout the study area (**Figure 7-25**).

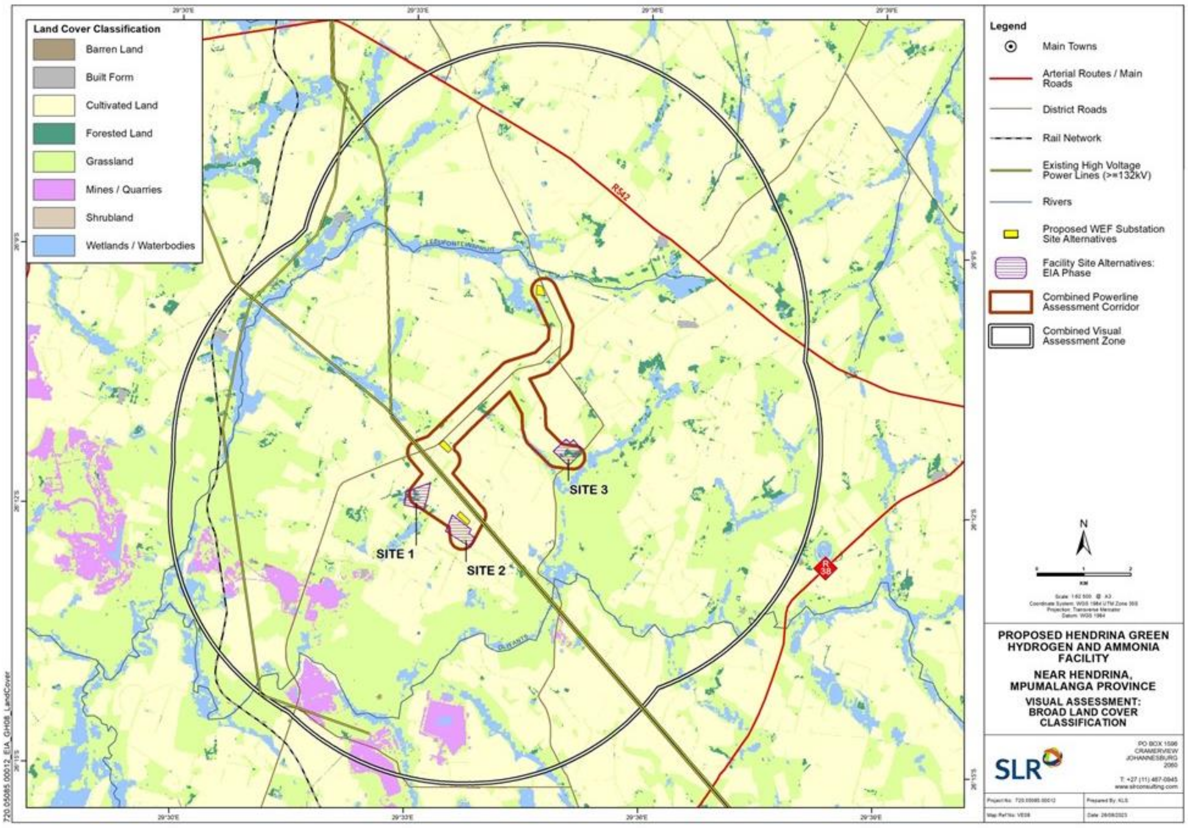


Figure 7-25: Broad land cover classification (SLR, 2023)

7.3.2 NOISE CLIMATE

The existing noise climate surrounding the Hendrina GH&A Facility is predominantly rural with very low baseline noise levels anticipated. Most dwellings featuring in the vicinity of the project focus area are scattered in a heterogeneous fashion, typical of a rural area. Croplands, animal husbandry and subsistence farming are predominant in the study area.

Noise sources may include birds, insects, livestock and activities of resident farmers. Anthropogenic influences may include traffic on local roads.

Ambient (background) noise levels were measured during the week of 30 July to 6 August 2021 in accordance with the South African National Standard SANS 10103:2008, with the ambient sound levels measured at two different locations. The measurements indicate that the ambient sound levels are elevated at all the measurement locations.

The two measurement locations had different soundscapes, with the one location being very quiet, being located away from typical human habitation, animals or vegetation, with the second location within 300 m of the R542 road. The R542 is used as a coal transport.

The ambient sound levels concluded that, excluding locations up to an estimated distance of 1,000 m from the R542 road, that ambient sound levels are expected to be low and would be typical of a rural noise district. The acceptable zone sound level (noise rating level) during low and no-wind conditions would be typical of a rural noise district are

- 45 dBA for the daytime period; and,
- 35 dBA for the night-time period.

Residential areas and potential noise-sensitive developments/receptors/communities (NSRs) were identified using aerial images as well as a physical site visit. Based on information gained during the site visit by the noise specialists the site, Alternative 1 has two (NSR29 & NSR 28) possible receptors that are within a range of encountering 35dbA of noise from the proposed facility approximately 1km away.

Alternative 2 has the same two NSR as Alternative 1, however is more than 1km away.

Alternative 3 has three potential NSR (NSR21, 22, 23) within 500-750m away, within the 40-45dbA range.

It should be noted that the upper limit for noise receptors is 45dbA.

- NSR 29 represents a caravan. There was no access to the site and the noise sensitive receptor is assumed noise-sensitive.
- NSR 28 is an old farm dwelling, currently used by the employees of the Overlooked Coal mine. An employee confirmed that the offices are not used for residential activities
- NSR 21, 22 & 23 are noted to be residential in nature.

Sensitive receptors are identified as areas that may be impacted negatively due to noise associated with the proposed GH&A Facility. Being such a remotely located site, dominant receptors in the area surrounding the site include small farmsteads and farmhouses. The specific sensitive receptors considered in this study are presented in **Figure 7-26, Figure 7-27 & Figure 7-28 below.**

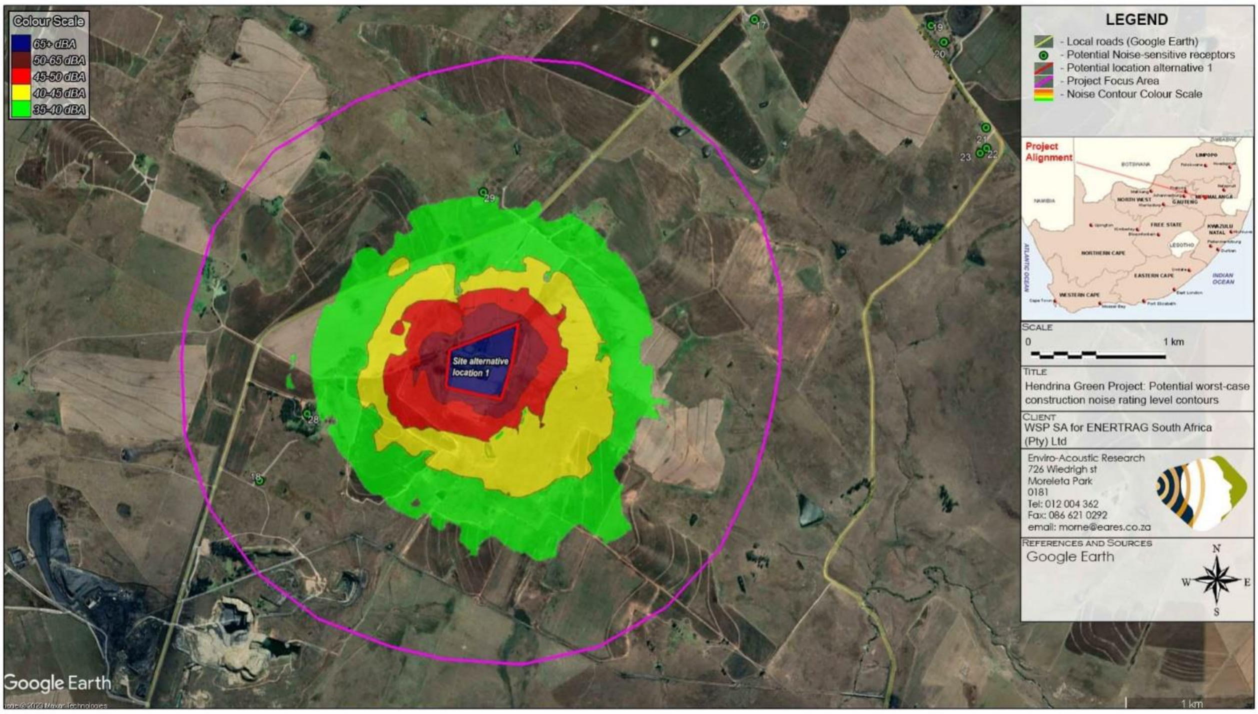


Figure 7-26: Sensitive receptors surrounding the Hendrina GH&A Facility Alternative 1 (Enviro-Acoustic Research, 2021)

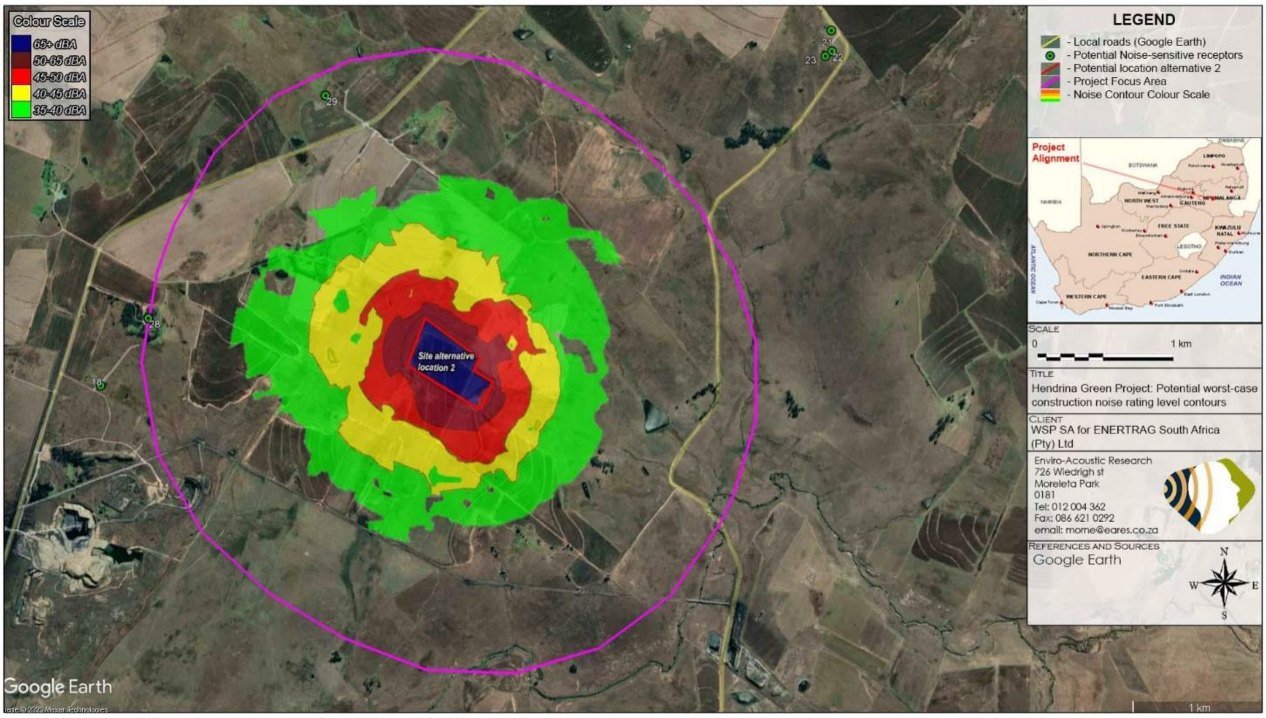


Figure 7-27: Sensitive receptors surrounding the Hendrina GH&A Facility Alternative 2 (Enviro-Acoustic Research, 2021)

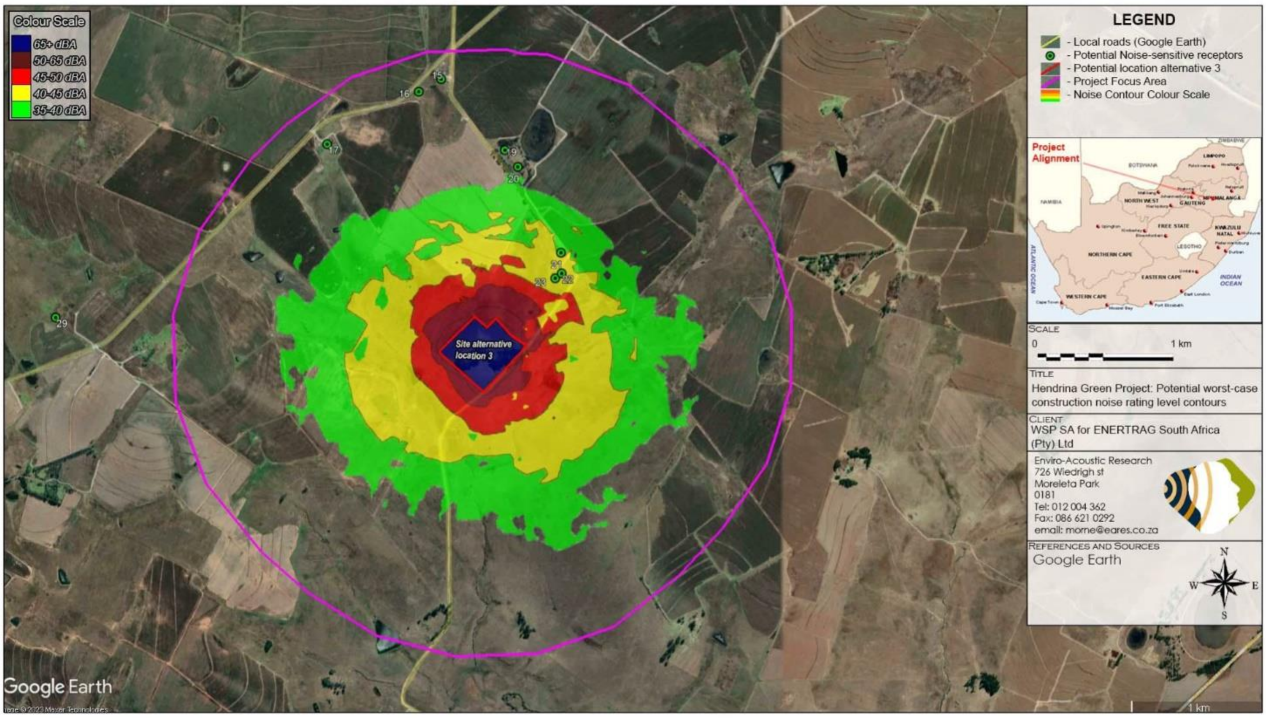


Figure 7-28: Sensitive receptors surrounding the Hendrina GH&A Facility Alternative 3 (Enviro-Acoustic Research, 2021)

Considering the ambient sound levels measured on-site, the projected noise rating levels will be similar or less than the on-site ambient sound levels. It is slightly possible that the noise rating levels could exceed the ambient sound levels during certain periods although it is unlikely to impact on the quality of living (at night) for the closest receptors. The closest receptors should not lose the peace or quiet that they are used to.

7.3.3 TRANSPORT NETWORK

The Hendrina green hydrogen facilities are located on farm portions that connect to rural collector roads. The Site alternative 1 and 2 can be accessed off an existing gravel while the site alternative 3 site shows no sign of a definitive farm access road. The access will therefore need to be determined during design stage. The gravel access roads may need to be upgraded to accommodate vehicle access needs during construction and operation of the site.

The nearest towns in relation to the proposed project site are Hendrina, Komati, Bethal, Middelburg and Emalahleni. It is envisaged that most materials, water, plant, services and people will be procured within a 50km radius of the proposed site.

The site is traversed by one district road, refer to **Figure 7-29** for the alignment of these roads as shown on the potential site access map.

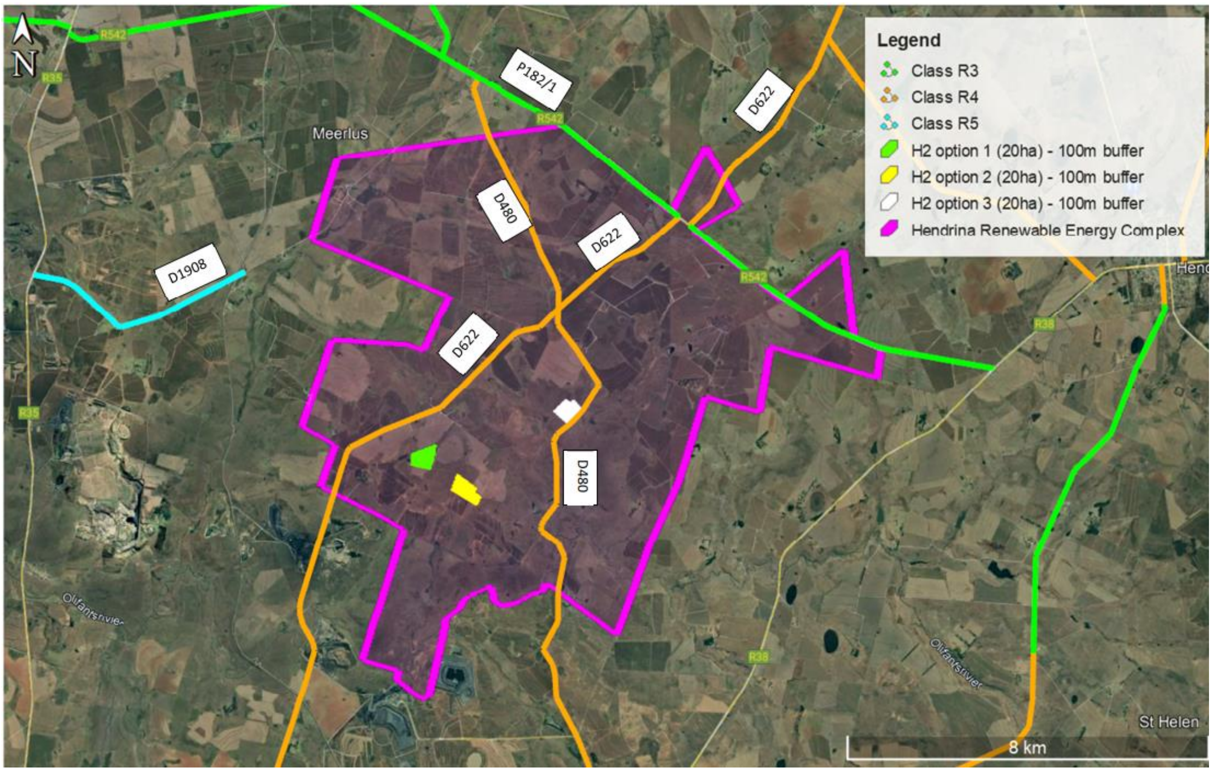


Figure 7-29: Road network in the project area

Figure 7-30 below shows that based on the Mpumalanga Road Asset Management System, the 2019 Annual Average Daily Traffic (AADT) on the D622 and D480 road sections surrounding the green hydrogen and ammonia site options is rated as low to medium. The AADT on the D480 road section located north of the site is rated as low (i.e. D480_170) , and the P181/1 road section north of the site (i.e. P182/1_040 to P182/1_050) is rated as high.

Traffic congestion is therefore expected on the P181/1 road section north of the site, while the D622 and D480 road sections in the vicinity of the site are expected to have some capacity. Traffic congestion mitigation measures are therefore strongly encouraged during the construction stage.

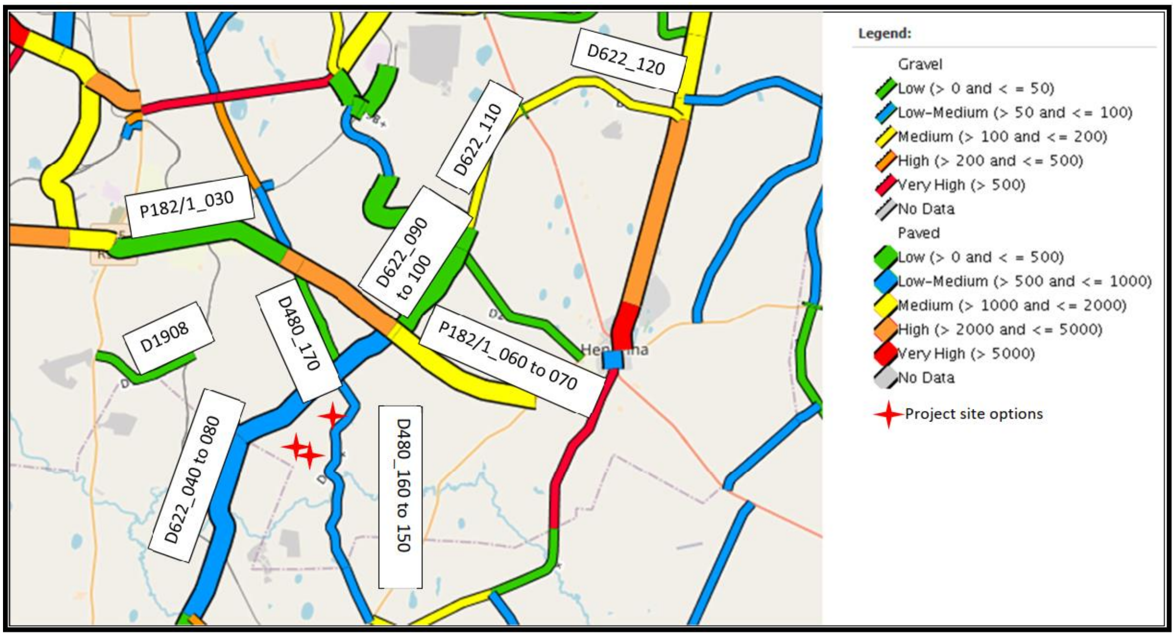


Figure 7-30: Traffic data information (2019)

Traffic during the Construction of facility:

<u>Material delivery</u>: Concrete for foundations (cement, sand, stone deliveries to batching plant) 3 20000 m³. Generated trips are estimated at 1926 total trips. Assuming a 24-month construction phase, material delivery will be spread over the construction preparation and civil works period (i.e., 235 days or 50% of construction period), and the peak hour trips in rural environments are typically 20-40% of the average daily traffic. The estimated daily trips are 9 veh/h and the peak hour trips are estimated at 4 veh/h.

<u>Construction machinery:</u> This includes cranes for turbine assembly, heavy vehicles required for earthworks and roadworks. These vehicles are expected to have negligible traffic impact as they will arrive on site in preparation for construction. Once on site, these vehicles will produce internal site traffic with minimal effect on the external road network.

<u>Component delivery:</u> An estimated total component delivery trips of 55 is assumed for the project. Assuming: a 24-month construction phase, and that the component delivery will occur over 24 days spread out across the construction prep and civil works period, and the peak hour trips in rural environments are typically 20-40% of the average daily traffic. The estimated daily trips are 3 veh/h and the peak hour trips are estimated at 2 veh/h.

<u>Site personnel and workers:</u> It is estimated that 200 workers can be expected during the construction period. 10% of the workforce is estimated to travel by private car with an average 1.5 persons occupancy, and 905 of the workforces is assumed to travel by minibus taxi at a 16 person per vehicle occupancy. This results in 12 minibus taxis and 14 passenger vehicles expected to be generated by worker trips. If 40% of the daily trips is expected to occur during the peak hour, 11 peak hour trips can be expected for worker trips.

Based on the above 17 peak hour trips are estimated for the site during the construction of the facility.

Traffic during the Construction of Grids/Power lines:

<u>Material and component delivery</u>: Vehicle trips from material and component delivery vary depending on the construction task/program, fuel supply arrangements, as well as distance from the material source to the site. Not enough detail about the powerline is known at this stage to provide an estimated trip generation volume for material and component traffic.

The materials and most components expected for the powerline construction can generally be transported by normal heavy load vehicles. Project planning can be used to reduce delivery trips during peak hours. In addition to this, using a mobile batch plant as well as temporary construction material stockpile yards near the proposed site can also reduce peak hour trips.

The transmission tower sections, and transformer are expected to be transported by abnormal load. The number of tower sections and transformer units is unknown thus the number of abnormal loads cannot be estimated.

<u>Construction machinery</u>: Cranes for pylon/tower assembly, heavy vehicles required for earthworks etc.

These vehicles are expected to have negligible traffic impact as they will arrive on site in preparation for construction. Once on site, these vehicles will produce internal site traffic with minimal effect on the external road network.

<u>Site personnel and workers:</u> Based on information obtained from similar projects it is assumed that 50 to 70 workers can be expected on site per workday for the powerline construction. Minibus Taxis have an average 16 passenger capacity and assuming approximately 20% highly skilled personnel will travel by means of passenger vehicles the following trips are assumed: for the skilled personnel a maximum of 11 trips are expected (estimated 1.5 passenger vehicle occupancy).

The remaining 56 workers can travel by minibus taxis (i.e., 4 trips).

Assuming 40% of the trips will occur during the peak hour, a maximum of 6 peak hour site personnel trips is assumed for the purposes of this assessment.

Estimated peak hour traffic generated by the site when operational:

<u>Operational Staff traffic</u>: It is estimated that 25 permanent employment opportunities will be created during the operational phase. If it is further assumed that 20-40% of the average daily traffic occurs during the peak hour. An estimated 10 peak hour traffic trips are assumed for staff commuter trips.

Hydrogen and oxygen gas delivery trips: up to 20,000 tons per annum (tpa) of green hydrogen and up to 40 000 tpa of green oxygen are estimated for production. The oxygen obtained as part of the hydrogen production process may be released or stored and sold as a by-product. The hydrogen may be directed to the Ammonia production plant or be stored and sold to interested parties directly.

Assuming 20t of oxygen capacity per truck, 248 working days a year, 40 000 tpa of oxygen produced, and the peak hour trips in rural environments are typically 20-40% of the average daily traffic. The estimated daily number of trucks for oxygen delivery is 9 veh/h while the peak hour vehicles are estimated at 4 veh/h.

Not much information is available on how the Hydrogen will be transported (i.e., pipeline or land transport). Based on the assumptions made for the oxygen delivery above, and an estimated 20,000 tons per annum (tpa) of green hydrogen envisaged for production, approximately 2 veh/h can be assumed for Hydrogen for delivery during the peak hour.

Ammonia delivery trips: Liquid Ammonia may readily be transported via road, rail or a combination of the two by means of Standard pressurised road tanker or ISOtainer (for road transport options), or via pressured rail container (Isotank).

Use of 40ft pressured tanker trucks or trucks with ISOtainer capability (20ft length each). Volumes will be up to 24 tons per truck load depending on pressured tanker or Isotainer, therefore 12 daily 24-ton ISOtainer truck trips are envisaged.

If it is further assumed that 20-40% of the average daily traffic occurs during the peak hour. An estimated 5 peak hour traffic trips are assumed for ammonia delivery.

The total estimated peak hour trips during the operational phase is 21 veh/h.

7.3.4 HERITAGE AND CULTURAL RESOURCES

Most of the Project area and surrounding environment consists of active agricultural lands that have been cultivated. Existing powerlines, water pipelines and railroad infrastructure traverse the larger area. The continuous ploughing and the existing infrastructure would have impacted on archaeological sites if any were present in these areas and the Project area is of low archaeological potential.

STONE AGE

The Stone Age is divided in Early; Middle and Late Stone Age and refers to the earliest people of South Africa who mainly relied on stone for their tools.

Very few Early Stone Age (ESA) sites are on record for Mpumalanga and no sites dating to this period are expected for the study area. An example in Mpumalanga is Maleoskop on the farm Rietkloof where ESA tools have been found. This is one of only a handful of such sites in Mpumalanga.

The Middle Stone Age (MSA) has not been extensively studied in Mpumalanga, but evidence of this period has been excavated at Bushman Rock Shelter, a well-known site on the farm Klipfonteinhoek in the Ohrigstad district. This cave was excavated twice in the 1960's by Louw and later by Eloff. The MSA layers show that the cave was repeatedly visited over a long period. Lower layers have been dated to over 40 000 BP (Before Present) while the top layers date to approximately 27 000 BP (Esterhuizen & Smith in Delius, 2007; Bergh, 1998). Some isolated finds were recorded close to Witbank as well by Huffman (1999) on the farm Rietfontein.

The Later phases of the Stone Age (LSA) began at around 20 000 years BP. This period was marked by numerous technological innovations and social transformations within these early hunter-gatherer societies. These people may be regarded as the first modern inhabitants of Mpumalanga, known as the San or Bushmen. They were a nomadic people who lived together in small family groups and relied on hunting and gathering of food for survival. Evidence of their existence is to be found in numerous rock shelters throughout the Eastern Mpumalanga where some of their rock paintings are still visible. A number of these shelters have been documented throughout the province (Bornman, 1995; Schoonraad in Barnard, 1975; Delius, 2007). These include areas such as Witbank, Ermelo, Barberton, Nelspruit, White River, Lydenburg and Ohrigstad.

Three LSA sites are on record in the greater area. The sites are Welgelegen Skuiling close to Ermelo, Chrissiesmeer (also known for rock art) and lastly Groenvlei close to Carolina, this area is also known for rock art (Bergh 1999).

IRON AGE

The Iron Age as a whole represents the spread of Bantu speaking people and includes both the pre-Historic and Historic periods. It can be divided into three distinct periods:

— The Early Iron Age: Most of the first millennium AD.
— The Middle Iron Age: 10th to 13th centuries AD
— The Late Iron Age: 14th century to colonial period.

The Iron Age is characterised by the ability of these early people to manipulate and work Iron ore into implements that assisted them in creating a favourable environment to make a better living. No Early Iron Age sites are on record in the greater region. Around 220 Late Iron Age stone walled sites are on record to the east of the study area (Bergh 1999) and is also associated with numerous pre-difaqane and difaqane wars that took place during the last quarter of the 18th century and during the first three decades of the 19th century. The sites are located close to Bethal. The study area was most probably inhabited by the Phuting group (Berg 1999). Around the study area the Phuting moved south due to the Ndebele migration (Difaqane). These wars led to the displacement of large numbers of Tswana clans on the Highveld where Mzilikazi's Ndebele caused chaos and havoc.

Late Iron Age settlements are characterised by extensive dry stonewalls and dates back to the 17th century. Late Iron Age communities who contributed to this stone walled architecture were the Sotho, Pedi, Ndebele and Swazi. The stone building tradition that these indigenous groups established many decades before the first colonial settlers arrived, may have influenced the colonial farmers to utilize these same resources as building material for the first farmsteads which arose on the Eastern Highveld (Pistorius 2006).

HISTORICAL CONTEXT OF THE AREA

Sites dating to the historic period occur sporadically in the study area. These are mostly farming related, although some mining sites also occur. The farming related sites are usually farmsteads and farm cemeteries, either belonging to the landowners or their labourers. Mining related sites are for example the old Albion Colliery, dating to the 1940's.

BATTLEFIELDS AND WAR HISTORY

The Anglo-Boer War, which took place between 1899 and 1902 in South Africa, was one of the most turbulent times in South Africa's history. Even before the outbreak of war in October 1899 British politicians, including Sir Alfred Milner and Mr. Chamberlain, had declared that should Britain's differences with the Z.A.R. result in violence, it would mean the end of republican independence. This decision was not immediately publicized, and therefore republican leader based their assessment of British intentions on the more moderate public utterances of British leaders. Consequently, in March 1900, they asked Lord Salisbury to agree to peace based on the status quo ante bellum. Salisbury's reply was, however, a clear statement of British war aims (Du Preez 1977).

During the Anglo-Boer War, several battles took place in the region. The one closest to the study area took place on the farm Wilmansrust, some distance to the east, in June 1901. During this clash, more than 50 British troops were killed.

RUINS AND BURIAL SITES

Most of the Project area and surrounding environment consists of active agricultural lands that have been cultivated. Existing powerlines, water pipelines and railroad infrastructure traverse the larger area. The continuous ploughing and the existing infrastructure would have impacted on archaeological sites if any were present in these areas and the Project area is of low archaeological potential.

This was confirmed during the survey and finds were limited to burial sites and ruins. Recorded heritage features along the line were given waypoint numbers. The field surveys were conducted from 2021 onwards and different site numbers reflect respective site visits. General site conditions, site distribution and selected features are illustrated in **Figure 7-32** to **Figure 7-45.** Recorded observations are briefly described in **Table 7-19** and shown in **Figure 7-31**.

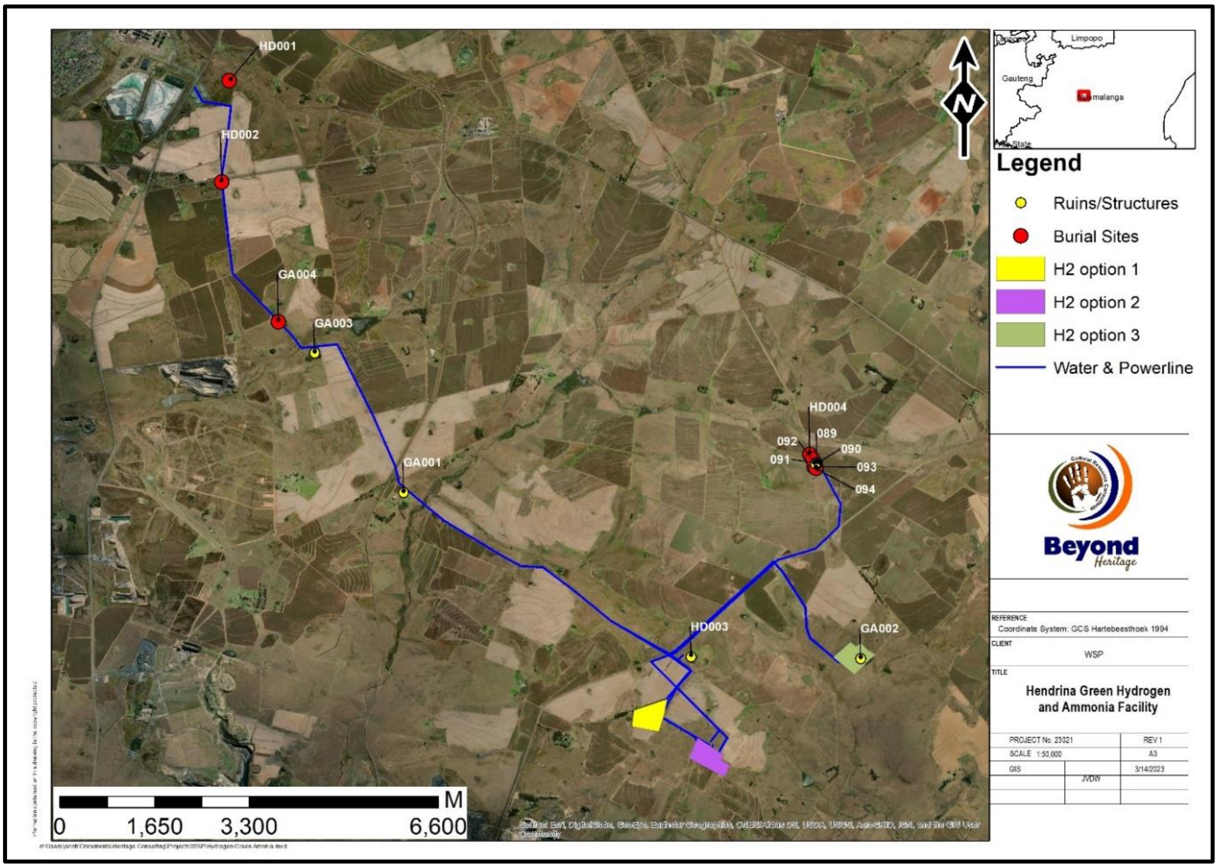


Figure 7-31: Ruins and burial sites observed in relation to the proposed project infrastructure

Table 7-18: Heritage significance and field ratings

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP. A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP. B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction
National Significance (NS)	Grade 1	-	Conservation; national site nomination

The recorded sites in the assessed area are briefly described in **Table 7-19**.

Table 7-19: Details of observed sites

LABEL	LONGITUDE	LATITUDE	TYPE OF SITE	DESCRIPTION	SIGNIFICANCE AND FIELD RATING
089, 090, 091, 092	29° 34' 40.8793" E	26° 09' 28.7928" S	Ruins	Remains of a small homestead on the side of a large gravel road. The site consists of the remains of multiple small, demolished structures that are half buried under overgrown grass over an area measuring ~ 40 x 40m. Only the ephemeral foundations of the structures are left. These features are located in association with burial sites recorded as 093 and 094.	The ruins potential to contribute to aesthetic, historic, scientific and social aspects are non-existent, and it is therefore of low heritage significance (GP C) unless associated with burial sites (e.g., still born graves) in which case the burial sites are of high social significance (GP A)
093	29° 34' 41.0124" E	26° 09' 28.6452" S	Cemetery	Four graves situated in a small fenced off area (4 x 10 m) near an existing access road. New granite gravestones and skirting have been placed over the graves with the older material laying on the side of the small cemetery.	GP A High Social significance
094	29° 34' 40.3177" E	26° 09' 28.3643" S	Cemetery	A single grave that is fenced off and is probably that of a child due to its size. The grave also has a fairly modern granite gravestone and cover. - Dated 1932.	GP A High Social significance
HD001 (previously recorded as 095)	29° 34' 40.0296" E	26° 09' 28.9980" S	Burial Sites	Two graves situated near the Komati power station. The graves are situated directly under an existing powerline. The graves both have granite headstones and grave dressings. The area measures 4 x 2 m. The graves date to 1965 and 1975 respectively. This site is located outside of the study area and are not further discussed here as they will not be impacted on by the proposed project.	GP A High social significance
HD002 (Previously recorded as 096)	29° 34' 39.1189" E	26° 09' 30.7548" S	Cemetery	Informal cemetery located next to the main road. The cemetery has recently been cleaned of most vegetation suggesting recent use. The cemetery is partially fenced off with a degraded wire fence. Various graves are found within the cemetery including infant and adult graves. Grave dressings	GP A High social significance

LABEL	LONGITUDE	LATITUDE	TYPE OF SITE	DESCRIPTION	SIGNIFICANCE AND FIELD RATING
				consist of packed stone, cement, tiles and granite. The cemetery measures 25 x 15 m. Visible dates on the headstones include 1948 and 2011.	
HD003 (Previously recorded as 097)	29° 34' 40.2529" E	26° 09' 31.5505" S	Ruins	Large partially broken-down farmstead situated near the main road. The farmstead contains multiple broken-down structures scattered across a wide area including a large farmhouse, brick silo and various cement foundations. The structures are mostly broken down and overgrown. The site is also surrounded by maize fields.	The ruins potential to contribute to aesthetic, historic, scientific and social aspects are non-existent, and it is therefore of low heritage significance (GP C) unless associated with burial sites (e.g., still born graves) in which case the burial sites are of high social significance (GP A)
HD004 (Previously recorded waypoint 098)	29° 29' 08.6315" E	26° 05' 52.7605" S	Cemetery	4 to 5 graves in a small cemetery situated on the fence line of a large, cultivated field. The cemetery is degraded and overgrown. The feature measures 4 x 2 m.	GP A High Social significance
HD101	29° 29' 04.3223" E	26° 06' 49.9068" S	Grave	Possible packed stone grave situated in an area close to the aforementioned sites. The potential grave site consists of multiple stones that seem to have been packed as grave dressing with a piece of corrugated iron situated nearby that could have formed part of a grave marker.	GP A High Social significance if it is a burial site
GA001	29° 34' 36.6059" E	26° 09' 23.6628" S	Built Environment	Large degraded and disused farmstead containing multiple structure associated with cattle farming. These include a large degrading structure that contains feeding bays and multiple rooms, various feeding troughs spread throughout the area, a large brick and cement silo and a series of large, raised cement foundations	GP C Low significance
GA002	29° 34' 38.3377" E	26° 09' 26.3447" S	Built Environment	Series of extremely degraded and overgrown foundations as well as some lines of packed stone possibly indicating the remnants of a packed stone wall. The foundations or mounds resemble small informal structures that include one	GP C Low significance

LABEL	LONGITUDE	LATITUDE	TYPE OF SITE	DESCRIPTION	SIGNIFICANCE AND FIELD RATING
				rondawel and a small multi-roomed structure. The features are all situated within a thicket of Eucalyptus trees on the edge of a gravel road that runs along the southern edge of the project.	
GA003	29° 30' 47.2104" E	26° 09' 45.3060" S	Built Environment	Series of broken-down structures and foundations built from cut stone, brick and cement. The site contains multiple foundations scattered across the area and resemble a past farmstead that has been demolished	GP C Low significance
GA004	29° 35' 05.4383" E	26° 11' 19.1256" S	Burial Site	Small cemetery (10 – 15 graves) situated next to an existing agricultural field near a small gravel road. A small stream also runs towards the eastern edge of the small burial site. The burial site contains various graves made from packed stones, cement and brick, granite as well as various headstones such as granite and metal grave markers and measures 30 x 10 m.	GP A High Social significance

The general site conditions, site distribution and selected features are illustrated in **Figure 7-32** to **Figure 7-45** below.

Figure 7-32: Demolished remains of structures at Feature 091

Figure 7-33: General site conditions showing the ephemeral remains of the structures at Feature 091

Figure 7-34: Grave dressings at Feature 093

Figure 7-35: Single grave at Feature 094

Figure 7-36: Graves recorded at Waypoint 095

Figure 7-37: Graves recorded at Waypoint 096

Figure 7-38: Brick structures at Waypoint 097

Figure 7-39: Cemetery recorded at HD004

Figure 7-40: Potential stone packed grave at HD101

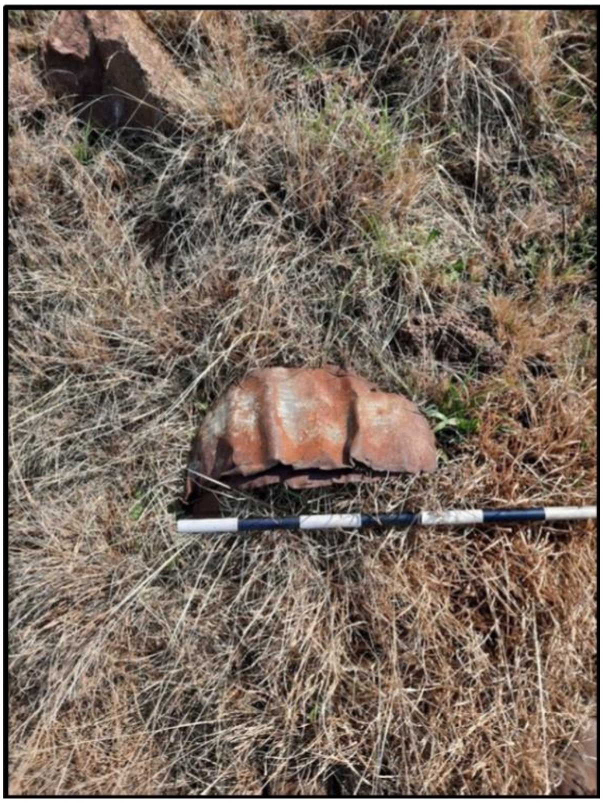


Figure 7-41: Corrugated iron that could have been a grave marker at HD101

Figure 7-42: Built feature at GA001 – north facing wall

Figure 7-43: Stone packed feature on Eastern site of GA002

Figure 7-44: Remains of a rectangular structure at GA003

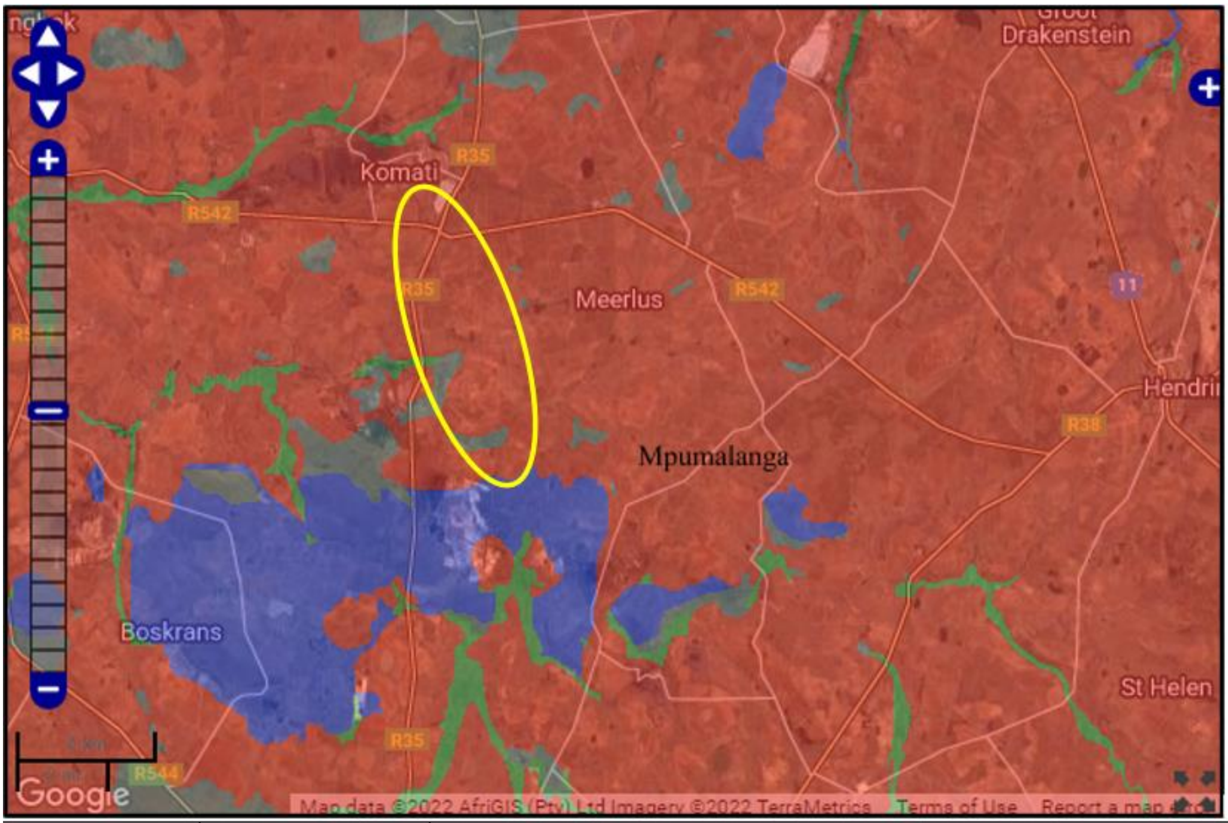
Figure 7-45: General view of graves in the cemetery at GA004

PALAEONOLOGY

According to the SAHRA Paleontological map the study area is of very high paleontological significance (**Figure 7-46**) and an independent study was conducted for this aspect. Bamford (2022) found that the proposed routes lie on the potentially very highly sensitive Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve impressions of fossil plants of the Glossopteris flora.

The site visit and walk through by the palaeontologist at the end of 2022 (summer) confirmed that there were NO FOSSILS of any kind present on the land surface. Most of the route is adjacent to existing roads and servitudes or across secondary grasslands or agricultural fields so there were no rocky outcrops and no fossils.

Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, developer, environmental officer, or other designated responsible person once excavations for pole foundations, access roads or the new substation have commenced. The routes are on the Vryheid Formation so there is no preferred option as far as the palaeontology is concerned. Since the impact will be low to moderate, as far as the palaeontology is concerned, the project should be authorised.



Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map

Figure 7-46: Palaeontological sensitivity of the site

CULTURAL LANDSCAPE

The site consists of multiple degraded and broken-down structures. These structures could possibly have been part of a farmstead with various buildings such as a house and accompanying infrastructure. The site is surrounded by large trees (pine and eucalyptus). The area is fairly overgrown with grass and weeds.

Farmsteads are complex features in the landscape, being made up of different yet interconnected elements. Typically, these consist of a main house, gardens, outbuildings, sheds and barns, with some distance from that labourer housing and various cemeteries. In addition, roads and tracks, stock pens and windmills complete the setup (Van Schalkwyk, 2012).

The greater area is mostly cultivated, and forms part of a landscape characterised by wide scale cultivation and mining activities. Development in the study area is limited to farming infrastructure such as access roads, fences, and agricultural developments. The cultural landscape qualities of the region essentially consist of one component. The first is a rural area in which the human occupation is made up of a pre-colonial element (Iron Age) as well as a much later colonial (farmer and industrial) component

7.3.5 VISUAL CHARACTER AND SENSITIVITY

VISUAL CHARACTER AND CULTURAL VALUE

The physical and land use-related characteristics of the study area as described above contribute to its overall visual character. Visual character largely depends on the level of change or transformation from a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural undisturbed landscape. Visual character is also influenced by the presence of built infrastructure including buildings, roads, and other objects such as telephone or electrical infrastructure. The visual character of an area largely determines the sense of place relevant to the area. This is the unique quality or character of a place, whether natural, rural, or urban which results in a uniqueness, distinctiveness, or strong identity.

The predominant land use in the area (maize cultivation) has significantly transformed the natural landscape across much of the study area. In addition, electricity infrastructure and mining activity, particularly in the south-western areas, have resulted in a high degree of visual degradation. The more industrial character of the landscape is an important factor in this context, as the introduction of the proposed elements of the Project would result in less visual contrast where other anthropogenic elements are already present, especially where the scale of those elements is similar to that of the proposed Project.

The scenic quality of the landscape is also an important factor that contributes to the visual character or inherent sense of place. Visual appeal is often associated with unique natural features or distinct variations in form. As such, the pastoral landscape and rolling hills in parts of the study area are important features that could increase the visual appeal and visual interest in the area.

Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world. The concept of 'cultural landscape' is a way of looking at a place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). In this instance, the rural / pastoral landscape represents how the environment has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small towns, such as Hendrina, engulfed by an otherwise rural / pastoral environment, form an integral part of the wider landscape.

Considering this, it is important to assess whether the introduction of the development as proposed into the study area would be a degrading factor in the context of the prevailing character of the cultural landscape. Broadly speaking, visual impacts on the cultural landscape in the area around the proposed project would be reduced by the fact that the visual character in much of the area has been significantly transformed and degraded by mining and infrastructural development.

VISUAL CONTRAST

The visual contrast of a development refers to the degree to which the development would be congruent with the surrounding environment. This is based on whether or not the development would conform to the land use, settlement density, structural scale, form and pattern of natural elements that define the structure of the surrounding landscape. Visual compatibility is an important factor to be considered when assessing the impact of the development on receptors within a specific context. A development that is unlike with the surrounding area could change the visual character of the landscape and have a significant visual impact on sensitive receptors.

In order to determine the likely visual compatibility of the proposed development, the study area was classified into the following zones of visual contrast:

- High –
  - undeveloped / natural / rural areas.
- Moderate –
  - areas within 500m of existing power lines (>=88kV)
  - areas within 500m of main roads
  - areas within 500m of railway infrastructure

— Low –

  — areas within 500m of urban / built-up areas
  — areas within 500m of quarries / mines etc

These zones are depicted in **Figure 7-47.**

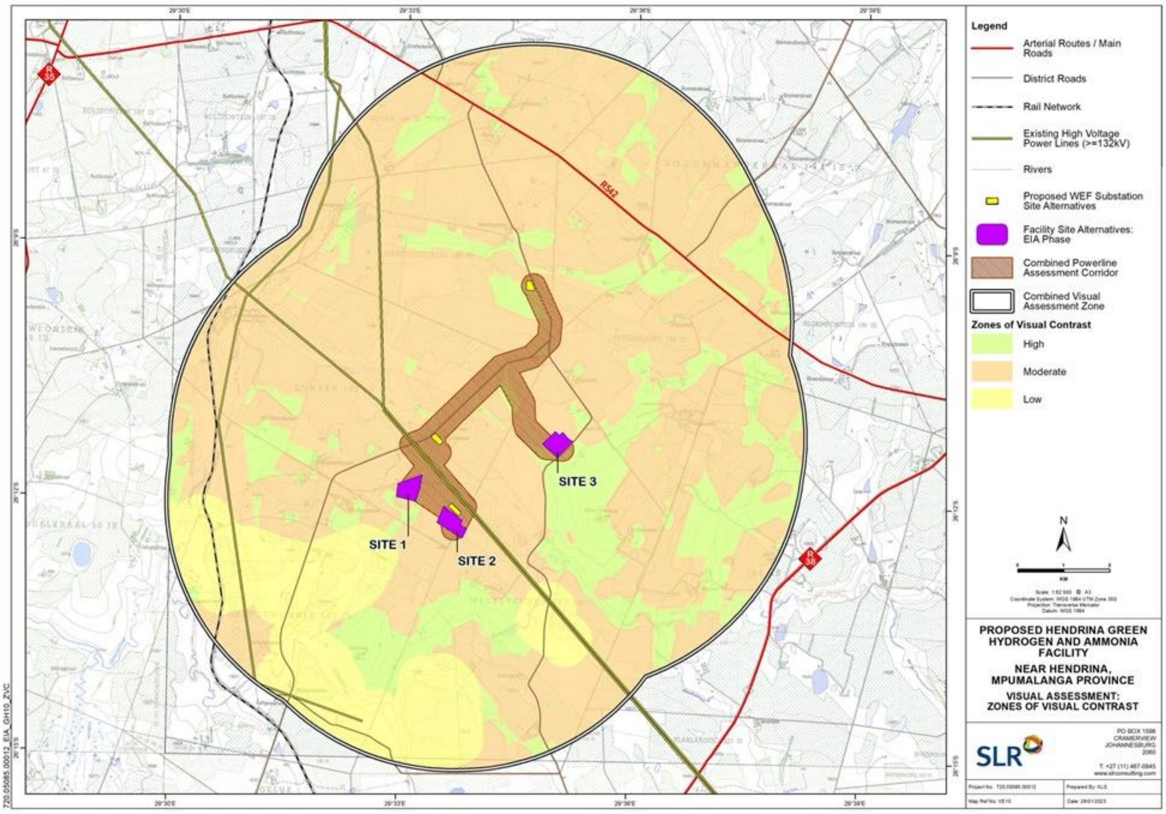


Figure 7-47: Zones of Visual Contrast for the Hendrina GH&A Site

A preliminary desktop assessment did not identify any formal protected areas or leisure-based tourism activities in the study area. The desktop assessment did however identify multiple farmsteads and residences within the study area. While these homesteads and residences could be seen as receptors, not all of them would be sensitive to the proposed development and given the number of farmsteads, it was not possible to confirm the presence of receptors at all the identified locations. Notwithstanding these limitations, all the identified receptor locations were assessed as part of the VIA as they are still regarded as being potentially sensitive to the visual impacts associated with the proposed development. None of these receptor locations was found to be sensitive.

Although the receptor locations are all believed to be farmsteads, they are regarded as potentially sensitive visual receptors as the proposed development could potentially alter natural or semi-natural vistas experienced from these locations. At this stage however, little information has been received regarding local sentiments towards the proposed development.

In many cases, roads along which people travel, are regarded as sensitive receptors. The primary thoroughfare in the study area is the R542 main road. This road and the other thoroughfares in the study area are primarily used as local access roads and do not form part of any scenic tourist routes. These roads are not specifically valued or utilised for their scenic or tourism potential and are therefore not regarded as visually sensitive.

The distance of the viewer / receptor location from the development is an important factor in the context of experiencing visual impacts which will have a strong bearing on mitigating the potential visual impact.

A high impact rating has been assigned to receptor locations that are located within 500m of the proposed facility and within 500m of the nearest OHL assessment corridor. The visual impact of the facility or powerline diminishes beyond 5km as the development would appear to merge with the elements on the horizon. Any visual receptor locations beyond these distance limits have therefore not been assessed as they fall outside the study area and would not be visually influenced by the proposed development.

At this stage of the process, zones of visual impact for the proposed facility and OHL have been delineated according to distance from the boundary of the facility site alternatives and from the combined OHL assessment corridors. Based on the height and scale of the project, the distance intervals chosen for the zones of visual impact, are as follows:

- 0 – 500 m (high impact zone)
- 501 m – 2 km (moderate impact zone)
- 2.1 km – 5 km (low impact zone)

A GIS-based visibility analysis was undertaken, it was possible to determine areas that would be visible to the highest numbers of receptors in the study area. However, this analysis found that none of the site alternatives are significantly more visible than the others. As such, in terms of visibility, no areas were found to be more sensitive than others.

In addition, investigation determined that there are no sensitive or potentially sensitive receptors within 500 m of any of the site alternatives that would be affected by the development and as such, no areas of visual sensitivity were identified in relation to any of the site alternatives.

The identified potentially sensitive visual receptor locations for the proposed project and OHL are indicated in **Figure 7-48** and **Figure 7-49** below.

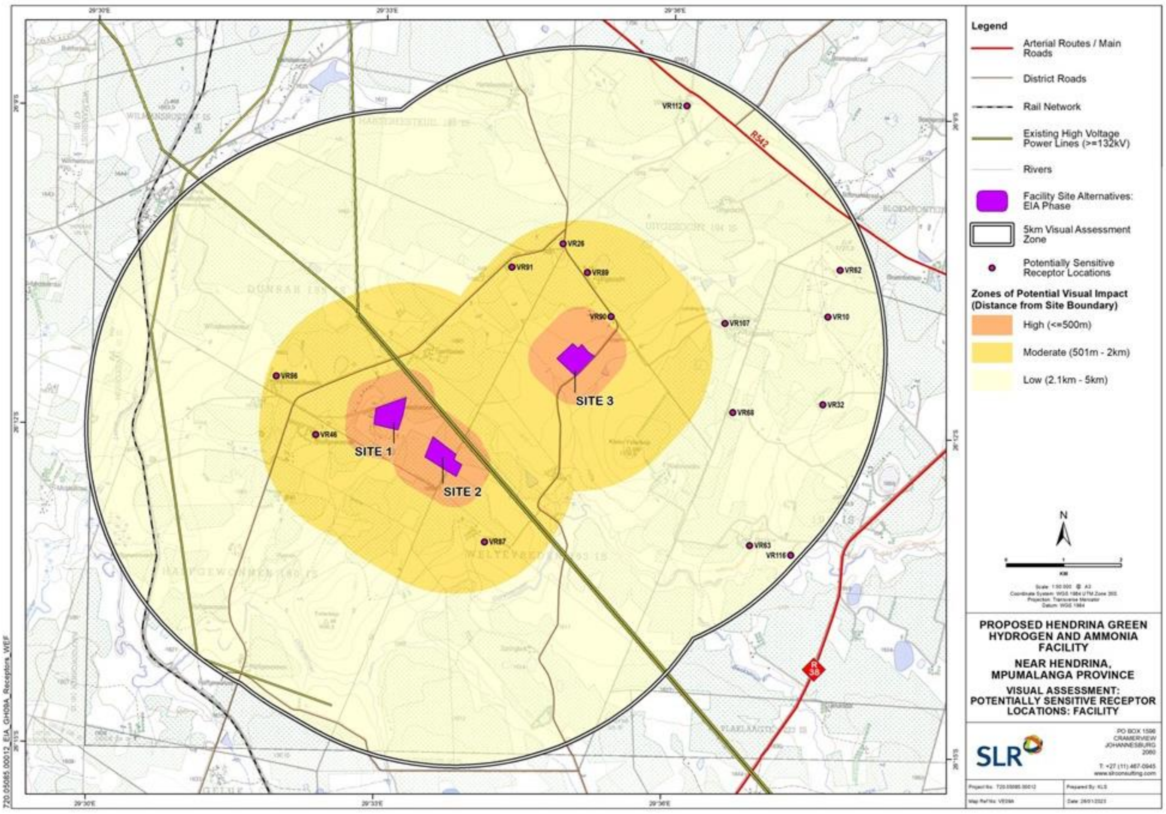


Figure 7-48: Receptor locations within 5km of the Hendrina GH&A site alternatives

The same GIS-based visibility analysis was undertaken for the OHL, it was possible to determine which sectors of the combined assessment corridor would be visible to the highest numbers of receptors in the study area. This analysis confirmed that areas of higher elevation are visible to greater numbers of potentially sensitive receptors. Hence the visual prominence of a tall structure such as a powerline tower would be exacerbated if located on any ridges or a relatively higher-lying plateaus.

It is noted that the proposed OHL route alignment traverses some ridges and areas of relatively higher elevation that could be seen as areas of potentially high visual sensitivity. However, the presence of existing powerlines and road infrastructure as well as the fact that the study area as a whole is rated as having a low visual sensitivity would reduce the sensitivity rating of the ridges to "Medium".

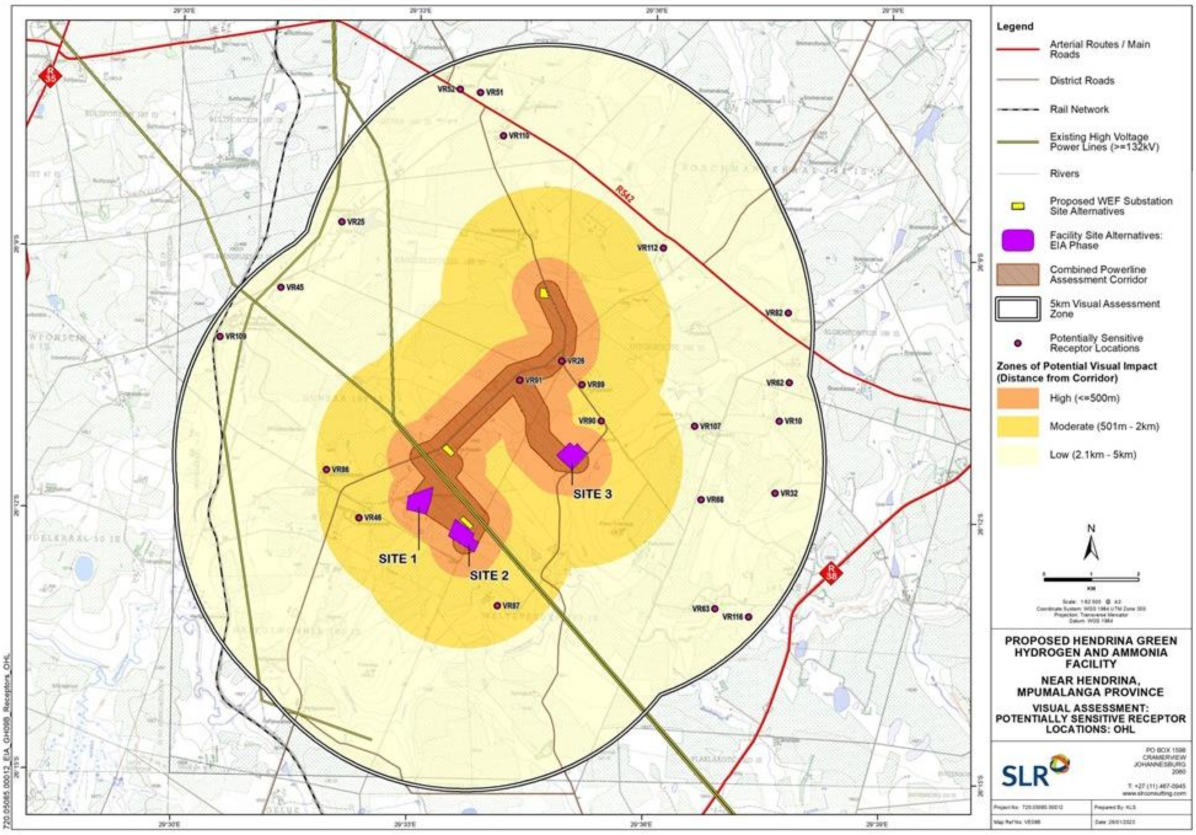


Figure 7-49: Receptor locations within 5km of the OHL combined assessment corridor

7.3.6 SOCIO-ECONOMIC

SOCIAL OVERVIEW OF THE STUDY AREA

According to Census 2011, Steve Tshwete Local Municipality has a total population of 217 073 people, of whom 73,6% are black African, and 21,8% are white. The other population groups make up the remaining 4,6%. Of those aged 20 years and older, 3,4% have completed primary school, 30,8% have some secondary education, 35% have completed matric, and 14,4% have some form of higher education, while 7,4% of have no form of schooling. According to Census 2011, Govan Mbeki Local Municipality has a total population of 294 538, of which 80,5% are black African, 16,0% are white, with the other population groups making up the remaining 3,5%.

Of those 20 years and older, 3,9% completed primary school, 33,9% have some secondary education, 31,4% completed matric, and 12,6% have some form of higher education. The percentage of those aged 20 years and older with no form of schooling is 7,9%.

Mpumalanga has a youthful population with approximately 64% of the population consisting of economically active people (15 to 34 years of age). This provides significant human resources for future economic growth and sustainability. The project will promote infrastructure and create employment opportunities.

The land portions on which the proposed project will be located are currently used for agriculture (predominant use). This farming is in the form of livestock farming with the predominant form of livestock being beef (50% of respondents). Most of the farms earmarked for development indicated crop farming (drylands). None of the farms are utilised for tourism related activities, such as hunting.

According to the Socio-Economic Impact Assessment report, undertaken by Urban Econ (2021), from the data obtained from surveyed landowners, it is estimated that agricultural operations in the directly affected area employ approximately 112 people, the majority of whom are permanent employees (71 people). Most of the employees live on the farm and those who do not, live on the adjacent farms and Kwazamakuhle in Hendrina. It is recognised that the majority farms in the area practice a combination of crop and livestock activity. As such, most farms are involved in both land uses as indicated previously. The following observations were made regarding land use:

— Three of the four respondents operate as commercial farmers
— Beef was the largest portion of livestock, approximately 1150 cattle, followed by sheep, with approximately 30 sheep. One of the farmers indicated that they farm with pigs (10 pigs)
— The average size of property owned was 1060ha and ranged between 120 and 2000ha
— The majority of labourers live on the farms they work on with their family members
— Livestock animals reared for sale and kept for production of food products include goats, sheep and cattle
— All of the farms are the primary residence of the farm owner

Given the small number of responses received from owners in the area, it has not been possible through primary research to estimate the total contribution of the agricultural industry to the local economy.

ADMINISTRATIVE CONTEXT

The study area is located within the Steve Twhwete Local Municipality within the Mpumalanga Province. This is one of the six Local Municipalities that make up the Nkangala District Municipality (**Figure 7-50**). The town of Middleburg is the administrative seat of the Steve Twhwete Local Municipality.

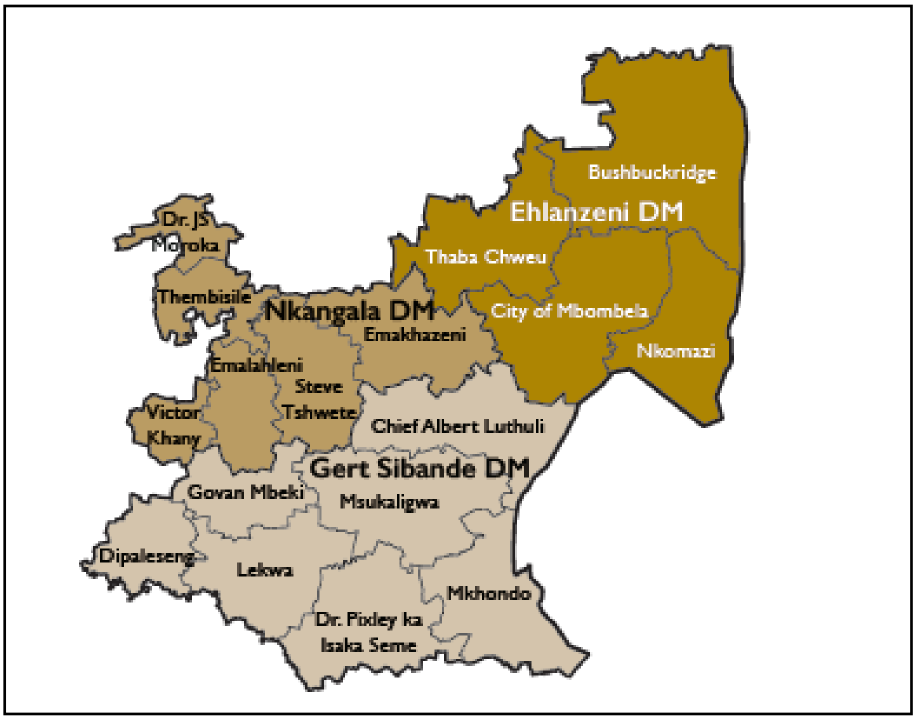


Figure 7-50: Location of Steve Tshwete Municipality within the Nkangala District Municipality and Mpumalanga Province

DEMOGRAPHIC OVERVIEW

POPULATION

The Steve Tshwete Local Municipality falls within the Nkangala District Municipality and collectively account for 17% of the population, and 18% of the households in the district. Population growth between 2011 and 2021 was 2,5% year-on-year for the LM which compared favourably to the DM (2,2%) and Mpumalanga (1,5%) over the same period. The overview of both the local and district municipalities are outlined in **Table 7-20** below.

Table 7-20: Overview of the Local and District Municipalities population structure (*Standardised Regional (2021); Stats SA (2021) forecast to 2023*)

INDICATOR	MPUMALANGA	NKANGALA DISTRICT MUNICIPALITY	STEVE TSHWETE LOCAL MUNICIPALITY
Area (km^2)	76 495	16 758	3 976
Population	4 839 562	1 702 174	289 117
Number of Households	1 292 665	467 029	82 678
Population density (km^2)	63	101	72
Average household size	3,8	3,7	3,6
Annual population growth (2009-2019)	1,5%	2,2%	2,5%
Average monthly household income	**R 7 061**	**R 7 601**	**R 11 778**

The disposable average monthly income of households in the LM was R 11 778 which was 35% higher than the average for DM (R 7 601) and 40% higher than the average for the Mpumalanga.

HOUSEHOLDS AND HOUSE TYPES

The following infrastructure categories are amongst the key within the municipality; water and sanitation, waste and electricity. The municipality provide services at household level rather than individual level. The number of households in Steve Tshwete increased from 64 971 in 2011 to 86 713 households (almost 22 000 households increase) in 2016 representing 20.6% of the Nkangala household figure. The household size declined from 3.5 to 3.2 in the same period. The community survey 2020 results indicates that the housing backlog for the municipality is at 51 570 and 14.4% of the households live in informal settlements.

HOUSEHOLD INCOME

According to Census 2011, the average annual household income increased from R 55 369 per annum in 2001 to R134 026 per annum in 2011. This represents an absolute increase in nominal terms over the 10-year period, which was the highest among the eighteen local municipalities in the province. This is closely related to its higher education levels and employment rates.

Household income levels are likely to have been impacted by the COVID-19 pandemic. The number of households in the Steve Tshwete Local Municipality that live close to or below the poverty line is likely to have increased over the last 18 months. This, coupled with the high dependency ratio, is a major cause of concern for the area.

EMPLOYMENT

The review of the employment profile of the LM indicates that 28.2% of the economically active population within the municipality is formally unemployed (**see Table 7-21**). The unemployment rate and labour force participation rate in the LM were also notably better than that of the DM (Unemployment rate: 40,3%; Labour force participation rate: 33,1%).

The relatively lower unemployment rate and higher labour force participation relative to the district averages further suggests that the LM is subject to inward migration due to the employment opportunities available within the local municipality

The largest employing industries in Steve Tshwete trade (including tourism), community services, finance and mining. Concern about the high-unemployed youth & especially females relatively low level of education and inadequate skills impact negatively on their employability. Importance of quality and relevant education and training in line with the economic needs of the province – important role of the University of Mpumalanga & TVETs.

Table 7-21: Employment profile of the study areas (2021) (*Quantec Standardised Regional, 2023*)

INDICATOR	MPUMALANGA	NKANGALA DISTRICT MUNICIPALITY	STEVE TSHWETE LOCAL MUNICIPALITY
Employed	1 051 844	370 184	89 088
Unemployment Rate	37,3%	40,3%	28,2%
Not Economically Active	1 395 317	498 445	75 071
Labour force participation rate	34,2%	33,1%	44,7%

EDUCATION

Steve Tshwete's grade 12 pass rates deteriorated slightly from 85.6% in 2014 to 84.7% in 2020 but was still the 2nd best/highest in the province. Steve Tshwete's pass rate also declined/deteriorated between 2019 and 2020 by 4.3 percentage points – very much Covid-19 related factors. The area achieved an admission rate to university/degree studies of 42.0% in 2020, which was the highest of the 17 municipal areas in the province.

The challenge is to accommodate the educated young people in the area – inadequate economic opportunities. Provision of adequate educational, recreational infrastructure, and skills development activities to meet the needs of the community. Steve Tshwete's functional literacy is improving, and it is the 2nd highest in the province.

MUNICIPAL SERVICES

ELECTRICITY

The 2016 community survey figures depicted that there were 86713 households in the municipal area of which 90.1% households had access to electricity. This backlog is made up of backyard dwellers, rural and farm dweller homes. Electricity is an average size industry in the municipality with only no operational green hydrogen facilities. Any new development would likely greatly increase the contribution of the utilities and construction sectors to the gross value added.

ACCESS TO WATER AND SANITATION

According to the Steve Tshwete IDP (2022), 81.9% of households had access to potable water (household connections and communal stands) and 85.4% had flush and chemical toilets.

The rural areas of the municipality is about 39.7% which is the lowest levels of households provided by the local water scheme by the municipality and water service provider, at least 41.1% use boreholes and water tankers whilst 10.1% utilize source of water. Most of the households located within the functional areas (Middelburg (68.2%) and Steve Tshwete Mining Area (71.1%)) piped water within the dwelling (36.2%) and access to piped water within the yard (26.2%)

REFUSE COLLECTION

Waste collection from residential premises is carried out on a weekly or bi- weekly basis. The total percentage of households with access to waste removal services is 85% as per 2016 community survey (Steve Tshwete IDP, 2022). The municipal service has extended the services to all the municipal towns but excluded the mining towns which are self-served, Kranspoort, Somaphepha, Mafube and rural areas. The areas are currently serviced with either communal skips or through waste transfer stations.

Waste disposal is centralized, and all waste collected in the various centres (including garden waste and builder's rubble) is transported to the permitted Middelburg landfill site for disposal. The haulage of waste from Hendrina and surrounding areas creates a huge financial burden on the operating budget due to fuel and maintenance costs, and the landfill is reaching its lifespan earlier than it was expected.

ECONOMIC DEVELOPMENT

Steve Tshwete LM can be regarded as one of the commercial hubs in Mpumalanga with a 14.3% contribution to the Mpumalanga economy – 3rd largest ranked economy in the province for 2019. In the District the municipality contributes 36.0% to the economy making it the 2nd largest economy in the Nkangala District Municipality. The dominating economic sectors are Mining, Manufacturing, Trade and Agriculture.

Steve Tshwete's economy and Growth Domestic Product (GDP) continues to grow steadily. The average annual economic growth was 2.4% over the period 1996 to 2019. For the period 2014 to 2019, the economy only expanded by 0.8% p.a. as a result of the weak economic climate in the country and the impact of Covid-19 lockdown in 2019/2020.

The GVA (Gross Value Added) of the LM was R 76,7 million in 2021 (2015 constant prices), which collectively accounts for 28,2% of the district economy's GVA, and 11,3% of the Mpumalanga's GVA (Quantec, 2023). This suggests that, although the LM is relatively small in terms of its GVA, it is important in the broader DM in terms of economic output.

Manufacturing, Mining, tourism, energy generation and agriculture are the main drivers of the municipal economy in Steve Tshwete. These industries generate mass employment and procurement opportunities and are mainly in rural parts of this local municipality. The two main economic drivers and dominant industries are the mining and metal and steel manufacturing industries.

Table 7-22 shows that the mining and quarrying sector employs the most with a 19,44% contribution in 2021. In 2011 the trade sector employed 18,21% of the total employment in the LM.

The local agricultural sector includes limited subsistence (informal) farming, unlike other areas in Mpumalanga, where this practice is more dominant. The presence of this subsistence agricultural means that the number of households that are dependent on agricultural activities for income could be slightly greater than the figures presented in **Table 7-22**. This is because the table only indicates those individuals that are formally employed in the agricultural sector.

Table 7-22: Employment structure and contribution of the Steve Tshwete Local Municipality between 2011 and 2021, per economic sector

	CONTRIBUTION TO EMPLOYMENT PER SECTOR	
SECTOR	2011	2021
Agriculture and hunting	4,11%	4,55%
Mining and quarrying	19,34%	19,44%
Manufacturing	11,36%	10,67%
Electricity, gas, and water	1,93%	1,74%
Construction	7,58%	8,47%
Trade	18,21%	16,25%
Transport and communication	3,18%	3,13%

	CONTRIBUTION TO EMPLOYMENT PER SECTOR	
SECTOR	**2011**	**2021**
Finance and business services	11,43%	12,92%
Community services	4,65%	4,84%
General government	18,21%	17,99%
TOTAL EMPLOYMENT	**80 088**	**89 088**

In general, agricultural activities are relatively labour intensive, thus a small decline in the size of the sector would generally lead to greater job losses than for example in manufacturing or utilities, which tend to be more capital intensive in nature. The agricultural sector is also frequently one of the largest employers in rural areas and it is for these two reasons that the sector is generally prioritised in development strategies. An important aspect to note is that finance and business services now account for a larger proportion of labourers in the municipality than agriculture.

HEALTH, EDUCATION AND COMMUNITY FACILITIES

The healthcare sector is developing through the expansion of both the public and private health facilities. Midmed hospital has expanded to increase its capacity. The new regional public hospital is under construction and is scheduled to be completed by end of 2020. New clinics have been built in Sikhululiwe village and Rockdale and an additional one planned for Newtown.

7.3.7 HEALTH AND SAFETY RISK

The map below shows that the Green Hydrogen and Ammonia facility are planned in relatively isolated locations. Activities in the area consist of farming, power generation and there are coal mining rights over some of the land involved in the greater Hendrina development.

The three alternatives have been assessed from a SHE risk assessment point of view by the specialist and where there is a choice of location that is further from public roads, water courses or isolated farmhouses, that would be preferred. **Figure 7-51** below shows the closest occupied farmhouses are approximately 900m west of the site alternative 1, 1.8km west of location option 2 and 300m northeast of site alternative 3. Residential areas of concentrated population are all over 10km from the site. There is active coal mining activity over 2km to the south location alternatives 1and 2. The local access road (tar between the R542 in the northeast and the R35 in the southwest) runs 750m away to the west of site alternative 1. From these tar access roads there will be local gravel access roads to the actual sites.

Figure 7-51 below shows the locality of the proposed alternative sites.

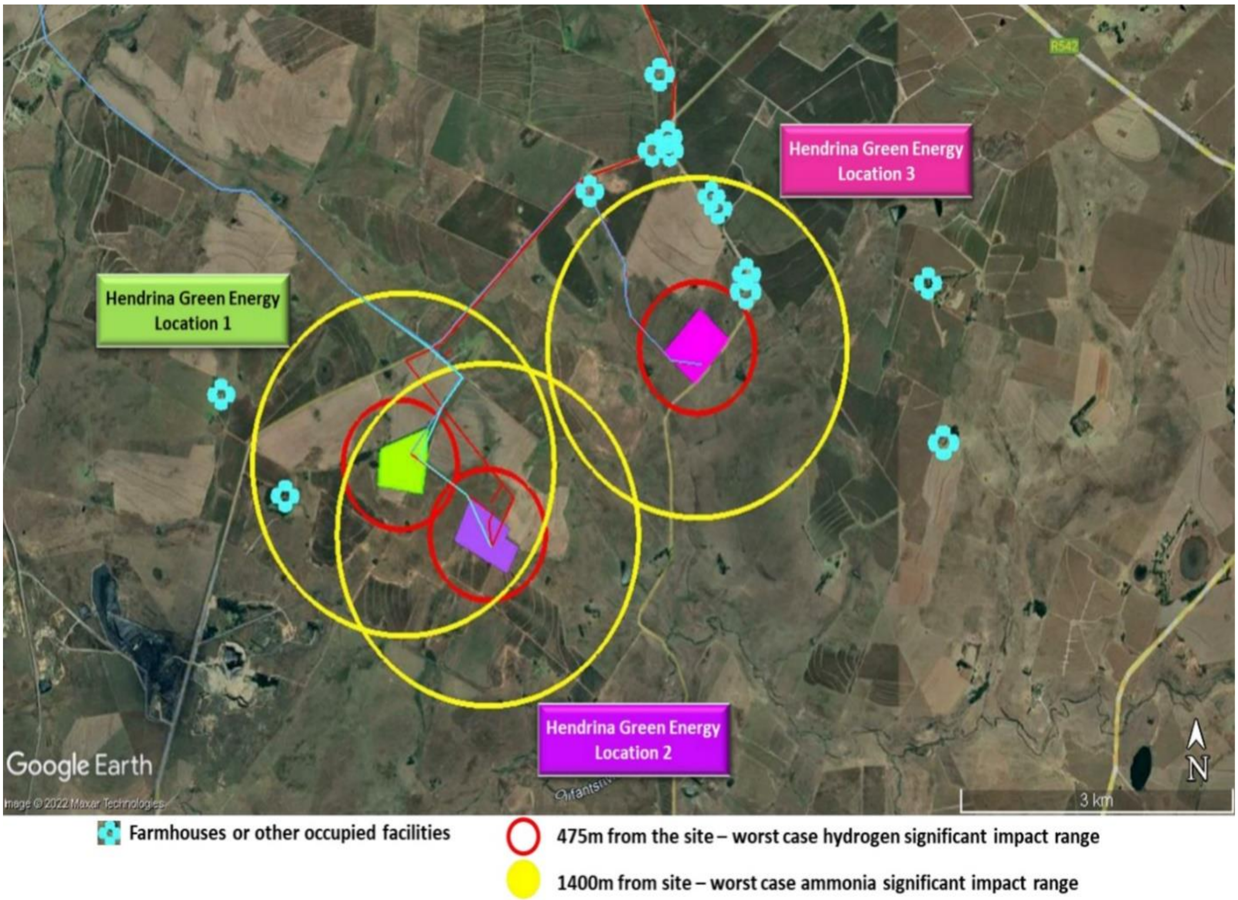


Figure 7-51: Worst case significant impact circles around the Green Hydrogen (Red) and Ammonia (Yellow) facilities - in relation to the location of Farmhouses (Blue) in the area

Across South Africa, lightning strikes are conceivable as a source of ignition of major hazards, refer to SANS10313:2012 lightning strike density table. The lightning ground flash density (ground strike rate) in Ermelo (12.8 Flashes/km^2/year) in very high. Nevertheless, ignition from on-plant sources is much more likely than lightning but lightning cannot be ignored as a source of risk particularly for tall structures in wide open flat areas.

The combination these three technologies, hydrogen electrolysis, LAES and Haber-Bosch, into a new arrangement in order to store and transport energy is however a relatively new concept. There have been a few demonstration plants built around the world. At this stage of the project development only the basic elements of the design are known, e.g. production rate, total storage capacities, possible range of operating pressures and temperatures etc. Details of the plant design, as would typically appear on piping and instrumentation diagrams, such as process conditions, control systems, emergency shutdown systems, and pipeline sizes are not yet available. Listed below are the associated risks with the operation of the facility these include but are not limited to:

Electrolyser

Water will be piped to the site (possibly from the Komati Power Station) where it will be filtered before being stored for use in the electrolysis plant. There will be a reverse osmosis plant on site to treat water to a suitable standard for use in the brine makeup to the electrolysers. The brine will be circulated into the electrolysis unit where the water molecules will be split into hydrogen and oxygen gases at the anodic and cathodic sides of the unit. The gases will disengage from the brine phase and be extracted from the electrolyser using extraction fans/compressors. Any waste brine will be crystalized and disposed of under suitable license.

Hydrogen

Hydrogen gas will then be compressed to about 200 bar and stored in one of 20 horizontal 40-ton storage tanks. The tanks will be specifically designed for hydrogen service and located in a dedicated storage area.

Oxygen

Oxygen gas generated on the other side of the electrolyser can either be vented or compressed and stored or cooled, condensed and stored cryogenically as a liquid. At this stage the project only makes allowance for venting.

Air Separation Plant

A standard air separation plant including cold box will be installed. The oxygen from the facility will join the oxygen from the electrolyser plant.

Nitrogen

Nitrogen will be stored cryogenically in one of 2 tanks of approximately 2000 tons each. Nitrogen liquid can be re-vapourised for use in the Haber-Bosch process and as purging gas throughout the plant.

Argon

Argon will be generated from the air separation plant and at this stage it will be vented.

Haber-Bosch Process

In the Haber-Bosch process nitrogen and hydrogen vapours are mixed in a catalytic reactor under 100 - 200 barg. To favour the production of ammonia, an operating temperature in the range of 350 - 525 °C is recommended. After production cooling and clean-up, the ammonia can be liquefied for ease of storage and safety. For this process it is assumed to be stored at cryogenically in one of three 1523-ton tanks. If the ammonia is stored at ambient conditions of 25°C and 10 bar, or if the cryogenic storage volumes are larger than stated above, then the worst-case impact ranges quoted in this report will change.

LPG

There will be a need for hydrogen and ammonia pressure relief valves, hydrogen / ammonia purging etc. and for this purpose a flare may be required. LPG is likely to be needed to ensure a constant pilot flame in the flare.

Gantry and Road Tanker Loading

There will be an area where anhydrous ammonia, possibly nitrogen, oxygen and/or hydrogen may be loaded into various types of road tankers for despatch to customers, or importation for supply shortfall etc. On any site, the human interface is greatest at the gantry area and this area usually presents some of eth heist risks. Therefore, this facility will need to be state of the art with loading arms, break away couplings, curing, gas detectors and emergency shut down systems, over fill protection etc.

Other

As part of the facility there will be various support utilities such as, a small sewage treatment plant, maybe a small boiler, workshops, admin buildings, diesel powered generator, diesel for trucks/forklifts electrical infrastructure and a flammable store (e.g. for paints and maybe cylinder) etc.

Staff and shift arrangement

At this stage the numbers of persons on site are unknown. However, the green ammonia plant is not likely manually intense processes and there are likely to be very few persons on site, mostly during the day for maintenance activities etc. This assessment as assumed a maximum of 100 persons on the entire facility during the day and 20 at night. If the project is constructed in phases, it is noted that there may be significantly more persons on the site doing construction adjacent operating facilities. This will need to be carefully planned to ensure limited exposure of construction personnel to operating hazards.

Environmental hazards

Since most of the materials that will be generated on this site are actually gases that occur naturally in the atmosphere (except ammonia) no major chemical pollution impact would be expected from catastrophic events.

Anhydrous ammonia is used by some agricultural operations as a fertilizer and may thus have nitrification effects on the vegetation in the area if accidentally released. It should be noted that the cryogenic materials are extremely cold and destruction of vegetation by freezing could be expected within approximately the same range as the adverse effects on humans. In a similar vein, hydrogen flash fires that extend off site will lead to destruction of vegetation and possible secondary veld fires.

As with any site with chemicals and equipment, a fire and the use of large amounts of firewater used in fighting fires on site, which may be severely contaminated and may then flow offsite into watercourses leading to offsite ground and water contamination. This needs to be considered in the on-site emergency plan.

Hazardous material interactions

On any site where different materials are used, it is conceivable (however unlikely) that at some time certain materials may inadvertently be mixed with other materials. On this site no materials will be arriving in bulk road trucks or other containers. Uncontrolled mixing from offloading is therefore not conceivable. Mixing may happen due to process upsets or incorrect operation of the plant. Uncontrolled mixing of oxygen and hydrogen may lead to fires/explosions etc. Although extremely unlikely, if oxygen, nitrogen or argon are produced as by-products to be sold it may be possible to load products into the incorrect road tankers. Mixing of oxygen and ammonia may lead to a fire and explosion. This scenario is included in the catastrophic rupture scenario for ammonia road tankers.

The products and raw materials as they are normally stored are stable with no hazardous breakdown products.

8 SITE SENSITIVTY VERIFICATION

8.1 SOIL AND AGRICULTURAL SENSITIVITY

Agricultural sensitivity is a direct function of the capability of the land for agricultural production. All arable land that can support viable crop production, is classified as high (or very high) sensitivity. This is because there is a scarcity of arable production land in South Africa and its conservation for agricultural use is therefore a priority. Land which cannot support viable crop production is much less of a priority to conserve for agricultural use and is rated as medium or low agricultural sensitivity.

The screening tool classifies agricultural sensitivity according to only two independent criteria – the land capability rating and whether the land is used for cropland or not. All cropland is classified as at least high sensitivity, based on the logic that if it is under crop production, it is indeed suitable for it, irrespective of its land capability rating.

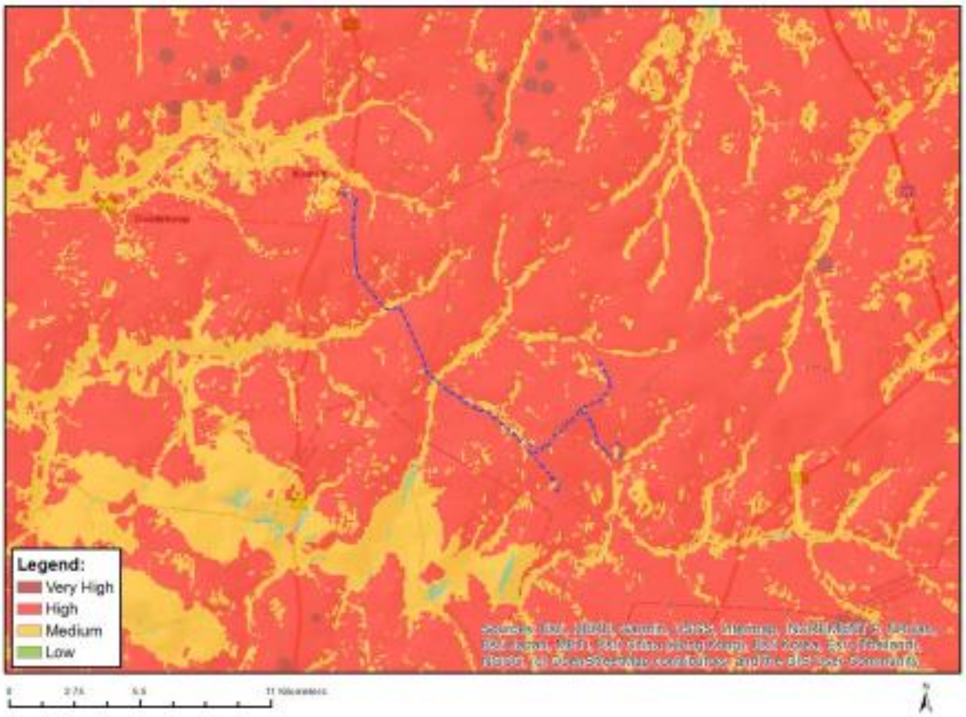
The screening tool sensitivity categories in terms of land capability are based upon the Department of Agriculture's updated and refined, country-wide land capability mapping, released in 2016. The data is generated by GIS modelling. Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rain fed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land, based on its soil, climate and terrain. The higher land capability values (≥8 to 15) are likely to be suitable as arable land for crop production, while lower values are only likely to be suitable as non-arable grazing land.

A map of the proposed development area overlaid on the screening tool sensitivity is shown in **Figure 8-1**. The land capability values of all three alternative facility sites vary between 8 and 10. However, the small-scale differences in land capability across the project area are not very accurate or significant at this scale and are more a function of how the land capability data is generated by modelling, than actual meaningful differences in agricultural potential on the ground. Historical land use is a more reliable indication of soil cropping potential than land capability. The suitable versus the unsuitable soils have been identified over time through trial and error. In an agricultural environment like the one being assessed, all the suitable soils are generally cropped, and uncropped soils can therefore fairly reliably be considered to be unsuitable for crop production. Cropped areas are shown in **Figure 7-10.**

The most easterly of the 3 sites (alternative 3) is therefore actually the lower potential site because it is uncropped and should be classified as medium agricultural sensitivity. Part of both of the other two sites are on cropland which is therefore confirmed as high agricultural sensitivity. Much of the pipeline route runs on land classified as high agricultural sensitivity, but the entire pipeline route runs on the edges of croplands rather than through them, which reduces its agricultural impact, furthermore the pipeline will run along an existing servitude route.

This site sensitivity verification verifies those parts of the site that are indicated as cropland in **Figure 7-10** and **Figure 7-11** as being of high agricultural sensitivity and the rest of the site as being of medium agricultural sensitivity.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;09. Moderate-High/10. Moderate-High
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

Figure 8-1: The DFFE screening tool rating for the Agriculture Theme, Alternatives 1, 2 & 3

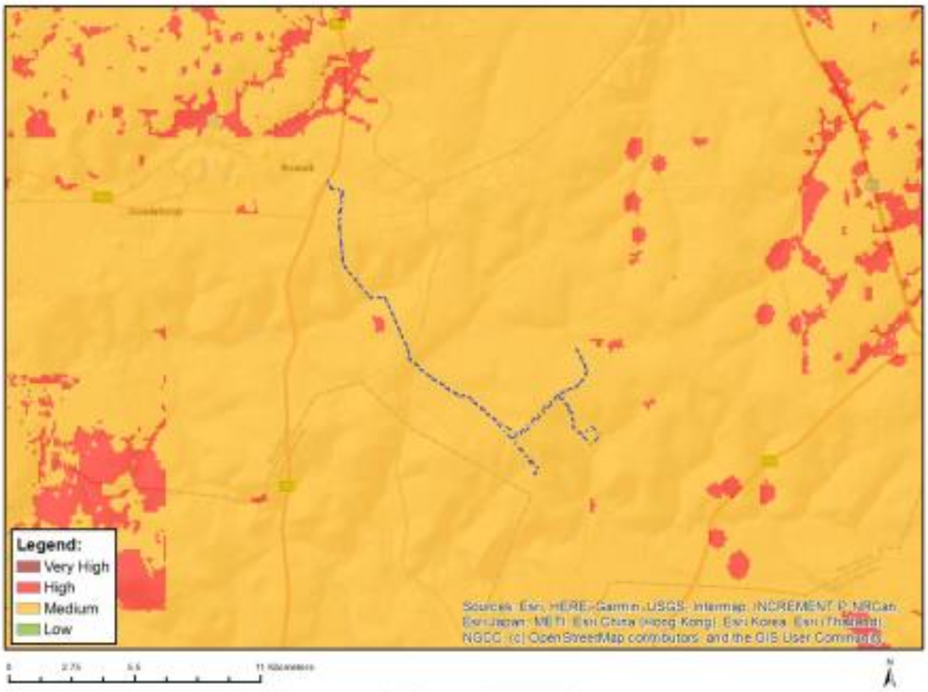
8.2 AVIFAUNAL SENSITIVTY

According to the DFFE national screening tool, the habitat within the broader area is classified as mostly Medium sensitivity with a two small High sensitivity areas according to the Animal Species theme (**Figure 8-2**). According to the Terrestrial Animal Species Protocol, confirmed habitat, or the presence SCC within the project area, triggers a High sensitivity classification (see definition of High sensitivity in the protocol).

The classification should therefore be High sensitivity for the project area, based on actual conditions recorded on the ground during the four seasons of pre-construction monitoring at the proposed wind energy facilities, which included the area covered by the project area of interest.

The High classification is linked to Yellow-billed Stork Mycteria ibis, and the medium classification is linked to Caspian Tern *Hydroprogne caspia*, White-bellied Korhaan *Eupodotis senegalensis* and African Grass Owl *Tyto capensis.*

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Hydroprogne caspia
Medium	Aves-Eupodotis senegalensis
Medium	Aves-Tyto capensis
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi

Figure 8-2: The DFFE screening tool rating for the Animal Theme (inclusive of avifauna), Alternatives 1, 2 & 3

Hydroprogne caspia

The Caspian Tern is listed globally as Least Concern and as Vulnerable in South Africa. It has a cosmopolitan but scattered distribution. Their breeding habitat is large lakes and ocean coasts in North America, Europe, Asia, Africa, and Australasia (Australia and New Zealand). European and Asian birds spend the non-breeding season in the Old World tropics. African and Australasian birds are resident or disperse over short distances. Within South Africa, it is found in estuaries and sheltered bays along the coastline, and at large, permanent inland waterbodies. The study area is marginal for the species and there is no suitable habitat on site. It is therefore unlikely to occur there.

Eupodotis senegalensis

The White-bellied Korhaan, listed as Vulnerable, is patchily distributed in the Afrotropics from West Africa to South Africa. It is the most-commonly sighted Korhaan at high altitudes in KwaZulu-Natal and southern

Mpumalanga. It is near-endemic to the Grassland Biome. It requires longer grass than other bustards and generally avoids overgrazed and recently burnt areas, although they do occasionally move into open areas in winter to forage. The species could possibly occur in the study area, although there is limited amounts of suitable habitat available.

Tyto capensis

The African Grass Owl is listed as Vulnerable. It is confined to the higher rainfall areas in the eastern half of South Africa, where it typically roosts and breeds in tall, rank grass or sedges associated with damp substrates, such as permanent and non-perennial wetlands and streams. The Olifants River is an important corridor for the species, and there is an important (No-Go) location mapped on the Endangered Wildlife Trust website 8 km to the east of the site. It is possible that extends up the connected drainage lines into the study area. It is almost certain that this species occurs on site and that it traverses the areas within and adjacent to the Olifants River and associated floodplain, as well as within surrounding natural grasslands and wetlands.

The following SCC were recorded in the project area: Secretarybird (Globally Endangered, Locally Vulnerable), Southern Bald Ibis (Locally and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), Denham's Bustard (Globally Near-threatened, Regionally Vulnerable) Lanner Falcon (Regionally Vulnerable) and Lesser Flamingo (Globally and Regionally Near threatened).

8.3 BAT SENSITIVITY

The national Screening Tool does not provide information for a Green Hydrogen and Ammonia theme in relation to bats, therefore the sensitivity map is based on the specialist site visits and data gathered during the 12-month assessment.

Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and moderate sensitivities relating to bat species ecology and habitat preferences, where high sensitivities are no-go zones for certain GH&A infrastructure (**Table 8-1** and **Table 8-2**) and **Figure 8-3** depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

Considering the bat sensitivity map, both location Options 1 & 3 are intruding onto high bat sensitivity areas, and should be relocated to be outside these areas, or not be selected as preferred options.

Table 8-1: Description of parameters used in the development of the sensitivity map.

Last revision	**November 2021**
High sensitivities and 200m buffers	Clumps/rows of tall trees and buildings that can provide roosting space for bats, or attract foraging bats
	Pans and depressions
	Dams
	Drainage lines capable of supporting riparian vegetation
	Other water bodies and other sensitivities such as manmade structures, buildings, houses, barns, sheds.
Moderate sensitivities and 150m buffers	Seasonal wetlands
	Seasonal drainage lines

Table 8-2: The significance of sensitivity map categories for each infrastructure component for the Grid connection substations.

Sensitivity	GHA buildings	Roads and cables	Internal overhead transmission lines	Substation and construction camp/yards)
High Sensitivity	These areas are 'no-go' zones for infrastructure where earthworks and vegetation clearing are required.	Preferably keep to a minimum within these areas where practically feasible.	Allowed inside these areas.	Avoid these areas.
High Sensitivity buffer	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.
Moderate Sensitivity	Not favourable for infrastructure where earthworks and vegetation clearing are required.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.
Moderate Sensitivity buffer	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.

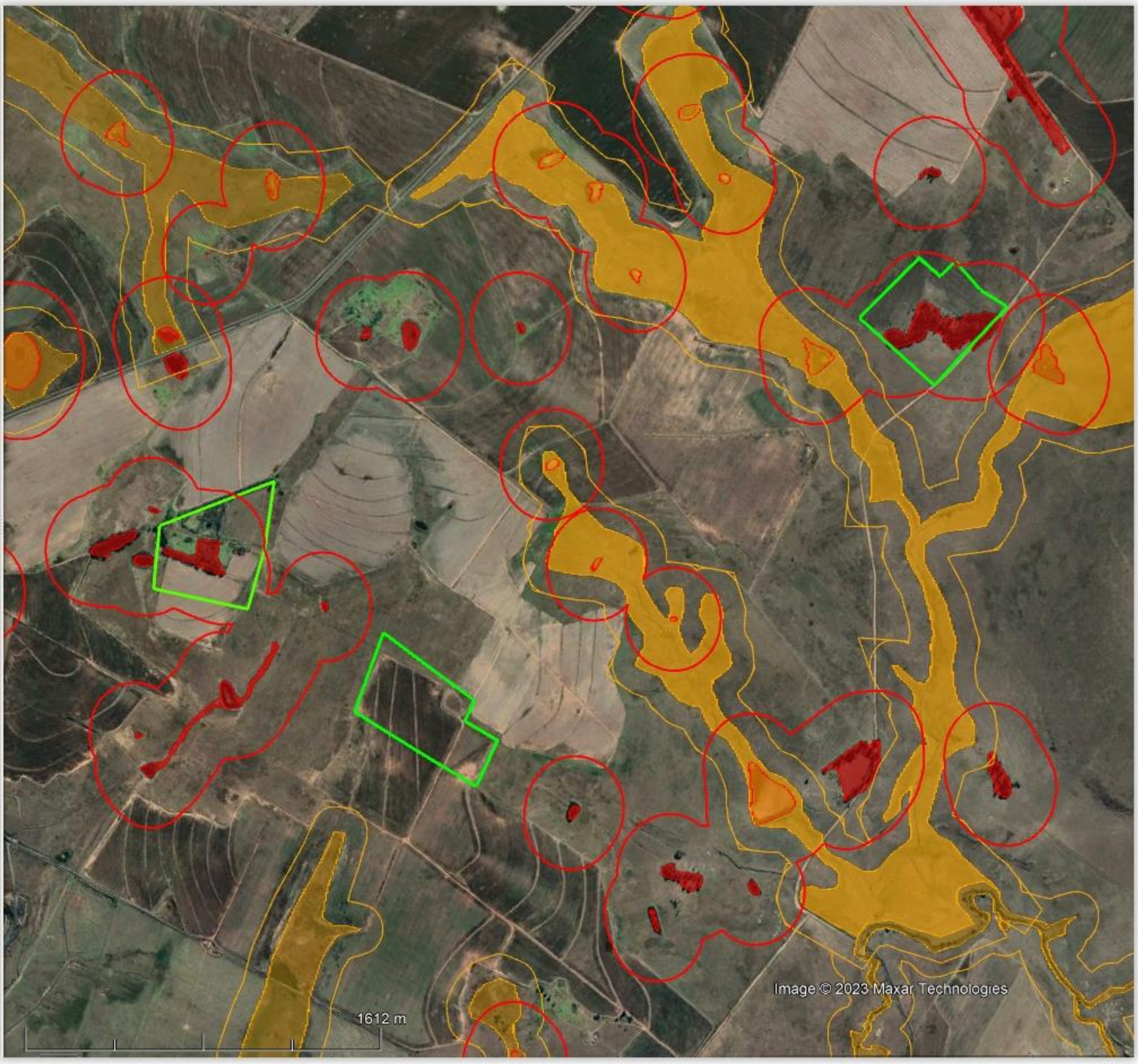
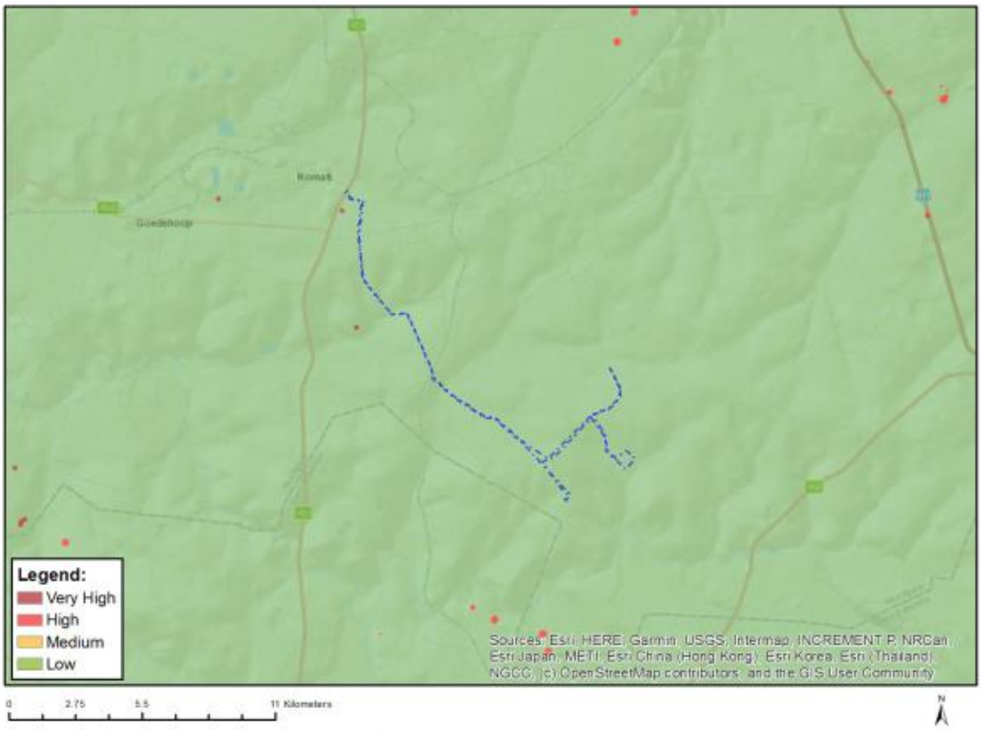


Figure 8-3: Bat sensitivity map of the site. Site area indicated in a white boundary. Sensitivity polygons are provided in .kml format with this report. Shaded red = high sensitivity; Red line = 200m high sensitivity buffer; Shaded orange = medium sensitivity; Orange line = 150m medium sensitivity buffer. The three options for the GHA facility are indicated in green.

8.4 HERITAGE

The DFFE national screening tool (**Figure 8-4**) identified the site as having a low sensitivity for the cultural heritage theme.

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

Figure 8-4: The DFFE screening tool rating for the Heritage Theme, Alternatives 1, 2 & 3

The specialist undertook a site visit on the 13 December 2022 and a follow up visit during the week of 25 January 2023.

The project area is characterised by extensive cultivated fields and is of low archaeological potential. This was confirmed during the field survey and no archaeological sites of significance were noted and finds were limited to burial sites (Feature 093, 094, HD001, HD002, HD 004, HD101 and GA004) as well as ruins (Feature 089, 090, 091, 092, HD003, GA001, GA002, and GA003). The survey focused on tangible heritage resources within the proposed footprint however several features (residential dwellings and settlements) were also noted outside of the proposed project footprint.

The overall impact of the project and residual impacts can be mitigated to an acceptable level through implementation of the recommendations made by the specialist. The socio-economic benefits also outweigh the possible impacts of the development if the correct mitigation measures are implemented for the project.

Table 8-3 indicates the distance of the sites from the proposed infrastructure and recommended mitigation

Table 8-3: Recorded features in relation to proposed project infrastructure

LABEL	TYPE SITE	SIGNIFICANCE AND FIELD RATING	IMPACT	MITIGATION
089, 090, 091, 092	Ruins	The ruins potential to contribute to aesthetic, historic, scientific and social aspects are non-existent, and it is therefore of low heritage significance (GP C) unless associated with burial sites (e.g., still born graves) in which case the burial sites are of high social significance (GP A)	Option 2 Powerline	If avoidance is not possible the presence of graves should be confirmed during social consultation and the area should be monitored during construction.
093	Cemetery	GP A High Social significance	90 m from Option 2 Powerline	Avoid with a 30m buffer zone and ensure access for family members
094	Cemetery	GP A High Social significance	90 m from Option 2 Powerline	Avoid with a 30m buffer zone and ensure access for family members
HD001 (previously recorded as 095)	Burial Sites	GP A High social significance	No direct impact expected	Avoid with a 30m buffer zone and ensure access for family members
HD002 (Previously recorded as 096)	Cemetery	GP A High social significance	7 m east of Powerlines	Avoid with a 30m buffer zone and ensure access for family members
HD003 (Previously recorded as 097)	Ruins	The ruins potential to contribute to aesthetic, historic, scientific and social aspects are non-existent, and it is therefore of low heritage significance (GP C)	188 m Southeast of Powerlines – no impact expected	No preconstruction mitigation required.
HD004 (Previously recorded waypoint 098)	Cemetery	GP A High Social significance	130m from Powerlines – no impact expected.	Avoid with a 30m buffer zone and ensure access for family members
HD101	Grave	GP A High Social significance if it is a burial site	50 m from Powerlines	Avoid with a 30m buffer zone and ensure access for family members
GA001	Built Environment	GP C Low significance	75 m from Option 1 Powerline	No preconstruction mitigation required.
GA002	Built Environment	GP C Low significance	H2 Option 3	If avoidance is not possible the presence of graves should be confirmed during social consultation and the area should be monitored during construction.
GA003	Built Environment	GP C Low significance	120 m South of the powerline – no direct impact expected	No preconstruction mitigation required.
GA004	Cemetery	GP A High Social significance	8m from Powerline	Avoid with a 30m buffer zone and ensure access for family members

8.5 NOISE

The project site was assessed in terms of the Noise Sensitivity Theme using the online Environmental Screening Tool.

Potential noise-sensitive areas with a "very high" sensitivity were obtained from the online screening tool using the Utilities Infrastructure => Electricity => Generation => Renewable => Wind category, with the potential noise-sensitive areas illustrated on **Figure 8-5** (site alternative option 1), **Figure 8-6** (site alternative option 2) and **Figure 8-7** (site alternative option 3).

Figure 8-5: The DFFE screening tool rating for the Noise Theme, Alternatives 1

Figure 8-6: The DFFE screening tool rating for the Noise Theme, Alternatives 2

Figure 8-7: The DFFE screening tool rating for the Noise Theme, Alternatives 3

The proposed green hydrogen and ammonia facility will slightly raise the noise levels at a number of the closest potential NSR. Three potential locations were investigated in detail, with the assessment indicating a low to very low significance for a noise impact to occur during the long-term operational phase. There might be a noise impact of a moderate significance during the construction phase, relating to construction traffic passing NSR.

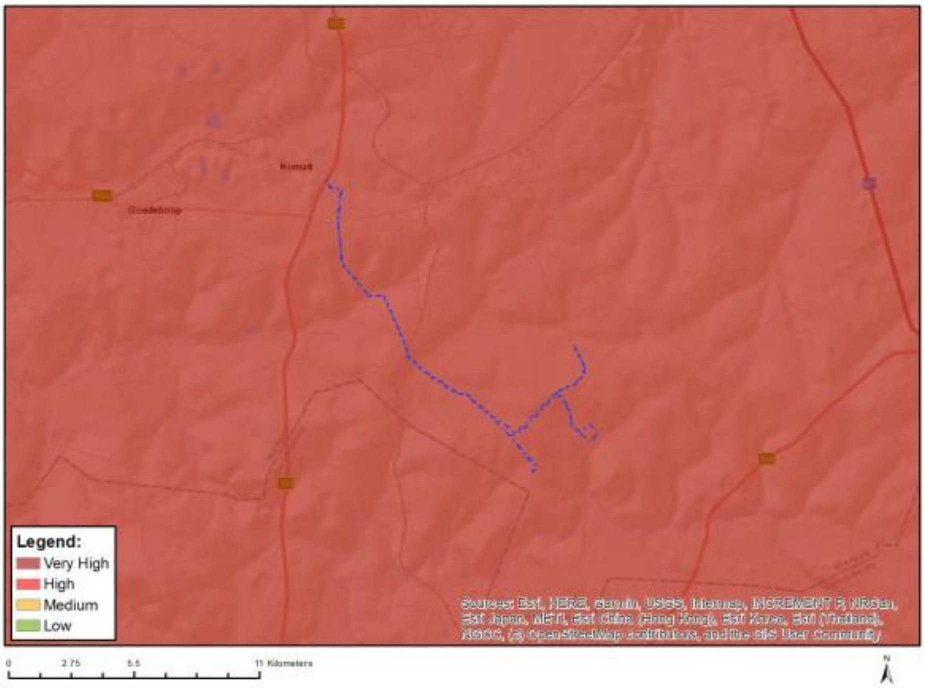
In terms of acoustics, there is a slight preference for alternative site locations 1 and 2, with site location 3 least preferred. This is mainly due to the relative proximity of NSR to alternative location 3 compared to the other alternative locations.

8.6 TERRESTRIAL BIODIVERSITY

The DFFE online screening tool identifies Terrestrial Biodiversity as a theme of very high sensitivity (**Figure 8-8**). Reasons on site for this sensitivity Critical biodiversity area 1 (Site alternative 3 only), Critical biodiversity area 2, Vulnerable Ecosystem, and Protected Areas Expansion Strategy.

The theme indicates almost the entire study area as being in the Very High sensitivity category, but there are significant areas that have been cultivated that do not warrant this classification. However, remaining natural areas are sensitive and of high biodiversity value.

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Critical biodiveristy area 2
Very High	Protected Areas Expansion Strategy
Very High	Vulnerable ecosystem

Figure 8-8: The DFFE screening tool rating for the terrestrial biodiversity theme Alternatives 1, 2 & 3

The project study area for the proposed project consists largely of cultivated areas with some remnant natural habitat within a rural area.

Currently, the rates of transformation within the vegetation in this general region is moderately high. The regional vegetation type that occurs on site, Eastern Highveld Grassland (as well Eastern Temperate Freshwater Wetlands), is listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).

Any remaining natural habitat on site therefore has high biodiversity value, which is reflected in the Provincial Conservation Plan assessment of the area. The proposed project will therefore potentially have impacts on areas of natural habitat that have potentially high biodiversity value, including CBA1 and CBA2 areas. The specific locations of potentially affected areas are described in detail in the section above where impacts are discussed.

The proposed project consists of a hydrogen and ammonia plant, powerlines to link to the grid, and a pipeline from Komati Power Station. There are three plant location options, and various pipeline and powerline options for each of these. From a landscape perspective, construction of the infrastructure will lead to relatively localized impacts.

Due to the small area of CBA1 affected by Option 3, this is the least preferred project option. Option 1 and Option 2 are both favourable. For the powerline and pipeline routes, there is not any major difference between any of the various options and they can all be considered as potential options.

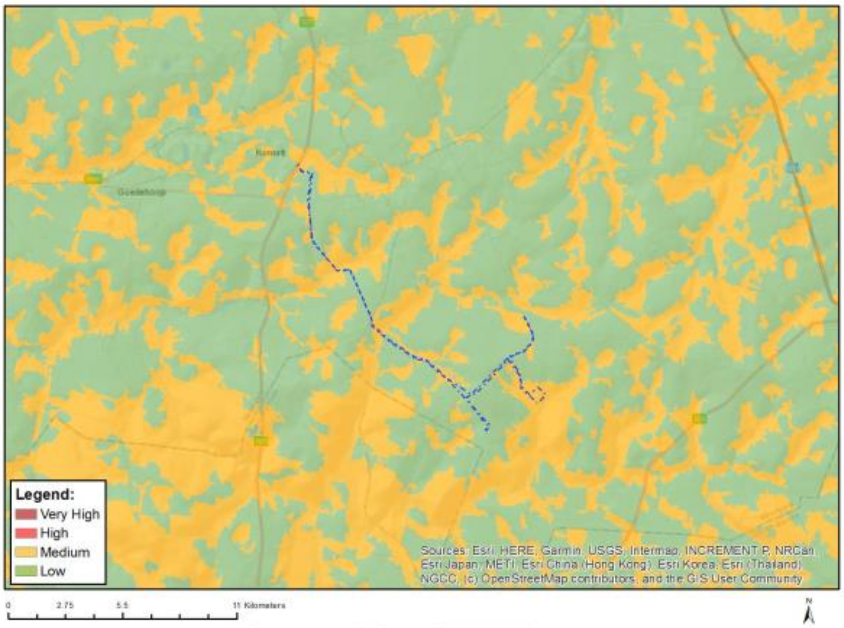
8.7 PLANT SPECIES

For all infrastructure components there is the possibility that individuals or populations of plant species of conservation concern may be lost due to construction impacts. Based on known information, and data collected on site, the probability of encountering species of conservation concern at any location is moderate to low. There are only small areas of habitat on site in which rare species are likely to be found.

The best mitigation to address uncertainty issues related to SCC is to do a walk-through survey of all final infrastructure positions to check for SCC, and to collect the necessary data for any flora permits that may be required.

Based on the field data and desktop assessment of SCC, the specific habitats, or locations where the risk is higher than anywhere else is within the wetlands and adjacent grasslands. Any areas with permanent moisture are potential habitat for one SCC.

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 41
Medium	Sensitive species 691
Medium	Pachycarpus suaveolens

Figure 8-9: The DFFE screening tool rating for the plant species theme alternatives 1, 2 & 3

According to the DFFE online environmental screening tool (**Figure 8-9**), three plant species have been flagged as of concern for the area the current project is in. A description of each species is provided below.

Sensitive species 41

A common and widespread geophyte that is very similar to *Gladiolus crassifolius*, also a widespread and common species with a similar distribution. The main distribution area is Witbank to Lydenburg, and southwards to Piet Retief and Wakkerstroom. It occurs in wetlands or marshes in high altitude grassland that remain wet throughout the year or dry out for only a short period. This species is listed on the South African Red List with a national assessment of Vulnerable, but is currently not recognized by the IUCN as it is regarded as a synonym of *G. crassifolius*. Whereas this species is confined more to wetland habitats, *G. crassofolius* has larger leaves, longer spikes and smaller flowers, and is found in drier, more stony habitats. It flowers from October to January and has a high probability of occurring in wetland areas on the study site. Without flowers, the plant can be recognized as a Gladiolus. The closest historical record is approximately 30km from the study site. This species has a MODERATE chance of occurring on the site.

Sensitive species 691

A widespread geophyte distributed in Free State, North West, Gauteng, and in Mpumalanga from Belfast and Ermelo to Wolmaransstad. It is found in wetlands in undulating grasslands. The species is currently listed as Vulnerable. It flowers from January to March but its peak flowering month is February. It could feasibly be found in wet areas on the site but is quite conspicuous in February when if flowers. The closest historical record is approximately 40km from the site. It has a MODERATE chance of occurring on the site.

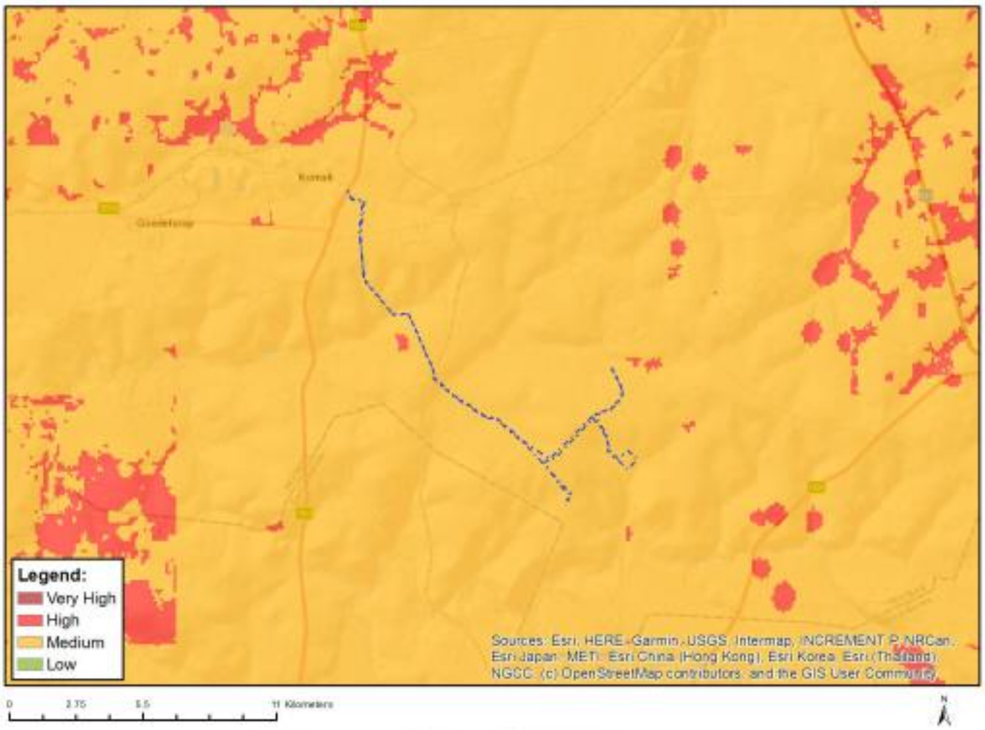
***Pachycarpus suaveolens* -Vulnerable**

This is a rare plant, usually found as solitary individuals, although widespread due to the wind-dispersal mechanism of its seeds. It is conspicuous and showy when flowering in mid-summer, from December to February. The closest historical record of this species is about 30km from the site. It has a MODERATE probability of occurring on the site.

8.8 ANIMAL SPECIES

The DFFE national screening tool (**Figure 8-10**) indicated that the project infrastructure has a medium sensitivity for the animal species theme for all three project alternatives.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Aves-Hydroprogne caspia
Medium	Aves-Eupodotis senegalensis
Medium	Aves-Tyto capensis
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi

Figure 8-10: The DFFE screening tool rating for the animal species theme Alternatives 1, 2 & 3

Hydroprogne caspia

The Caspian Tern is listed globally as Least Concern and as Vulnerable in South Africa. It has a cosmopolitan but scattered distribution. Their breeding habitat is large lakes and ocean coasts in North America, Europe, Asia, Africa, and Australasia (Australia and New Zealand). European and Asian birds spend the non-breeding season in the Old World tropics. African and Australasian birds are resident or disperse over short distances. Within South Africa, it is found in estuaries and sheltered bays along the coastline, and at large, permanent inland waterbodies. The study area is marginal for the species and there is no suitable habitat on site. It is therefore unlikely to occur there. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

Eupodotis senegalensis

The White-bellied Korhaan, listed as Vulnerable, is patchily distributed in the Afrotropics from West Africa to South Africa. It is the most-commonly sighted Korhaan at high altitudes in KwaZulu-Natal and southern Mpumalanga. It is near-endemic to the Grassland Biome. It requires longer grass than other bustards and generally avoids overgrazed and recently burnt areas, although they do occasionally move into open areas in winter to forage. The species could possibly occur in the study area, although there is limited amounts of suitable habitat available. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

Tyto capensis

The African Grass Owl is listed as Vulnerable. It is confined to the higher rainfall areas in the eastern half of South Africa, where it typically roosts and breeds in tall, rank grass or sedges associated with damp substrates, such as permanent and non-perennial wetlands and streams. The Olifants River is an important corridor for the species, and there is an important (No-Go) location mapped on the Endangered Wildlife Trust website 8 km to the east of the site. It is possible that extends up the connected drainage lines into the study area. It is almost certain that this species occurs on site and that it traverses the areas within and adjacent to the Olifants River and associated floodplain, as well as within surrounding natural grasslands and wetlands. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

Crocidura maquassiensis

The Maquassie Musk Shrew (***Crocidura maquassiensis***), listed as Vulnerable, is endemic to South Africa, Eswatini and Zimbabwe, where it is found in moist grassland habitats in Savannah and Grassland Biomes. It appears to tolerate a wide range of habitats, although threats to the species have been inferred as being related to loss or degradation of moist, productive areas, such as rank grassland and wetlands. The species is patchily distributed within the north-eastern quadrant of South Africa. The study area is within the known distribution of this species in the sense that there are records in quarter degree grids throughout the Highveld, although not from the current grid or any nearby grids. It is, however, flagged in the DFFE Online Screening Tool as potentially occurring on site. It is therefore considered possible that it could occur on site and individuals could therefore possibly be affected by construction activities.

Hydrictis maculicollis

The Spotted-necked Otter (***Hydrictus maculicollis***), listed as Vulnerable, is widely but patchily distributed in the higher parts of the eastern half of South Africa. It is also found in lakes and large rivers throughout much of Africa south of 10oN. They are restricted to areas of permanent fresh water where there is good shoreline cover and an abundant prey base (small fishes). They prefer water that is not silt-laden and is unpolluted, but are known to occur in relatively polluted rivers, such as the Braamfonteinspruit, Jukskei and Blesbokspruit in Gauteng. The site is within the known distribution of this species and there are historical records for one nearby grid to the north-east, although not from the current grid. There is no suitable habitat for this species within the direct footprint of the proposed project and it is therefore unlikely to occur there.

Ourebia ourebi ourebi

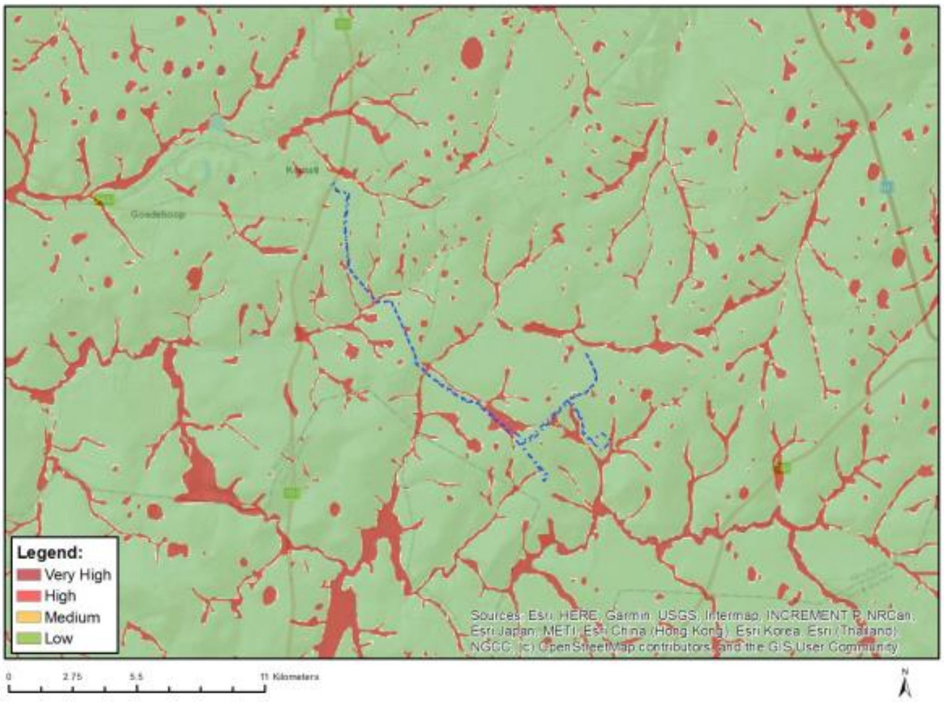
The Oribi (***Ourebia ourebi***), listed as Endangered in South Africa and Least Concern globally, has a geographical distribution that includes the study area. It is widely distributed in Africa, but the subspecies found in South Africa has a more limited distribution that includes South Africa and Mozambique. The species inhabits savanna woodlands, floodplains and other open grasslands from sea level to 2200 m asl (in Mpumalanga). They reach their highest density on floodplains and moist tropical grasslands. They prefer open grassland in good condition containing a mosaic of short grass for feeding and tall grass for feeding and shelter. It has not been recorded in the grid in which the site is located, which is one of a group of grids in south-western Mpumalanga where the species does not appear to occur. Nevertheless, the area is within the overall distribution range of the species. Based on the gap in the distribution of the species, there is a low likelihood that it could occur on site within any suitable habitat, although it is flagged for the project in the Screening Tool.

According to the specialist study undertaken, of the animal species flagged for the site, none are likely to occur there. Only the Maquassie Musk Shrew has a distribution and habitat preference that would indicate that there is a possibility of it occurring in the study area. However, based on the poor quality of most habitat on site, it is not suspected that this species would be found on site. The site therefore has LOW sensitivity with respect to the Animal Species Theme.

8.9 SURFACE WATER AND WETLANDS

According to the DFFE national screening tool (**Figure 8-11**), the wetland sensitivity for the site has been identified as very high to low.

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands and Estuaries

Figure 8-11: The DFFE screening tool rating for the aquatic biodiversity theme Alternatives 1, 2 & 3

The greater Project Area consisted of a total of 1722.32ha of wetland areas. Thirty-six (36) Hydrogeomorphic (HGM) units were identified and categorized based on terrain units by the wetland assessment undertaken by the specialist. These included seeps, Unchanneled valley bottoms (UVBs), and Channelled valley bottoms (CVBs). The wetlands were grouped into seven groups for ease of the assessment.

The health and integrity of each of the HGM units varied from 'Moderately Modified' to 'Largely Modified' with a Present Ecological State (PES) of C to D. The entire catchment has been impacted by mining and agricultural activities and infrastructure development. The CVBs have mainly been impacted by agropastoral activities, including cattle grazing, dams, and cultivation. In addition, some of the CVBs have been fragmented by linear infrastructure, including roads, powerlines, and fence lines. Fragmentation of wetlands impacts the natural habitat, functionality, and health of a wetland. The UVBs within the Project Area was dominantly used for cattle grazing. There were no clear signs of channelling, erosion, or extensive cattle trampling.

The vegetation was stable with few changes to water inputs to the systems. Regardless of some of the UVBs being moderately impacted, some of the systems were fragmented by agropastoral, and linear infrastructure. Dams were also indicated in some of the systems. Most of the Hillslope Seep wetlands were used for agropastoral activities, including commercial cultivation and cattle grazing. Unimpacted Hillslope Seep wetlands were recorded within the Project Area. These wetlands were mainly used for cattle grazing, however, this was well regulated and little erosion and few impacts on the vegetation and geomorphology were noted.

In terms of ES sediment trapping, phosphate assimilation, nitrate assimilation, and toxicant assimilation are the dominant ecological services provided by the HGM units. The unimpacted Hillslope Seeps and CVBs are providing biodiversity maintenance and the CVBs are important for water supply.

The UVBs Fragmented, Hillslope Seep (Agriculture), and Hillslope Seep (Fragmented) HGM units Ecological Importance and Sensitivity (EIS) were regarded as 'Moderate (C)'. Whereas the CVBs, CVBs Fragmented, UVBs, and Hillslope Seep Unimpacted were considered 'High (B)'. This suggests that these systems are of ecological importance and are sensitive. The biodiversity of the systems is sensitive to modifications to the habitat and low flows. These systems play an important role in moderating the quality and quantity of water in larger systems.

The proposed GH&A facility will have Low impacts on the wetland environment when the proposed mitigation and management plans are considered. In addition, the upgrading of existing roads and wetland crossing potentially also pose a Low risk of impacts to the aquatic systems onsite. The installation of electrical cables and water pipelines will potentially have low impacts to the freshwater resources within the study boundary.

Based on the above, **Table 8-4**Table 8-4: Site Sensitivity of wetlands shows the following sensitivities of Low to High were derived for the wetlands identified on site:

Table 8-4: Site Sensitivity of wetlands

HGM UNIT NUMBER	HGM UNIT	PES	ES	EIS	SENSITIVITY
1	CVBs	D	1.3	2.1	Medium
2	CVBs Fragmented	D	1.3	2.1	Medium
3	UVBs	C	1.5	2.3	High
4	UVBs Fragmented	C	1.5	2.0	High
5	HS Agriculture	C	1.7	1.8	Medium
6	HS Fragmented	D	1.8	1.8	Low
7	HS Unimpacted	C	1.9	2.3	Medium

8.10 SITE SENSTIVITY VERIFICATION SUMMARY

Specialist assessments were conducted in accordance with the Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes, which were promulgated in Government Notice No. 320 of 20 March 2020 and in Government Notice No. 1150 of 30 October 2020 (i.e. "the Protocols"), or Appendix 6 of the EIA Regulations, depending on which legislation apply to the assessment under consideration. A summary of the DFFE screening tool, the applicable legislation as well as the specialist sensitivity verification are detailed in **Table 8-5** below.

Table 8-5 - Assessment Protocols and Site Sensitivity Verifications

SPECIALIST ASSESSMENT	ASSESSMENT PROTOCOL	DFFE SCREENING TOOL SENSITIVITY	SPECIALIST SENSITIVITY VERIFICATION
Agricultural Assessment	*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Agricultural Resources*	High Sensitivity	High and Medium Sensitivity
Terrestrial Biodiversity Impact Assessment	*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity*	Very high Sensitivity	High and Low Sensitivity
Aquatic Biodiversity Impact Assessment	*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity*	Very High Sensitivity	High and Low Sensitivity
Plant Species	*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Plant Species*	Medium Sensitivity	Medium Sensitivity
Animal Species	*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species*	Medium Sensitivity	Low Sensitivity
Avifauna Impact Assessment	*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species*	Medium Sensitivity	High and Low Sensitivity
Bat Assessment	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	No Sensitivity Identified	High and Medium Sensitivity
Archaeological and Cultural Heritage Impact Assessment	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	Low Sensitivity	Low Sensitivity
Civil Aviation	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	Medium Sensitivity	Low Sensitivity
Defence	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	Low Sensitivity	Low Sensitivity

SPECIALIST ASSESSMENT	ASSESSMENT PROTOCOL	DFFE SCREENING TOOL SENSITIVITY	SPECIALIST SENSITIVITY VERIFICATION
Palaeontology Impact Assessment	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	Very High Sensitivity	Low Sensitivity
Visual (Landscape) Impact Assessment	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	No Sensitivity Identified	Medium Sensitivity
Social Impact Assessment	*Site Sensitivity Verification Requirements where a specialist Assessment is required but no Specific Assessment Protocol has been prescribed*	No Sensitivity Identified	Low to Medium Sensitivity

9 IMPACT ASSESSMENT

This impact assessment phase of the EIR process is aimed to assess those potential impacts that are most likely to be significant from an environmental and social perspective. The assessment of anticipated impacts associated with the proposed Project is a key component to the EIR process. This Chapter identifies and assesses those perceived environmental and social effects associated with the proposed Project. The assessment methodology is indicated in **Section 4.2**.

The issues assessed stem from those aspects presented in **Section 7** of this document as well as project description provided. Each significant issue that has been identified has been investigated further during this EIR process.

Potential impacts have been identified and assessed according to the phases of the project's development. For purposes of this report, these phases have been generically defined below.

— Construction Phase:

  The construction phase includes the preparatory works/activities typically associated the creation of surface infrastructure, access and electrical power. The activities most relevant to this phase include but not limited to : Topsoil stripping; Cut and fill activities associated with site preparation (if required).

— Operation Phase:

  The operational phase includes the daily activities associated with Hendrina GH&A facility.

— Decommissioning Phase:

  The closure phase includes the activities associated with the removal/dismantling of machinery/equipment/infrastructure no long necessary to the operation.

9.1 AIR QUALITY

9.1.1 CONSTRUCTION PHASE

Emissions during construction are associated with land clearing, drilling, and blasting, ground excavation, cut and fill operations and the movement of heavy construction vehicles on temporary roads. Pollutants associated with construction activities are typically Total Suspended Particulates (TSP), PM10 and PM2.5 with lesser contributions of CO, NO_2, SO_2 and C_6H_6 from vehicle exhausts.

PM refers to solid or liquid particles suspended in the air. PM varies in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. Particles can be classified by their aerodynamic properties into coarse particles, PM10 (particulate matter with an aerodynamic diameter of less than 10 µm) and fine particles, PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5 µm). In addition to reduced visibility, particulate air pollution poses health risks associated with the respiratory system.

Heavy construction activity is a source of dust emissions that can have a significant but transient impact on local air quality. The amount of dust emitted from construction operations depends on the area of land being worked, the proportion of land lying exposed at any time, the clearing and dozing equipment used, the number and type of vehicles on temporary roads, and the duration of the construction phase. The majority proportion of dust emissions result from heavy vehicle traffic movement on temporary gravel roads at the construction site.

Considering the proposed site extent is small (0.25 km^2) and sensitive receptors are more than 1.4 km from the development site**,** atmospheric impacts from dust emissions during the temporary construction phase are anticipated to be low. With the implementation of appropriate control measures, the impact on neighbouring sensitive receptors will be reduced further but is still assessed to be very low.

The impact of the construction phase on the generation of dust and particulate matter (PM) is shown in **Table 9-1**.

Table 9-1: Construction Impact on Generation of Dust and PM

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
GENERATION OF DUST AND PM									
Without Mitigation	1	2	1	2	4	**24**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	3	**15**	**Very Low**	(-)	
Mitigation and Management Measures	— Limit the duration of the construction phase to as short a timeframe as possible. — Where possible, minimise the area under construction. — Make use of wet suppression techniques to minimise dust entrainment along unpaved roads and during periods of high wind speeds. — Where possible, minimise speed limits, vehicle weights and the number of vehicles using unpaved roads. — All stockpiles (if any) must be restricted to designated areas and may not exceed a height of two (2) metres; — Ensure that all vehicles, machines and equipment are adequately maintained to minimise emissions; — It is recommended that the clearing of vegetation from the site should be selective, be kept to the minimum feasible area, and be undertaken just before construction so as to minimise erosion and dust potential; — All materials transported to, or from, site must be transported in such a manner that they do not fly or fall off the vehicle. This may necessitate covering or wetting friable materials. — No burning of waste, such as plastic bags, cement bags and litter is permitted; — Once construction is complete, initiate rehabilitation (e.g. re-vegetation) procedures to reduce wind speed across exposed surfaces.								

9.1.2 OPERATIONAL PHASE

The only atmospheric pollutant applicable to the operational phase of Hendrina GH&A facility is NH_3. Potential impacts on human health and vegetation from exposure to NH_3 are discussed below.

HUMAN HEALTH IMPACTS

NH_3 is an alkaline chemical widely used in industrial applications as a feedstock for fertilizers, plastics, and explosives. It is a colourless, water-soluble gas with an unpleasant, sharp, and pungent odour. NH_3 vapour causes irritation to the eyes and respiratory tract with high concentrations causing conjunctivitis, laryngitis, and pulmonary oedema. NH_3 can combine with moisture in the eyes and mucous membranes to form ammonium hydroxide (NH_4OH). NH_4OH causes saponification and liquefaction of the exposed, moist epithelial surfaces of the eye and can easily penetrate the cornea and damage the iris and the lens. Damage to the iris may eventually lead to cataracts.

Inhalation exposure may result in an increase in systemic arterial blood pressure. Documented odour thresholds for NH_3 vary from 30 to 73,000 µg/m3 causing annoyance and potentially exacerbating pre-existing asthma. Reported health effects due to NH_3 gas exposure include eye, nose, and throat irritation, coughing, dermal irritation, and respiratory failure.

Generally, emissions from bulk storage and loading activities typically occur near the ground with ambient concentrations peaking within the operational boundary of a facility. It is unlikely that NH_3 emissions from a low-level emission source would reach sensitive receptors more than 1.4 km from the development site especially at concentrations required to induce health impacts or create an odour nuisance. As such, any potential NH_3 emissions from the proposed development will have a very low impact (if any) on human health.

It is highlighted that, with the intended temperature-controlled storage and loading solutions proposed, emissions under a normal operating scenario are not anticipated.

EFFECTS ON VEGETATION

In the South African context, increased rates of nitrogen deposition and nutrient accumulation in the soil during high pollution episodes may threaten plant species that are accustomed to nutrient poor soils.

Although high pollution episodes are common in the HPA, the land surrounding the proposed development site is used for mining, crop cultivation or is vacant open veld earmarked for future mining ventures and is not considered to be sensitive. As such, any ambient NH_3 contributions from the proposed development will have a very low impact (if any) on neighbouring grasslands and crop production. It is highlighted that, with the intended temperature-controlled storage and loading solutions proposed, emissions under a normal operating scenario are not anticipated.

BULK STORAGE OF NH_3

Synthesised anhydrous NH_3 will be stored in temperature-controlled bulk storage tanks at -33.4°C, sufficiently low to prevent product evaporation. Storage tank vents will remain closed to sustain this low liquid temperature and prevent any mechanically induced turbulence inside the tanks. As such, NH_3 emissions from bulk storage vessels are not anticipated as the liquid cannot vaporise and cannot escape containment.

The impacts of the NH_3 emission generation for the operational phase are outlined in **Table 9-2** below.

Table 9-2: Operational Impact on Air Quality due to NH_3 Emissions

Potential Impact **Degradation of ambient air quality due to NH_3 emissions**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Without Mitigation	1	1	1	4	1	**7**	**Very Low**	(-)	Moderate
With Mitigation	N/A	N/A	N/A	N/A	N/A	**N/A**	**N/A**	N/A	
Mitigation and Management Measures	— ***Note: A post-mitigation scenario is not applicable for the control of NH_3 emissions during the operational phase. All emission controls are considered standard operating procedure and thus the pre-mitigation scenario is representative of normal operations as the proposed facility is designed to function*** — Maintain appropriate operational controls (e.g. appropriate temperature and pressure settings for storage vessels and loading gantries). — Conduct regular equipment inspections for visible/audible/odorous leaks. — Conduct regular checks and periodic replacement of components including pump seals, compressor seals, pipeline valves, open-ended valves, flanges, and other connections (as applicable) in line with manufacturer specifications. — Conduct training of the workforce at all levels (i.e. workers, foremen, managers) in awareness of air emissions. This can be included in site induction courses and should focus on promoting understanding as to why operational controls are in place and should be adhered to. — Complaints and any actions arising from a complaint must be recorded in a complaints register maintained by site management. — Undertake passive monitoring of NH_3 along the facility's fence line and at proximate receptors. A monthly monitoring frequency for a period of 12-months is recommended to provide sufficient data for follow up quantitative assessment of impacts. Monitoring requirements and the frequency thereof can be revised during at the PAEL review process.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Degradation of ambient air quality due to NH_3 emissions									
	— Maintain meticulous record keeping of all inputs, throughputs, and production rates, including loading and dispatch quantities to enable a mass balance quantification of facility wide evaporative losses (if any) over time. — Assess and revise impacts when sufficient operational information is available to do so.								

9.1.3 DECOMISSIONING PHASE

The impacts associated with the decommissioning phase will be the same as that of the construction phase.

9.2 NOISE EMISSIONS

9.2.1 CONSTRUCTION PHASE

Elevated noise levels are likely to be generated by the construction activities (machinery and vehicles) and the workforce. It is important to note that noise impacts (nuisance factor) may vary in the different areas as a result of the surrounding land uses and will be temporary in nature. Due to the temporary and limited nature of the Project activities, coupled with the fact that there are a limited number of noise receptors around the Project area, the impact is regarded as low.

The significance of noise during the construction phase may have a noise impact of very low and of a low significance for all site location alternatives. The potential noise impact mainly relates to construction traffic passing close to NSR and daytime noise levels may exceed the recommended daytime noise limit of 52 dBA. Noises from passing traffic may annoy NSR.

During the construction phase of the facility various noise sources will be present onsite including earth-moving equipment (trucks, cranes, scrapers and loaders), compressors and generators, pumps, rotary drills, concrete mixers and materials handling activities among others. All of these sources will generate substantial amounts of noise and may impact on neighbouring sensitive receptors. As such, mitigation interventions are advised during the construction phase. These mitigation recommendations are detailed in the section that follows.

The construction impact on noise is indicated in **Table 9-3**.

Table 9-3: Construction Impact on Noise

Potential Impact:	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise generated during construction									
Without Mitigation	2	2	1	1	3	18	Low	(-)	Easy
With Mitigation	1	2	1	1	2	10	Very low	(-)	
Mitigation and Management Measures	— Planning construction activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance. Information regarding construction activities should be provided to identified and nearby receptors likely to be affected. — Such information includes:								

Potential Impact:	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise generated during construction									
	— Proposed working times. — Anticipated duration of activities. — Explanations on activities to take place and reasons for activities. — Contact details of a responsible person on site should complaints arise. — When working near a potential sensitive receptor, limit the number of simultaneous activities to a minimum, as far as possible; — Using noise control devices, such as temporary noise barriers and deflectors for high impact activities, and exhaust muffling devices for combustion engines. — Selecting equipment with the lowest possible sound power levels whilst still being suitable for the specific task. — The equipment must be in maintained in good working order, within service dates, and inspected before use; — Install noise reducing fittings on machinery (if required). — Community participation, with the community notified of construction activities, the duration of the activities and potential impacts on them. — Only permitting construction traffic during the daytime period — Including noise as an environmental component in Health and Safety Induction training to employees, contractors and sub-contractors.									

9.2.2 OPERATIONAL PHASE

Outcomes of the acoustic impact assessment are contained within **Table 9-4** outlining the impact of each parameter and the resulting risk level. The resultant environmental acoustic risks for residential receptors were ranked "very low" during the unmitigated and mitigated operational phase.

Table 9-4: Operational Phase Impacts on Noise

Potential Impact:	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Noise Emissions related to operation of GH&A Facility									
Without Mitigation	2	1	1	4	1	**8**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	4	1	**7**	**Very Low**	(-)	
Mitigation and Management Measures	— The equipment must be in maintained in good working order, within service dates, and inspected before use; — Align working times with the substation related operational times; and — Installing acoustic louvres for natural or forced ventilation systems. — Developing a mechanism to record and respond to complaints. — Installing suitable mufflers on engine exhausts and compressor components.								

Potential Impact: Noise Emissions related to operation of GH&A Facility	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Confidence
	— Installing acoustic enclosures for equipment causing radiating noise, if required. — Improving the acoustic performance of constructed buildings through the application of sound insulation. — Installing acoustic screens alongside noisy equipment if required — Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective. (if required) — Install noise reducing fittings on machinery (if required).							

9.2.3 DECOMISSIONING PHASE

The noise impacts during the decommissioning phase are expected to be the same as the construction phase. Therefore, the same mitigation measures should be applied.

9.3 SOILS, LAND CAPABILITY AND AGRICULTURAL

An Agricultural Agro-Ecosystem Specialist Assessment is required by the protocol to identify the extent of the impact of the proposed development on agricultural resources. The assessment of impacts in an environmental impact assessment is done according to a prescribed, semi-quantitative rating methodology that is supposed to cover all specialist disciplines and allow comparison of the impacts across them. However, the system was designed for biological components of the ecosystem such biodiversity and does not rate agricultural impacts in a sensible or particularly useful way. As has been discussed above, the significance of the agricultural impact is simply the degree to which the future agricultural production potential of the site will be changed and that is predominantly a function of the size of the area of land that is impacted and the production potential of that impacted land. The dominant factor in this case is the relatively small size of the area of land that is impacted (25 ha) which is a small proportion of the affected farm. The prescribed methodology is presented below for compliance purposes but is not really an effective indication of the significance of the agricultural impact.

No losses of agricultural employment are expected because the site occupies only a small proportion of a much larger farming operation and the cessation of cropping on the site will not significantly reduce the farm's labour requirement.

Furthermore, it is important to assess the agricultural impact within the context of the whole Hendrina renewable energy project. It does not make sense to consider the agricultural impacts of the different components of the project in isolation from each other, in the way that the rating methodology forces one to do. The context of the net overall agricultural impact of the greater project is important to take into account.

9.3.1 CONSTRUCTION PHASE

The construction impact is indicated in **Table 9-5**.

Table 9-5: Construction Impact on Agricultural production potential

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Decrease in agricultural production potential due to occupation of 25 hectares of land by the green hydrogen plant.									
Without Mitigation	2	1	3	4	5	**50**	**Moderate**	(-)	N/A
With Mitigation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mitigation and Management Measures	— The entire site will be excluded as agricultural production land by the development and there can therefore be no environmental management programme inputs/mitigation measures to protect the agricultural production potential of the site. — The only micro-siting that is recommended is that pylons not be placed within any croplands, but instead be located on the edges of them. — To mitigate disturbance to croplands it is recommended that pylons not be placed within any croplands, but instead be located on the edges of them. The overhead power lines can cross croplands, but they should span across them with the pylons being placed on either side. — Where excavation is done to bury the pipeline, the upper 30 cm of topsoil must be kept separate from the rest of the excavation spoils and stored in a separate stockpile. — When the excavation is back-filled, the topsoil must be back-filled last, so that it remains at the surface, as it originally was.								

9.3.2 OPERATIONAL PHASE

The operational impacts are expected to be the same as the construction impacts. No mitigation

9.3.3 DECOMISSIONING PHASE

The decommissioning impacts are expected to be the same as the construction impacts. No mitigation

9.4 SURFACE WATER AQUATIC ASSESSMENT

The impacts on the surface water of the area due to the proposed Green Hydrogen Facility, are limited. The is mainly due to the overall layout avoided the delineated systems inclusive of the calculated buffers and the recommended 100m buffer. The section below indicates the resultant impact assessment should these recommendations be approved, however no direct impacts are anticipated as all aquatic systems have been avoided.

9.4.1 CONSTRUCTION PHASE

Destruction of wetland for the construction of roads, pipelines and power cables in preparation for construction activity will definitely occur on at least the development footprint, where protected ecosystems are present. This will result in the permanent loss of the affected portions of the system if not mitigated, and may lead to the following, Head cut erosion and channel forming from the roads (culverts), Increased erosion and consequently sedimentation potential into wetlands and Loss of vegetation and habitat.

The construction impact along with mitigation measures are outlined in **Table 9-6**.

Table 9-6: Construction Impact on wetlands

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Wetland destruction									
Without Mitigation	3	2	3	4	4	**48**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	3	3	**27**	**Low**	(-)	
Mitigation and Management Measures	— Where the destruction of wetlands is unavoidable (i.e. at road crossings), disturbance must be minimised and suitably rehabilitated — At areas where new road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing — Environmental Compliance Officer (ECO) to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area — Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction — Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems — A Storm Water Management Plan (SWMP) should be designed and implemented during the construction phase. This should consider wetlands associated with the new developments/infrastructure which should divert stormwater and runoff away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible.									

During the construction phase, contamination from hydrocarbon waste (lubricants, oils, explosives, and fuels) and contamination from sewage and wastewater will result in changes to wetland health and biodiversity.

The construction impact along with mitigation measures are outlined in **Table 9-7.**

Table 9-7: Construction Impact of hazardous substances

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Hydrocarbon & Waste Spills									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— All vehicle maintenance must occur within designated areas — All vehicles must be regularly inspected for leaks — All spills must be cleaned up immediately to prevent contaminants to enter the wetlands — Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions and health and safety requirements — Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil — The edge of the wetland and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the construction phase.									

9.4.2 OPERATIONAL PHASE

The operation phase could bring about head cut erosion and channels forming from the roads (culverts), and increased erosion and consequently potential sedimentation into wetlands as well as loss of vegetation and habitat and wetland fragmentation.

The operational impact along with mitigation measures are outlined in **Table 9-8**.

Table 9-8: Operational Impact of usage of existing roads and vehicle movement

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Increased run off leading to erosion and sedimentation									
Without Mitigation	3	2	3	4	3	**36**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Quarterly (four times a year) inspections by the site environmental officer to ensure no unnecessary impact to the freshwater resources present, and if so that a remedy is put in place as soon as possible — All stormwater infrastructure must be maintained								

During the operational phase, contamination from hydrocarbon waste (lubricants, oils, explosives, and fuels) and contamination from sewage and wastewater will result in changes to wetland health and biodiversity. The operational impact along with mitigation measures are outlined in **Table 9-9**

Table 9-9: Operational Impact of spillages

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Hydrocarbon & Waste Spills									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— All vehicle maintenance must occur within designated areas — All vehicles must be regularly inspected for leaks — All spills must be cleaned up immediately to prevent contaminants to enter the wetlands — Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions — Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil.								

9.4.3 DECOMISSIONING PHASE

During the decommissioning phase, uneven surfaces and topographies will be prevalent, causing water ponding and changes to the hydrogeomorphology of the wetlands and cause the proliferation of alien invasive species.

Furthermore, the exposure of soils and subsequent compaction will lead to erosion and sedimentation into the wetlands causing the deterioration of water quality. Potential spillage of hydrocarbons such as oils, fuels, and grease will also lead to contamination of wetlands.

The decommissioning impact along with mitigation measures are outlined in **Table 9-10**

Table 9-10: Decommissioning Impact from Rehabilitation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Rehabilitation – rehabilitation mainly consists of profiling and landscaping of the land, and re-vegetation.									
Without Mitigation	3	2	3	5	3	**39**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Decommissioning should occur in the dry season where possible to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands — Stormwater must be diverted from decommissioning activities — All areas of increased ecological sensitivity outside of the project footprint should be designated as "No-Go" areas and be off-limits to all unauthorised vehicles and personnel — Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas; and — Implement and maintain a Wetland and Alien invasive management Plan for the duration of the decommissioning phase								

During the decommissioning phase failure to undertake post closure monitoring and rehabilitation will result in wetland degradation. The decommissioning impact along with mitigation measures are outlined in **Table 9-11**

Table 9-11: Decommissioning Impact on post closure

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Post-closure monitoring and rehabilitation.									
Without Mitigation	3	1	3	2	3	**27**	**Low**	(-)	Easy
With Mitigation	2	1	3	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; and — Wetland monitoring (See EMPr Section 7.16) must be carried out after the decommissioning phase to ensure the success of wetland rehabilitation.								

9.5 TERRESTRIAL BIODIVERSITY

9.5.1 CONSTRUCTION PHASE

Vegetation on site is within the Grassland Biome. Mesic grasslands in South Africa have a life-form composition that includes a high number of resprouting sub-terranean species that constitute more than 50% of the species richness at any single location and a higher proportion, if counted across a wider area. Secondary grassland that develops in previously cleared areas (for example, cultivated lands) usually develop a perennial grass cover, but the resprouting component of the flora almost never recovers. This means that any clearing of grassland vegetation, even if temporary, results in permanent loss of the local species composition. Clearing of natural grassland is therefore a permanent impact.

Habitat loss refers to physical disturbance of habitats through clearing, grading and other permanent to semi-permanent loss or degradation. Loss of habitat on site could lead to loss of biodiversity as well as habitat important for the survival of populations of various species. The construction impact along with mitigation measures are outlined in in **Table 9-12**.

Table 9-12: Construction Impact on natural habitats

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of indigenous natural vegetation									
Without Mitigation	1	1	3	5	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	4	4	**36**	**Moderate**	(-)	
Mitigation and Management Measures	— Restrict impact to development footprint only and limit disturbance in surrounding areas. — Prior to commencement of construction, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval. — Prior to commencement of construction, compile an Alien Plant Management Plan, to be included into the EMPr during final approval.								

Major factors contributing to invasion by alien invader plants includes inter alia high disturbance (such as clearing for construction activities) and negative grazing practices. Exotic species are often more prominent near infrastructural disturbances than further away. Consequences of this may include:

- loss of indigenous vegetation;
- change in vegetation structure leading to change in various habitat characteristics;
- change in plant species composition;
- change in soil chemical properties;
- loss of sensitive habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

Low existing populations of alien plants were observed on site, but areas of farm infrastructure were not investigated in detail during the field survey. There is a high possibility that alien plants could be introduced to areas within the footprint of the proposed activities from surrounding areas in the absence of control measures. The potential consequences may be of moderate seriousness for affected natural habitats. Control measures could prevent the impact from occurring. These control measures are relatively standard and well-known. The construction impact along with mitigation measures are outlined in in **Table 9-13.**

Table 9-13: Construction impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment and spread of declared weeds and alien invader plants									
Without Mitigation	2	2	3	1	3	**24**	**Low**	(-)	Easy
With Mitigation	1	1	3	1	2	**12**	**Very low**	(-)	
Mitigation and Management Measures	— Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control, including monitoring specifications. — Undertake regular monitoring to detect alien invasions early so that they can be controlled.								

9.5.2 OPERATIONAL PHASE

During the operational phase of the project, there will be continuous activity on site, including normal operational activities, maintenance and monitoring. There may also be minor additional construction. Rehabilitation of various sites, such as the construction camps, will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation. The operational impact along with mitigation measures are outlined in in **Table 9-14**.

Table 9-14: Operational Impact on habitats

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Continued disturbance to natural habitats due to general operational activities and maintenance									
Without Mitigation	1	1	3	5	3	**30**	**Low**	(-)	Moderate
With Mitigation	1	1	3	5	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Restrict impact to development footprint only and limit disturbance in surrounding areas. — Prior to commencement of operation, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval. — Prior to commencement of operation, compile an Alien Plant Management Plan, to be included into the EMPr during final approval.								

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established. The operational impact along with mitigation measures are outlined in in **Table 9-15.**

Table 9-15: Operational impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment and spread of declared weeds and alien invader plants									
Without Mitigation	3	2	3	4	3	**36**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	2	2	**14**	**Very low**	(-)	
Mitigation and Management Measures	— Prior to commencement of operation, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control. — Undertake regular monitoring to detect alien invasions early so that they can be controlled.								

Increased erosion (water and wind) and water run-off will be caused by the clearing of indigenous vegetation, creation of new hard surfaces and compaction of soil. Increased run-off and erosion could affect hydrological processes in the area and will change water and silt discharge into drainage lines and streams. The operational impact along with mitigation measures are outlined in in **Table 9-16.**

Table 9-16: Operational impact on runoff and erosion

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Continued runoff and erosion									
Without Mitigation	1	1	3	5	3	**30**	**Low**	(-)	Moderate
With Mitigation	1	1	3	5	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Prior to commencement of operation, compile and implement a stormwater management plan including monitoring specifications.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Continued runoff and erosion									
	— Monitor surfaces for erosion, repair and/or upgrade, where necessary.								

9.5.3 DECOMMISSIONING PHASE

It is expected that the project will operate for a minimum of twenty to twenty-five years (a typical planned life-span for a project of this nature). Decommissioning will probably require a series of steps resulting in the removal of equipment from the site and rehabilitation of footprint areas. It is possible that the site could be returned to a rural nature, but it is unlikely that natural vegetation would become established at disturbed locations on site for a very long time thereafter. The reality is that it is not possible to determine at this stage whether rehabilitation measures will be implemented or not or what the future plans for the site would be nor is it possible at this stage to determine what surrounding land pressures would be. These uncertainties make it difficult to undertake any assessment to determine possible impacts of decommissioning. It is recommended that a closure and rehabilitation plan be compiled near to the decommissioning stage but in advance of when decommissioning is planned, and that this would be required to be implemented prior to closure of the project. The closure and rehabilitation plan must be in compliance with the regulatory requirements at the time of decommissioning.

During the decommissioning phase of the project, there will be a flurry of activity on site over a period of time, similar to during the construction phase, including dismantling and removal of equipment and rehabilitation. There may also be minor additional construction. Rehabilitation of various sites will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation. The decommissioning impact along with mitigation measures are outlined in in **Table 9-17.**

Table 9-17: Decommissioning Impact on habitats

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss and/or disturbance of indigenous natural vegetation during removal of infrastructure									
Without Mitigation	1	1	3	5	2	**20**	**Low**	(-)	Moderate
With Mitigation	1	1	3	5	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Prior to decommissioning commencing, compile a Rehabilitation Plan in compliance with the regulatory requirements at the time of decommissioning.								

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established. The decommissioning impact along with mitigation measures are outlined in in **Table 9-18.**

Table 9-18: Decommissioning impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment and spread of declared weeds and alien invader plants									
Without Mitigation	2	2	3	4	4	**44**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	4	3	**27**	**Low**	(-)	
Mitigation and Management Measures	— Rehabilitate disturbed areas in accordance with the specifications of a Rehabilitation Plan.								

9.6 ANIMAL SPECIES

9.6.1 CONSTRUCTION PHASE

During the construction phase there will be activity on site over a period of time, where vegetation is cleared for construction. These activities have the potential to cause additional direct and/or indirect loss of natural habitat for fauna. However, the infrastructure will not be located in favourable habitat for fauna, therefore it is unlikely that habitat loss will occur.

The construction impact along with mitigation measures are outlined in in **Table 9-19.**

Table 9-19: Construction impact on faunal habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of faunal habitat									
Without Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	Moderate
With Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	
Mitigation and Management Measures	— Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. — Footprints of infrastructure, laydown areas, construction sites, roads and substation sites should be clearly demarcated. — Ensure all possible steps are taken to limit erosion of surfaces, including proper management of storm-water runoff. — Control alien invasive plant species by implementing an alien invasive control plan prior to construction. — Compile a Rehabilitation Plan prior to the commencement of construction. — No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities, unless for maintenance purposes, in which case all reasonable steps should be taken to limit damage to natural areas. — No driving of vehicles off-road outside of construction areas. — It is a legal requirement to obtain permits for specimens or protected species that will be lost due to construction of the project. — Limit clearing of natural habitat designated as sensitive, especially riparian habitats, where possible. — Pre-construction walk-through, undertaken in the correct season, in front of construction must be undertaken to move any individual animals, such as tortoises, prior to construction. — Personnel on site should undergo environmental induction training, including the need to abide by speed limits, the increased risk of collisions with wild animals on roads in rural areas. — Proper waste management must be implemented, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard. — No collecting, hunting or poaching of any plant or animal species. — A trained expert should be available for consultation should snakes be encountered. Snakes need to be relocated by a trained snake handler. — Report any mortality of protected species to conservation authorities. — Personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species.									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of faunal habitat									
	— Report any illegal collection to conservation authorities. — Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment. — Personnel and vehicles should be restricted to access / internal roads and no off-road driving should occur. — Noise and light pollution should be managed according to guidelines from the noise specialist study and visual specialist assessment respectively.								

Construction activities will require use of heavy machinery and vehicles, as well as placement of various obstructions that may be hazardous and can directly impact on the faunal communities in the area. The construction impact along with mitigation measures are outlined in in **Table 9-20.**

Table 9-20: Construction impact on faunal mortality

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct mortality of fauna									
Without Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	Moderate
With Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	
Mitigation and Management Measures	— Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. — Footprints of infrastructure, laydown areas, construction sites, roads and substation sites should be clearly demarcated. — Ensure all possible steps are taken to limit erosion of surfaces, including proper management of storm-water runoff. — Control alien invasive plant species by implementing an alien invasive control plan prior to construction. — Compile a Rehabilitation Plan prior to the commencement of construction. — No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities, unless for maintenance purposes, in which case all reasonable steps should be taken to limit damage to natural areas. — No driving of vehicles off-road outside of construction areas. — It is a legal requirement to obtain permits for specimens or protected species that will be lost due to construction of the project. — Limit clearing of natural habitat designated as sensitive, especially riparian habitats, where possible. — Pre-construction walk-through, undertaken in the correct season, in front of construction must be undertaken to move any individual animals, such as tortoises, prior to construction. — Personnel on site should undergo environmental induction training, including the need to abide by speed limits, the increased risk of collisions with wild animals on roads in rural areas. — Proper waste management must be implemented, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard. — No collecting, hunting or poaching of any plant or animal species.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct mortality of fauna									
	— A trained expert should be available for consultation should snakes be encountered. Snakes need to be relocated by a trained snake handler. — Report any mortality of protected species to conservation authorities. — Personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species. — Report any illegal collection to conservation authorities. — Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment. — Personnel and vehicles should be restricted to access / internal roads and no off-road driving should occur. — Noise and light pollution should be managed according to guidelines from the noise specialist study and visual specialist assessment respectively.								

The impact will occur due to clearing of indigenous vegetation for the purposes of construction of infrastructure. Where this intersects with linear systems, it will result in fragmentation that may inhibit normal population processes, including movement. Infrastructure will mostly be located outside of favourable habitat, therefore fragmentation of habitat is unlikely to occur. The construction impact along with mitigation measures are outlined in in **Table 9-21**

Table 9-21: Construction impact on faunal habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Fragmentation of faunal habitat									
Without Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	Moderate
With Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	
Mitigation and Management Measures	— No driving of vehicles off-road outside of construction areas. — Apply mitigation measures recommended in the Terrestrial Biodiversity Assessment to minimize loss of natural vegetation. — Restrict impact to development footprint only and limit disturbance in surrounding areas. — Prior to commencement of construction, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval.								

9.6.2 OPERATIONAL PHASE

Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure. The operational impact along with mitigation measures are outlined in in **Table 9-22.**

Table 9-22: Operational impact on faunal mortality

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct mortality of fauna									
Without Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	Moderate
With Mitigation	1	1	5	1	1	**8**	**Very low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Direct mortality of fauna								
Mitigation and Management Measures	— Personnel on site should undergo environmental induction training, including the need to abide by speed limits, the increased risk of collisions with wild animals on roads in rural areas. — Proper waste management must be implemented, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard. — A trained expert should be available for consultation should snakes be encountered. Snakes need to be relocated by a trained snake handler. — Report any mortality of protected species to conservation authorities. — Personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species. — Report any illegal collection to conservation authorities. — Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment. — No additional clearing of vegetation should take place during the operational phase without a proper assessment of the environmental impacts and authorization from relevant authorities, unless for maintenance purposes, in which case all reasonable steps should be taken to limit damage to natural areas. — Fences to demarcate activity areas, prevent activities in no-go areas, protocols, education, keep products and items properly stored that could be dangerous to animals, no open pits or holes.								

9.6.3 DECOMMISSIONING PHASE

The decommissioning impacts are expected to be the same as the construction impacts.

9.7 PLANT SPECIES

9.7.1 CONSTRUCTION PHASE

There are three plant SCC flagged for the study area, all of which have a moderate probability of occurring in the types of habitats affected by the proposed project. There are an additional eight plant SCC that have moderate to high probability of occurring in the types of habitats affected by the proposed project. Any project component that causes direct loss of natural habitat has a probability of affecting individuals of SCC if present.

During the construction phase, the loss of individuals of Species of Conservation Concern due to clearing will be highly likely. The construction impact along with associated mitigation measures are indicated in **Table 9-23.**

Table 9-23: Construction impact on plant habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of individuals of Species of Conservation Concern									
Without Mitigation	3	5	5	3	3	**48**	**Moderate**	(-)	Moderate
With Mitigation	1	5	5	1	2	**24**	**Very Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of individuals of Species of Conservation Concern									
Mitigation and Management Measures	— Prior to construction, undertake a detailed walk-through survey of footprint areas that are within habitats where SCC are likely to occur. — Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control — Where significant populations of SCC are found, collect the data for any flora permits or micro-siting of infrastructure that may be required. — Compile a Plant Rescue Plan — During the construction, undertake monitoring to evaluate whether further measures would be required to manage impacts.								

9.7.2 OPERATIONAL PHASE

During the operational phase of the project, there will be continuous activity on site, including normal operational activities, maintenance, and monitoring. There may also be minor additional construction. Rehabilitation of various sites, such as the construction camps, will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation that may possibly result in loss of individuals of SCC. The operational impact along with associated mitigation measures are indicated in **Table 9-24**

Table 9-24: Operational impact on plant habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Disturbance due to general operational activities and maintenance leading to loss of individuals of SCC									
Without Mitigation	3	5	5	3	2	**32**	**Moderate**	(-)	Moderate
With Mitigation	1	5	5	1	1	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Protect natural habitat within project area of influence as sensitive. — Where undisturbed areas are to be affected by maintenance activities, undertake a detailed walk-through survey of footprint areas that are within habitats where SCC are likely to occur. — Prior to operation, undertake a detailed walk-through survey of footprint areas that are within habitats where SCC are likely to occur. — Where significant populations of SCC are found, collect the data for any flora permits or micro-siting of infrastructure that may be required. — Compile a Plant Rescue Plan — During the operation, undertake monitoring to evaluate whether further measures would be required to manage impacts.								

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established. Where these become well-established, they alter ecological conditions leading to loss of vegetation and plant species within the affected areas. This may include plant SCC. The operational impact along with associated mitigation measures are indicated in **Table 9-25.**

Table 9-25: Operational impact on alien species establishment

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment and spread of declared weeds and alien invader plants leading to loss of SCC									
Without Mitigation	3	4	5	3	3	**45**	**Moderate**	(-)	Moderate
With Mitigation	1	2	3	1	2	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— Prior to commencement of Operation, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control — Undertake regular monitoring to detect alien invasions early so that they can be controlled. — Implement control measures.								

9.7.3 DECOMMISSIONING PHASE

During the decommissioning phase of the project, there will be a flurry of activity on site over a period, similar to during the construction phase, including dismantling and removal of equipment and rehabilitation. There may also be minor additional construction. Rehabilitation of various sites will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation that may possibly result in loss of individuals of SCC.

It is recommended that a closure and rehabilitation plan be compiled near to the decommissioning stage but in advance of when decommissioning is planned, and that this would be required to be implemented prior to closure of the project. The closure and rehabilitation plan must follow the regulatory requirements at the time of decommissioning. The decommissioning impact along with associated mitigation measures are indicated in **Table 9-26**

Table 9-26: Decommissioning impact on species of concern

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss and/or disturbance of indigenous natural vegetation during removal of infrastructure that may lead to loss of individuals of SCC									
Without Mitigation	3	5	5	3	3	**48**	**Moderate**	(-)	Moderate
With Mitigation	1	5	5	1	2	**24**	**Low**	(-)	
Mitigation and Management Measures	— Prior to decommissioning commencing, compile a Rehabilitation Plan in compliance with the regulatory requirements at the time of decommissioning.								

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established. Where these become well-established, they alter ecological conditions leading to loss of vegetation and plant species within the affected areas. This may include plant SCC. The decommissioning impact along with associated mitigation measures are indicated in **Table 9-27**

Table 9-27: Decommissioning impact on spread of alien species

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment and spread of declared weeds and alien invader plants leading to loss of SCC									
Without Mitigation	3	4	5	3	3	**45**	**Moderate**	(-)	Moderate
With Mitigation	1	2	3	1	2	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— Rehabilitate disturbed areas in accordance with the specifications of a Rehabilitation Plan. — Adhere to alien management plan, which highlights control priorities and areas and provides a programme for long-term control. — Undertake regular monitoring to detect alien invasions early so that they can be controlled. — Implement control measures.								

9.8 AVIFAUNA

9.8.1 CONSTRUCTION PHASE

During the construction of the green hydrogen and ammonia facility, habitat destruction/transformation will inevitably take place, as the 25 hectares that constitute the facility footprint will be completely transformed through the construction of the infrastructure which will result in the removal of all vegetation.

The construction of the facility will impact on birds breeding, foraging and roosting in the facility footprint through transformation of habitat, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact (other than offsets) as the total permanent transformation of the habitat within the construction footprint of the facility is unavoidable. However, the impact of habitat loss for SCC due to direct habitat transformation associated with the construction of the proposed facility is likely to be limited, due to the relatively small size of the footprint (25 ha), and the fact that almost no natural grassland will be affected, which is the most important habitat type for SCC. In the case of Site Alternatives 1 and 3, it will result in the removal of stands of alien trees, which could potentially serve as a nest location for Secretarybird and Lanner Falcon, although no such breeding was recorded during the year of pre-construction monitoring for the proposed wind energy facilities.

It is highly unlikely that SCC will be significantly affected by this potential impact, but species that are potentially vulnerable to this impact are as follows: African Grass Owl, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Lanner Falcon, Martial Eagle, Secretarybird and Southern Bald Ibis

The construction impact along with associated mitigation measures are indicated in **Table 9-28.**

Table 9-28: Construction Impact on habitat transformation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of SCC due to habitat transformation associated with the construction of the GH&A facility.									
Without Mitigation	3	1	3	4	2	**22**	**Low**	(-)	Easy
With Mitigation	3	1	3	4	1	**11**	**Very low**	(-)	
Mitigation and Management Measures	— Vegetation clearance should be limited to what is absolutely necessary								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of SCC due to habitat transformation associated with the construction of the GH&A facility.									
	— Conduct a pre-construction inspection to identify SCC that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed. — Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. — The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.								

Apart from direct habitat destruction, the above-mentioned activities also impact on birds, including some SCC, through displacement due to disturbance; this could lead to breeding failure if the displacement happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement, due to demanding construction schedules.

Terrestrial species and owls, and raptors and crows breeding on existing high voltage lines running next to the proposed alignments, are most likely to be affected by displacement due to disturbance associated with the construction of the 132kV grid line.

In the case of Site Alternatives 1 and 3, it will necessitate the removal of stands of alien trees, which could potentially serve as a nest location for Secretarybird and Lanner Falcon, although no such breeding was recorded during the year of pre-construction monitoring for the proposed wind energy facilities. There is a possibility that Blue Korhaan could use natural grassland in the PAOI for breeding, but very little of this habitat is impacted by the proposed facilities, therefore the likelihood of breeding birds being disturbed by construction activities are remote.

SCC which are potentially vulnerable to this impact are as follows: Secretarybird, Lanner Falcon and Blue Korhaan

The construction impact along with associated mitigation measures are indicated in **Table 9-29.**

Table 9-29: Construction impact on disturbance of breeding birds

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of SCC due to disturbance of breeding birds associated with the construction of the GH&A facility.									
Without Mitigation	3	2	1	2	2	16	Low	(-)	Moderate
With Mitigation	2	2	1	2	2	14	Very Low	(-)	
Mitigation and Management Measures	— Conduct a pre-construction inspection to identify SCC that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed. — Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum — Measures to control noise and dust should be applied according to current best practice in the industry. — The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.								

The construction impact along with associated mitigation measures are indicated in **Table 9-30**

Table 9-30: Construction impact on habitat transformation due to 132kV powerline

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement due to habitat transformation associated with the construction of the 132kV grid connection power line.									
Without Mitigation	3	1	1	2	2	**14**	**Low**	(-)	Moderate
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Vegetation clearance should be limited to what is absolutely necessary. — The mitigation measures proposed by the biodiversity specialist must be strictly enforced.								

The construction impact along with associated mitigation measures are indicated in **Table 9-31.**

Table 9-31: Construction impact due to displacement from the 132kV powerline

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement due to disturbance associated with the construction of the 132Kv grid connection power line.									
Without Mitigation	3	2	1	2	3	**24**	**Low**	(-)	Moderate
With Mitigation	3	2	1	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— Avifaunal specialist to conduct an inspection to identify SCC that may be breeding within the project footprint to ensure that the impacts to breeding species (if any) are adequately managed. — Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the surrounding area should be strictly controlled to prevent unnecessary disturbance of priority species. — Measures to limit noise and dust should be applied according to current best practice in the industry. —								

9.8.2 OPERATIONAL PHASE

Collisions are perhaps the biggest threat posed by high voltage lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds, and to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Shaw et al. 2017). However, the short length of line (maximum 8km) significantly reduces the potential collision risk.

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three up to 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality. The two different marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw et al. 2017).

The powerline sensitive species which could occur in the study area and are potentially vulnerable to powerline collision impacts are as follows:

African Grass Owl (SCC), Blue Korhaan (SCC), Denham's Bustard (SCC), Greater Flamingo (SCC), Grey Crowned Crane (SCC), Lesser Flamingo (SCC), Maccoa Duck (SCC), Secretarybird (SCC), Southern Bald Ibis (SCC), Yellow-billed Stork (SCC), African Black Duck, African Darter, African Sacred Ibis, African Spoonbill, African Swamphen, Black-headed Heron, Black-necked Grebe, Cape Shoveler, Cape Teal, Egyptian Goose, Glossy Ibis, Goliath Heron, Great Crested Grebe, Great Egret, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Little Egret, Little Grebe, Marsh Owl, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, South African Shelduck, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Western Barn Owl, Western Cattle Egret White Stork, White-backed Duck, White-breasted Cormorant, White-faced Whistling Duck and Yellow-billed Duck

The operational impact along with associated mitigation measures are indicated in **Table 9-32**.

Table 9-32: Operational Impact on mortality due to collisions

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Mortality of priority species due to collisions with the up to 132kV overhead power line									
Without Mitigation	3	3	1	4	4	**44**	**Moderate**	(-)	Moderate
With Mitigation	3	3	1	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Bird Flight Diverters must be fitted to the entire OHL according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines). These devices must be installed as soon as the conductors and earth wires are strung. — If a steel monopole pole design is used, the approved vulture friendly pole/tower design D-DT-7649 in accordance with the Eskom Distribution Technical Bulletin titled Refurbishment of 66/88kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467 relating to bird friendly structures, must be used. — If lattice type structures are used, it is imperative that a minimum vertical clearance of 1.8m is maintained between the jumper cables and/or insulator live ends, and the horizontal earthed components. Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles is also recommended (if suitable insulation material is readily available), alternatively all jumper cables must be suspended below the crossarms.								

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pole/tower design. Should the proposed OHL be constructed using a 132kV tower specification, the electrocution impact for the majority of priority species will be negligible. The only priority species capable of bridging the clearance distances of an OHL constructed using this specification is the Cape Vulture, due to their size and gregarious nature. The impact is rated as Low pre-mitigation and it will decrease to Very Low post-mitigation due to the short length of line.

The operational impact along with associated mitigation measures are indicated in **Table 9-33.**

Table 9-33: Operational impact on mortality due to electrocution

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Electrocution of priority species on the up to 132kV overhead powerline									
Without Mitigation	5	3	3	4	2	**30**	**Low**	(-)	High
With Mitigation	5	3	3	4	1	**15**	**Very low**	(-)	
Mitigation and Management Measures	— Bird Flight Diverters must be fitted to the entire OHL according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Electrocution of priority species on the up to 132kV overhead powerline									
	Diverters on Eskom Overhead Lines). These devices must be installed as soon as the conductors and earth wires are strung. — If a steel monopole pole design is used, the approved vulture friendly pole/tower design D-DT-7649 in accordance with the Eskom Distribution Technical Bulletin titled Refurbishment of 66/88kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467 relating to bird friendly structures, must be used. — If lattice type structures are used, it is imperative that a minimum vertical clearance of 1.8m is maintained between the jumper cables and/or insulator live ends, and the horizontal earthed components. Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles is also recommended (if suitable insulation material is readily available), alternatively all jumper cables must be suspended below the crossarms.								

9.8.3 DECOMMISSIONING PHASE

The impacts during the decommissioning phase are expected to be the same of that during the construction phase. The impacts along with associated mitigation measures are indicated in **Table 9-34.**

Table 9-34: Decommissioning impact on priority avifaunal species

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of SCC due to disturbance of breeding birds associated with the decommissioning of the GH&A facility									
Without Mitigation	3	2	1	1	1	**16**	**Low**	(-)	Moderate
With Mitigation	2	2	1	1	1	**14**	**Very low**	(-)	
Mitigation and Management Measures	— Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. — Measures to control noise and dust should be applied according to current best practice in the industry. — Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. — The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.								

The impacts during the decommissioning phase are expected to be the same of that during the construction phase. The impacts along with associated mitigation measures are indicated in **Table 9-35.**

Table 9-35: Decommissioning impact on priority avifaunal species

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement due to disturbance associated with the decommissioning of the 132Kv grid connection power line.									
Without Mitigation	3	2	1	2	3	**24**	**Low**	(-)	Moderate

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement due to disturbance associated with the decommissioning of the 132Kv grid connection power line.									
With Mitigation	3	2	1	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. — Measures to control noise and dust should be applied according to current best practice in the industry. — Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. — The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.								

9.9 VISUAL

9.9.1 CONSTRUCTION PHASE

Large construction vehicles, equipment and construction material stockpiles will alter the natural character of the study area and expose visual receptors to impacts associated with construction. Construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Temporary stockpiling of soil during construction may alter the flat landscape.

Dust emissions and dust plumes from increased traffic on the gravel roads serving the construction site may evoke negative sentiments from surrounding viewers. Surface disturbance during construction would expose bare soil resulting in visual scarring of the landscape and increasing the level of visual contrast with the surrounding environment. Potential visual pollution resulting from littering on the construction site.

The construction impact along with associated mitigation measures are indicated in **Table 9-36**.

Table 9-36: Construction Impact on the Visual surroundings

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual deterrence									
Without Mitigation	3	2	3	4	3	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Carefully plan to minimise the construction period and avoid construction delays. — Position laydown areas and related storage/stockpile areas in unobtrusive positions in the landscape, where possible. — Vegetation clearing should take place in a phased manner. — Make use of existing gravel access roads where possible. — Limit the number of vehicles and trucks travelling to and from the proposed sites, where possible. — Ensure that dust suppression techniques are implemented on all access roads, in all areas where vegetation clearing has taken place and on all soil stockpiles.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual deterrence									
	— Maintain a neat construction site by removing litter, rubble and waste materials regularly.								

9.9.2 OPERATIONAL PHASE

The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. The proposed facility and associated infrastructure will alter the visual character of the surrounding area and expose potentially sensitive visual receptor locations to visual impacts.

Dust emissions and dust plumes from maintenance vehicles accessing the site via gravel roads may evoke negative sentiments from surrounding viewers. The night-time visual environment will be altered as a result of operational and security lighting at the proposed facility.

The operational impact along with associated mitigation measures are indicated in **Table 9-37**.

Table 9-37: Operational Impact on Visual surroundings

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual deterrence									
Without Mitigation	3	3	3	4	4	**52**	**Moderate**	(-)	Easy
With Mitigation	3	3	3	4	4	**52**	**Moderate**	(-)	
Mitigation and Management Measures	— Restrict vegetation clearance on the site to that which is required for the correct operation of the facility and the OHL. — As far as possible, limit the number of vehicles which are allowed to access the site. — Ensure that dust suppression techniques are implemented on all gravel access roads. — As far as possible, limit the amount of security and operational lighting present on site. — Light fittings for security at night should reflect the light toward the ground and prevent light spill. — Lighting fixtures should make use of minimum lumen or wattage whilst adhering to safety and security requirements. — Mounting heights of lighting fixtures should be limited, or alternatively foot-light or bollard level lights should be used. — If economically and technically feasible, make use of motion detectors on security lighting.								

9.9.3 DECOMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to the same of that of the construction phase.

9.10 WASTE MANAGEMENT

9.10.1 CONSTRUCTION PHASE

The waste generated during this phase will be mostly construction related waste and must be manged effectively to prevent pollution of the site. The construction impact and associated mitigation measures are outlined in **Table 9-38.**

Table 9-38: Construction Impact on general waste

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
General Waste generated									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	1	2	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— General waste on the site must be always contained in bin/skips and should not be allowed to stand on site for more than 30 days — There will need to be waste segregation (e.g. electronic equipment, chemicals, oil contaminated rags, paper, plastic) and management on the site. — Waste management plan to be in place e.g. liquid waste treatment or suitable removal and disposal will be provided.								

The usage of numerous hazardous chemicals will be required during this phase. The construction impact and associated mitigation measures are outlined in **Table 9-39.**

Table 9-39: Construction impact on hazardous waste generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Hazardous Waste generated									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Easy
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Spill clean-up procedures to be in place before commencing construction. — Spillages of oils, fuels, paints, and other hazardous chemicals should be cleaned up in the correct manner according to industry standards, and disposed thereafter appropriately with proof retained — There will need to be waste segregation (e.g. electronic equipment, chemicals, oil contaminated rags, paper, plastic) and management on the site. — Reportable Quantities in terms of NEMA must be known for the relative hazardous chemicals present on site								

The construction impact and associated mitigation measures are outlined in **Table 9-40.**

Table 9-40: Construction impact on sanitation waste

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Sanitation Waste generated									
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Easy
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Sewage and any kitchen liquids must have suitable containment and suitable treatment/disposal — There will need to be waste segregation (e.g. electronic equipment, chemicals, oil contaminated rags, paper, plastic) and management on the site.								

9.10.2 OPERATIONAL PHASE

The operational impact associated with general waste along with associated mitigation measures is indicated in **Table 9-41.**

Table 9-41: Operational Impact general waste

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
General waste									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	1	2	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— General waste on the site must be always contained in bin/skips and should not be allowed to stand on site for more than 30 days — There will need to be waste segregation (e.g. electronic equipment, chemicals, oil contaminated rags, paper, plastic) and management on the site. — Waste management plan to be in place e.g. liquid waste treatment or suitable removal and disposal will be provided.								

During the operation of the facility, multiple sources of hazardous waste may be encountered. The operational impact associated with hazardous waste along with associated mitigation measures is indicated in **Table 9-42.**

Table 9-42: Operational impacts on hazardous waste generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Hazardous waste									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Easy
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Waste management plan to be in place e.g. liquid waste treatment or suitable removal and disposal will be provided. — Spill clean-up procedures to be in place before bringing chemical containers on site, including spill kits – non-combustible materials, hazmat disposal.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Hazardous waste								
	— Spillages of oils, fuels, paints, and other hazardous chemicals should be cleaned up in the correct manner according to industry standards, and disposed thereafter appropriately with proof retained — There will need to be waste segregation (e.g. electronic equipment, chemicals, oil contaminated rags, paper, plastic) and management on the site. — Reportable Quantities in terms of NEMA must be known for the relative chemicals present at the facility — Process controls in place for the BESS to prevent contamination and deterioration of electrolyte leading to excessive purging.							

9.10.3 DECOMISSIONING PHASE

The waste generated during the decommissioning phase is expected to be similar to the construction phase.

9.11 TRAFFIC

9.11.1 CONSTRUCTION PHASE

The main impact on the external road network will be during the construction and decommissioning phase. Both these phases are temporary in comparison to the operational period. The impacts during these phases include noise, dust and exhaust pollution, as well as road surface wear and tear due to the increase in traffic. The road surface wear and tear is more prevalent for gravel roads.

With the exception of abnormal loads, it is estimated that 17 peak hour trips will be generated during the construction phase. The noise and dust impacts are expected to be negative in character with a moderate significance rating pre-mitigation and a low significance rating post mitigation.

This phase includes the transportation of people, construction materials and equipment to the site. This phase also includes typical construction activities such as clearing the site, constructing facility infrastructure (buildings, wind turbine footings, solar panel track footings, roads, etc) and ancillary construction works. This phase will temporarily generate the most development traffic.

Construction traffic will include vehicles for material and component deliveries, construction staff and all other associated personnel. Trips will include the delivery of over-sized components such as storage tanks and plant equipment manufactured off site. The route/s between the origin of the material and components and the facility may be National, Provincial or Local roads, and each authority will be required to provide the necessary permits for the transportation of any oversized or weight components.

However, due to access to the facility off low to medium trafficked National roads, and low trafficked district roads, the traffic impact during the workday AM and PM peak hours are expected to be low.

The transportation of any overweight/size freight to the site such as storage tanks and plant equipment will require assessment in due course. The route/s between the origin (port of entry) of the oversize/weight components and the site may be National, Provincial or Local roads. The transportation of any overweight freight to the site is limited to generators, and the volumes are expected to be negligible.

It is recommended that an abnormal vehicle route management plan be undertaken when the port/s of entry are confirmed. This plan will cover all aspects such as horizontal and vertical vehicle requirements, bridges along the route, speed limits, etc. These plans and the application for the abnormal permits is normally the responsibility of the logistics company that will transport the components to site.

The construction impact and associated mitigation measures are indicated in **Table 9-43**.

Table 9-43: Construction Impact on noise due to additional vehicles on site

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Increase in noise due to increase in traffic due to vehicle trips on-site									
Without Mitigation	3	2	3	2	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	
Mitigation and Management Measures	— The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods. — Dust suppression of gravel roads during the construction phase, as required. — The use of mobile batch plants and quarries near the site would decrease impacts of material delivery trips. — Manufacturing some components on site. — Use of on-site borrow pits for material sourcing. — Staff and general trips can occur outside of peak traffic periods as far as possible. — Use of high occupancy vehicles to transport workers can reduce traffic volumes. — The preferred abnormal load travel routes should be surveyed to identify problem areas (e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification). This can reduce traffic delays by allowing ease of travel. — Accommodating on site storage for components and materials to allow for practical scheduled delivery outside of peak hours. — Periodic maintenance of the gravel roads utilized during the construction phase. This maintenance will require liaising with the provincial authority charged with maintaining the road to determine the appropriate maintenance level, extent and frequency.								

The construction impact and associated mitigation measures are indicated in **Table 9-44**.

Table 9-44: Construction impact on dust and pollution due to additional vehicles on site

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Dust & exhaust pollution due to additional trips on the national and district roads									
Without Mitigation	3	2	3	2	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	
Mitigation and Management Measures	— The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods. — Dust suppression of gravel roads during the construction phase, as required. — The use of mobile batch plants and quarries near the site would decrease impacts of material delivery trips. — Manufacturing some components on site. — Use of on-site borrow pits for material sourcing. — Staff and general trips can occur outside of peak traffic periods as far as possible.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Dust & exhaust pollution due to additional trips on the national and district roads									
	— Use of high occupancy vehicles to transport workers can reduce traffic volumes — The preferred abnormal load travel routes should be surveyed to identify problem areas (e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification). This can reduce traffic delays by allowing ease of travel. — Accommodating on site storage for components and materials to allow for practical scheduled delivery outside of peak hours. — Periodic maintenance of the gravel roads utilized during the construction phase. This maintenance will require liaising with the provincial authority charged with maintaining the road to determine the appropriate maintenance level, extent and frequency.								

9.11.2 OPERATIONAL PHASE

During operation, it is expected that the same nature of impacts as the construction phase will occur however at a significantly lower degree of significance. This is as a result of the lower development traffic expected during the operational phase when compared to the construction and decommissioning phases.

It is estimated that 21 peak hour trips will be generated during the operational phase. The noise and dust impacts are expected to be negative in character with a low significance rating pre-mitigation and a very low significance rating post mitigation.

This phase includes the operation and maintenance of the development and its supporting infrastructure throughout the life span of the facility.

The nature of the impact expected to be generated at this stage would be traffic congestion and delays on the surrounding road network, and the associated noise, dust and exhaust pollution, as well as road surface impact due to the increase in traffic.

The proposed mitigating measures are moderate to implement (maintenance of district roads) and will assist to either prevent or reduce the impacts of increased vehicle engine and tyre noise, exhaust fumes and generation of dust on unsurfaced roads.

The operational impact due to road transport of ISOtainer vehicle trips to site and associated mitigation measures are indicated in **Table 9-45**.

Table 9-45: Operational Impact on noise due to additional vehicles on site

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Transport of ISOtainers generating noise pollution on the national and district roads									
Without Mitigation	2	1	3	4	3	**30**	**Low**	(-)	Easy
With Mitigation	1	1	1	4	2	**14**	**Very low**	(-)	
Mitigation and Management Measures	— Transport of oxygen, hydrogen, and ammonia can be staggered, and trips can be scheduled to occur outside of peak traffic periods. — Maintenance of internal roads to maintain good riding quality								

The operational impact due to ISOtainer transport on national and district roads and associated mitigation measures are indicated in **Table 9-46**

Table 9-46: Operation impact on dust and pollution due to additional vehicles on site

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Transport of ISOtainers generating dust & exhaust pollution on the national and district roads									
Without Mitigation	2	1	3	4	3	**30**	**Low**	(-)	Easy
With Mitigation	1	1	1	4	2	**14**	**Very low**	(-)	
Mitigation and Management Measures	— Transport of oxygen, hydrogen, and ammonia can be staggered, and trips can be scheduled to occur outside of peak traffic periods. — Dust suppression of internal gravel roads as required. — Maintenance of internal roads to maintain good riding quality.								

9.11.3 DECOMISSIONING PHASE

It is not possible to determine the volume of traffic that will be generated during the decommissioning phase. It is however expected that the volumes will be similar to the construction phase, and the resultant transport impact on the local road network will be similar as well.

9.12 HERITAGE

9.12.1 CONSTRUCTION PHASE

Impacts to heritage resources without mitigation within the project footprint will be permanent and negative and occur during the pre-construction and construction activities. Graves at 093, 094, HD001, HD002, HD 004, HD101 and GA004 must be preserved in situ with a 30-meter buffer as mitigation measure prescribed by SAHRA, which means that the linear infrastructure will have to be micro sited in the areas where HD002 and GA004 were recorded. As best practice these features should be indicated with buffer zones on development plans.

Based on the current layout the ruins at GA002 are in the site alternative 3 footprint and the cluster of sites at 089 – 092 is located close to the Option 2 powerline. Although of low significance the possible presence of graves at the ruins is a risk. If avoidance is not possible the presence of graves should be confirmed during social consultation and the area should be monitored during construction.

Any additional effects to subsurface heritage resources can be successfully mitigated by implementing a chance find procedure. With the implementation of the recommended mitigation measures impacts of the project on heritage resources is acceptable.

No impacts are anticipated for operation or decommissioning phases.

The construction phase involves the removal of topsoil and vegetation as well as the establishment of infrastructure. These activities can have a negative and irreversible impact on heritage features if any occur. Impacts include destruction or partial destruction of non-renewable heritage resources.

The construction impact on existing graves and associated mitigation measures are indicated in **Table 9-47.**

Table 9-47: Construction Impact on existing graves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Destruction or damage to Graves at 093, 094, HD001, HD002, HD 004, HD101, HD102 and GA004.									
Without Mitigation	4	2	5	5	3	**48**	**Moderate**	(-)	Easy
With Mitigation	2	2	5	5	1	**14**	**Very low**	(-)	
Mitigation and Management Measures	— Must be preserved in situ with a 30-meter buffer as mitigation measure as prescribed by SAHRA, which means that the powerline will have to be micro sited in the areas where HD002 and GA004 were recorded. — Implementation of a Chance Find Procedure for the Project — The study area should be monitored by the ECO during construction. — The final layout should be subjected to a heritage walkthrough. — If during construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager. — It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area. — The senior on-site Manager will inform the ECO of the chance find and its immediate impact on construction activities. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.									

The construction impact on existing ruins and associated mitigation measures are indicated in **Table 9-48**

Table 9-48: Construction Impact on existing ruins

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Destruction or damage to recorded ruins									
Without Mitigation	2	2	5	5	3	**42**	**Moderate**	(-)	Easy
With Mitigation	1	2	5	5	1	**13**	**Very low**	(-)	
Mitigation and Management Measures	— If avoidance is not possible the presence of graves should be confirmed during social consultation and the area should be monitored during construction. — The study area should be monitored by the ECO during construction. — The final layout should be subjected to a heritage walkthrough. — If during construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager. — It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area.									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Destruction or damage to recorded ruins									
	— The senior on-site Manager will inform the ECO of the chance find and its immediate impact on construction activities. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.								

The construction impact on unknown heritage resources and associated mitigation measures are indicated in **Table 9-49**

Table 9-49: Construction Impact on unknown heritage resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage/ destruction of unknown heritage resources.									
Without Mitigation	2	2	5	5	2	**28**	**Low**	(-)	Easy
With Mitigation	1	2	5	5	1	**13**	**Very low**	(-)	
Mitigation and Management Measures	— Implementation of a Chance Find Procedure for the Project — The study area should be monitored by the ECO during construction. — The final layout should be subjected to a heritage walkthrough. — If during construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager. — It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area. — The senior on-site Manager will inform the ECO of the chance find and its immediate impact on construction activities. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.								

9.12.2 OPERATIONAL PHASE

No operational impacts are anticipated with the GH&A facility on heritage resources in the area.

9.12.3 DECOMISSIONING PHASE

The decommissioning phase is expected to have the similar impacts as the construction phase.

9.13 PALAEONTOLOGY

The proposed route and sites predominantly lie on the potentially fossiliferous Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossil plants of the Vryheid Formation. A short section of the site and route lie on the non-fossiliferous Jurassic dolerite.

Based on the fossil record but confirmed by the site visit and walk through, there are NO FOSSILS of the Glossopteris flora even though fossils have been recorded from rocks of a similar age and type in South Africa.

It is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur below the ground surface in the shales of the Vryheid Formation (Ecca Group, Karoo Supergroup) therefore, a Fossil Chance Find Protocol will be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations and drilling for foundations and amenities have commenced, then they should be rescued, and a palaeontologist called to assess and collect a representative sample. There is no preferred site for the facilities, as far as the palaeontology is concerned.

The impact pre-mitigation is low, and post-mitigation (collection of fossils) very low but positive. If fossils are recovered, removed and placed in a recognised institution such as a museum or university palaeontology collection this will be a positive impact because the fossils will be available for research. Otherwise, they would have remained unknown to science. There is no preferred alternative for the facility site.

9.13.1 CONSTRUCTION PHASE

Once fossils have been removed there will be not further impact on the palaeontological heritage. Therefore, the impact is only applicable to the construction phase. The operation and de-commissioning phases will NOT impact the palaeontology.

The construction impact and associated mitigation measures are indicated in **Table 9-50.**

Table 9-50: Construction Impact on Palaeontological finds

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Encountering Fossils									
Without Mitigation	2	1	3	4	2	**20**	**Low**	(-)	Easy
With Mitigation	1	1	3	1	6	**6**	**Very low**	(+)	
Mitigation and Management Measures	— If fossils occur in the footprint of any section of the project, the route for the grid connection (overhead powerline pole foundations/below ground water piping), the hydrogen and ammonia facilities, access roads or infrastructure, they can be removed as per the Fossil Chance Find Protocol in the EMPr, and the project can continue. If no fossils are found, then no mitigation is required. — When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) should be put aside in a suitably protected place. This way the project activities will not be interrupted. — Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones. This information will be built into the EMP's training and awareness plan and procedures. — Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment. — If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible. — Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained.									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Encountering Fossils								
	Annual reports must be submitted to SAHRA as required by the relevant permits. — If no good fossil material is recovered, then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils. — If no fossils are found and the excavations have finished, then no further monitoring is required.							

9.13.2 OPERATIONAL PHASE

There will be no impacts on palaeontology in the area when the facility in operational.

9.13.3 DECOMISSIONING PHASE

The decommissioning phase are not expected to have any impacts on the palaeontology in the area.

9.14 SOCIO-ECONOMIC

9.14.1 CONSTRUCTION PHASE

The proposed facility will cost R4,2 billion (2023 prices) to establish. This will equate to a total impact of R18,8 billion (direct, indirect, and induced) on production/new business sales in the country. The localised expenditure on the project will stimulate the local and national economies albeit for a temporary period of 24 months during construction. It is estimated that the project will increase the GDP directly in the country by R1,3 billion in 2021 prices, which will translate into a total impact of R5,4 billion (direct, indirect, and induced) of Gross Domestic Product (GDP). These effects will take place for the duration of construction.

The greatest effects on production and GDP stimulated during construction activities will be created through the multiplier effects, specifically through a combination of production and consumption induced effects. The former refers to the impact generated along backwards linkages when the project creates demand for goods and services required for construction and subsequently stimulates the business sales of the suppliers of inputs that are required to produce these goods and services. The latter refers to the effects of household spending which is derived from an increase in salaries and wages directly and indirectly stimulated by the project's expenditure.

Sectors and industries that will experience the greatest stimulus from this expenditure include:

- Basic metals, structural metal products and other fabricated metal products industries
- Trade
- Insurance
- Transport services
- Electrical machinery and apparatus

The construction impacts and associated mitigation measures are indicated in **Table 9-51**.

Table 9-51: Construction Impact on local and national economy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Temporary stimulation of the national and local economy									
Without Mitigation	4	5	3	1	5	**65**	**High**	(+)	Easy
With Mitigation	4	5	4	1	5	**70**	**High**	(+)	
Mitigation and Management Measures	— The developer should encourage the contractor to increase the local procurement practices and promote the employment of people from local communities, as far as feasible, to maximise the benefits to the local economies. — The developer should engage with local authorities and business organisations to investigate the possibility of procuring construction materials, goods and products from local suppliers were feasible.								

The construction of the facility will create 300 full time equivalent employment positions over the course of the development. The total number of employment that will be created is estimated to 1 221 (including direct, indirect and induced). Given the size of the construction sector within the municipality, it is anticipated that there will be sufficient local labour to satisfy the demand for 300 South African based construction workers.

Furthermore, if most of the local staff comes from the Local Municipality it will have a positive effect on local unemployment particularly since the area experiences an unemployment rate above the provincial average.

Beyond the direct employment opportunities that will be created by the project during the construction phase the development will also have a positive spin-off effect on the employment situation in other sectors of the national and local economies. Through the procurement of local goods (i.e., consumption induced effects) the project will support an estimated total of 524 full time equivalent employment positions (indirect). Most of these positions will be in sectors such as construction, business services and trade. The expenditure on the project outside of the local economies will also have a positive effect on employment creation, albeit for a temporary period of 24 months. Through the production and consumption induced impacts the project is envisioned to create an estimated additional 398 full time equivalent employment (induced) positions. Given that a significant portion of the multiplier effects will be generated through backward linkages, more than half of these full time equivalent employment positions will be created along the supply chain and amongst industries providing inputs to the businesses in the supply chain.

Throughout the construction phase it is recommended that the developer encourage the EPC contractor to fill as many local positions as possible using labour from within the local municipality rather than from outside of the municipal boundaries. The construction impacts and associated mitigation measures are indicated in **Table 9-52**.

Table 9-52: Construction impact on local and national economies due to employment

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Temporary increase employment in the national and local economies									
Without Mitigation	4	4	2	1	5	**44**	**Moderate**	(+)	Moderate
With Mitigation	4	4	3	1	4	**48**	**Moderate**	(+)	
Mitigation and Management Measures	— Co-ordinate with the local municipality and relevant labour unions to inform the local labour force about the project that is planned to be established and the jobs that can potentially be applied for. — Recruit local labour as far as feasible. Employ labour-intensive methods in construction where feasible. — Sub-contract to local construction companies particularly SMMEs and BBBEE compliant enterprises where possible. — Use local suppliers where feasible and arrange with the local SMMEs to provide transport, catering and other services to the construction crews.								

The construction of the proposed facility is likely to have a positive impact on the skills development in South Africa. During the construction of the facility, which is planned to be conducted in Mpumalanga, it is likely that foreign technical experts will be involved. This will present an opportunity for skills and knowledge transfer between these technical experts and local manufacturers.

It is also expected that the construction staff involved in the project will gain knowledge and experience in respect of the development of such facilities. This will be highly beneficial given that this is relatively a new concept and the plant will be one of the first in South Africa. In addition to the direct effects of the project on skills development in the country and the local economy, the project could contribute to the development of the local research and development and manufacturing industries associated with green hydrogen and ammonia technology. This could be achieved through partnerships with the University of Mpumalanga (situated in the Mbombela Local Municipality). Partnerships of this nature could further enhance the development of new skills and expertise. The construction impacts and associated mitigation measures are indicated in **Table 9-53.**

Table 9-53: Construction impact on local communities as a result of skill development

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Contribution to skills development in the country and local economy									
Without Mitigation	4	4	2	1	5	**44**	**Moderate**	(+)	Easy
With Mitigation	4	4	3	1	4	**48**	**Moderate**	(+)	
Mitigation and Management Measures	— Facilitate knowledge and skills transfer between foreign technical experts and South African professionals during the pre-establishment and construction phases. — Facilitate a broader skills development programme as part of socio-economic development commitments.								

The presence on and movement of construction workers on and off the site poses a potential safety threat to local famers and farm workers in the vicinity of the site. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open and/or fences being damaged, or stock theft linked either directly or indirectly to the presence of farm workers on the site. The potential risks (safety, livestock, and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction on and off the site workers during the construction phase. The construction impacts and associated mitigation measures are indicated in **Table 9-54.**

Table 9-54: Construction impact on household earnings

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Temporary increase in household earnings									
Without Mitigation	4	4	2	1	5	**55**	**Moderate**	(+)	Easy
With Mitigation	5	4	2	1	5	**60**	**Moderate**	(+)	
Mitigation and Management Measures	— Recruit local labour as far as feasible to increase the benefits to the local households. — Employ labour intensive methods in construction where feasible. — Sub-contract to local construction companies where possible.								

The investment in the facility will generate revenue for the government during the construction period through a combination of personal income tax, VAT, companies' tax etc. Additional government revenue will also be earned through corporate income tax, however since the gross operating surplus of the EPC contractor employed to construct the facility is not known, an estimate of the overall corporate income tax value is not possible at this stage. Government earnings will be distributed by national government to cover public spending which includes amongst others the provision and maintenance of transport infrastructure, health, and education services as well as other public goods. The construction impacts and associated mitigation measures are indicated in **Table 9-55.**

Table 9-55: Construction impact on government revenue

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Temporary increase in government revenue									
Without Mitigation	2	4	1	1	4	32	Moderate	(+)	N/A
With Mitigation	2	4	2	1	4	36	Moderate	(+)	
Mitigation and Management Measures	— None suggested								

A community's sense of place is developed over time as it embraces the surrounding environment, becomes familiar with its physical properties, and creates its own history. The sense of place is created through the interaction of a number of different factors such as the areas visual resources, its aesthetics, climate, culture, and heritage as well as the lifestyle of individuals that live in and visit the area. Most importantly, it is a highly subjective matter and dependent on the demographics of the population that resides in the area and their perceptions regarding trade-offs.

For example, a community living in poverty is generally more likely to be accepting of industrial-type development that promises employment opportunities while a more affluent residential area is more likely to oppose such a development on the grounds that the development is not likely to generate gains for the community (Sinding, 2009). The area proposed for the development as well as its surrounds does have large-scale industries such as coal mining. Noise and light intrusion during the night in the area is currently high.

Given the above characteristics the area can be defined as being largely rural with mining activities. Any rapid changes that alter the characteristics that define the area's sense of place could potentially have a negative impact to the local population's sense of place. During the construction of the proposed facility there are likely to be noise and dust impacts caused by the movement of vehicles as well as construction activities on site.

These impacts are anticipated to occur primarily during the day with illumination from the site being experienced during the night. The presence of this noise is likely to alter the way the surrounding environment is experienced by households (farms) in the area. As construction activities progress and the footprint of the facility grows, the visual impact will also become more apparent, and the sense of place experienced by households residing within the visually affected area will be altered further. It is anticipated that residents residing on the farm on which the facility is proposed to be established will experience the greatest disruption in their sense of place during the construction period. Individuals who live on the surrounding farms will, over the course of the construction phase of the project, be subjected to either visual or noise disruptions that are currently not present in the area.

The sense of place at the farms located adjacent to or beyond the site of the proposed facility will also be affected to some extent. The facility will be visible from several of these farms. The visual exposure on all these farms during the construction phase will not be continuous given the proximity of some of the farms from the proposed facility. Nevertheless, the knowledge of the facility near the farm and the fact that it could be seen from some parts will still have a negative connotation and will alter the sense of place experienced by the households residing on these farms. As stated, the sense of place of local residents is likely to begin to be altered once the construction of the proposed facility begins.

Visual impacts will, however, remain for the entire operation of the development, this means that although the effect on the sense of place could be relatively small considering the population to be affected, the duration of the impact increases it significantly. It is advisable that all efforts be made to address the factors that will affect individual's sense of place such as visual effects and noise pollution to make them less intrusive. However, due to the current activities in the area, the proposed project will not have a significant impact on the sense of place, as the area is already severely affected by the mining activities. The construction impacts and associated mitigation measures are indicated in **Table 9-56.**

Table 9-56: Construction impact on sense of place

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Negative changes to the sense of place									
Without Mitigation	4	3	2	1	4	40	Moderate	(-)	Easy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Negative changes to the sense of place									
With Mitigation	4	3	1	1	4	**36**	**Moderate**	(-)	
Mitigation and Management Measures	— Natural areas that are not affected by the footprint should remain as such. — Efforts should also be made to avoid disturbing such sites during construction. — Undertake a public relations (PR) campaign prior to commencement of construction to communicate to community members the construction programme, inclusive of regular updates to generate excitement in the community								

As construction begins at the proposed site, disturbances will likely be minimal. The presence of construction machinery, increased traffic to and from the site (transporting staff, equipment, and material) and staff on or near the site will likely be the largest disturbances. The longer construction continues, the greater the disturbances will likely be. As the plant, and related infrastructure are erected there is likely to be an increased disturbance as this become increasingly visible in the surrounding area.

Once construction is completed the disturbances associated with the vehicular traffic, equipment and staff will be reduced and the remaining disturbance will be that of the facility itself. According to the landowner's survey's they indicated that some agricultural land will be lost, but they support the project. Thus, the impact on the agricultural operations will be minor. The construction impacts and associated mitigation measures are indicated in **Table 9-57.**

Table 9-57: Construction impact on local agricultural operations

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Negative impact on the local agriculture operations									
Without Mitigation	3	2	1	1	4	**28**	**Low**	(-)	Easy
With Mitigation	2	2	1	1	4	**24**	**Low**	(-)	
Mitigation and Management Measures	— Ensure that the farm owners are aware of construction activities that will take place on their premisses.								

Neither the local nor the surrounding municipalities are sufficiently diversified to supply the entire workforce for the construction of the proposed green hydrogen facility, particularly in terms of skilled positions. A significant number of the unskilled and semi-skilled workers required during the construction phase will however be sourced locally. In addition, given the scale and extent of the development, the project is likely to attract job seekers from other parts of the country, particularly from within Mpumalanga and Gauteng. This would be in addition to the migrant workers contracted to work on the project.

The migration of people to the area could result in social conflicts between the local population and the migrant work force as the local population could perceive these migrant workers as "stealing" their employment opportunities. Likewise, the influx of people into the area, could potentially lead to a temporary increase in the level of crime, illicit activity and possibly a deterioration of the health of the local community through the spread of infectious diseases. Semi-skilled and unskilled construction workers could also choose to remain in the area following the completion of the construction phase. without any form of income these individuals run the risk of exacerbating the level of poverty within the local municipality. Aside from the broader community issues the increase in the number of people in the area is likely to have an adverse effect on crime levels, incidents of trespassing, development of informal trading and littering. There is also potentially a likelihood of increased stock theft. The influx of job seekers and the potential social conflicts that can arise with in-migration of temporary workers to an area is difficult to mitigate. Appropriate awareness campaigns and strict adherence to recruiting practices could, however, reduce the extent of the adverse effect.

Addressing the challenges related to potential social impacts is best done in partnership with all stakeholders in the area, specifically the affected and adjacent property owners, local communities, ward communities and municipalities. This would promote transparency; information sharing and help build good relationships between all affected parties. In addition, all opportunities that would include the community in the project should be explored and where possible implemented.

Employment opportunities, including the provision of ancillary services, are particularly relevant in this incidence as the creation of employment opportunities for locals could eliminate the potential alienation between the community and the project as well as migrant workers.

The construction impacts and associated mitigation measures are indicated in **Table 9-57.**

Table 9-58: Construction impact on local social conflicts

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Temporary increase in social conflicts associated with the influx of people									
Without Mitigation	3	4	2	1	4	**40**	**Moderate**	(-)	Easy
With Mitigation	2	2	1	1	4	**24**	**Low**	(-)	
Mitigation and Management Measures	— Employ locals as far as feasible through the creation of a local skills database. — Ensure that any damages or losses to nearby affected farms that can be linked to the conduct of construction workers are adequately reimbursed. — Assign a dedicated person to deal with complaints and concerns of affected parties.								

The proposed facility will create and estimated 300 full time equivalent employment positions (South African based positions) for the duration of the project. Given that these workers will require services there is likely to be an increase in the demand for social services, access to water and electricity. Given the proximity of the development site to Hendrina, it is most likely that the health facilities in the area will experience additional demand for medical services brought about by the influx of works and job seekers.

If a construction camp is established to accommodate workers there will be a need for additional water and electrical connections for both the camp as well as the site office. These connections will, however, be minimal and it is unlikely to alter the demand significantly. The effects of the project on road infrastructure should also be considered as it is highly likely that the development will lead to an increase in traffic volumes on surrounding roads. The deterioration of these roads could place additional financial burdens on the municipality through additional maintenance costs. Additional traffic volumes are also likely to impact the condition of secondary roads used to access surrounding farms. The deterioration of secondary roads could add additional operating costs to farmers in the area due to delays in deliveries and damage to vehicles.

Based on the above discussion it is expected that the basic service provision, health facilities and road infrastructure will be under additional strain during the construction period. Given that the project is anticipated to attract additional people to the area the significance of the impact is considered to be medium. These impacts can however be mitigated if the developer engages with the local municipalities and plans accordingly.

The construction impacts and associated mitigation measures are indicated in **Table 9-57.**

Table 9-59: Construction impact on economic and social infrastructure

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Impact on economic and social infrastructure									
Without Mitigation	3	4	2	1	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	3	4	1	1	4	**36**	**Moderate**	(-)	
Mitigation and Management Measures	— Provide adequate signage along the access roads to warn motorists of the construction activities taking place on the site. — Where feasible, assist the municipality in ensuring that the quality of the local social and economic infrastructure does not deteriorate through the use of social responsibility allocations.								

9.14.2 OPERATIONAL PHASE

The proposed facility will require an annual operational expenditure of R80 million over 20 years. The total impact on production in the country as a result of the project's operations will equate to R238 million per annum in 2023 prices for the 20 years. Aside from the utilities sector, industries that will experience the greatest stimulus from the project will include electrical machinery and apparatus, insurance, trade, transport service and chemical production industry. It is estimated that the project will generate R53 million of value add per year over the 20-year period (comprising gross operating surplus before taxes and labour) and taxes.

In addition to the positive production and GDP impacts arising from expenditure related to the operation of the WEF, the local economy is anticipated to be positively stimulated by expenditure related to the developer's intended socio-economic development contributions in the immediate area.

The operational impact and associated mitigation measures are indicated in **Table 9-60.**

Table 9-60: Operational impact of green hydrogen and ammonia production

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Sustainable increase in production and GDP nationally and locally									
Without Mitigation	3	5	2	4	4	**56**	**Moderate**	(+)	Easy
With Mitigation	3	5	3	4	4	**60**	**Moderate**	(+)	
Mitigation and Management Measures	— The operator of the green hydrogen facility should be encouraged to, as far as possible, procure materials, goods and products required for the operation and maintenance of the facility from local suppliers to increase the positive impact in the local economy.								

The proposed facility will create an estimated 100 permanent employment positions across the operation phase of the development which, will be retained for approximately 20 years. Of these, an estimated 100 will be South African based positions. It is envisaged that some of the skilled and low skilled staff will be employed from within the local area with the remaining staff being sourced from other parts of Mpumalanga and the country. Aside from the direct employment opportunities, the facility will support an estimated 89 full time equivalent employment positions created through the production and consumption induced effects.

Due to the spatial allocation of procurement spending and direct employment created, most of the indirect and induced positions will also be created within the local area. The trade, manufacturing and community and personal services sectors will benefit the most from these new employment opportunities.

The operational impact and associated mitigation measures are indicated in **Table 9-61.**

Table 9-61: Operational impact on employment and business opportunities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Creation of sustainable employment positions nationally and locally									
Without Mitigation	3	5	1	4	4	**52**	**Moderate**	(+)	Moderate
With Mitigation	3	5	2	4	4	**56**	**Moderate**	(+)	
Mitigation and Management Measures	— Where possible, local labour should be considered for employment so as to increase the positive impact on the local economy.								

Highly skilled personnel would need to be recruited from outside of the local municipality as the economy would not be diversified enough to attract such specialists. These employees would include skilled "mechatronics" engineers (specialised in both electrical and mechanical engineering) likely to be recruited from the Johannesburg Metro.

As part of the developer's intended socio-economic development spend contributions to the immediate area, both on-project, and non-hydrogen and ammonia skills development initiatives will be funded. The non-energy skills to be developed should be relevant and required in the region and should seek to provide value to the community and the environment.

The operational impact and associated mitigation measures are indicated in **Table 9-62.**

Table 9-62: Operational impact on skills development

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Skills development of permanently employed workers									
Without Mitigation	2	4	2	4	4	**48**	**Moderate**	(+)	Easy
With Mitigation	3	4	2	4	4	**52**	**Moderate**	(+)	
Mitigation and Management Measures	— The developer should consider establishing vocational training programmes for the local labour force to promote the development of skills required by the green hydrogen facility and thus provide for the opportunities for these people to be employed in other similar facilities elsewhere in the future.								

The creation of an estimated 270 full time equivalent employment positions throughout the country will generate R39 million of personal income (2023 prices), which will be sustained for the entire duration of the project's lifespan. Given the average household size in affected local municipalities and nationally, this increase in household earnings will support several people. The sustainable income generated as a result of the project's operation will positively affect the standard of living of all benefitting households.

This is specifically applicable to the Local Municipality, as the average income per employee at the facility would far exceed the average household income within these municipalities. Skills development coupled with sustainable employment creation opportunities as a result of the developer's intended socio-economic development spend, are expected to contribute towards an improved standard of living amongst families that might not have had a sustainable income previously.

The operational impact and associated mitigation measures are indicated in **Table 9-63.**

Table 9-63: Operational impact on standards of living for benefiting households

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Improved standards of living for benefiting households									
Without Mitigation	3	4	2	4	4	**52**	**Moderate**	(+)	Easy
With Mitigation	3	4	3	4	4	**56**	**Moderate**	(+)	
Mitigation and Management Measures	— Where possible, the local labour supply should be considered for employment opportunities to increase the positive impact on the area's economy.								

The proposed facility will, through property taxes and salaries and wages payments, contribute towards both local and national government revenue. At a local level, the project will contribute to local government through payments for utilities used in the operation of the facility. It will also increase its revenue through an increase in property taxes compared to the current level. Given that the Local Municipality has a relatively small economy, any additional income would greatly benefit the municipality.

On a national level, the revenue derived by the project during its operations, as well as the payment of salaries and wages to permanent employees will contribute to the national fiscus. Although it is impossible to trace exactly how such revenue is allocated, any additional revenue generated means that national governments can increase its spending on public goods and services.

The operational impact and associated mitigation measures are indicated in **Table 9-64.**

Table 9-64: Operational impacts on national and local government revenue

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Sustainable increase in national and local government revenue									
Without Mitigation	3	5	3	4	4	**60**	**Moderate**	(+)	N/A
With Mitigation	3	5	3	4	4	**60**	**Moderate**	(+)	
Mitigation and Management Measures	— None suggested								

The proposed facility will make a notable contribution to poverty and social and community development in the area. It is advised that 2% of the gross annual revenue will be dedicated to socio-economic and economic development initiatives for the duration of operation of the green hydrogen facility, while 0.5% will be channelled to the Just Energy Transition Fund. Thus, this revenue share of the project can subsequently be utilised for local social and economic development projects.

Since the community has not yet been selected, it is not possible to quantify the number of households that will be direct beneficiaries of the project at this stage. Furthermore, the social and economic development plan will prioritise numerous local welfare projects and community development initiatives that will be directed at uplifting local people and improving their standards of living.

At this stage it is unknown how much the proposed development will contribute towards local economic development but, it is envisioned that the revenue generated for local economic development will be significant and assist in uplifting the local communities.

The operational impact and associated mitigation measures are indicated in **Table 9-65.**

Table 9-65: Operational impacts on local economic and social development

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Local economic and social development benefits derived from the project's operations									
Without Mitigation	3	4	3	4	4	**56**	**Moderate**	(+)	Moderate
With Mitigation	4	4	3	4	4	**60**	**Moderate**	(+)	
Mitigation and Management Measures	— When identifying enterprise development initiatives, the focus should be on creating sustainable and self-sufficient enterprises. — In devising the programmes to be implemented, the developer should take into account the local Integrated Development Plans.								

It is anticipated that farms where the facility are located on will enter into a rental agreement with the developer. The owners will likely thus receive rental revenue as a result of hosting the facility on their property. The revenue that the owners of the properties receive will have a positive impact on the local economies especially if spent in the local area. This revenue is also likely to assist local property owners in dealing with economic shocks to their current business activities such as drought or unfavourable economic conditions that currently prevail. The revenue generated from the rental of land for the facility will additionally assist farmers in investing in new technologies to improve the efficiencies of their current agricultural practices and allow farmers to better compete in the open market.

The operational impact and associated mitigation measures are indicated in **Table 9-65.**

Table 9-66: Operational impacts on farms revenue

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Sustainable rental revenue for farms where the facility is located									
Without Mitigation	2	1	3	4	5	**50**	**Moderate**	(+)	N/A
With Mitigation	2	1	3	4	5	**50**	**Moderate**	(+)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Sustainable rental revenue for farms where the facility is located									
Mitigation and Management Measures	— None suggested								

The development of the facility will lead to a sustainable increase in the supply of hydrogen and ammonia for the country. Commercially, hydrogen is used as a fuel for transport in hydrogen fuel cells. Alternatively, hydrogen is used for welding and in the production of other chemicals such as methanol and hydrochloric acid and also has other commercial uses like the filling of balloons. It is also a primary input to the production of ammonia. Ammonia in turn is primarily used in the production of ammonium nitrate (fertiliser) and is also used as refrigerant gas and the manufacture of plastics, explosives, textiles, pesticides and other chemicals. Ammonia can also be used as a stable 'carrier' of hydrogen, allowing hydrogen to be readily stored and transported.

The operational impact and associated mitigation measures are indicated in **Table 9-65.**

Table 9-67: Operational impacts on hydrogen production in South Africa

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Sustainable increase in hydrogen and ammonia production in South Africa									
Without Mitigation	2	5	4	4	5	**75**	**High**	(+)	N/A
With Mitigation	2	5	4	4	5	**75**	**High**	(+)	
Mitigation and Management Measures	— None suggested								

The effects on the community's sense of place will initially be felt during the construction period and will continue into the operation phase. The assessment of the negative change in the sense of place that was examined in the construction phase will likely be in place during the operation phase due to the long-term duration of the development. However, due to the current conditions (coal mining) in the area, the facility will not have a significant negative impact on the sense of place.

The operational impact and associated mitigation measures are indicated in **Table 9-65.**

Table 9-68: Operational impacts on sense of place

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Negative changes to the sense of place									
Without Mitigation	2	2	5	4	5	**65**	**High**	(-)	Moderate
With Mitigation	2	2	4	4	4	**48**	**Moderate**	(-)	
Mitigation and Management Measures	— Natural areas that are not affected by the footprint should remain as such. — Efforts should also be made to avoid disturbing such sites during operations.								

The impact of agricultural land was assessed through a survey that was distributed among the landowners. Some of the landowners indicated that they will be impacted by reduced dryland farming portions due to the facility (approximately 25 hectares). However, the landowners indicate that they are comfortable with the project and support the renewable energy that will be created. Thus, the impact on the farming operations will be low due to the local farming community's support.

The operational impact and associated mitigation measures are indicated in **Table 9-65.**

Table 9-69: Operational impacts on agricultural operations

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Negative impact on agricultural operations									
Without Mitigation	2	1	5	4	4	**48**	**Moderate**	(-)	Easy
With Mitigation	2	1	5	4	3	**36**	**Moderate**	(-)	
Mitigation and Management Measures	— Ensure that the farm owners get the revenue from rent paid								

9.14.3 DECOMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

9.15 HEALTH AND SAFETY

The three alternatives have been assessed from a SHE risk assessment point of view by the specialist and where there is a choice of location that is further from public roads, water courses or isolated farmhouses, that would be preferred. The **Figure 9-1** below shows the closest occupied farmhouses are approximately 900m west of the site alternative 1, 1.8km west of location option 2 and 300m northeast of site alternative 3.

Residential areas of concentrated population are all over 10km from the site. There is active coal mining activity over 2km to the south location alternatives 1and 2.

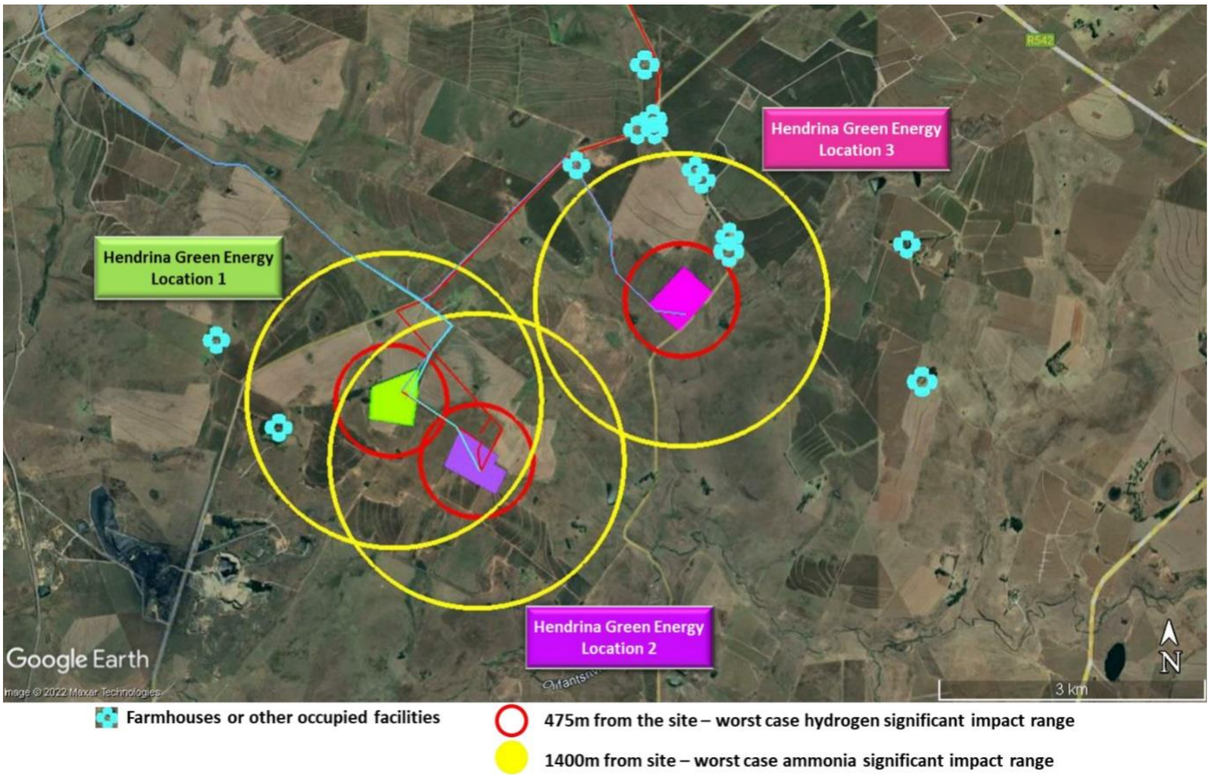


Figure 9-1: Worst case significant impact circles around the Green Hydrogen (Red) and Ammonia (Yellow) facilities in relation to the location of Farmhouses (Blue) in the area

9.15.1 CONSTRUCTION PHASE

GREEN HYDROGEN AND AMMONIA FACILITY

Exposure during construction to materials such as cement, paints, solvents, welding fumes, truck fumes etc can result in Employee / contractor illness. The construction impact along with associated mitigation measures are indicated in **Table 9-70.**

Table 9-70: Construction Impact on Human Health

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	4	4	**44**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	4	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy and procedure must be compiled and implemented. — A detailed construction risk assessment must be undertaken prior to work. — Specify/Provide relevant PPE. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — All necessary health controls/ practices must be in place, e.g. ventilation of welding and painting areas. — SHE monitoring and reporting programs must be implemented. — Emergency response plan must be put in place prior to beginning construction and to include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.								

Exposure to drilling, piling, generators, air compressors during construction could lead to an adverse impact on hearing of workers as well as a possible nuisance factor in near-by areas. The construction impact along with associated mitigation measures are indicated in **Table 9-71.**

Table 9-71: Construction Impact on Noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	3	1	5	5	4	**56**	**Moderate**	(-)	Easy
With Mitigation	2	1	5	5	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— Health risk assessment to determine if equipment continuous noise exceeds 85dB at workstation and 61dB at boundary of the site — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits. —								

During construction workers will be exposed to heat during the day and cold in winter. This could result in Heat stroke or Hypothermia. The construction impact along with associated mitigation measures are indicated in **Table 9-72.**

Table 9-72: Construction Impact on exposure to temperature extremes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	3	2	3	1	2	**18**	**Low**	(-)	Easy
With Mitigation	2	2	3	1	1	**8**	**Very low**	(-)	
Mitigation and Management Measures	— Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Adequate potable water to be provided during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the plants during all phases of the project.								

The construction large projects bring many contractor workers into a small, isolated community. This may lead to a lack of sufficient accommodation, entertainment etc, resulting in an increase in alcohol abuse and violence. The construction impact along with associated mitigation measures are indicated in **Table 9-73**.

Table 9-73: Construction Impact on worker's psychological state

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	**20**	**Low**	(-)	easy
With Mitigation	2	3	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Depending on size of contract and scope, project may need to provide regular/periodic transport to town and nearby cities. — Local community involvement and as far as possible preferably use of local persons as contract workers on the project.								

During construction employees Lifting heavy equipment and getting into awkward angles will be prone to back and other injuries. The construction impact along with associated mitigation measures are indicated in **Table 9-74.**

Table 9-74: Construction impact on ergonomics of workers

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	4	1	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Training in lifting techniques — Ensure that despite the isolated location all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. — Isolated location, maintenance of construction equipment to ensure safe operation is critical. Ensure this is in place prior to project beginning. — Development of local service providers as far as possible. — First aid provision on site.								

The construction phase brings the possibility of involvement in an external fire. Fire involving fuels used in construction vehicles or vehicles themselves (e.g. tyre fire). Fire due to uncontrolled welding or other hot-work. This will result in injuries due to radiation especially amongst first responders and bystanders. Fatalities unlikely from the heat radiation as not highly flammable nor massive fire. The construction impact along with associated mitigation measures are indicated in **Table 9-75.**

Table 9-75: Construction impact on works due to fire exposure

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	4	2	3	5	4	**56**	**Moderate**	(-)	Complex
With Mitigation	4	2	3	5	2	**28**	**Low**	(-)	

Mitigation and Management Measures	— Fuels stored on site in dedicated, demarcated and bunded areas.
	— Suitable fire-fighting equipment on site near source of fuel, e.g. diesel tank, generators, mess, living quarters, workshops etc
	— The company responsible for the facility at this stage is to have:
	  — Emergency plan to be in place prior to commencement of construction.
	  — Fuel spill containment procedures and equipment to be in place.
	  — Hot-work permit and management system to be in place.								

During construction, employees can be exposed to human pathogens and diseases, sewage, food waste. Snakes, insects, wild and domesticated animals and harmful plants may also be encountered. These can result in illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The construction impact along with associated mitigation measures are indicated in **Table 9-76.**

Table 9-76: Construction impact on employees from exposure to biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Complex
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others. — Prior to construction determine the dangerous species in the area and what responses are needed to bites/exposure/attacks. — Awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations some distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts								

Exposure to construction moving equipment, heavy loads, elevated loads and working at heights. This could result in injury or possibly fatality. Damage to equipment. Delays in starting the project, financial losses. The construction impact along with associated mitigation measures are indicated in **Table 9-77.**

Table 9-77: Construction impact as a result of exposure to kinetic energy release

Potential Impact Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	1	5	5	4	**64**	**High**	(-)	complex
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— The construction phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — SHEQ policy in place. — A detailed construction risk assessment prior to work. — SHE procedure in place. — PPE to be specified. — SHE appointees in place. — Contractors safety files in place and up to date. — SHE monitoring and reporting programs in place. — Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc. — Civil and building structures to National Building Regulations and building Standards Act 103 of 1977 — SANS 10400 and other relevant codes. — Other constructions such as roads, sewers etc also to relevant SANS standards. — All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc to be in place before construction begins — Emergency response plan to be in place before construction begins.									

During the construction phase employees will make use of electrical machines, generators etc. Hot dry area static generation is highly likely and as well as Lightning strikes. This may result in Electrocution, ignition and burns, injury and/or death, or incur damage to electrical equipment. The construction impact along with associated mitigation measures are indicated in **Table 9-78.**

Table 9-78: Construction impact of exposure to electromagnetic waves

Potential Impact Human and Equipment Safety - exposure to electromagnetic waves	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Standard maintenance of condition of electrical equipment and safe operating instructions. — Ability to shut off power to systems in use on site. — If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, installations to be suitably designed and maintained. — Outside work must be stopped during thunderstorms. — Lighting conductors may be required for the final installation, to be confirmed during design phase.									

Dust from construction and generally hot dry areas will result in adverse impacts on employee health. The construction impact along with associated mitigation measures are indicated in **Table 9-79.**

Table 9-79: Construction impact on employees due to dust generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to air									
Without Mitigation	3	2	1	1	4	**28**	**Low**	(-)	Easy
With Mitigation	2	2	1	1	2	**12**	**Very low**	(-)	
Mitigation and Management Measures	— May need to use dampening on roads etc. as per normal construction practices. — May need PPE (dust masks) for specific construction workers.								

The construction phase will make use of diesel for equipment, paints and solvents. There is also a possibility of Transformer oil spills and Sewage and kitchen/mess area wastewater generation. This could lead to environmental damage, particularly to the surface and underground water in the area if not managed correctly. The construction impact along with associated mitigation measures are indicated in **Table 9-80.**

Table 9-80: Construction impact on water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Normal construction site practices for preventing and containing fuels/paint/oil etc spills. — Bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area is particularly important. — Spill clean-up procedures to be in place before commencing construction. — Sewage and any kitchen liquids must have containment and suitable treatment/disposal								

The construction phase will generate solid waste. Improper management of this waste will result in pollution of the area. The construction impact along with associated mitigation measures are indicated in **Table 9-81.**

Table 9-81: Construction impact on waste generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – waste generation									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	1	2	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— There will be packaging materials that will need to be disposed of after the entire system is connected and commissioned as well as after regular maintenance. — There will need to be waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

The construction phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. The construction impact along with associated mitigation measures are indicated in **Table 9-82.**

Table 9-82: Construction impact on resource usage

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	**20**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	2	**10**	**Very low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols to be provided by supplier. — Water management plan and spill containment plans to be in place.								

The construction site will likely have bright surfaces reflecting light and tall structures in a flat area. This may result in irritation to the public. The construction impact along with associated mitigation measures are indicated in **Table 9-83.**

Table 9-83: Construction impact on aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Moderate
With Mitigation	2	2	3	3	3	**30**	**Low**	(-)	
Mitigation and Management Measures	— Confirm height limitations for buildings, structures, tanks and electrical infrastructure, in terms of visual aspects. — Sheeting, structures and tanks likely to be painted, not left as reflective steel. — Visual impact assessment to include green hydrogen and ammonia installation when design details become available.								

The result of possible defective technology could be extreme project delays and financial loss. The construction impact along with associated mitigation measures are indicated in **Table 9-84.**

Table 9-84: Construction impact of extreme project delays

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	**39**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Design by experienced contractors using internationally recognized and proven technology. — Project management with deviation monitoring.								

During the construction phase there is a potential hi-jacking of valuable loads while en-route to site. While on site, theft of construction equipment and installation facilities is also a possibility. Civil unrest or violent strike by employees can also arise. The construction impact along with associated mitigation measures are indicated in **Table 9-85.**

Table 9-85: Construction impact on security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	1	3	2	4	**40**	**Moderate**	(-)	Complex

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
With Mitigation	4	1	3	2	4	**27**	**Low**	(-)	
Mitigation and Management Measures	— Fencing around electrical infrastructure to SANS standard and Eskom Guidelines. — Isolated location both helps and hinders security, planning should be made with this in mind. — Night lighting to be provided both indoors and outdoors where necessary.								

During the construction phase, fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse are possibilities. These can be the result of inadequate emergency response to small event leads to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The construction impact along with associated mitigation measures are indicated in **Table 9-86.**

Table 9-86: Construction impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	4	3	**39**	**Moderate**	(-)	Complex
With Mitigation	4	2	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— Emergency procedures need to be practiced prior to commencement of construction								

The Green energy field is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This could result in unknown hazards manifest due to using "cheaper supplier or less developed technology". The construction impact along with associated mitigation measures are indicated in **Table 9-87.**

Table 9-87: Construction impact on legal matters

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Legal									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Use only internationally reputable technology suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art technology systems are used.								

9.15.2 OPERATIONAL PHASE

GREEN HYDROGEN AND AMMONIA FACILITY

During the operation and maintenance, materials, spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc. may be used by employees, improper usage of these can result in occupational illness. The operational impact along with associated mitigation measures are indicated in **Table 9-88.**

Table 9-88: Operational impact on employee's health

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - chronic exposure to toxic chemical or biological agents.									
Without Mitigation	2	1	3	4	5	**50**	**Moderate**	(-)	Moderate
With Mitigation	1	1	3	4	2	**18**	**Low**	(-)	

Mitigation and Management Measures	— The operation and maintenance phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993.
	— Ensure a SHEQ policy is in place.
	— A detailed risk assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning.
	— SHE procedure in place, e.g. PPE specified, management of change, integrity monitoring.
	— Ensure SHE appointees are in place.
	— Training of staff in general hazards on site.
	— All necessary health controls/ practices to be in place, e.g. ventilation of confined areas, occupational health monitoring if required and reporting programs in place.
	— Emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as:
	  — appointment of emergency controller,
	  — emergency isolation systems for electricity,
	  — emergency isolation and containment systems for electrolyte,
	  — provision of PPE for hazardous materials response,
	  — provision of emergency facilities for staff at the main office building,
	  — provision of first aid facilities,
	  — first responder contact numbers etc									

The usage of slightly compromised equipment during the operational phase (e.g. small ammonia leaks) will allow toxic vapours to accumulate in buildings or structures, solids/liquids on surfaces. Furthermore, maintenance of components is essential to prevent corrosive (e.g. water treatment chemicals) and mildly toxic liquid on surfaces as well. Dermatitis, skin /eye/lung irritation could be the impact on employees. The operational impact along with associated mitigation measures are indicated in **Table 9-89.**

Table 9-89: Operational impact employees due to exposure to toxic agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	5	4	**44**	**Moderate**	(-)	Complex
With Mitigation	1	1	3	5	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Maintenance procedures will be in place should equipment need to be opened, e.g. pumps drained and decontaminated prior to repair in workshop etc. — PPE will be specified for handling contaminated parts and other equipment on site. — Training of staff in hazards of chemicals on site. — Labelling of all equipment. — Confined space entry procedures if entering tanks									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - chronic exposure to toxic chemical or biological agents									
	— Safety Data Sheets (SDSs) to be available on site. — Operating manuals to be provided including start-up, shut-down, steady state, monitoring requirements. — Maintenance manuals with make safe, decontamination and repair procedures. — Proposed maintenance schedules daily, weekly, monthly, annual etc. — Provided portable equipment for calibration and for testing/verification of defective equipment.								

Employee exposure to moving parts inside buildings, pumps, compressors, cooling systems etc, during the operation phase could result in adverse impact on hearing of workers. Nuisance factor at near-by residences or other activities could also be possible. The operational impact along with associated mitigation measures are indicated in **Table 9-90.**

Table 9-90: Operational impact on employees due to noise generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	2	1	5	5	4	**52**	**Moderate**	(-)	Easy
With Mitigation	2	1	5	5	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— Design to ensure continuous noise does not exceed 85dB in the plant or at any other location on site or 61 dB at the site boundary, e.g. emergency generator, air compressor etc. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

Operation during the day brings about exposure to Heat. Furthermore, the Electrolysis plant and Haber process generate heat within enclosed building / structures. Cold temperatures in winter are likely. Heat stroke and Hypothermia can result from the afore mentioned. Lastly, night work will require thermal lighting. The operational impact along with associated mitigation measures are indicated in **Table 9-91.**

Table 9-91: Operational impact on employees due to exposure in temperature extremes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to temperature extremes and/or humidity									
Without Mitigation	4	2	3	1	2	**20**	**Low**	(-)	Easy
With Mitigation	3	2	3	1	1	**9**	**Very low**	(-)	
Mitigation and Management Measures	— Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Night work is likely. Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. — PPE for operations and maintenance staff to be suitable for the weather conditions. — Adequate potable water to be provided during all phases of the project. — PPE for operations and maintenance staff to be suitable for the weather conditions.								

During the operation phase Isolated workstations and monotonous repetitive work can lead to low performance and system productivity suffers. The operational impact along with associated mitigation measures are indicated in **Table 9-92.**

Table 9-92: Operational impact on employee psychological state

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	**20**	**Low**	(-)	Easy
With Mitigation	1	3	3	2	1	**9**	**Very low**	(-)	
Mitigation and Management Measures	— Staff rotation to other activities within the site may be necessary. — Performance monitoring of inspections / maintenance tasks in particular will be necessary.								

Employees lifting heavy equipment during the operational phase and getting into awkward angles during maintenance, stretching reaching to high level and bending to low level is likely to occur. Working at height may be undertaken if equipment is located on top of tanks, roofs or elevated electrical equipment (e.g. pylons). The consequences of this can be back and other injuries. The operational impact along with associated mitigation measures are indicated in **Table 9-93.**

Table 9-93: Operational impact on employees' ergonomics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	5	1	3	2	3	**33**	**Moderate**	(-)	Easy
With Mitigation	4	1	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Training in lifting techniques. — Training in working at heights. — If equipment is at height (see OHS Act General Safety Regulation 6), ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. — Working at height procedure to be in place								

The following are possible fire radiation situations during the operational phase. Encountering the involvement in an external fire e.g. veld fire, maintenance vehicle fire, electrical systems fire. Operator negligence, mechanical failure or other cause of loss of containment of flammable hydrogen / ammonia. Enhanced flammability due to leaks of oxygen. Incorrect extinguishing medium, escalate the fire. Consequences of the above include flash or jet fire. Radiation burns due to highly flammable materials on site. Possible offsite effects on members of the public. Damaged equipment. Contaminated fire water run-off. Fire spreads to other units or offsite if grass/vegetation not controlled. The operational impact along with associated mitigation measures are indicated in **Table 9-94.**

Table 9-94: Operational impact of fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Facilities to be declared a Major Hazard Installation and to comply with all the regulatory requirements, e.g. MHI QRA to be done by AIA to SANS 1461, Notifications/registration etc.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
	— Full Process Safety Management system with all elements to be implemented to highest international best practice levels. — Extremely flammable hydrogen systems to be designed to latest applicable international codes. — Grass cutting and fire breaks around the installations to prevent veld fires. — No combustible materials to be stored in or near the main chemical infrastructure especially hydrogen system. — Separation of site diesel tank, transformers from hydrogen / ammonia and vice versa. — Detailed FMEA/Hazop/Bowtie to done during design at the component level and system levels. — Safety integrity level rating of equipment (failure probably) with suitable redundancy if required. — Site Acceptance Testing as part of commissioning of each unit and the overall system. — Hazardous Area Classification (SANS 10108) studies done and equipment suitably specified and maintained. — Suitable ingress protection level provided for electrical equipment, e.g. IP55 - 66. — Monitoring of critical parameters on SCADA, data needs to be stored for trend analysis. — Protective systems are only as good as their reliability and functionality testing is important, e.g. testing that all plant alarms trips work. — Refer to construction phase above and apply as suitable. — Emergency Response plan in compliance with SANS 1514 to be compiled, e.g. plan from transport and construction phase to be extended to operational phase to include the hazards of the systems containing large quantities of highly hazardous chemicals.								

During the operation of the facility, ingress of oxygen into hydrogen or ammonia systems can result in ignition and internal explosion. Loss of containment of hydrogen (possibly also ammonia), ignition and confined explosion within structures or semi confined if cloud drifts is also a possibility. The loss of containment of oxygen leading to enhance flammability is another possibility. These aforementioned can lead to potential fatalities including possibly member of the public, significant impacts up to 350m from the site. Damage to nearby equipment and possible secondary events such a large toxic ammonia as clouds could result. The operational impact along with associated mitigation measures are indicated in **Table 9-95.**

Table 9-95: Operational impact on potential explosions due to Hydrogen, Ammonia or Oxygen leaks

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	5	3	5	5	3	**54**	**Moderate**	(-)	Moderate
With Mitigation	5	3	5	5	1	**18**	**Low**	(-)	
Mitigation and Management Measures	— As for fire (**Table 9-94**) above. — Occupied building study to confirm suitable location / design of main control room. — Emergency response plan and employee training referred to above is critical.								

During the operation of the facility transformer shorting / overheating / explosion is a possibility. This could result in potential fatalities, e.g. amongst first responders and damage to nearby equipment. The operational impact along with associated mitigation measures are indicated in **Table 9-96.**

Table 9-96: Operational impact on potential explosions due to transformer faults

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	5	1	5	5	1	**32**	**Moderate**	(-)	Moderate
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— Electrical equipment will be specified to suit application. — Emergency response plan and employee training referred to above is critical.								

During the operation of the facility, human pathogens and diseases, sewage, food waste will likely be encountered by employees. Snakes, insects, wild and domesticated animals and harmful plants are also likely to be encountered. Employees who interact with the above can display illness and at worst without mitigation, possibly result in fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The operational impact along with associated mitigation measures are indicated in **Table 9-97.**

Table 9-97: Operational impact on employees from exposure to biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	1	2	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others. — Awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations some distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts								

During the operational phase of the facility the following may occur, design or construction faults, mechanical failure, failure to follow correct procedures leading to loss of containment of hazardous chemicals (e.g. ammonia, nitrogen), large leaks, catastrophic failures, entry into unpurged confined spaces etc. these may result in impacts can vary from mild skin irritation from exposure to small leaks to large numbers of fatalities for exposure to catastrophic releases, significant impacts up to 1.4km from the site. The operational impact along with associated mitigation measures are indicated in **Table 9-98.**

Table 9-98: Operational impact on employees' exposure to hazardous chemicals

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic/hazardous chemicals									
Without Mitigation	5	3	5	5	4	**68**	**High**	(-)	Moderate
With Mitigation	5	3	3	5	1	**16**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic/hazardous chemicals									
Mitigation and Management Measures	— Facilities to be declared a Major Hazard Installation and to comply with all the regulatory requirements. — Suitable PPE (e.g. overalls, gloves, eyeglasses) to be specified for all operations in process areas. — PPE to be increased (e.g. full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g. sampling, maintenance. — All operators/maintenance staff trained in the hazards of chemicals on site and correct operating / maintenance procedures. — Emergency Response Plan to be in place to SANS 1514. — 24/7 helpline response available for customers of hazardous goods. — Standard dangerous goods requirements for Hazmat labels. — Shelter-in-place facilities to be provided for all persons on site. — Offsite - closest potentially affected neighbours to be provided with emergency response information (i.e. shelter in place).								

Employees will be exposed to moving equipment, pumps, heavy equipment at elevation, nip points, working at heights during the operational phase of the facility. Traffic accidents. Earthquake / tremors are also possibilities. The above could lead to injury and fatality in unlikely worst case, e.g. traffic accidents or fall from heights. Damage to equipment, spills, environment pollution are also potential impacts. The operational impact along with associated mitigation measures are indicated in **Table 9-99.**

Table 9-99: Operational impact on employees due to exposure to kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	3	**48**	**Moderate**	(-)	Moderate
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— All moving equipment will be guarded/protected as per OHS Act requirements. — Hot surfaces will be insulated for personnel protection. — Maintenance equipment to be serviced and personnel suitably trained in the use thereof. — Normally just small vehicles on site, bakkies, grass cutting, cherry-pickers etc. Possibly large cranes if large equipment or elevated structure removed/replaced. — Traffic signs, rules etc in place on site. — All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc to be in place. — Emergency response plan. — Civil design to take seismic activity into account.								

The operational phase will bring about the usage of electrical machines, generators etc. In hot dry areas, static generation is highly likely. Lightning strikes are also a possibility. The consequences of the above are potential electrocution, ignition and burns, injury and death. Damage to electrical equipment may also be a result. The operational impact along with associated mitigation measures are indicated in **Table 9-100.**

Table 9-100: Operational impact on employees due to exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Codes and guidelines for electrical insulation must be implemented. — PPE to suit. — Electromagnetic fields, impact on other equipment e.g. testing devices, mobile phones – malfunction, permanent damage. — Software also needs maintenance, patches, updates. — Consider suitably located Emergency stop buttons for the plant and the other equipment on site. — PPE to consider static accumulation for entering the plant, and particularly in the hydrogen areas. — Lightning strike rate in proposed development area is very high. — All outside work must be stopped during thunderstorms. — Lighting conductors may be required for the installation, to be confirmed during design								

During the operation of the facility, oxygen is a by-product and may be vented. Cryogenic storage may release a small amount of stored material that cannot be re-condensed in the boil-off gas system. Production upsets may lead to imbalances resulting in venting or flaring of hydrogen, ammonia etc. During start-up / shut-down there may be venting / flaring of out of specification products. Consequences: minor release of pollutants. The operational impact along with associated mitigation measures are indicated in **Table 9-101.**

Table 9-101: Operational impact on air emissions

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to air									
Without Mitigation	3	1	1	1	3	**18**	**Low**	(-)	Easy
With Mitigation	3	1	1	1	1	**6**	**Very low**	(-)	
Mitigation and Management Measures	— Design to minimize heat ingress and loss of cryogenic fluids — Design of hydrogen and ammonia systems to minimise direct releases, e.g. flare excess.								

The operational phase will result in generation of water treatment brine, cooling water blow-down, floor washings and laboratory waste (if included in the design). Maintenance waste generated can include oils, spills from coolant system, diesel trucks, transformers and parked vehicles oil drips. Fire water runoff control may also form part of the operational phase. Kitchen waste and sewage will be produced. There also may be accidental refrigerant release. The consequences of the above will result in pollution if not contained. Excessive disposal costs if emissions not limited. The operational impact along with associated mitigation measures are indicated in **Table 9-102.**

Table 9-102: Operational impact on water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	3	2	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Tank areas fully bunded to 110% of largest tank, or more.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
	— Curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area is particularly important. — Sewage and any kitchen liquids - containment and suitable treatment/disposal. — Procedures for dealing with damaged/leaking equipment as well as clean-up of spills, hazmat services. — Normal site practices for preventing and containing diesel/paint etc spills. — Waste management plan to be in place e.g. liquid waste treatment or suitable removal and disposal will be provided. — The National Environment Management Act (NEMA) has a list of substances with Reportable spill Quantities, ensure compliance with this. — Storm water management system to be in place.								

Operational waste will be generated during the operation of the facility. These can include but not limited to admin solid waste, packaging from new components, spent catalyst, filters, hoses, gaskets and other old plant components. The operational impact along with associated mitigation measures are indicated in **Table 9-103.**

Table 9-103: Operational impact on waste generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – waste generation									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	2	2	3	3	1	**10**	**Very low**	(-)	
Mitigation and Management Measures	— There will need to be solid waste segregation (e.g. electronic equipment, chemicals, oil contaminated rags, paper, plastic) and management on the site.								

The operational phase will require the usage of water and power. Uncontrolled usage of both will result in excessive costs and disposal of large volumes of hazardous waste (by-product). The operational impact along with associated mitigation measures are indicated in **Table 9-104.**

Table 9-104: Operational impact on resource consumption

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	2	1	1	2	4	**24**	**Low**	(-)	Easy
With Mitigation	2	1	1	2	2	**12**	**Very low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site. — Water management plan and spill containment plans to be in place. — Investigate End of Life plan for decommissioned equipment – reuse / recovery / repurpose.								

Once the facility is operational, the visual impact of the structures and buildings will be apparent to those passing by. The operational impact along with associated mitigation measures are indicated in **Table 9-105.**

Table 9-105: Operational impact on aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	3	2	3	4	4	48	Moderate	(-)	Moderate
With Mitigation	1	2	3	4	2	20	Low	(-)	
Mitigation and Management Measures	— Confirm height limitations for buildings / structures and electrical infrastructure, in terms of visual aspects. — Sheeting likely to be painted, not left as reflective steel. — Visual impact assessment to include green hydrogen and ammonia installation when design details become available. — Refer to Visual Impact Assessment which is to include the Green Energy installation once design details are available								

The operational phase could be affected by defective technology and subsequently extreme project delays. This can result in financial loss. The operational impact along with associated mitigation measures are indicated in **Table 9-106.**

Table 9-106: Operational impact on financial state

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	39	Moderate	(-)	Easy
With Mitigation	3	1	3	4	2	22	Low	(-)	
Mitigation and Management Measures	— Design by experienced contractors using internationally recognized and proven technology. — Project management with deviation monitoring. — Project insurance.								

During the operational phase of the facility there is a potential for hi-jacking of valuable and hazardous loads (e.g. road tanker of ammonia). On site, theft of equipment is possible. Civil unrest or violent strike by employees is another likelihood. Cyber security attacks on facility systems can also occur. The consequences of this can include financial loss, ransom money lost, loss of life. Injury to burglars or members of the public if stolen hazardous loads not contained. Damage to equipment and possibly setting off explosions or loss of containment incident on site. The operational impact along with associated mitigation measures are indicated in **Table 9-107.**

Table 9-107: Operational impact on security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	3	1	3	2	4	36	Moderate	(-)	Moderate
With Mitigation	3	1	3	2	2	18	Low	(-)	
Mitigation and Management Measures	— Cyber security protection of plant control systems, firewalls etc. — Fencing around infrastructure to SANS standard and Eskom Guidelines. — Consider motion detection lights and CCTV. — The hazardous nature of the facility should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Isolated location both helps and hinders security.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
	— Night lighting to be provided both indoors and outdoors where necessary.								

The following have been identified as possible emergency incidents during the operation of the facility. Fires, explosions, toxic vapour clouds, asphyxiating vapour clouds, large spills, traffic accidents, equipment/structural collapse. Consequences of this can include inadequate emergency response to small event leads to escalation, injuries turn to fatalities, small losses become extended down time. The operational impact along with associated mitigation measures are indicated in **Table 9-108.**

Table 9-108: Operational impact on facility emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Facility emergencies									
Without Mitigation	4	2	3	4	3	**39**	**Moderate**	(-)	Complex
With Mitigation	4	2	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— Major Hazard Installation Registration and compliance with all emergency response requirements. — Full on-site Emergency Response Plan to be in place as per SANS 1514, e.g. emergency co-ordinator, first responder team, equipment (BA sets, hazmat suits), Command Centre etc. — Off-site emergency response plant to be compiled and implement by local authorities. — Emergency plan to be tested and fully operational before cold commissioning — Annual MHI Emergency Drill. Monthly small emergency drills. — Evacuation siren, audible at closest neighbouring farms, to be in place and tested weekly. — Gas escape Shelter-in-place rooms to be designed and installed. Integrity levels to vary depending on location. — Control room to be suitably located or made explosion proof, to also be airtight as a gas escape room. — Firefighting systems to suitable international codes, e.g. NFPA. — First aid facilities and due to isolated location on-site clinic / medical stabilization facilities ((e.g. medical oxygen, burn treatment, defibrillator). — Escape doors must open outwards. — More than one exit from buildings.								

The Green energy field is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. Consequences could include encountering unknown hazards manifest due to using "cheaper supplier or less developed technology". The operational impact along with associated mitigation measures are indicated in **Table 9-109.**

Table 9-109: Operational impact on legal matters

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Legal									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	3	2	**20**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Legal									
Mitigation and Management Measures	— Use only internationally reputable technology suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art technology systems are used.								

9.15.3 DECOMISSIONING PHASE

The decommissioning phase of the facility can be managed by implementing the preventative and mitigative measures as per construction and operational phases. However, the impacts outlined below differ. Chemical plant components may have a limited lifespan and there are possibilities of damaged equipment etc.

Therefore, there could already be "waste" on the first day of commissioning and plans should be in place to deal with this. Ideally an End-of-Life plan needs to be in place before the first equipment is brought on site.

The decommissioning impact along with associated mitigation measures are indicated in **Table 9-110.**

Table 9-110: Decommissioning impact on waste disposal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Equipment reached end of life and may leak									
Without Mitigation	4	3	3	5	4	**60**	**Moderate**	(-)	Complex
With Mitigation	4	3	3	5	2	**30**	**Low**	(-)	
Mitigation and Management Measures	— Preventative maintenance system to be in place. — End of Life shutdown procedure including a risk assessment of the specific activities involved. — Preferably, re-purpose the equipment with associated Environmental impact considered. — Disposal according to local regulations and other international directives applicable at the time.								

Disposal of "waste" is rife with difficulties and numerous regulations that need to be complied with. The decommissioning impact along with associated mitigation measures are indicated in **Table 9-111**

Table 9-111: Decommissioning impact on waste disposal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Equipment reached end of life and may leak									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Complex
With Mitigation	3	1	3	3	3	**30**	**Low**	(-)	
Mitigation and Management Measures	— Applicants should seek the opinion from a waste consultant on how to correctly dispose of hazardous waste.								

9.16 BATS

The primary impacts predicted for these facilities are destruction of bat roosting and foraging habitats during construction which can also lead to accidental bat fatalities if a roost is destroyed. This applies for micro roosts that may be present in tall vegetation (such as trees), buildings. Light pollution is also a significant factor to be considered.

9.16.1 CONSTRUCTION PHSSE

Construction activities, temporary and long term, such as construction yards, will clear vegetation supporting bat insect prey. The construction impact and associated mitigation measures are outlined below in **Table 9-112**

Table 9-112: Construction impact on bat habitat and foraging

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of foraging habitat by clearing of vegetation.									
Without Mitigation	1	1	3	2	4	**28**	**Low**	(-)	Easy
With Mitigation	1	1	3	2	3	**21**	**Low**	(-)	
Mitigation and Management Measures	— Adhere to the sensitivity map criteria. — Rehabilitate cleared vegetation where possible at areas such as laydown yards. — Vegetation should be allowed to recover where it was cleared after the construction and decommissioning of the facility. — All lights on substation and/or Operations and Management (O&M) buildings, should be down-hooded and connected to motion sensors (where safe to do so), to minimise light pollution.								

Construction activities may possibly disturb or destroy bat roosts in tall trees. Forcing bats to find alternative roosts. The construction impact and associated mitigation measures are outlined below in **Table 9-113**

Table 9-113: Construction impact on bat roosting

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Roost destruction during earthworks.									
Without Mitigation	4	1	3	2	2	**20**	**Low**	(-)	Easy
With Mitigation	4	1	3	2	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Adhere to the sensitivity map criteria. — Vegetation should be allowed to recover where it was cleared after the construction and decommissioning of the facility. — All lights on substation and/or Operations and Management (O&M) buildings, should be down-hooded and connected to motion sensors (where safe to do so), to minimise light pollution.								

9.16.2 OPERATIONAL PHASE

Floodlights and other lights at buildings or structures that are placed close to wind turbines (applicable to the Hendrina GH&A infrastructure), will attract bats preying on insects and therefore significantly increase the likelihood of these bats being impacted on by the wind turbines. Habitat creation in the roofs of nearby buildings can cause a similar increased risk factor.

The operation impact and associated mitigation measures are outlined below in **Table 9-114**

Table 9-114: Operational Impact on Bat mortalities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased bat mortalities due to light attraction and habitat creation.									
Without Mitigation	4	2	3	4	5	**65**	**Moderate**	(-)	Easy
With Mitigation	4	2	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— All lights on substation and/or Operations and Management (O&M) buildings, should be down hooded and where possible, lights with a colour (lighting temperature) that attract less insects should be used. This mitigation step is a simple and cost-effective strategy to effectively decrease the chances of bat mortalities. — Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools. This will be at all infrastructure buildings. — For buildings, avoid tin roofs and roof structures that offer entrance holes into the roof cavity. — The storm water drainage plan must avoid creations of artificial ponds/open water sources or wetlands near turbines (closer than 300m from any turbine base), of the proposed Hendrina North & South WEF's turbines. — As such artificial water sources will increase insect activity and therefore bat activity in the area. This can result in the GHA facility increasing the likelihood of bats being killed by the WEF's. — Bi-annual visits to the facility at night must be conducted for the operational lifetime of the facility by operational staff of the facility, to assess the lighting setup and whether the passive motion sensors are functioning correctly. — The bat specialist conducting the operational bat mortality monitoring of the proposed Hendrina North & South WEF's must conduct at least one visit to site during night-time to assess the placement and setup of outside lights on the facility. — When lights are replaced and maintenance on lights is conducted, this Mitigation Action Plan must be consulted.									

9.17 GROUNDWATER

9.17.1 CONSTRUCTION PHASE

Regarding groundwater quantity during the construction phase, a temporary water supply for construction will need to be installed. Should existing or new boreholes be used or required, this must comprise of over-ground water pipelines and tanks to the construction camp. In addition, over abstraction of groundwater can result in aquifer depletion and loss of resource for farmers.

Another impact on groundwater quantity could potentially relate to an increase in recharge due to topsoil and vegetation clearance but will be counteracted by lowered recharge on compacted surfaces.

The construction impact and associated mitigation measures are outlined below in **Table 9-115**

Table 9-115: Construction Impact on water use groundwater quality

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water use									
Without Mitigation						**24**	**Low**	(-)	Easy
With Mitigation						**12**	**Very low**	(-)	
Mitigation and Management Measures	— The design, construction and maintenance of all infrastructure related to construction phases of the Project must ensure that the quantity of the groundwater that feeds sensitive receptors (groundwater abstractions and groundwater dependant terrestrial ecosystems) downstream from any infrastructure does not significantly change and the development does not act as a preferential pathway to groundwater flow. — Identified boreholes should be subjected to pump tests overseen by a professional geohydrologist. — Boreholes should not be pumped more than its sustainable use allows as recommended by the geohydrologist.								

The impacts on groundwater quality during the construction phase are primarily related to the management of materials, wastes and spills and unauthorised disposal of contaminated substances. Contamination of groundwater may also arise due to incorrect handling and disposal of waste materials. The risks associated are considered low.

Operation of earth moving equipment and machinery within the project site presents a risk of petrochemical spillages. Equipment and machinery require fuels, lubricants and hydraulic fluids to operate. Should a machine malfunction occur, and a spill result, it could lead to groundwater contamination.

Except for the lesser oil and diesel spills and sewage from generated from construction campsites there are no activities expected that could impact on regional groundwater quality. This phase should thus cause very little additional impacts.

Risks related to groundwater quality and quantity are potentially expected during the construction phases of development. These impacts are primarily related to minor hydrocarbon or other spills, potable water sourcing, clearance of vegetation and soil compaction.

The construction impact and associated mitigation measures are outlined below in **Table 9-116**

Table 9-116: Construction Impact on water use groundwater quality

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water use									
Without Mitigation						**16**	**Low**	(-)	Easy
With Mitigation						**12**	**Very low**	(-)	
Mitigation and Management Measures	— The design, construction and maintenance of all infrastructure related to construction phases of the Project must ensure that the quantity of the groundwater that feeds sensitive receptors (groundwater abstractions and groundwater dependant terrestrial ecosystems) downstream from any infrastructure does not significantly change and the development does not act as a preferential pathway to groundwater flow. — Contain spillage, excavate and dispose of soil if required. Utilisation of spill kits and/or excavation of affected soil with subsequent disposal at an accredited disposal site is crucial. — Uncontrolled discharges from the construction camp/s should not be permitted. — All vehicles must be properly maintained and serviced so that no oil leaks occur on site.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Water use								
	— Diesel fuel storage tanks should be above ground on an impermeable concreted surface in a bunded area in accordance to SANS 10131: Above-ground storage tanks for petroleum products.							

9.17.2 OPERATIONAL PHASE

Potential risks associated with the Green Hydrogen and Ammonia Facility during the operational phases include risks from a groundwater quality and quantity perspective. These risks are mainly associated with waste disposal and water sourcing activities.

A reliable source of water is needed to produce commercially usable green hydrogen and ammonia. Highly pure RO water is needed for hydrogen production and an environmental concern would be production, storage and disposal of the brine waste. The long-term availability and sustainability of water (both quantity and quality) is a critical issue for hydrogen production through water electrolysis.

Komati Power Station (technical preferred option): Bulk water infrastructure from the Usuthu Water Scheme currently feeding the surrounding coal mines and power stations (specifically Eskom Komati Power Station) may be utilised for construction and operational water. Initial water results indicate good quality supply in sufficient quantities is available. This option is the preferred water sourcing for the development due to excess water being available at the Power Station's water reservoirs. Little or no impacts are associated with this option.

The operational impact and associated mitigation measures are outlined below in **Table 9-117**

Table 9-117: Operational Impact on water feed from Usuthu Water Scheme

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water feed									
Without Mitigation								(-)	Easy
With Mitigation								(-)	
Mitigation and Management Measures	—								

Various boreholes may be utilised across the project site for extraction of construction and operational water requirements. The volumes will be dependent on the available groundwater and the quality thereof, which has not yet been determined. Large quantities of water are needed for the project and one option is to utilise groundwater from a multitude of scattered boreholes or from wellfields designed for this purpose. A groundwater quantity impact is mainly associated with this option.

Over abstraction of groundwater can result in aquifer depletion and loss of resource for farmers that rely on groundwater as sole source of water for farming and domestic purposes.

If groundwater needs to be treated with RO, the remaining brine could result in groundwater pollution if not adequately contained.

The operational impact and associated mitigation measures are outlined below in **Table 9-118**

Table 9-118: Operational Impact on Groundwater abstraction for production purposes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water use from boreholes									
Without Mitigation						**44**	**Moderate**	(-)	Easy
With Mitigation						**18**	**Low**	(-)	
Mitigation and Management Measures	— The maintenance of all infrastructure must ensure that the quantity of the groundwater that feeds sensitive receptors (groundwater abstractions and groundwater dependant terrestrial ecosystems) downstream from any infrastructure does not significantly change and the development does not act as a preferential pathway to groundwater flow. — Identified boreholes should be subjected to pump tests overseen by a professional geohydrologist. — Boreholes should not be pumped more than its sustainable use allows as recommended by the geohydrologist. — Prevent groundwater pollution from brine seepages or spillages. — Contain brine in fit for use holding facilities and remove from site as frequently as possible.								

The operational impact and associated mitigation measures are outlined below in **Table 9-119**

Table 9-119: Operational Impact on

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water use									
Without Mitigation								(-)	Easy
With Mitigation								(-)	
Mitigation and Management Measures	—								

The operational impact and associated mitigation measures are outlined below in **Table 9-120**

Table 9-120: Operational Impact on

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water use									
Without Mitigation								(-)	Easy
With Mitigation								(-)	
Mitigation and Management Measures	—								

The operational impact and associated mitigation measures are outlined below in **Table 9-121**

Table 9-121: Operational Impact

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Water use									
Without Mitigation								(-)	Easy
With Mitigation								(-)	
Mitigation and Management Measures	—								

Wastewater from nearby commercial or mining facilities could be sourced to provide the facility with water. This would depend on availability of suitable quality wastewater and agreements with the respective entities involved. It is possible that water may be sourced from existing surrounding mining operations that are experiencing or anticipating mine water decant from their operations. A groundwater quality impact is mainly associated with this option.

Water source is at this stage unknown but is expected to be sourced from coal mines in the area, which is typical of a poor quality being acidic with solubilised heavy metals and saline. Leakage or bursting pipes transporting this water or mine-water storage can result in groundwater contamination.

The operational impact and associated mitigation measures are outlined below in **Table 9-122**

Table 9-122: Operational Impact from usage of purified wastewater

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Use of purified wastewater from nearby mining									
Without Mitigation						**65**	**High**	(-)	Easy
With Mitigation						**18**	**Low**	(-)	
Mitigation and Management Measures	— The maintenance of all infrastructure must ensure that the quality of the groundwater that feeds sensitive receptors (groundwater abstractions and groundwater dependant terrestrial ecosystems) downstream from any infrastructure does not significantly change and the development does not act as a preferential pathway to groundwater flow. — Contain brine in fit-for-purpose facilities and prevent seepage, spills and groundwater contamination. — Pipes and tanks should be regularly inspected for leaks, leaks should be repaired upon detection. — All facilities constructed to contain brine should be constructed according to water balance so as not to allow overflow of the facilities.								

9.17.3 DECOMMISSIONING PHASE

The impacts associated with decommissioning of the facility will be similar to the construction phase, therefore the recommended mitigation measures can be implemented.

10 CUMULATIVE IMPACT ASSESSMENT

Although the S&EIR process is essential to assessing and managing the environmental and social impacts of individual projects, it often may be insufficient for identifying and managing incremental impacts on areas or resources used or directly affected by a given development from other existing, planned, or reasonably defined developments at the time the risks and impacts are identified.

IFC PS 1 recognizes that, in some instances, cumulative effects need to be considered in the identification and management of environmental and social impacts and risks. For private sector management of cumulative impacts, IFC considers good practice to be two pronged:

— effective application of and adherence to the mitigation hierarchy in environmental and social management of the specific contributions by the project to the expected cumulative impacts; and
— best efforts to engage in, enhance, and/or contribute to a multi-stakeholder, collaborative approach to implementing management actions that are beyond the capacity of an individual project proponent.

Even though Performance Standard 1 does not expressly require, or put the sole onus on, private sector clients to undertake a cumulative impact assessment (CIA), in paragraph 11 it states that the impact and risk identification process "*will take into account the findings and conclusions of related and applicable plans, studies, or assessments prepared by relevant government authorities or other parties that are directly related to the project and its area of influence*" including "*master economic development plans, country or regional plans, feasibility studies, alternatives analyses, and cumulative, regional, sectoral, or strategic environmental assessments where relevant*."

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities (IFC GPH).

Evaluation of potential cumulative impacts is an integral element of an impact assessment. In reference to the scope for an impact assessment, IFC's Performance Standards specify that "*Risks and impacts will be analysed in the context of the project's area of influence. This area of influence encompasses…areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.*" (IFC 2006).

A cumulative impact assessment is the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible (IFC GPH).

Cumulative impacts with existing and planned facilities may occur during construction and operation of the proposed OHPL. While one project may not have a significant negative impact on sensitive resources or receptors, the collective impact of the projects may increase the severity of the potential impacts.

Potential cumulative impacts identified are summarised below. Other planned or existing projects that can interact with the Project will be identified during stakeholder engagement and finalisation of the S&EIA process.

10.1 NOISE

Cumulative noise impacts generally only occur when noise sources are closer than 2,000m from each other, with the cumulative impact also only affecting the area between the noise sources. As the distance between potential noise sources increase, the cumulative effect decreases, with noise sources further than 2,000m from an NSR having an insignificant influence on cumulative noises.

There is a very low risk of cumulative noises during the construction phase, as noises from other construction activities are highly unlikely to result in cumulative construction noise impacts, as it is unlikely to take place at the same time.

It is projected that typical ambient sound levels will be higher during typical operational periods, with the projected ambient sound level higher than the night-time rural rating levels (de Jager, 2022) due to wind-induced noises. As such, this will significantly diminish the potential effect of cumulative noises and the significance is expected to be very low.

The cumulative noise impact on the identified receptors in the area will not be significantly affected by the proposed developments in the area. The proposed Hendrina WEF will be the other source of noise on the site to consider. However, the impacts can be brought to an acceptable level provided the recommended mitigation measures stipulated by the specialist are implemented. The cumulative is outlined in **Table 10-1** below.

Table 10-1: Cumulative impact on acoustic environment

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative acoustic impacts									
Without Mitigation	2	3	1	4	1	**10**	**Very Low**	(-)	Easy
With Mitigation	2	3	1	4	1	**10**	**Very Low**	(-)	

10.2 SURFACE WATER /AQUATIC

For the proposed GH&A facility, a number of projects have been assessed within a 35km radius and or other sites were accessed during the course of travelling between the various projects.

All of the projects have indicated that their intention with regard to mitigation, i.e. selecting the best possible sites to minimise the local and regional impacts, or improving the drainage or hydrological conditions within these rivers, and therefore the cumulative impact could be seen as a net benefit. However, the worse-case scenario has been assessed below, i.e. only the minimum of mitigation be implemented by the other projects such as stormwater management. The cumulative impact is outlined below in **Table 10-2.**

Table 10-2: Cumulative aquatic impacts

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative Aquatic impacts									
Without Mitigation	4	4	5	4	2	**34**	**Moderate**	(-)	Moderate
With Mitigation	2	2	2	2	2	**16**	**Low**	(-)	

10.3 SOILS, LAND CAPABILITY AND AGRICULTURAL POTENTIAL

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment.

The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss (including by degradation) of future agricultural production potential. The defining question for assessing the cumulative agricultural impact is this:

What loss of future agricultural production potential is acceptable in the area, and will the loss associated with the proposed development, when considered in the context of all past, present or reasonably foreseeable future impacts, cause that level in the area to be exceeded?

Department of Forestry, Fisheries and the Environment (DFFE) requires compliance with a specified methodology for the assessment of cumulative impacts. This is positive in that it ensures engagement with the important issue of cumulative impacts. However, the required compliance has some limitations and can, in the opinion of the author, result in an over-focus on methodological compliance, while missing the more important task of effectively answering the above defining question.

This development is an integral part of the Hendrina wind energy facilities. A cumulative impact assessment needs to consider it as such and not in isolation. The cumulative impact assessment has considered all renewable energy projects within a 30 km radius. These are listed in Appendix 3 of the specialist report (**Appendix H-1**). In quantifying the cumulative impact, the area of land taken out of agricultural use as a result of these projects (total generation capacity of 490 MW) will amount to a total of approximately 344 hectares. This is calculated using the industry standards of 2.5 and 0.3 hectares per megawatt for solar and wind energy generation respectively, as per the Department of Environmental Affairs (DEA) Phase 1 Wind and Solar Strategic Environmental Assessment (SEA) (2015). As a proportion of the total area within a 30km radius (approximately 282,700 ha), this amounts to only 0.12% of the surface area. That is considered to be within an acceptable limit in terms of loss of agricultural land.

The cumulative impact of mining in the area is also relevant because it has excluded large areas of agricultural land. However, renewable energy development in South Africa decreases the need for coal power and thereby contributes to reducing the large agricultural impact that open cast coal mining has had on highly productive agricultural land in this area.

Due to the considerations discussed above, the cumulative impact of loss of agricultural land use will not have an unacceptable negative impact on the agricultural production capability of the area. The proposed development is therefore acceptable in terms of cumulative impact, and it is therefore recommended that it be approved.

10.4 AVIFAUNA

When considered in isolation, the Hendrina Ammonia and hydrogen facility and associated powerline is expected to have a low to very low impact on the priority avifauna following recommended mitigation measures (detailed in **Section 9.8**), without appropriate mitigations measures, this development poses a low to moderate impact risk on priority avifauna.

However, the potentially low impact of this development should be contextualised alongside related local/regional developments. According to the official database of DFFE and other documents in the public domain, there are currently at least five planned wind and solar energy facilities and associated grid connections within a 30km radius around the proposed development. These are the following:

— Solar photovoltaic power plant at ESKOM Duvha power station (DFFE Reg Nr. 14/12/16/3/3/2/759)
— Halfgewonnen Solar PV facility (DFFE Reg Nr. 14/12/16/3/3/2/2068)
— Hendrina North Wind Energy Facility (DFFE Reg Nr. 2017/143710/07)
— Hendrina South Wind Energy Facility (DFFE Reg Nr.14/12/16/3/3/2/2131)
— Arnot Solar PV facility (DFFE Reg Nr. 14/12/16/3/3/2/760)

The cumulative impact along with associated mitigation measures are outlined below in **Table 10-3.**

Table 10-3: Cumulative avifaunal impacts GH&A facility

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative Avifaunal impacts from GH&A facility									
Without Mitigation	3	1	5	4	2	**26**	**Low**	(-)	Moderate
With Mitigation	2	1	5	4	2	**24**	**Low**	(-)	

The most serious potential impacts on avifauna associated with the proposed ammonia and hydrogen facility will be the potential impacts of the 132kV powerline i.e. mortality of SCC due to collisions with the overhead line. The potential displacement impact on avifauna due to habitat transformation is relatively negligible due to the small size of the footprint i.e. 25 ha, especially if Site Alternative 1 or 2 is utilised which consist mostly of transformed habitat. The combined length of the grid connections for the proposed Arnot and Halfgewonnen PV facilities and Hendrina North Wind Energy Facility renewable energy projects listed above is approximately 26km. The PV plant at the Duvha Power Station will be on the premises of power station. The proposed Hendrina South grid connection will be a maximum of 23.8km long. The existing high voltage lines in the 30km radius around the proposed Hendrina South grid connection extend for several hundred kilometres.

At a length of between 0.5 and 8km, depending on which alternative is utilised, the powerline associated with the proposed ammonia and hydrogen facility represents a comparatively Low contribution towards the total length of high voltage power lines within a 30km radius. However, this project will increase the density of planned and existing high voltage lines within a 30km radius, and the cumulative effect of all the existing and planned high voltage lines represent a potentially Moderate impact risk to priority avifauna. The cumulative impact is outlined below in **Table 10-4.**

Table 10-4: Cumulative impact on avifauna from 132kV powerline

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative Avifaunal impacts from 132kV powerline									
Without Mitigation	3	3	1	2	4	**36**	**Moderate**	(-)	Moderate
With Mitigation	2	1	1	2	3	**18**	**Low**	(-)	

10.5 ANIMAL SPECIES

Cumulative construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible loss of habitat for populations of SCC. The cumulative construction impact is outlined below in **Table 10-5.**

Table 10-5: Cumulative impacts on faunal habitat from construction clearing due to a number of projects

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Type of impact
Direct loss of faunal habitat, fragmentation and loss of SCC due to cumulative impacts of clearing for construction									
Current project	2	2	5	1	1	**10**	**Very low**	(-)	direct
Combination of projects	3	2	5	2	1	**12**	**Very low**	(-)	

10.6 PLANT SPECIES

The terrestrial vegetation type in the broad study area is listed as Vulnerable and is impacted across its range by historical activities. Loss of habitat will occur for the project, which will be a small area in comparison to the total area of the vegetation type. However, the total loss of habitat due to several projects together will be greater than for any single project, so a cumulative effect will occur. The area lost in total will be very small compared to the total area of the vegetation type concerned. The cumulative effect will therefore be low for individuals of SCC within this vegetation type.

Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible loss of populations of SCC. The cumulative impact is outlined below in **Table 10-6.**

Table 10-6: Cumulative impacts on SCC from construction clearing due to a number of projects

Potential Impact	Magnitude	Extent	Reversibilit y	Duration	Probability	Significance		Character	Type of impact
Loss of individuals of Species of Conservation Concern									
Current project	3	5	5	3	3	**48**	**Moderate**	(-)	direct
Combination of projects	3	5	5	3	4	**64**	**High**	(-)	

10.7 TERRESTRIAL BIODIVERSITY

The regional terrestrial vegetation type in the broad study area is listed as Vulnerable and is impacted across its range by historical activities. Loss of habitat will definitely occur for the project, which will be a small area in comparison to the total area of the vegetation type. However, the total loss of habitat due to a number of projects together will be greater than for any single project, so a cumulative effect will occur. The area lost in total will be very small compared to the total area of the vegetation type concerned. The cumulative effect will therefore be low for vegetation loss. The cumulative impact is outlined below in **Table 10-7.**

Table 10-7: Cumulative impact on indigenous vegetation

Potential Impact	Magnitude	Extent	Reversibilit y	Duration	Probability	Significance		Character	Type of impact
Clearing of natural habitat for construction									
Current project	1	1	3	4	4	**36**	**Moderate**	(-)	Indirect
Combination of projects	2	3	3	5	5	**65**	**High**	(-)	

There are various ecological processes that may be affected at a landscape level by the presence of multiple projects. This includes population processes, such as migration (movement of species through the landscape), pollination (can be disrupted if insect pollinators are blocked from movement)and dispersal, but also more difficult to interpret factors, such as spatial heterogeneity (the diversity of habitats and their spatial relationship to one another), community composition (the species that occur in the landscape) and environmental gradients, that can become disrupted when landscapes are disturbed at a high level. Disturbance can alter the pattern of variation in the structure or function of ecosystems. Fragmentation is the breaking up of a habitat, ecosystem, or land-use type into smaller parcels. An important consequence of repeated, random clearing is that contiguous cover can break down into isolated patches. This happens when the area cleared exceed a critical level and landscapes start to become disconnected. Spatially heterogenous patterns can be interpreted as individualistic responses to environmental gradients and lead to natural patterns in the landscape. Disrupting gradients and creating disturbance edges across wide areas is very disruptive of natural processes and will lead to fundamental changes in ecosystem function.

The current project has been designed to mostly occupy areas that are already disturbed. Where infrastructure is located in natural areas, it is near to edges or follows existing roads. There are few places where it intrudes significantly into natural areas. The cumulative impact is outlined below in **Table 10-8.**

Table 10-8: Cumulative impacts on ecological processes

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Type of impact**
Disruption of ecological processes at landscape level									
Current project	2	1	3	4	3	**30**	**Low**	(-)	Direct
Combination of projects	2	3	3	4	4	**52**	**Moderate**	(-)	

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The greater the number of projects, the more likely this effect will happen; therefore, the effect is cumulative. For the current site, the impact is predicted to be low due to the current absence of invasive species on site and the high ability to control any additional impact. The significance will therefore be low, especially if control measures are implemented. However, the increased overall disturbance of the landscape will create opportunities and, if new invasions are not controlled, can create nodes that spread to new locations due to the heightened disturbance levels. The cumulative impact is outlined below in **Table 10-9.**

Table 10-9: Cumulative impacts due to establishment and spread of declared weeds and alien invader plants

Potential Impact	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Type of impact**
Establishment and spread of declared weeds and alien invader plants									
Current project	1	1	3	2	2	**14**	**Very low**	(-)	Indirect
Combination of projects	3	3	3	4	4	**52**	**Moderate**	(-)	

10.8 HERITAGE AND PALAEONTOLOGY

Cumulative impacts or effects can be described as “changes to the environment that are caused by an action in combination with other past, present and future human actions”. They are the result of multiple activities whose individual direct impacts may be relatively minor but which, in combination with others result are significant environmental effects (DEAT 2004:5).

Cumulative impacts considered as an effect caused by the proposed action that results from the incremental impact of an action when added to other past, present, or reasonably foreseeable future actions. (Cornell Law School Information Institute, 2020). Cumulative impacts occur from the combination of effects of various impacts on heritage and palaeontological resources. The importance of identifying and assessing cumulative impacts is that the whole is greater than the sum of its parts. In the case of this project, impacts can be mitigated to an acceptable level. However, this and other projects in the area can have a negative impact on heritage and palaeontological sites in the area where these sites have been destroyed unknowingly. The cumulative impact is outlined in **Table 10-10** below.

Table 10-10: Cumulative impact on heritage and palaeontology

Potential Impact Damage or loss of Heritage or palaeontological finds	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	1	5	5	3	**42**	**Moderate**	(-)	Easy
With Mitigation	3	1	5	5	2	**28**	**Low**	(-)	

10.9 VISUAL & LANDSCAPE

Cumulative impacts occur where existing or planned developments, in conjunction with the proposed development, result in significant incremental changes in the broader study area. In this instance, such developments would include:

- existing and proposed mining / quarrying activities,
- electrical infrastructure; and
- other existing / proposed renewable energy facilities within a 30km radius.

Existing mining / quarrying and electrical infrastructure have already resulted in large scale visual impacts, especially to the south-west of the proposed facility. These developments have significantly altered the sense of place and visual character in the broader region. It is known that there are several existing (active), abandoned and proposed Mining Right Areas (MRAs) and Prospecting Right Areas in the vicinity of the Hendrina Renewable Energy Complex. As such the future expansion of mining activity and further transformation of the landscape in this area is a distinct possibility.

Renewable energy facilities have the potential to cause large-scale visual impacts, and although the level of transformation already present in the landscape will reduce the contrast and overall visual impact of the new development, the incremental change in the landscape will be increased and the visual impacts on surrounding visual receptors would be exacerbated.

From a visual perspective, the concentration of renewable energy facilities, in conjunction with the proposed facility as proposed will further change the visual character of the area and alter the inherent sense of place, extending an increasingly industrial character into the broader area, and resulting in significant cumulative impacts. It is however anticipated that these impacts could be mitigated to acceptable levels with the implementation of the recommended mitigation measures. In addition, it is possible that these developments in close proximity to each other could be seen as one large Renewable Energy Facility (REF) rather than several separate developments. Although this will not necessarily reduce impacts on the visual character of the area, it could potentially reduce the cumulative impacts on the landscape. The cumulative impact is outlined below in **Table 10-11.**

Table 10-11: Cumulative visual impact

Potential Impact Cumulative Visual impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	3	3	5	4	**64**	**High**	(-)	Moderate
With Mitigation	4	3	3	4	4	**56**	**Moderate**	(-)	
	— Proposed mining, infrastructural and renewable energy developments in the broader area will alter the natural character of the study area towards a more industrial landscape and expose a greater number of receptors to visual impacts. — Visual intrusion of mining, infrastructural and renewable energy developments may be exacerbated, particularly in more natural undisturbed settings. — Additional mining, infrastructural and renewable energy facilities in the area would generate additional traffic on gravel								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative Visual impact									
	roads thus resulting in increased impacts from dust emissions and dust plumes. — The night time visual environment could be altered as a result of operational and security lighting serving new developments in the broader area.								

10.10 TRAFFIC

The maximum traffic generation is expected if the Hendrina WEF and Hendrina GH&A facility are expected to occur at the same time, as the facilities will be developed and operated concurrently. It should be noted that the significance of the transport impact of the Hendrina GH&A facility is expected to be Moderate (without with mitigation), and Low (with mitigation). The cumulative impacts are indicated below in **Table 10-12** and **Table 10-13.**

Table 10-12: Cumulative construction impact on traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increase in noise & dust due to increase in traffic.									
Without Mitigation	3	3	3	3	4	**48**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	3	**30**	**Low**	(-)	
	— The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods. — Dust suppression of gravel roads during the construction phase, as required. — The use of mobile batch plants and quarries near the site would decrease impacts of material delivery trips. — Manufacturing some components on site. — Use of on-site borrow pits for material sourcing. — Staff and general trips can occur outside of peak traffic periods as far as possible. — Use of high occupancy vehicles to transport workers can reduce traffic volumes. — The preferred abnormal load travel routes should be surveyed to identify problem areas (e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification). This can reduce traffic delays by allowing ease of travel. — Accommodating on site storage for components and materials to allow for practical scheduled delivery outside of peak hours. — Periodic maintenance of the gravel roads utilized during the construction phase. This maintenance will require liaising with the provincial authority charged with maintaining the road to determine the appropriate maintenance level, extent and frequency.								

Table 10-13: Cumulative impact operational impact on traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increase in noise & dust due to increase in traffic.									
Without Mitigation	3	2	3	4	3	**36**	**Moderate**	(-)	Easy
With Mitigation	2	1	3	4	2	**20**	**Low**	(-)	
	— Transport of oxygen, hydrogen, and ammonia can be staggered, and trips can be scheduled to occur outside of peak traffic periods. — Dust suppression of internal gravel roads as required. — Maintenance of internal roads to maintain good riding quality.								

10.11 SOCIAL

Currently the Hendrina Green Hydrogen and Ammonia Facility is the only project of its kind in the area. Resulting in limited cumulative impacts, however, should the facility be constructed simultaneously with the Hendrina North and South Wind Energy facilities, some cumulative impacts will be experienced.

However, the impact on the areas sense of place should be viewed within the context of the impact of the Hendrina Power Station and associated transmission lines on areas sense of place. The areas sense of place has also been impacted by large-sale coal mining operations. The potential visual impact on the areas sense place is therefore likely to be limited. In addition, none of the affected landowners interviewed raised concerns about potential visual impacts associated with the proposed project. The potential cumulative impact on the areas sense of place is therefore likely to be limited. The cumulative impact along with associated mitigation measures are outlined below in **Table 10-14.**

Table 10-14: Cumulative impact on sense of place and the landscape

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative change in the Sense of place and the landscape									
Without Mitigation	2	2	3	4	3	**33**	**Low**	(-)	Easy
With Mitigation	2	2	3	4	3	**33**	**Low**	(-)	
Mitigation and Management Measures	— Restrict vegetation clearance on the site to that which is required for the correct operation of the facility. — As far as possible, limit the number of vehicles which are allowed to access the site. — Ensure that dust suppression techniques are implemented on all gravel access roads. — As far as possible, limit the amount of security and operational lighting present on site. — Light fittings for security at night should reflect the light toward the ground and prevent light spill. — Lighting fixtures should make use of minimum lumen or wattage whilst adhering to safety and security requirements. — Mounting heights of lighting fixtures should be limited, or alternatively foot-light or bollard level lights should be used. — If economically and technically feasible, make use of motion detectors on security lighting.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative change in the Sense of place and the landscape									
	— The buildings should not be illuminated at night and should be painted in natural tones that fit with the surrounding environment. — Non-reflective surfaces should be used where possible.								

The cumulative impact on local services and accommodation will depend on the timing construction phases for the different renewable energy projects in the area. With effective planning the significance of the potential impact was rated as Low Negative. The cumulative impact is outlined below in **Table 10-15.**

Table 10-15: Cumulative impact on local services and accommodation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative impact on Local services and accommodation									
Without Mitigation	3	3	3	2	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	3	3	3	2	**22**	**Low**	(-)	
	— Before the construction phase commences the proponent should meet with representatives from the Municipality to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase. — No construction workers, with the exception of security personnel, should be permitted to stay over-night on the site. — The proponent should implement a "locals first" policy, specifically with regard to unskilled and low skilled opportunities.								

The cumulative impact on local economy is expected to be Moderate Positive. The cumulative impact is outlined below in **Table 10-16.**

Table 10-16: Cumulative impact on local economy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative impact on local economy									
Without Mitigation	2	2	n/a	4	3	**24**	**Low**	(+)	Moderate
With Mitigation	3	2	n/a	4	5	**45**	**Moderate**	(+)	
	— Local government should be encouraged to develop and implement economic incentives to support investment in and the development of green hydrogen and ammonia initiatives. — Maximise opportunities for local content and procurement. — Maximise employment opportunities for local community members. — Implement training and skills development programs for members from the local community.								

10.12 BATS

There are no other GH&A facilities proposed or authorised in the area. However, four Solar PV Facilities within 30km of the Project have been proposed or approved as follows:

- Eskom Duvha PV Facility: Approved (26km north-west)
- Eskom Arnot PV Facility: In Process (26km north-east)
- Forzando PV Facility: In Process (1.5km south-west)
- Halfgewonnnen PV Facility: Proposed (1.3km west)

Should significant (unmitigated) light pollution be created at the Forzando or Halfgewonnen Solar PV Facilities which border almost directly with the Project, cumulative impacts will be relevant.

Floodlights and other lights at buildings, will attract insect eating bats and therefore significantly increase the likelihood of these bats being impacted on by moving turbine blades of the adjacent wind energy facilities. Habitat creation in the roofs of nearby buildings, creation of wetlands or open water sources due to stormwater drainage can cause a similar increased risk factor. Considering several facilities, the overall mortality rate will be significantly higher with an increased likelihood of impact.

The cumulative impact is outlined below in **Table 10-17**

Table 10-17: Cumulative impact on Bats

Potential Impact **Increased bat mortalities due to light attraction and habitat creation.**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Ease of mitigation**
Without Mitigation	4	3	3	4	3	**42**	**Moderate**	(-)	Moderate
With Mitigation	4	3	3	4	2	**28**	**Low**	(-)	
	— Each facility to Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools. This will be at all infrastructure buildings. — For buildings, avoid tin roofs and roof structures that offer entrance holes into the roof cavity. — The storm water drainage plan must avoid creations of artificial ponds/open water sources or wetlands near turbines (closer than 300m from any turbine base), of the proposed Hendrina North & South WEF's turbines. — As such artificial water sources will increase insect activity and therefore bat activity in the area. This can result in the GHA facility increasing the likelihood of bats being killed by the WEF's.								

11 ENVIRONMENTAL IMPACT STATEMENT

The essence of any S&EIR process is aimed at ensuring informed decision-making, environmental accountability, and to assist in achieving environmentally sound and sustainable development. In terms of NEMA, the commitment to sustainable development is evident in the provision that "development must be socially, environmentally, and economically sustainable and requires the consideration of all relevant factors…" NEMA also imposes a duty of care, which places a positive obligation on any person who has caused, is causing, or is likely to cause damage to the environment to take reasonable steps to prevent such damage. In terms of NEMA's preventative principle, potentially negative impacts on the environment and on people's environmental rights (in terms of the Constitution of the Republic of South Africa, Act No. 108 of 1996) should be anticipated and prevented, and where they cannot be altogether prevented, they must be minimised and remedied in terms of "reasonable measures".

In assessing the environmental feasibility of the proposed Hendrina Green Hydrogen & Ammonia Facility, the requirements of all relevant legislation have been considered. The identification and development of appropriate management and mitigation measures that should be implemented in order to minimise potentially significant impacts associated with the project, has been informed by best practice principles, past experience and the relevant legislation (where applicable).

The conclusions of this EIA are the result of comprehensive assessments. These assessments were based on issues identified through the S&EIR process and the parallel process of public participation. The public consultation process has been undertaken according to the requirements of NEMA and every effort has been made to include representatives of all stakeholders within the process.

11.1 SENSITIVITY MAPPING

Preliminary consolidated environmental sensitivity maps (**Figure 11-1, and)** have been compiled based on the sensitivities and buffers outlined in the specialist studies.

The environmental sensitivity map indicates consolidated sensitivity significance ranking (i.e. Low, Medium-Low, Medium, Medium-High, High and Very High) as per the above input from the relevant specialist studies.

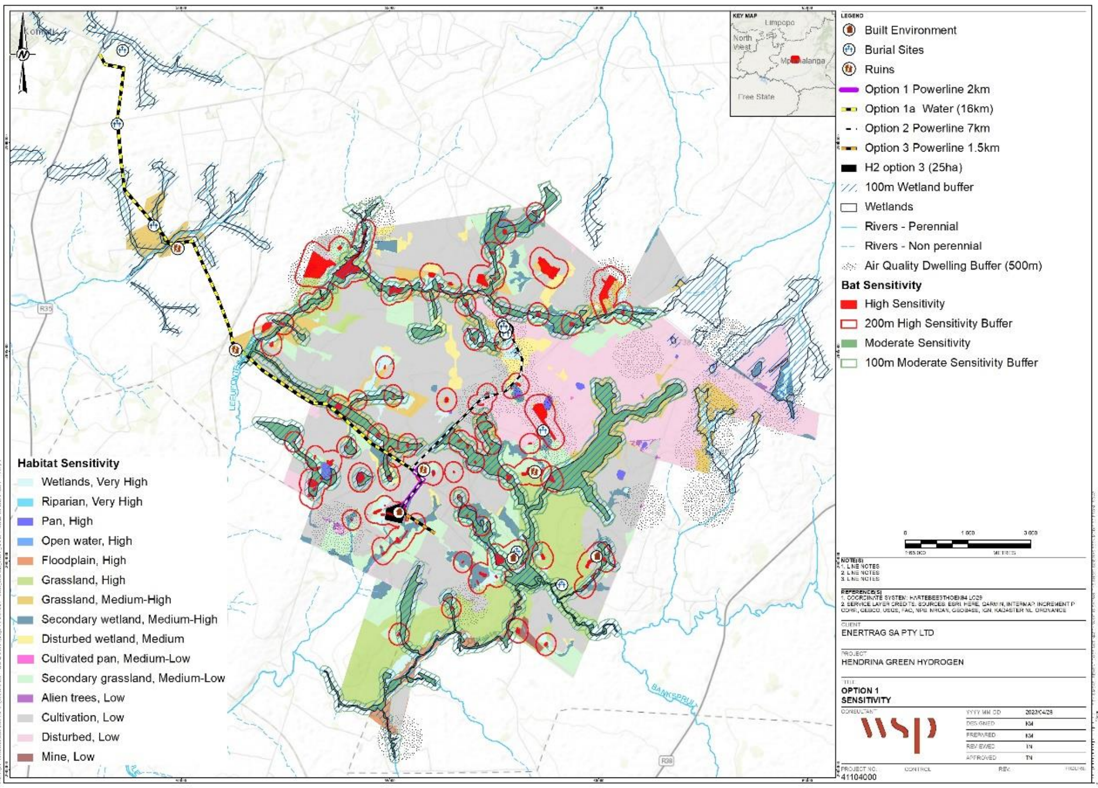


Figure 11-1: Site Layout overlain onto a Preliminary Consolidated Environmental Sensitivity Map – Alternative 1

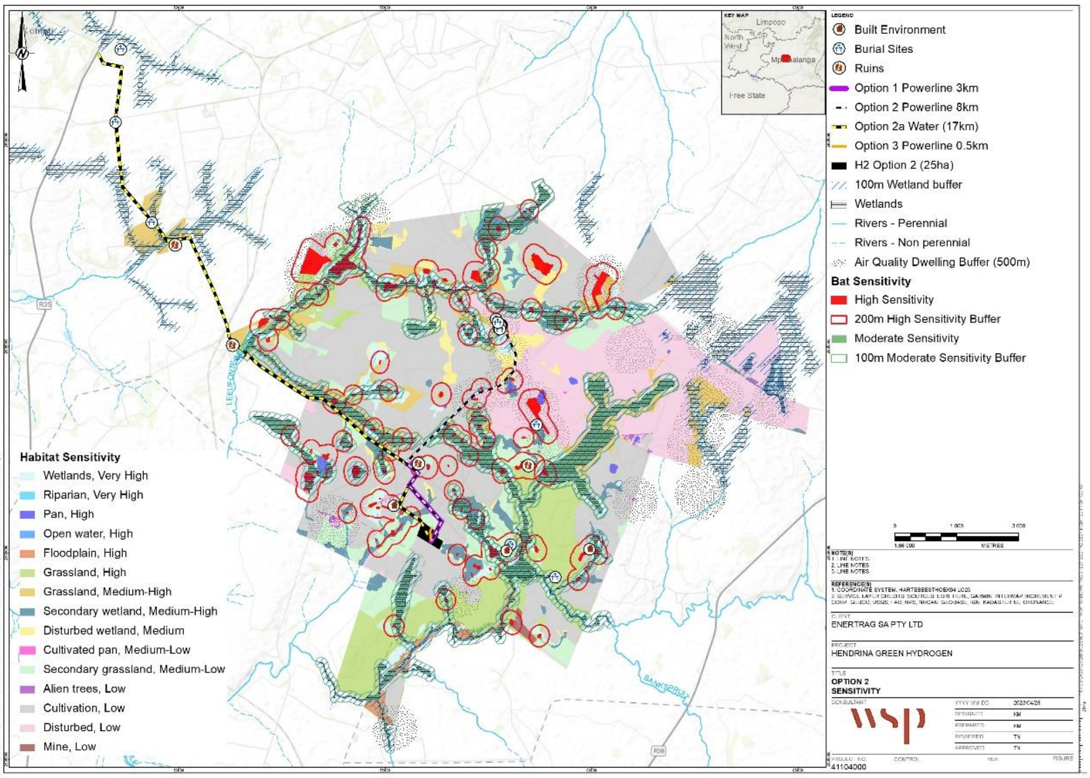


Figure 11-2: Site Layout overlain onto a Preliminary Consolidated Environmental Sensitivity Map – Alternative 2 (Preferred)

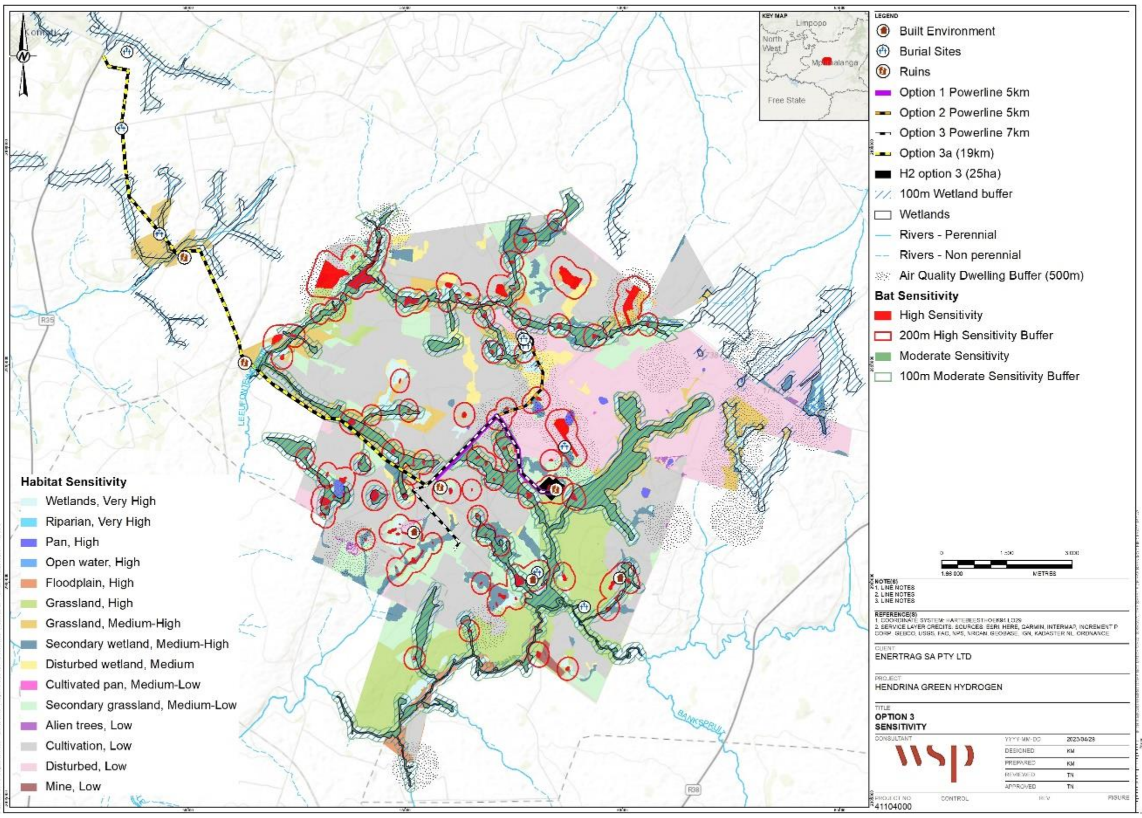


Figure 11-3: Site Layout overlain onto a Preliminary Consolidated Environmental Sensitivity Map – Alternative 3

11.2 SPECIALIST CONCLUSIONS

11.2.1 AIR QUALITY ASSESSMENT

The green NH_3 production facility will ideally have a capacity of 100,000 tpa. NH_3 production in excess of 100 tons per annum triggers listed activity *Subcategory 7.1: Production and or use in Manufacturing of Ammonia, Fluorine, Fluorine Compounds, Chlorine and Hydrogen Cyanide of the Listed Activities*, promulgated in line with Section 21 of NEM:AQA , and thus an AEL is required.

In the absence of appropriate methodologies to quantify emission rates using the available activity data, the study qualitatively assessed potential air quality impacts from the proposed site activities. The assessment relied on the intended operational design data provided by Enertrag SA and well understood principles of bulk liquid storage and compound properties.

Assessment findings are summarised as follows:

CONSTRUCTION PHASE

— Dust (TSP, PM10 and PM2.5) emissions typical of construction activities are expected during the construction of the green NH_3 production facility. Considering the small extent of the proposed site, the site's distance from proximate receptors, and the transient nature of the construction phase, impacts are expected to be low. Appropriate control measures can be applied to further reduce impacts.

— The impact significance of the construction phase is assessed to be low (without mitigation) to very low (with mitigation).

OPERATIONAL PHASE

- Hydrogen and nitrogen feedstock for the Haber-Bosch process will be of exceptional purity negating the need for impurity purging. As such, NH_3 emissions from the Haber-Bosch process are not anticipated under normal operating conditions. The purging of noble gases may be required under upset conditions
- Synthesised anhydrous NH_3 will be stored in temperature-controlled bulk storage tanks at -33.4℃, sufficiently low to prevent product evaporation. Storage tank vents will remain closed to sustain this low liquid temperature and prevent any mechanically induced turbulence inside the tank/s. As such, NH_3 emissions from bulk storage vessels are not anticipated as the liquid cannot vaporise and cannot escape containment.
- Product loading to pressure vessels for dispatch will occur under temperature and pressure-controlled conditions to prevent evaporation during dispatch.
- In a scenario where NH_3 is emitted, emissions will occur at a low-level and are therefore unlikely to reach proximate receptors at concentrations required to induce health or nuisance impacts. Surrounding vegetation is not considered sensitive to nutrient accumulation and impacts on neighbouring grasslands and crop production are also not anticipated.
- The impact significance of the operational phase (under normal operating conditions) is assessed to be very low (NH_3 will be stored in temperature-controlled bulk storage tanks as the norm, so no further mitigate is applicable).

As agreed with the licensing authority, further quantitative assessment should be conducted when operational information and site monitoring data is available to do so and must form part of the facility's PAEL review process.

Therefore, in addition to emissions control measures, it is recommended that:

- Complaints and any actions arising from a complaint must be recorded in a complaints register maintained by site management.
- Passive monitoring of NH_3 along the facility's fence line and at proximate receptors be conducted to provide context in terms of actual impact (if any). A monthly monitoring frequency for a period of 12-months is recommended to provide sufficient data for follow up quantitative assessment of impacts. Monitoring requirements and the frequency thereof can be revised during at the PAEL review process.
- Site management maintain meticulous record keeping of all inputs, throughputs, and production rates, including loading and dispatch quantities to enable a mass balance quantification of facility wide evaporative losses (if any) over time.
- The specialist has concluded that the project may proceed provided the prescribed mitigation measures are applied

DECOMMISSIONING PHASE

- Dust (TSP, PM10 and PM2.5) emissions typical of decommissioning activities are expected during the decommissioning of the Green NH_3 Processing Facility. Considering the small extent of the proposed site, the site's distance from proximate receptors, and the transient nature of the decommissioning phase, impacts are expected to be low. Appropriate control measures can be applied to further reduce impacts.
- The impact significance of the decommissioning phase is assessed to be low (without mitigation) to very low (with mitigation).

POST-CLOSURE PHASE

- Once decommissioning activities cease, the only associated emissions may include wind-blown dust from exposed land on the site footprint. Post closure, the site should revegetate relatively quickly limiting this wind-blown dust and creating no permanent air quality issues going forward. Atmospheric impacts from dust emissions during the post-closure phase are therefore anticipated to be very low (with and without mitigation).

11.2.2 NOISE / ACOUSTIC ASSESSMENT

The proposed green hydrogen and ammonia facility will slightly raise the noise levels at a number of the closest potential NSR. Three potential locations were investigated in detail, with the assessment indicating a low to very low significance for a noise impact to occur during the long-term operational phase. There might be a noise impact of a moderate significance during the construction phase, relating to construction traffic passing NSR.

In terms of acoustics, there is a slight preference for alternative site locations 1 and 2, with site location 3 least preferred. This is mainly due to the relative proximity of NSR to alternative location 3 compared to the other alternative locations.

Considering the low to very low significance of the potential operational noise impacts (inclusive of cumulative impacts) for the proposed project and associated infrastructure, it is recommended that the project be authorized.

No further noise studies or noise measurements are required, subject that potential noise complaints be investigated which may include additional noise level measurements.

11.2.3 AVIFAUNA ASSESSMENT

According to the Terrestrial Animal Species Protocol, confirmed habitat, or the presence SCC within the project area, triggers a High sensitivity classification (see definition of High sensitivity in the protocol). The classification should therefore be High sensitivity for the PAOI, based on actual conditions recorded on the ground during surveys at the proposed wind energy facilities, which included the area covered by the project area. The following SCC were recorded in the PAOI: Secretarybird (Globally Endangered, Locally Vulnerable), Southern Bald Ibis (Locally and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), Denham's Bustard (Globally Near-threatened, Regionally Vulnerable) Lanner Falcon (Regionally Vulnerable) and Lesser Flamingo (Globally and Regionally Near threatened).

The proposed facility will have an anticipated moderate to low pre-mitigation negative impact on priority avifauna, which is expected to be reduced to low and very low with appropriate mitigation

The preferred alternatives are site alternatives 1 and 2 for the following reasons:

- Both site alternatives are situated in highly transformed habitat which is of lesser importance to SCC
- Site Alternative 3 is also acceptable, but less so because there are still areas of natural grassland, and the stand of alien trees could potentially be used by used certain SCC for breeding and roosting.

Assuming that either site alternative 1 or 2 will be utilised, the shortest powerline would be preferable from an avifaunal impact perspective. In the case of site alternative 1, that would be option 1. In the case of site alternative 2, that would be option 3.

11.2.4 TERRESTRIAL BIODIVERSITY ASSESSMENT

The vegetation type that occurs on site, Eastern Highveld Grassland, is listed as Vulnerable. The entire site is therefore within a listed ecosystem. All areas of natural vegetation are therefore representative of this listed ecosystem. These specific parts of the site have High sensitivity in terms of the Terrestrial Biodiversity Theme.

Most remaining natural areas of vegetation on the site are within Critical Biodiversity Areas (CBA1 and CBA2), or within an Ecological Support Area. All areas of natural vegetation within CBAs must therefore be treated as having high sensitivity. These specific parts of the site have High sensitivity in terms of the Terrestrial Biodiversity Theme.

Most of the site consists of secondary and/ or degraded areas, including areas heavily invaded by alien invasive shrubs. Significant parts of the site therefore have very low sensitivity. Construction of project components is not problematic in these areas.

The project is supported if impacts on remaining natural areas on site can be minimised, as suggested.

Alternative 1 and 2 are preferred over alternative 3, simply because they affect almost no natural areas. However, all options are feasible. The specialist is of the opinion that the impacts associated with the project can be mitigated to acceptable levels provided the recommended mitigation measures identified are implemented.

11.2.5 ANIMAL SPECIES ASSESSMENT

There are a small number of animal species that are flagged for the site, as well as others not directly flagged that may occur there. These animals may make use of various habitats available in the general study area, which consists mostly of grasslands and wetlands within shallow drainage valleys. The infrastructure planned for the site has been located primarily in transformed areas (areas with no remaining natural habitat). If site alternative 1 or 2 is selected, then there will be almost no impact on any natural habitats. Vertical infrastructure is widely dispersed and will therefore have a limited impact on habitats. An assessment of these impacts indicates that they will have a significance of insignificant (very low).

The main concern in terms of threatened animal species is direct loss of habitat, but this will be limited for this project. Fragmentation of habitat will be very limited due to the placement of infrastructure as well as existing patterns of transformation on site. There may also be direct mortality of individual animals, but this is not very likely due to the placement of most of the infrastructure away from natural habitats.

In conclusion, desktop information, field data collection and mapping from aerial imagery provides the following verifications of patterns for the Animal Species Theme:

Most of the site consists of secondary and/ or degraded areas, including areas heavily invaded by alien invasive shrubs. There are small patches of grassland and wetland remaining in the study area.

The habitat on site is mostly transformed, degraded and/or fragmented. No animal species of concern are suspected to occur on site. The site therefore has been assessed as having low sensitivity in terms of the Animal Species Theme.

The proposed development is mostly within areas mapped as degraded / secondary that have low biodiversity value and sensitivity. The development is therefore supported.

Site alternative 1 and 2 are preferred over alternative 3, because they affect almost no natural areas. However, all options are feasible.

11.2.6 PLANT SPECIES ASSESSMENT

The specialist assessment determined that most of the site consists of secondary and/ or degraded areas, including areas heavily invaded by alien invasive shrubs. Significant parts of the site therefore have very low sensitivity. Construction of the proposed project components will be not problematic in these areas.

Where there is remaining natural habitat, this has characteristics of the regional vegetation type and is therefore representative of natural habitat in the general area, including the potential to support populations of plant SCC.

There are three plant species of conservation concern flagged by the screening tool that could possibly occur on site, as well as an additional eight species from historical records from SANBI databases.

A targeted walk-through survey of footprint of construction areas is required to determine if any of these occur at any specific location or not. This survey can take place at the same time as the required walk-through surveys for permitting purposes, or it can be undertaken as a separate targeted survey. It is recommended that this is undertaken in Spring or early Summer if possible.

The project is supported if impacts on remaining natural areas on site and thus on plant SCC can be minimised, as suggested.

Alternative 1 and 2 are preferred over Alternative 3, simply because they affect almost no natural areas. They are therefore unlikely to affect any individuals of plant SCC. However, all options are feasible, on condition measures are taken to exclude the likelihood of individuals of plant SCC being affected.

11.2.7 SURFACE WATER / AQUATIC ASSESSMENT

The proposed GH&A facility will have Low impacts on the wetland environment when the proposed mitigation and management plans are considered. In addition, the upgrading of existing roads and wetland crossing potentially also pose a Low risk of impacts to the aquatic systems onsite. The installation of electrical cables and water pipelines will potentially have low impacts to the freshwater resources within the study boundary, The Department of Water and Sanitation should be approached with regards to the applicability of a Water Use

Authorisation. Solitary sections of the wetlands will be impacted due to infrastructure access roads, underground cables, pipelines, electrical powerline infrastructure, and buildings, which can be mitigated and planned.

In terms of alternatives, the preferred site option from a wetland and aquatic biodiversity perspective is alternative 1, with the least preferred being alternative 3. From a powerline connection perspective, connection option 3 for site alternative 1 is the shortest and is preferred from a wetland and aquatic biodiversity perspective.

It is highly recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise potential impacts on the wetlands and associated catchments to maintain the wetland health and functionality. Wetland monitoring requirements should form part of the conditions for environmental authorisation. It is highly recommended that wetland areas and dams that are not to be impacted by construction are delineated and considered no-go zones (except where the project infrastructure has to cross over these areas). Wetlands and natural water resources are a valuable natural asset, especially within the Highveld area.

Based on the impact assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered.

Wetland management measures and monitoring requirements as set out in the specialist report **(Appendix H-4)** should form part of the conditions of environmental authorisation and be included in the EMPr.

11.2.8 HERITAGE ASSESSMENT

The Project area is characterised by extensive cultivated fields and is of low archaeological potential. This was confirmed during the field survey and no archaeological sites of significance were noted and finds were limited to burial sites (Feature 093, 094, HD001, HD002, HD 004, HD101 and GA004) as well as ruins (Feature 089, 090, 091, 092, HD003, GA001, GA002, and GA003). The survey focused on tangible heritage resources within the proposed footprint however several features (residential dwellings and settlements) were also noted outside of the proposed project footprint. These features were not assessed as they will not be directly impacted on, but burial sites can be found in these areas.

All three powerlines and water supply pipeline will impact on burial sites at HD002 and GA004. The sites must be preserved in situ with a 30-meter buffer as mitigation measure (prescribed by SAHRA), which means that the powerlines and water supply pipeline will have to be micro sited in these areas.

Based on the current layout the ruins at GA002 are located in the site alternative 3 footprint and the cluster of sites at 089 – 092 is located close to the site alternative 2 powerline. Although of low significance the possible presence of graves at the ruins is a risk. If avoidance is not possible the presence of graves should be confirmed during social consultation and the area should be monitored during construction.

All three facility alternatives are acceptable from a heritage point of view with the implementation of the recommendations in this report, but the facility alternative 2 is preferred from a heritage point of view

The impact to heritage resources can be mitigated to an acceptable level provided that the recommendations in this report are adhered to, based on the SAHRA's approval.

11.2.9 DESKTOP GEOTECHNICAL ASSESSMENT

The following findings concluded from a geotechnical desktop study undertaken for the proposed Hendrina GH&A facility.

The impact of the project alternatives on the geological environment will predominantly relate to the removal and displacement of soil, boulders and bedrock referred to in this report as "subsoils". The levelling of areas to create building platforms will also result in the displacement and exposure of subsoils. These impacts will have a negative visual impact on the environment, which in some cases can be remediated.

The risk of soil erosion is also increased during construction activities, by the removal of vegetation and by possible disturbance to the natural drainage environment, subsequently leading to the prevention of infiltration of rainwater and increased surface run-off. Areas of concentrated surface flow can be anticipated at the energy facilities, resulting in gradual erosion of unconsolidated soil during the operational life of the facilities. This can result in the creation of preferential drainage features, unless remediated through proper engineering design (i.e., stormwater drainage).

Based on the impact assessment matrix undertaken for this project, from a geotechnical perspective, the impact of the Hendrina Green Hydrogen and Ammonia Facility was found to be "Negative with High impacts and medium post mitigation **-** The anticipated impacts will have considerable negative effects and will require the implementation of mitigation and monitoring measures"

From a geological/geotechnical perspective, no fatal flaws have been identified in the desk study assessment that would prevent the construction of the proposed development at any of the aforementioned alternative sites, provided that the recommendations presented in the specialist desktop report are adhered to, which needs to be verified by more detailed geotechnical investigations during the detailed design stage.

These conclusions presented will have to be more accurately confirmed during the detailed geotechnical investigation, which is recommended to be undertaken during the detailed design phase of the project. The detailed geotechnical investigation must entail the following:

- Profiling and sampling exploratory test pits to determine founding and subgrade conditions for the green hydrogen and ammonia facility as well as the associated infrastructure.
- Geotechnical materials investigation for construction sources – gravel and rock.
- Thermal resistivity and electrical resistivity geophysical testing for electrical design and ground earthing requirements.
- Groundwater sampling of existing boreholes to establish a baseline of the groundwater quality for construction purposes.
- Disturbed and undisturbed sampling to be carried out across the proposed development area for laboratory analysis.

11.2.10 SOCIO-ECONOMIC ASSESSMENT

The proposed project will generate both positive and negative impacts starting from the construction period and ending with the decommissioning phase. The following points summarise the key socio-economic impacts that were identified to have the potential to occur during the different phases and sub-projects.

Impacts during construction

During the construction phase, the proposed facility will have both positive and negative effects on the socio-economic environment.

The facility is anticipated to make a prominent contribution towards the national and local economy. It is estimated that a total of R18,8 billion of new business sales, R5,3 billion of GDP and 1 221 full time equivalent employment positions will be generated by the project in the national economy through multiplier effects. Aside from the above positive effects, the project will contribute to skills development in the country, specifically as far as construction of the hydrogen and ammonia facility is concerned as well as increasing household earnings. The increase in household earnings is also likely to improve the standards of living of the affected households albeit temporarily.

Aside from the positive impacts though, the project will be creating negative direct, secondary and cumulative impacts on the local communities, specifically areas surrounding the site where the proposed facility is to be built. The main factors that will cause this negative impact are (1) the influx of workers and job seekers from outside of the local community and (2) visual and noise disturbances that would be created by the construction activities as the footprint of the facility grows. Potential negative impacts can be mitigated, although some more successfully than others. Visual impacts though cannot be eliminated although it is possible to reduce their significance.

Impacts during operations

During the operation of the facility the socio-economic impacts are likely to last longer when compared to those observed during the construction phase. This is the case for both positive and negative effects. The operation of the proposed Project will generate R237 million of new business sales, contribute R144 million to GDP and create 100 sustainable full time equivalent employment positions. The developer's intended socio-economic development spend will also notably contribute towards local employment, skills development and various conservation enterprises within the immediate area.

Negative impacts include the potential loss of sense of place and potential loss of income from agriculture-based businesses. These potential losses may, however, be mitigated by the rental that will be paid to landowners where the facility will be erected. As in the case with the impacts observed during construction, negative effects can be mitigated, and positive impacts enhanced. Mitigation of the negative impacts though will not result in their complete elimination as visual disturbance of the nature inherent to the project are difficult to eradicate entirely. Nevertheless, the significance ratings of the negative impacts are expected to be somewhat reduced.

Based on the above, the following recommendations have been made:

The net positive impacts associated with the development and operation of the proposed project are expected to outweigh the net negative effects. The project is also envisaged to have a positive stimulus on the local economy and employment creation, leading to the economy's diversification and a small reduction in the unemployment rate.

The project should therefore be considered for development. It should, however, be acknowledged that the negative impacts would be largely borne by the nearby farms and households residing on them, whilst the positive impacts will be distributed throughout both the local and national economies.

Due to this imbalance, it is recommended that the mitigation measures suggested, are strictly adhered to. Application of these mitigation measures will ensure that the negative impacts on the nearby farms and businesses are minimised and that the distribution of the potential benefits of the project are more balanced.

11.2.11 PALAEONTOLOGY ASSESSMENT

According to the SAHRA Paleontological sensitivity map the study area is of very high paleontological significance and an independent study was conducted for this aspect. Bamford (2022) concluded that it is extremely unlikely that any fossils would be preserved in the loose soils and sands of the Quaternary. There is a very small chance that fossils may occur in below the ground surface in the shales of the Vryheid Formation but more than 20m down, so a Fossil Chance Find Protocol should be added to the EMPr.

Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, developer, environmental officer, or other designated responsible person once excavations for pole foundations, access roads or the new substation have commenced. The routes are on the Vryheid Formation so there is no preferred option as far as the palaeontology is concerned. Since the impact will be low to moderate, as far as the palaeontology is concerned, the project should be authorised. There is no preferred site for the facilities, as far as the palaeontology is concerned.

11.2.12 VISUAL ASSESSMENT

A visual study was conducted to assess the magnitude and significance of the potential visual impacts associated with the development of the proposed Hendrina GHAF and associated OHL infrastructure near Hendrina in Mpumalanga Province. The VIA has demonstrated that the study area has a somewhat mixed visual character, transitioning from the heavily transformed landscape associated with the collieries and associated mining activities to the south-west of the proposed development, to a more rural / pastoral character across the remainder of the study area. Hence, although the Facility and OHL development would alter the visual character and contrast with this rural / pastoral character, the location of the development in relatively close proximity to mining activities and the associated power lines and rail infrastructure will significantly reduce the level of contrast.

A broad-scale assessment of visual sensitivity, based on the physical characteristics of the study area, economic activities and land use that predominates, determined that the area would have a low visual sensitivity. However, an important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. No formal protected areas, leisure-based tourism activities or sensitive receptor locations were identified in the study area, thus confirming the low level of visual sensitivity.

The desktop assessment did however identify multiple farmsteads and residences within the study area that could be considered to be receptors, although not all of them would be sensitive to the proposed development. These farmsteads are however regarded as potentially sensitive visual receptors as elements of the proposed development could potentially alter natural or semi-natural vistas experienced from these locations. At this stage however, local sentiments towards the proposed development are not known.

Only fourteen (14) potentially sensitive receptors were identified within 5kms of the Facility site alternatives, none of which are considered sensitive. Four (4) of the identified receptors were found to be outside the viewshed for the Facility site alternatives and were excluded from the assessment. None of the remaining receptors are expected to experience high levels of visual impact. Eight (8) potentially sensitive receptors are expected to experience moderate levels of visual impact, five (5) of which are located within either the Hendrina North WEF or Hendrina South WEF project areas. In these cases, it has been assumed that the relevant landowners are involved in the Hendrina renewable energy complex project and as such are not expected to perceive the proposed development in a negative light. The remaining two (2) receptors would only experience low levels of visual impact because of the Facility.

Twenty-two (22) receptors were identified within 5kms of the combined OHL assessment corridor, none of which are considered sensitive. Five (5) of the identified receptors were found to be outside the viewshed for the OHL alternatives and were excluded from the assessment. Only one receptor is expected to experience high levels of visual impact, this being VR91. As this receptor is located within the Hendrina North WEF project area, it has been assumed that the relevant landowners are involved in the project and as such are not expected to perceive the proposed development in a negative light. Eleven (11) potentially sensitive receptors are expected to experience moderate levels of visual impact, six (6) of which are also located within either the Hendrina North WEF or Hendrina South WEF project areas. In these cases, the relevant landowners are not expected to perceive the proposed development in a negative light. The remaining five (5) receptors would only experience low levels of visual impact because of the OHL development.

A preliminary assessment of overall impacts revealed that impacts associated with the proposed Facility and associated OHL infrastructure (post mitigation) are of low significance during both construction and decommissioning phases. During operation however, visual impacts (post mitigation) from the Facility would be of moderate significance with relatively few mitigation measures available to reduce the visual impact. Visual impacts associated with the OHL infrastructure during operation would be of low significance.

Considering the presence of existing and proposed mining activity and electrical generation and distribution infrastructure, the introduction of this type of facility in the area will result in further change in the visual character of the area and alteration of the inherent sense of place, extending an increasingly industrial character into the broader area, and resulting in significant cumulative impacts. It is however anticipated that these impacts could be mitigated to acceptable levels with the implementation of the recommended mitigation measures. Considering this, cumulative impacts have been rated as moderate.

A comparative assessment of site alternatives for the Facility was undertaken to determine which of the alternatives and associated grid connection infrastructure would be preferred from a visual perspective. No fatal flaws were identified in respect of any of the site alternatives or OHL route alignments being proposed for the project. In addition, no preference was determined for any of the facility site alternatives, although GH&A Site alternative 3 was found to be least preferred.

It is the opinion of the specialist, that the potential visual impacts associated with the proposed Hendrina GH&A facility and the associated OHL infrastructure are negative and of moderate significance. Given the relatively low number of potentially sensitive receptors and the significant level of human transformation and landscape degradation in areas near the proposed Facility, the project is deemed acceptable from a visual perspective and the EA should be granted.

11.2.13 TRAFFIC IMPACT ASSESSMENT

The traffic impact assessment for the construction and operational phases for the proposed GH&A facility was undertaken, and the following conclusions and recommendations were made.

It is envisaged that the proposed green hydrogen and ammonia facility will generate less than 50 peak hour trips. This is expected to produce an insignificant traffic impact.

The overall significance of each impact during the construction phase of the facility detailed in **Section 9.12 Traffic,** is Moderate without mitigation, and Low with mitigation. The impacts are limited to the peak construction period only, site only/local or regional, and fully reversible.

The proposed mitigating measures are easy to implement and will assist to either prevent or reduce the impacts of increased vehicle engine and tyre noise, exhaust fumes and generation of dust on unsurfaced roads.

The maintenance and repair of the local access roads due to damage by construction vehicles should be the responsibility of respective project companies of the Hendrina GH&A facilities.

It is concluded that the proposed Hendrina GH&A Facility will have a low transport impact on the adjacent road network. The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

11.2.14 BAT ASSESSMENT

Currently there is no evidence of GHA facilities posing a direct threat of fatality impact on bats during operation. However, roosting and foraging habitats may be significantly impacted during the construction phase. This is primarily due the fact that such facilities require areas of land to be cleared, and in some cases, earthworks are required for levelling purposes. This can result in habitat that is suitable for micro roosts, such as clumps of trees and certain vegetation being destroyed, which can also be fatal to bats residing in such roosts.

The presence of security lights on and around these facilities creates significant light pollution that can impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light averse) species and favouring species that readily forage around insect-attracting lights. Additionally, if the buildings and associated infrastructure for these facilities are placed close to wind turbines of nearby WEF's, such as the proposed Hendrina North & South WEF's (which the proposed GHA facility is sharing a site). The stormwater management should also avoid creating artificial wetlands and open water sources near turbines of the proposed Hendrina North & South WEF's (closer than 300m from any turbine base). The likelihood of bats being killed by moving turbine blades increases significantly when they are attracted to their proximity when it has become an improved foraging airspace due to the presence of artificial light or artificial water sources. This can result in the Hendrina GHA facility increasing the likelihood of bats being killed by the proposed Hendrina North & South WEF's.

At its nearest, this extends to approximately 70km north-north-east and 73km west of the Site. Dolomite is known to be prone to good cave formation, and many bat colonies are supported in such caves in the country, particularly in the province of Gauteng. Museum records of bats collected from three caves, one mine and one inspection tunnel within approximately 100km of the site exist. Specimens of *Miniopterus natalensis* and *Rhinolophus clivosus* were collected from River Cave (47km north-east of site); *R. simulator, Myotus tricolor* and *Cloeotis percivali* from a mine tunnel on Waterval Farm (79km east-north-east); *Nycteris thebaica, Hipposideros caffer, Miniopterus natalensis, R. simulator* from Loskopdam wall inspection tunnel (80 km north); *R. simulator, R. blasii, R. clivosus* and *Miniopterus fraterculus* from Kranskalkoen Cave (78km east); and *R. clivosus, Cloeotis percivali, Miniopterus natalensis* from Wonderboom cave (75km north west).

The Strategic Environmental Assessment (SEA) assigns 50km buffers to large bat roosts for wind energy but provide no information for GHA facilities. All of the above locations are further than 50km from the proposed site with the exception of River Cave (47km north-east of site). Cave bats do not utilise an area around a cave in a radial buffer shape, and therefore the bat sensitivity map will provide for foraging habitat around the River Cave, since it's almost 50km from the proposed Site. It is also unlikely that light pollution, which is considered the main impact of the proposed GH&A facility, will have a significant effect on the River Cave at 47km.

The High Bat Sensitivity areas designated by the specialist in the Sensitivity Map supplied with this report are expected to have elevated levels of bat activity and support greater bat diversity. Where high sensitivities are no-go zones for certain GH&A infrastructure (**Table 8-1** and **Table 8-2**), and **Figure 8-3** depicts the sensitive areas of the site based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

Considering the bat sensitivity map, both location alternatives 1 & 3 are intruding onto high bat sensitivity areas, and should be relocated to be outside these areas, or not be selected as options. Therefore, location alternative 2 is the only alternative for the proposed Hendrina GH&A facility.

The pre-construction bat monitoring of the proposed Hendrina North & South WEF's has been completed and informs the EIA phase assessment of the proposed Hendrina GHA facility since these renewable energy facilities are within the same site boundary.

Thus far, from a bat impact perspective, if the Mitigation Action Plan is incorporated into the EMPr, no reasons have been identified for the proposed alternative 2 location of the Hendrina GH&A facility not to receive Environmental Authorisation.

11.2.15 RISK ASSESSMENT

The assessment concluded that, in the event of accidents such as large releases of hydrogen, nitrogen, oxygen or ammonia, the proposed facilities have the potential to impact significantly on both employees and members of the public outside the site. Based on the current design information, worst case hydrogen events may have significant impacts up to 475m from the site and ammonia (stored cryogenically) up to 1.4km from the site. Note that worst case events are extremely unlikely and the chance of them occurring is similar to the average chance of being struck by lightning.

Therefore, for site alternatives 1 and 2 the risk assessment has found that provided suitable preventative and mitigative measures are in place and everything reasonably practicable has been done to reduce the risks both with the design and operation of the facilities, none of the identified potential risks need be intolerably high, i.e., from a SHE perspective no fatal flaws were found with the proposed Hendrina Green Energy Facilities at location 1 and 2.

At site alternative 3 the closest farmsteads as less than 300m (north) from the site and the closest water course less than 250m (east). As a result of this proximity, this risk assessment suggests that it may be difficult to achieve suitable low risk levels and therefore site alternative 3 is not deemed suitable.

From a SHE risk assessment point of view, where there is a choice of location that is further from public roads, water courses, isolated farmhouses or existing infrastructure, this would be preferred. The site alternative 1 for the Green Hydrogen and Ammonia facility is closer to the tar access road for the area as well as existing farmhouses. Site alternative 2 is slightly more isolated and is therefore slightly preferred from a SHE risk perspective.

Each of the hydrogen, air separation and ammonia plants have the potential to cause major accidents and the entire establishment should be classified as a Major Hazard Installation.

The hydrogen system, and ammonia under exceptional circumstances, have the potential to lead to fires and explosion which may lead to domino failures of other equipment in proximity.

The following recommendations have been made:

The entire Green Hydrogen and Ammonia Establishment is an MHI and the necessary risk assessment, notifications, emergency response plans etc. as per the MHI Regulations, should be in place prior to commencement of construction.

Initiate the Major Hazard Installation Quantitative Risk Assessment as soon as possible in the development process to ensure that risks to the public persons outside the site are as low as reasonably practicable. The MHI QRA can be used to assist with risk-based design decisions.

Note that the MHI regulations are under review and if the new regulations are promulgated before this Green Hydrogen and Ammonia facility is approved under the old regulations, compliance with the new regulation will be required which will entail, amongst other requirements, the obtaining of a license to operate.

At any large major hazard installation, such as this facility, a full formal Process Safety Management (PSM) system should be implemented and maintained. Such a system should begin to be implemented prior to commencement of the basic engineering design, i.e. certain elements will require specific tasks of the design team.

One element of PSM is that the design should be subject to a full Hazard and Operability Study (HAZOP) prior to commencement of procurement. A HAZOP is a detailed technical systematic study that looks at the intricacies of the design, the control system, the emergency system etc. and how these may fail under abnormal operating conditions. Additional safeguards may be suggested by the team doing the study.

The hydrogen systems, and ammonia under exceptional circumstances, have the potential to lead to fires and explosions which may lead to domino failures of other equipment in close proximity, e.g. within 350m. From an overall Hendrina project risk reduction point of view, suitable separation, or other mitigation, should be considered in the design of the site layout, including proximity to other critical infrastructure such as the Battery Energy Storage Systems (BESS) and electrical substations connecting the wind turbines or solar facilities to the National Electricity Grid.

Critical to the mitigation of any potential major accidents is a detailed, well-practiced Emergency Response plan. Such a plan, compliant with SANS 1514, should be in place and tested prior to commissioning.

From a SHE risk assessment point of view site alternative 3 is deemed unsuitable, while alternative 2 is slightly preferred over alternative 1.

The impact assessment tables in **Section 9.15** of this report contain some technical and system suggestions for managing and reducing risks. Ensure the items listed in these tables under preventative and mitigative measures are included in the design, operation and maintenance of the facilities.

Despite the fact that worst case impacts may extend a significant distance, there are many technical features that can be considered during the design phase of the project to reduce the risks, e.g. rapid inventory isolation systems, use of higher reliability road tanker loading arms instead of hoses etc. Further risk reduction measures may be suggested by the MHI QRA once more detailed design information is available.

11.2.16 SOIL AND AGRICULTURAL ASSESSMENT

The conclusion of the assessment is that the agricultural impact of the proposed development is acceptable because:

— The proposed development will exclude only a small area of land (25 ha) from future agricultural production.

— The proposed facility is an integral part of the greater Hendrina renewable energy project which offers a valuable opportunity for renewable energy facilities to be integrated with agricultural production in a way that provides renewable energy to the country as well as benefits to agriculture with very little loss of future agricultural production potential.

— The agricultural benefits are increased economic viability for agricultural operations on site, security benefits against stock theft and other crime, an improved road network, with associated storm water handling system, and that the project will decrease the need for coal power and thereby contribute to reducing the large agricultural impact that open cast coal mining has on highly productive agricultural land in the area.

The agricultural protocol requires confirmation that all reasonable measures have been taken through micro-siting to minimize fragmentation and disturbance of agricultural activities. As has been noted in **Section 7.1.5** above, alternative 3 has lower agricultural impact than the other two alternatives.

The only micro-siting that is recommended is that pylons not be placed within any croplands, but instead be located on the edges of them.

Therefore, from an agricultural impact point of view, it is recommended that the development be approved.

The conclusion of the assessment on the acceptability of the proposed development and the recommendation for its approval is not subject to any conditions.

11.2.17 GROUNDWATER

The assessment revealed that the farmers make use of a large number of boreholes (wind pumps and submersible pumps) that they mainly used for livestock watering and domestic use. This, in terms of groundwater volumes are minimal. The yield of the area is estimated as 0.1 – 0.5 l/s, however larger yields can be obtained when intersecting large water bearing fractures.

The proposed area is suitable for groundwater exploration and development due to the Ecca Formation of the Karoo Supergroup being host to a large number of Karoo age dolerite intrusions. Although not prevalent on the 1:250 000 geological map, more in-detail surveys would be required to locate such intrusions. Should the drilling of boreholes be considered as option, it is recommended that geophysical surveys be undertaken prior to the identification of drill targets. If water is encountered, the boreholes must be pump tested to determine sustainable abstraction yields.

Groundwater quality in the area is classified as very good (average EC of 40 mS/m), as confirmed by the extensive hydrocensus and groundwater quality analysis. Some occasional outliers of especially nitrogen (as nitrate-nitrogen) were, however, recorded. No substantial cumulative impacts are expected and risks towards the groundwater environment are expected to be minimal to negligible.

No specific routine monitoring requirements can at this stage be recommended for the project until a water source has been confirmed. Regardless, the baseline water quality and water levels as discussed in the report () prior to development should provide a qualitative and quantitative baseline. Should an impact on a groundwater supply feature be identified as significant then appropriate remediation measure(s) must be identified by developer.

Based on the findings of the geohydrological assessment, no fatal flaws have been identified that may limit the application. It is the opinion of the specialist that it may proceed on condition that all mitigation measures as outlined and discussed in the assessment are adhered to.

11.3 IMPACT SUMMARY

A summary of the identified impacts and corresponding significance ratings for the proposed GH&A facility is provided in **Table 11-1** for the construction operational and decommissioning phase below. The impacts summarised are applicable to both proposed site alternatives.

CONSTRUCTION, OPERATION AND DECOMISSIONING IMPACT SUMMARY

Table 11-1: Impact Summary

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
Air Quality	Generation of Dust and PM	Construction	**Low**	(-)	**Very Low**	(-)
	Ambient air quality due to NH_3 emissions	Operation	**Low**	(-)	**N/A**[4]	
Noise	Noise Emissions	Construction	**Low**	(-)	**Very Low**	(-)
	Noise Emissions from facility operation	Operation	**Very Low**	(-)	**Very Low**	(-)
Soil, land capability and Agricultural	Loss of agricultural potential	Construction	**Moderate**	(-)	**N/A**	(-)
Surface Water/Wetlands	Wetland destruction	Construction	**Moderate**	(-)	**Low**	(-)
	Hydrocarbon & Waste Spills	Construction	**Moderate**	(-)	**Low**	(-)
	Hydrocarbon & Waste Spills	Operation	**Moderate**	(-)	**Low**	(-)

[4] Note: A post-mitigation scenario is not applicable for the control of NH_3 emissions during the operational phase. All emission controls are considered standard operating procedure and thus the pre-mitigation scenario is representative of normal operations as the proposed facility is designed to function

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Increased run off leading to erosion and sedimentation	Operation	**Moderate**	(-)	**Low**	(-)
	Rehabilitation – rehabilitation mainly consists of profiling and landscaping of the land, and re-vegetation.	Decommission	**Moderate**	(-)	**Low**	(-)
	Post-closure monitoring and rehabilitation.	Decommission	**Low**	(-)	**Low**	(-)
Terrestrial Biodiversity	Loss of indigenous natural vegetation	Construction	**Moderate**	(-)	**Moderate**	(-)
	Establishment and spread of declared weeds and alien invader plants	Construction	**Low**	(-)	**Very Low**	(-)
	Continued disturbance to natural habitats due to general operational activities and maintenance	Operation	**Low**	(-)	**Low**	(-)
	Establishment and spread of declared weeds and alien invader plants	Operation	**Moderate**	(-)	**Very low**	(-)
	Continued runoff and erosion	Operation	**Low**	(-)	**Low**	(-)
	Loss and/or disturbance of indigenous natural vegetation during removal of infrastructure	Decommissioning	**Low**	(-)	**Low**	(-)
	Establishment and spread of declared weeds and alien invader plants	Decommissioning	**Moderate**	(-)	**Low**	(-)
Animal Species	Loss of faunal habitat	Construction	**Moderate**	(-)	**Low**	(-)
	Direct mortality of fauna	Construction	**Low**	(-)	**Very low**	(-)
	Direct mortality of fauna	Operation	**Low**	(-)	**Very low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
Plant Species	Loss of individuals of Species of Conservation Concern due to clearing for construction	Construction	**Moderate**	(-)	**Very low**	(-)
	Disturbance due to general operational activities and maintenance leading to loss of individuals of SCC	Operation	**Moderate**	(-)	**Very low**	(-)
	Establishment and spread of declared weeds and alien invader plants leading to loss of SCC	Operation	**Moderate**	(-)	**Very low**	(-)
	Loss and/or disturbance of indigenous natural vegetation during removal of infrastructure that may lead to loss of individuals of SCC	Decommission	**Moderate**	(-)	**Low**	(-)
	Establishment and spread of declared weeds and alien invader plants leading to loss of SCC	Decommission	**Moderate**	(-)	**Very Low**	(-)
Avifauna	Displacement due to disturbance associated with the construction	Construction	**Low**	(-)	**Very Low**	(-)
	Displacement of SCC due to disturbance of breeding birds associated with the construction	Construction	**Low**	(-)	**Very Low**	(-)
	Displacement due to habitat transformation associated with the construction of the 132kV grid connection power line.	Construction	**Low**	(-)	**Very Low**	(-)
	Displacement due to disturbance associated with the construction of the 132Kv grid connection power line.	Construction	**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Mortality of priority species due to collisions with the up to 132kV overhead power line	Operation	**Moderate**	(-)	**Low**	(-)
	Electrocution of priority species on the up to 132kV overhead powerline	Operation	**Low**	(-)	**Very low**	(-)
	Displacement of SCC due to disturbance of breeding birds associated with the decommissioning of the GH&A facility	Decommission	**Low**	(-)	**Very low**	(-)
	Displacement of priority species due to disturbance associated with decommissioning of the 132kV line	Decommissioning	**Low**	(-)	**Low**	(-)
Visual	Potential visual impact of construction activities on sensitive visual receptors in close proximity to the proposed grid connection infrastructure	Construction	**Moderate**	(-)	**Low**	(-)
	Potential visual impact on sensitive visual receptors located within a close proximity of the facility infrastructure during the operational phase	Operation	**Moderate**	(-)	**Moderate**	(-)
Waste	General Waste	Construction	**Low**	(-)	**Low**	(-)
	Hazardous Waste	Construction	**Moderate**	(-)	**Low**	(-)
	Sanitation Waste	Construction	**Low**	(-)	**Low**	(-)
	General Waste	Operation	**Low**	(-)	**Low**	(-)
	Hazardous Waste	Operation	**Moderate**	(-)	**Low**	(-)
Traffic	Noise due to vehicle trips on-site	Construction	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Dust & exhaust pollution due to additional trips on the national and district roads	Construction	**Moderate**	(-)	**Low**	(-)
	Transport of ISOtainers generating noise pollution on the national and district roads	Operation	**Low**	(-)	**Very Low**	(-)
	Transport of ISOtainers generating dust & exhaust pollution on the national and district roads	Operation	**Low**	(-)	**Very Low**	(-)
Heritage	Destruction or damage to Graves at 093, 094, HD001, HD002, HD 004, HD101, HD102 and GA004.	Construction	**Moderate**	(-)	**Very Low**	(-)
	Destruction or damage to recorded ruins	Construction	**Moderate**	(-)	**Very Low**	(-)
	Damage/ destruction of unknown heritage resources.	Construction	**Low**	(-)	**Very low**	(-)
Palaeontology	Encountering Fossils	Construction	**Low**	(-)	**Very Low**	(+)
Socio-economic	Temporary stimulation of the national and local economy	Construction	**High**	(+)	**High**	(+)
	Temporary increase employment in the national and local economies	Construction	**Moderate**	(+)	**Moderate**	(+)
	Contribution to skills development in the country and local economy	Construction	**Moderate**	(+)	**Moderate**	(+)
	Temporary increase in household earnings	Construction	**Moderate**	(+)	**Moderate**	(+)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Temporary increase in government revenue	Construction	**Moderate**	(+)	**Moderate**	(+)
	Negative changes to the sense of place	Construction	**Moderate**	(-)	**Moderate**	(-)
	Negative impact on the local agriculture operations	Construction	**Low**	(-)	**Low**	(-)
	Temporary increase in social conflicts associated with the influx of people	Construction	**Moderate**	(-)	**Low**	(-)
	Impact on economic and social infrastructure	Construction	**Moderate**	(-)	**Moderate**	(-)
	Sustainable increase in production and GDP nationally and locally	Operation	**Moderate**	(+)	**Moderate**	(+)
	Creation of sustainable employment positions nationally and locally	Operation	**Moderate**	(+)	**Moderate**	(+)
	Skills development of permanently employed workers	Operation	**Moderate**	(+)	**Moderate**	(+)
	Improved standards of living for benefiting households	Operation	**Moderate**	(+)	**Moderate**	(+)
	Sustainable increase in national and local government revenue	Operation	**Moderate**	(+)	**Moderate**	(+)
	Local economic and social development benefits derived from the project's operations	Operation	**Moderate**	(+)	**Moderate**	(+)
	Sustainable rental revenue for farms where the facility is located	Operation	**Moderate**	(+)	**Moderate**	(+)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Sustainable increase in hydrogen and ammonia production in South Africa	Operation	**High**	(+)	**High**	(+)
	Negative changes to the sense of place	Operation	**High**	(-)	**Moderate**	(-)
	Negative impact on agricultural operations	Operation	**Moderate**	(-)	**Moderate**	(-)
SHE Risk	Chronic exposure to toxic chemical or biological agents	Construction	**Moderate**	(-)	**Low**	(-)
	Human Health - exposure to noise	Construction	**Moderate**	(-)	**Low**	(-)
	Human Health -exposure to temperature extremes and/or humidity	Construction	**Low**	(-)	**Very Low**	(-)
	Human Health - exposure to psychological stress	Construction	**Low**	(-)	**Low**	(-)
	Human Health - exposure to ergonomic stress	Construction	**Low**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to fire radiation	Construction	**Moderate**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Construction	**Moderate**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Construction	**High**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to electromagnetic waves	Construction	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Environment - emissions to air	Construction	**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water	Construction	**Low**	(-)	**Low**	(-)
	Environment – waste generation	Construction	**Low**	(-)	**Low**	(-)
	Environment - waste of resources e.g. water, power etc	Construction	**Low**	(-)	**Very Low**	(-)
	Public - Aesthetics	Construction	**Low**	(-)	**Low**	(-)
	Investors - Financial	Construction	**Moderate**	(-)	**Low**	(-)
	Employees and investors - Security	Construction	**Moderate**	(-)	**Low**	(-)
	Emergencies	Construction	**Moderate**	(-)	**Low**	(-)
	Legal matters	Construction	**Moderate**	(-)	**Low**	(-)
	Human Health - chronic exposure to toxic chemical or biological agents.	Operation	**Moderate**	(-)	**Low**	(-)
	Human Health - chronic exposure to toxic chemical or biological agents	Operation	**Moderate**	(-)	**Low**	(-)
	Human Health - exposure to noise	Operation	**Moderate**	(-)	**Low**	(-)
	Human Health - exposure to temperature extremes and/or humidity	Operation	**Low**	(-)	**Very Low**	(-)
	Human Health - exposure to psychological stress	Operation	**Low**	(-)	**Very Low**	(-)
	Human Health - exposure to ergonomic stress	Operation	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Human and Equipment Safety - exposure to fire radiation	Operation	**Moderate**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to explosion over pressures-Hydrogen Ammonia & oxygen leaks	Operation	**Moderate**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to explosion over pressures-Transformer faults	Operation	**Moderate**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Operation	**Low**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to acute toxic/hazardous chemicals	Operation	**High**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Operation	**Moderate**	(-)	**Low**	(-)
	Human and Equipment Safety - exposure to electromagnetic waves	Operation	**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air	Operation	**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water	Operation	**Low**	(-)	**Low**	(-)
	Environment – waste generation	Operation	**Low**	(-)	**Very Low**	(-)
	Environment - waste of resources e.g. water, power etc	Operation	**Low**	(-)	**Very Low**	(-)
	Public - Aesthetics	Operation	**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	WITHOUT MITIGATION		WITH MITIGATION	
			SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
	Investors - Financial	Operation	**Moderate**	(-)	**Low**	(-)
	Employees and investors - Security	Operation	**Moderate**	(-)	**Low**	(-)
	Facility emergencies	Operation	**Moderate**	(-)	**Low**	(-)
	Legal matters	Operation	**Moderate**	(-)	**Low**	(-)
	Equipment reached end of life and may leak	Decommission	**Moderate**	(-)	**Low**	(-)
Bats	Loss of foraging habitat by clearing of vegetation.	Construction	**Low**	(-)	**Low**	(-)
	Roost destruction during earthworks.	Construction	**Low**	(-)	**Very Low**	(-)
	Increased bat mortalities due to light attraction and habitat creation.	Operation	**Moderate**	(-)	**Low**	(-)
Groundwater	Water use	Construction	**Low**	(-)	**Very Low**	(-)
	Soil clearing and construction of infrastructure	Construction	**Low**	(-)	**Very Low**	(-)
	Water feed from Usuthu water scheme	Operation	**Very low**	(-)	**Very low**	(-)
	Groundwater abstraction for production purposes	Operation	**Moderate**	(-)	**Low**	(-)
	Use of purified wastewater from nearby mining	Operation	**High**	(-)	**Low**	(-)

CUMULATIVE IMPACT SUMMARY

A summary of the identified cumulative impacts is outlined in **Table 11-2** below for both before and after mitigation measures have been considered for the current project as well as the combination of projects in the area.

Table 11-2: Cumulative impacts summary

ASPECT	IMPACT DESCRIPTION	CURRENT PROJECT		COMBINATION OF PROJECTS	
		SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
Noise	Cumulative acoustic impact	Very low	(-)	Very Low	(-)
Surface Water/ Aquatic	Cumulative surface water impact	Moderate	(-)	Low	(-)
Avifauna	Cumulative Avifaunal impacts from GH&A facility	Low	(-)	Low	(-)
	Cumulative Avifaunal impacts from 132kV powerline	Moderate	(-)	Low	(-)
Animal species	Loss of faunal habitat during construction	Very low	(-)	Very low	(-)
Plant species	Loss of individuals of Species of Conservation Concern	Moderate	(-)	High	(-)
Biodiversity	Clearing of natural habitat for construction	Moderate	(-)	High	(-)
	Disruption of ecological processes at landscape level	Low	(-)	Moderate	(-)
	Establishment and spread of declared weeds and alien invader plants	Very low	(-)	Moderate	(-)
Heritage and Palaeontology	Damage or loss of heritage or palaeontological finds	Moderate	(-)	Low	(-)
Visual and landscape	Cumulative visual impact	High	(-)	Moderate	(-)
Traffic	Increased traffic due to surrounding developments	Moderate	(-)	Low	(-)
Social	Cumulative change in the Sense of place and the landscape	Low	(-)	Low	(-)
	Cumulative impact on Local services and accommodation	Moderate	(-)	Low	(-)
	Cumulative impact on local economy	Low	(+)	Moderate	(+)

ASPECT	IMPACT DESCRIPTION	CURRENT PROJECT		COMBINATION OF PROJECTS	
		SIGNIFICANCE	STATUS	SIGNIFICANCE	STATUS
Bats	Cumulative bat mortalities due to light attraction and habitat creation.	**Moderate**	(-)	**Low**	(-)

11.4 ALTERNATIVES ASSESSMENT

Project alternatives in terms of activity, technology, location and layout were considered as part of this EIAr process. Three alternative sites have been assessed, as well as three alternative pipeline and powerline routes for each site.

The site alternative 2 (**Figure 11-4**) along with the associated pipeline alternative 1 (**Figure 11-5**) is the preferred option for the proposed Hendrina GH&A facility as outlined in **Section 6.5.5. Figure 11-6** shows the preferred 132kV powerline route for site alternative 2. However, it is important to note that while there are preferences specified, all site alternatives and options for pipelines locations are considered feasible.

Site Alternative 2 is preferred with the following coordinates:

- A2-A - 26°12'3.74"S 29°33'33.37"E
- A2-B - 26°12'17.06"S 29°33'26.78"E
- A2-C - 26°12'27.16"S 29°33'47.13"E
- A2-D - 26°12'19.30"S 29°33'51.76"E
- A2-E - 26°12'16.45"S 29°33'46.51"E
- A2-F - 26°12'13.49"S 29°33'48.09"E

Figure 11-4: Site alternative 2

Pipeline alternative 2 is preferred with the following coordinates:

- WP1 - 26° 5'56.52"S 29°28'49.09"E
- WP2 - 26° 6'4.43"S 29°28'53.68"E
- WP3 - 26° 6'7.11"S 29°29'9.59"E
- WP4 - 26° 6'47.00"S 29°29'4.29"E
- WP5 - 26° 7'41.63"S 29°29'11.03"E
- WP6 - 26° 8'16.65"S 29°29'44.31"E
- WP12 - 26° 8'23.47"S 29°29'49.43"E
- WP13 - 26° 8'21.50"S 29°30'9.72"E
- WP14 - 26° 9'30.08"S 29°30'42.55"E
- WP15 - 26° 9'39.44"S 29°30'44.32"E
- WP16 - 26°10'1.52"S 29°31'10.46"E
- WP17 - 26°11'35.01"S 29°33'21.75"E
- WP18 - 26°11'51.57"S 29°33'12.35"E
- WP19 - 26°12'3.26"S 29°33'31.43"E
- WP20 - 26°12'19.33"S 29°33'41.05"E

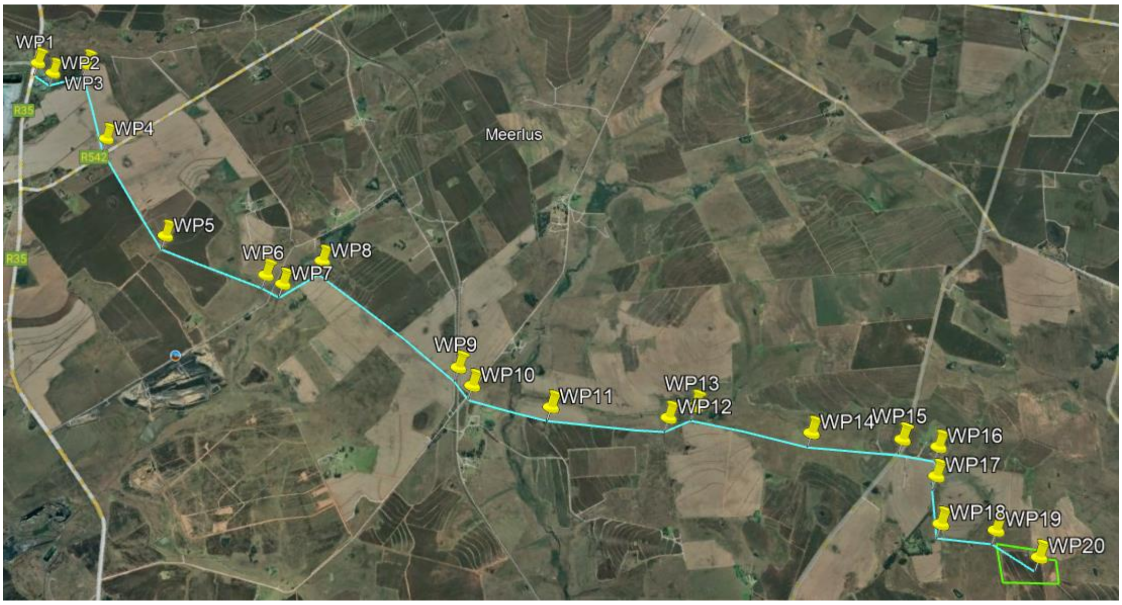


Figure 11-5: Preferred Pipeline alternative 2

Up to 132kV Grid Connection line preferred alternative with the following coordinates:

— PL1-A - 26°12'19.20"S	29°33'41.35"E
— PL1-B - 26°12'3.63"S	29°33'49.99"E
— PL1-C - 26°11'35.49"S	29°33'21.66"E
— PL1-D - 26°11'25.87"S	29°33'29.33"E
— PL1-E - 26°11'20.24"S	29°33'21.94"E
— PL1-F - 26°11'17.23"S	29°33'25.04"E

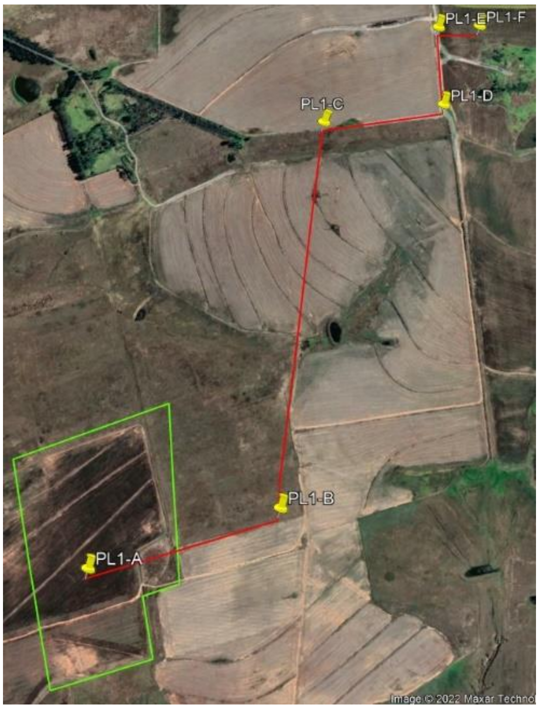


Figure 11-6: Preferred up to 132kV powerline option 1 for Site 2 (up to 3km)

In the “no project” alternative, the Hendrina GH&A Facility project will not be developed. In this scenario, there could be a missed opportunity to address the need for the green production of hydrogen and ammonia for commercial use in an effort to mitigate against concerns of climate change and exploitation of non-renewable resources. The no-go alternative would not assist in responding to the global call to reduce GHG emissions in the industrial sector. Conversely, negative environmental impacts of the project (as outlined in **Section 8**) associated with the development of the Hendrina GH&A Facility would be avoided.

11.5 IMPACT STATEMENT

The overall objective of the EIA is to provide sufficient information to enable informed decision-making by the authorities. This was undertaken through consideration of the proposed project components, identification of the aspects and sources of potential impacts and subsequent provision of mitigation measures.

It is the opinion of WSP that the information contained in this document (read in conjunction the final scoping report) is sufficient for the MDARDLEA to make an informed decision for the environmental authorisation being applied for in respect of this project.

Mitigation measures have been developed where applicable for the above aspects and are presented within the EMPr (**Appendix I**). It is imperative that all impact mitigation recommendations contained in the EMPr, of which the environmental impact assessment took cognisance, are legally enforced.

Considering the findings of the respective studies, no fatal flaws were identified for the proposed Project. Should the avoidance and mitigation measures prescribed be implemented, the significance of the considered impacts for all negative aspects pertaining to the environmental aspects is expected to be low. It is thus the opinion of the EAP that the Project can proceed, and that all the prescribed mitigation measures and recommendations are considered by the issuing authority.

EA AUTHORISATION PERIOD

Appendix 1(3)(1)(q) of the NEMA EIA Regulations 2014, as amended requires “where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised” must be included in the EIA Report.

The EA is required to be valid for a period of 10 years from the date of issuance of the EA. This is considered a reasonable period to allow the Applicant time to conduct relevant internal processes which can only begin after issuance of the EA.

FINALISATION OF THE EMPR AND LAYOUT

It is important to note that the EMPr (Appendix I) and project layout included in this EIR are not final and although included in this EIR, these are not submitted for approval at this stage. Subsequent to the decision-making phase, if environmental authorisation is granted for the project, the EMPr will have to be amended to include measures as dictated by the final layout map and micro-siting, including the requirements of the EA. The amended EMPr and final layout subjected to micro-siting will be submitted to MDARDLEA for review and approval following detailed design.

ASPECTS TO BE INCLUDED AS CONDITIONS IN THE EA

The following key aspects are recommended to be included as conditions of authorisation:

- The layouts submitted in the EIR are not final. The final layouts are to be submitted to the MDARDLEA for approval prior to construction.
- The EMPr submitted in the EIR is not final. The final EMPr is to be submitted to the MDARDLEA for approval prior to construction.
- All mitigation measures detailed in this EIR and the relevant specialist reports must be implemented.
- Recommendations for the layout as provided by the relevant specialists must be implemented as far as possible.

— The final EMPr must form part of all contractual documents with contractors during construction and operational phases of the project. Furthermore, a dedicated Environmental Control Officer (ECO) must be appointed to ensure compliance to all EA conditions and EMPr commitments throughout the construction phase.
— Applications for all relevant and required permits must be submitted prior to construction.
— Where required, water use authorisation under NWA is to be obtained from the Department of Water and Sanitation prior to construction.

12 CONCLUSION

A number of environmental impacts have been identified as requiring some more in-depth investigation and the identification of detailed mitigation measures. Therefore, this detailed EIAR provides an assessment of these potential impacts and recommend appropriate mitigation measures.

The anticipated environmental impacts associated with the proposed development have been evaluated according to their significance, which is determined as a result of their extent, magnitude, probability and duration. All impacts were assessed with and without management measures in place. This draft EIAR has been structured to comply with the requirements of the Appendix 3 of GNR 982. The report provides a description of the proposed project and details the aspects associated with the construction, operation and decommissioning. The report also includes the methodology followed to undertake the S&EIR process. A detailed description on the existing environment (bio-physical as well as socio-economic) is provided based on findings from the specialist surveys. Stakeholder engagement was undertaken from the onset of the project in a transparent and comprehensive manner. Outcomes of all comments received from the public review periods were recorded and responded to in the S&EIR. Based on the environmental description, specialist surveys as well as the stakeholder engagement a detailed EIA rating has been undertaken and where relevant the necessary management measures have been recommended.

In summary, the S&EIR process assessed both biophysical and socio-economic environments and identified appropriate management and mitigation measures. The biophysical impact assessment revealed that there are no environmental fatal flaws associated with the proposed project should mitigation and management measures be implemented. In addition, it should be noted that the overall socio-economic impacts associated with the project are positive.

WSP is of the opinion that should the identified mitigation and management measures be implemented the overall impact of the proposed Project is Low to Medium and can therefore by authorised.

This draft EIAR will be made available for public review from **8 May 2023 to 7 June 2023.**

All issues and comments submitted to WSP during the scoping and EIA phase have been incorporated in the SER (**Appendix D**). The Final EIR will be submitted to the MDARDLEA, as the competent authority, for review and decision -making.

If you have any further enquiries, please feel free to contact:

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