Environmental Management Programme

Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon

Applicant:
South African National Research Network

Prepared by:
CSIR Environmental Management Services

Reviewed by:
SLR Consulting South Africa

Version:
Draft for comment

Date:
August 2021

CSIR
Touching lives through innovation

SANReN
South African National Research Network

SKA AFRICA
SQUARE KILOMETRE ARRAY

Title:	*Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.* *Part B: Environmental Management Programme*
DFFE reference number:	To be confirmed
Applicant:	South African National Research Network (SANReN)
Prepared by:	Council for Scientific and Industrial Research (CSIR) - Environmental Management Services (EMS) group
Lead author / Environmental Assessment Practitioner: BAr mapping:	Luanita Snyman-van der Walt, Pr. Sci. Nat (400128/16) Lvdwalt1@csir.co.za
Specialist authors:	Terresrial ecology: Dr. Noel van Rooyen & Prof. Gretel van Rooyen (Ekotrust) Aquatic ecology: Dr. Brian Colloty (EnviroSci) Heritage, archaeology & palaeontology: Jenna Lavin & Dewald Wilken (CTS Heritage) Visual and aesthetic resources (overhead sections): Quinton Lawson (qarc) & Bernard Oberholzer (BOLA)
Internal CSIR review and contributors:	Paul Lochner, Pr. EAP (2019/745) Rohaida Abed, Pr.Sci.Nat. (400247/14)
Independent peer reviewer:	Edward Perry, Pr. EAP (2019/1210) (SLR Consulting SA)
Public participation support:	Shawn Johnston (Sustainable Futures ZA)
SAHRIS case ID:	15577
HWC case number:	20200206SB1006E
GA reference number:	WU18079
CSIR report number:	CSIR/SPLA/SECO/IR/2021/0015/A
CSIR project number:	EEMS035
Version:	Draft for comment
Date:	August 2021
To be cited as:	CSIR. 2021. Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon. Part B: Environmental Management Programme. CSIR/SPLA/SECO/IR/2021/0015/A. CSIR: Stellenbosch.

Contents

List of Figures

List of Tables

Boxes

Abbreviations and Acronyms

BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CR	Critically Endangered
CSIR	Council for Scientific and Industrial Research
DCP	Dynamic Cone Penetrometer
DEA	Department of Environmental Affairs (now Department of Forestry, Fisheries and the Environment)
DEA&DP	Western Cape Department of Environmental Affairs and Development Planning
DEFF	Department of Environment, Forestry and Fisheries (now Department of Forestry, Fisheries and the Environment)
DENC	Northern Cape Department of Environment and Nature Conservation
DFFE	Department of Forestry, Fisheries and the Environment, the title used from 01 April 2021 (previously Department of Environmental Affairs; and thereafter Department of Environment, Forestry and Fisheries)
DWDM	Dense Wavelength Division Multiplexing
EAP	Environmental Assessment Practitioner
EAPASA	Environmental Assessment Practitioners Association of South Africa
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMS	Environmental Management Services
HDD	Horizontal Directional Drilling
HWC	Heritage Western Cape
kW/h	Kilowatt per hour
LLD	Low Level Design
NCNCA	Northern Cape Nature Conservation Act (No. 9 of 2009)
NEM:BA	National Environmental Management: Biodiversity Act (No. 10 of 2004)
NEM:PAA	National Environmental Management: Protcted Areas Act (No. 57 of 2003)
NEMA	National Environmental Management Act (No. 107 of 1998)
NewPosa	New Plants of Southern Africa
O&M	Operations and Maintenance
SAHRA	South African Heritage Resources Agency
SANReN	South African National Research Network
SARAO	South African Radio Astronomy Observatory
SKA	Square Kilometre Array
TLB	Tractor Loader Backhoe
ToPS	Threatened or Protected Species
WCNECO	Western Cape Nature and Environmental Conservation Ordinance (No. 19 of 1974), as amended

CHAPTER 1 INTRODUCTION

1.1 Project overview

The Square Kilometre Array (SKA) will be the largest radio telescope ever built and will produce science that changes our understanding of the universe[1]. The telescope will be constructed in Australia and in the Northern Cape province of South Africa.

A high-speed fibre optic internet connection is required between the SKA core site in the Northern Cape and a facility in Cape Town where the data is processed. Fibre optic infrastructure already exists between the SKA core site and Carnarvon, and between Beaufort West and the existing data processing facility in Cape Town. To complete the SKA-Cape Town connection, new fibre optic cabling needs to be installed between Beaufort West and Carnarvon. The proposed route for the new fibre optic cable follows the R381 and R63 roads for a length of approximately 183 km in the Karoo Biome, from Beaufort West, via Loxton, to Carnarvon, and spans the Western Cape and Northern Cape Provinces (Figure 1).

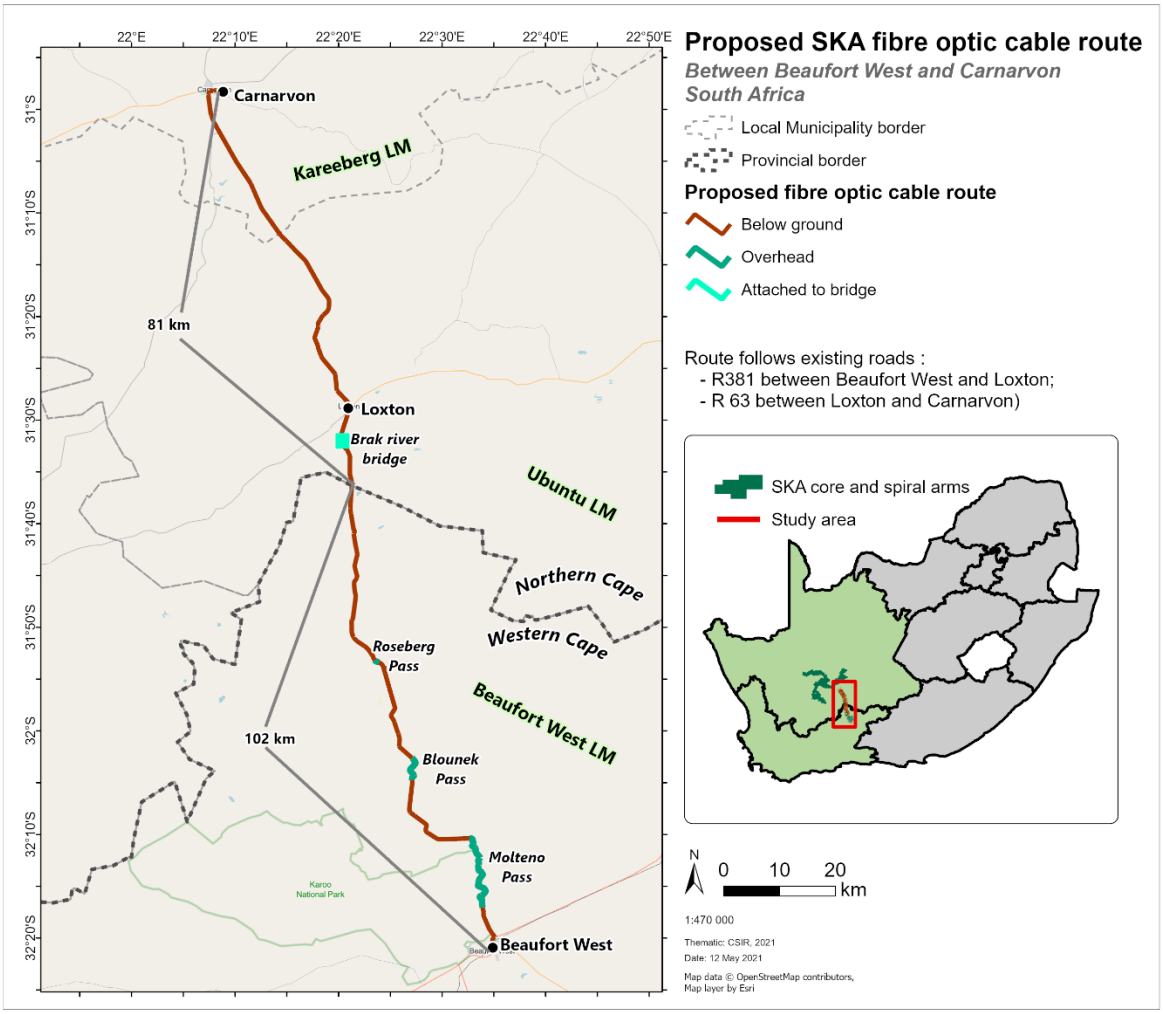


Figure 1: The proposed SKA fibre optic cable route starts in Beaufort West, follows the existing R 381 and R 63 roads via Loxton and terminates in Carnarvon.

[1] https://www.sarao.ac.za/

The South African National Research Network (SANReN)[2] ("the Applicant"), managed and implemented by the Council for Scientific and Industrial Research (CSIR), has been tasked with completing the fibre optic data connection between the SKA radio-telescope and the data processing facility in Cape Town by installing a fibre optic cable between the existing internet Point of Presence (PoP) in Carnarvon and Beaufort West (hereafter referred to as "the Fibre Optic Project").

1.2 EMPr overview

This document constitutes the Environmental Management Programme (EMPr) for the proposed Fibre Optic Project as required by the 2014 National Environmental Management Act (No. 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations (as amended, 2017) and is submitted to the Competent Authority, the National Department of Forestry, Fisheries and the Environment (DFFE)[3], as part of the Application for Environmental Authorisation (EA) for the proposed Fibre Optic Project. Furthermore, the EMPr satisfies the requirements of Section 24N of the NEMA (Table 1) and Appendix 4 of the 2014 NEMA EIA Regulations (as amended, 2017) (Table 2).

Table 1: Summary of where the requirements of Section 24N of the NEMA are met in this Environmental Management Programme.

Requirements of Section 24N of NEMA	**EMPr reference**
2) The environmental management programme must contain- a) information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts or objectives in respect of: (i) planning and design; (ii) pre-construction and construction activities; (iii) the operation or undertaking of the activity in question; (iv) the rehabilitation of the environment; and (v) closure, if applicable;	CHAPTER 4
b) details of- (i) the person who prepared the environmental management programme; and (ii) the expertise of that person to prepare an environmental management programme;	Section 1.3; Appendix 1
c) a detailed description of the aspects of the activity that are covered by the environmental management programme;	CHAPTER 2
d) information identifying the persons who will be responsible for the implementation of the measures contemplated in paragraph (a);	Section 4.3
e) information in respect of the mechanisms proposed for monitoring compliance with the environmental management programme and for reporting on the compliance;	CHAPTER 4
f) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking	CHAPTER 4

[2] https://sanren.ac.za/
[3] Previously Department of Environmental Affairs (DEA); and thereafter Department of Environment, Forestry and Fisheries (DEFF).

Requirements of Section 24N of NEMA	EMPr reference
of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and	
g) a description of the manner in which it intends to- (i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) remedy the cause of pollution or degradation and migration of pollutants; and (iii) comply with any prescribed environmental management standards or practices.	CHAPTER 4
3) The environmental management programme must, where appropriate- a) set out time periods within which the measures contemplated in the environmental management programme must be implemented; b) contain measures regulating responsibilities for any environmental damage, pollution, pumping and treatment of polluted or extraneous water or ecological degradation which may occur inside and outside the boundaries of the operations in question; and c) develop an environmental awareness plan describing the manner in which- (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment.	CHAPTER 4
8) Notwithstanding the Companies Act, 2008 (Act No. 71 of 2008), or the Close Corporations Act, 1984 (Act No. 69 of 1984), the directors of a company or members of a close corporation are jointly and severally liable for any negative impact on the environment, whether advertently or inadvertently caused by the company or close corporation which they represent, including damage, degradation or pollution.	Section 4.3

Table 2: Summary of where the requirements of Appendix 4 of the 2014 NEMA EIA Regulations (as amended, GN R326) are met in this Environmental Management Programme.

Requirements of Appendix 4 of the 2014 NEMA EIA Regulations (as amended on 7 April 2017 in GN R326)	EMPr reference
1. (1) An EMPr must comply with section 24N of the Act and include: a) details of: (i) the EAP who prepared the EMPr; and (ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	Section 1.3 Appendix 1
b) a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	CHAPTER 2
c) a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	Section 1.1 Appendix 2 Appendix 3

Requirements of Appendix 4 of the 2014 NEMA EIA Regulations (as amended on 7 April 2017 in GN R326)	**EMPr reference**
d) a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including: (i) planning and design; (ii) pre-construction activities; (iii) construction activities; (iv) rehabilitation of the environment after construction and where applicable post closure; and (v) where relevant, operation activities;	Section 2.1 CHAPTER 4
e) a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraphs (d) will be achieved, and must, where applicable, include actions to: (i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) comply with any prescribed environmental management standards or practices; (iii) comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;	CHAPTER 4
f) the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	
g) the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	
h) an indication of the persons who will be responsible for the implementation of the impact management actions;	
i) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	
j) the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	
k) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	
l) an environmental awareness plan describing the manner in which: (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	
m) any specific information that may be required by the competent authority.	None
(2) Where a government notice *gazetted* by the Minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply.	N/A

This EMPr is being made available to Interested and Affected Parties (I&APs), stakeholders and Organs of State, as part of the Basic Assessment (BA) Report (BAR), for a 30-day review period.

Comments received from stakeholders during this review period will be incorporated into this EMPr, where applicable. Following the incorporation of comments from I&APs, stakeholders and Organs of State, this EMPr is intended as a "living" document and should continue to be updated regularly, as needed.

1.3 Authors of the EMPr

In accordance with Regulation 12 (1) of the 2014 NEMA EIA Regulations (as amended, 2017), the Applicant (SANReN) appointed CSIR EMS to undertake the required BA process. CSIR EMS as the EAP has no vested interest (either business, financial, personal or other) in the proposed Fibre Optic Project proceeding, other than remuneration for the work performed. However, since CSIR is the parent organisation of SANReN (i.e. the Applicant forms part of CSIR and the EAP are both associated with the CSIR), an independent peer review EAP was appointed in accordance to Regulation 13 of the 2014 NEMA EIA Regulations (as amended, 2017).

This EMPr has been compiled by the EAP, Luanita Snyman-van der Walt, and the various specialists on the team (Table 3), and peer reviewed by Edward Perry. The details and expertise of the EAP and peer review EAP project team is included as individual curricula vitae in Appendix 1 to this EMPr.

Luanita Snyman-Van der Walt has seven years' experience as Environmental Scientist and Assessment Practitioner and is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP) (Registration Number 400128/16). Her work at the CSIR involves strategic environmental assessment and management, with a focus on Geographic Information System (GIS) analyses for environmental assessment and decision-making. She has acted as integrating author on numerous ecological specialist studies and served as project manager for several EIAs and BAs across South Africa.

Table 3: Basic Assessment and Environmental Management Programme project team.

Name	Organisation	Role
Luanita Snyman-van der Walt * SACNASP registered - Pr.Sci.Nat. 400128/16	CSIR EMS	EAP, Project Manager, Lead EMPr author.
Paul Lochner EAPASA registered - Pr. EAP 2019/745	CSIR EMS	EAP, Project Leader, quality control.
Edward Perry* EAPASA registered – Pr. EAP 2019/1210	SLR Consulting SA	Peer-review EAP
Dr. Noel van Rooyen SACNASP registered - Pr.Sci.Nat. 401430/83	Ekotrust cc	Terrestrial ecology, biodiversity and species specialist
Prof. Gretel van Rooyen	Ekotrust cc	
Dr. Brian Colloty SACNASP registered - Pr. Sci. Nat. 400268/07	EnviroSci Pty Ltd	Aquatic ecology, biodiversity and species specialist
Quinton Lawson SACAP registered - 3686	Quinton Lawson Architect (QARC)	Visual Impact Assessment specialist
Bernard Oberholzer SACLAP registered - 87018	Bernard Oberholzer Landscape Architect (BOLA)	

EAPASA: Environmental Assessment Practitioners Association of South Africa; SACNASP: South African Council for Natural and Scientific Professions; SACAP: South African Council for the Architectural Profession; SACLAP: South African Council for the Landscape Architectural Profession.
** See Appendix 1 for curricula vitae.*

CHAPTER 2 PROJECT DESCRIPTION AND CONSTRUCTION METHOD STATEMENT

The proposed fibre optic cable installation will start in Beaufort West at the Transnet building (22.576483°E, 32.350686°S, corner of 2nd Avenue and Kerk Street), via Loxton where a 3 m x 6 m container for regeneration of signal will be established, to Carnarvon where the cabling will terminate at the existing SKA internet PoP site (22.141312°E, 30.970004°S, just off Stasieweg Street). The total length of the proposed cable route is approximately 183 km.

The cabling will be installed underground, using a combination of trenching (Section 2.2.1.1), Horizontal Directional Drilling (HDD) (Section 2.2.1.3), and overhead (Section 2.2.2) where trenching is technically unfeasible. At one river crossing – the Brak river south of Loxton – the cabling will be attached to the bridge.

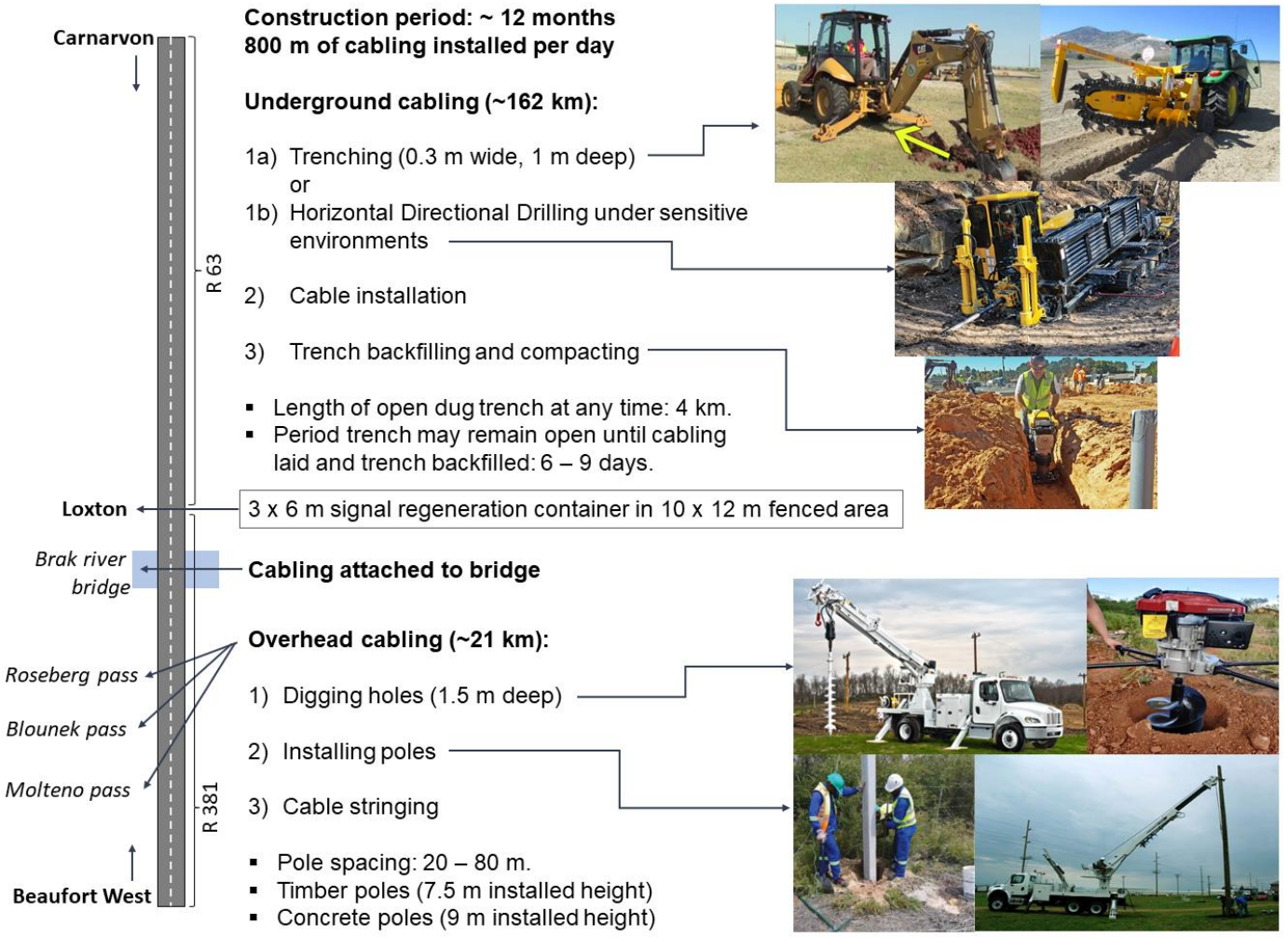


Figure 2: Schematic summary of the main activities to install the fibre optic cable between Beaufort West and Carnarvon.

2.1 Spatial extent

The spatial extent of the proposed Fibre Optic Project, for which an EA is being sought, is defined as follows:

- Underground sections (total of approximately 162 km): within a 30 m wide corridor around the centre line of the roads (i.e. the road reserve) where the cabling will be installed underground.
- Overhead sections, outside of the road reserve (total of approximately 21 km): a 30 m wide corridor around the engineering Low Level Design (LLD) route (latest technically feasible engineering design at the time of writing this report).

It is proposed that the EA (if granted) be applicable to the entirety of the corridor. Within this approved corridor the fine-scale routing of the fibre optic cable may be adjusted as required to avoid or compensate for any technical difficulties or environmental sensitivities identified in the field during construction. Any deviations to the route within the 30 m wide assessed corridor would not result in an Amendment to the EA (should it be granted). However, any amendments to the route that would result in encroachment outside of the corridor would require an amendment process.

For a list of coordinates detailing the project location and spatial extent, refer to Appendix 2.

2.2 Construction Phase

The construction phase is estimated to take approximately 12 months, with 800 m of cabling being installed per day. The majority of the activities related to the proposed Fibre Optic Project will take place in the construction phase. Two construction crews will work on installing the cable simultaneously: 1) starting in Beaufort West working northwards; and 2) starting in Carnarvon and working southwards.

2.2.1 Underground cabling

The underground fibre optic cabling will be installed at least 1 m from the fence of adjacent private land within the road reserves of the following roads:

Beaufort West:	2nd Ave. → Park Ave. → Kerk Str. →New Str. → Donkin Str. (N1 / N12) →
Beaufort West to Loxton:	R381 →
Loxton:	Fraserburg Str. → Auret Str. / R381 →
Loxton to Carnarvon:	R63 →
Carnarvon:	Biblioteek Str. → Zahn Str. → Van Riebeeck Str. → Stasieweg Str.

2.2.1.1 Trenching

- Trenches will be dug 1 m deep and 200 mm – 300 mm wide.
- A combination of two types of machinery will be used to dig trenches (Figure 3):
  - **Tractor Loader Backhoe (TLB)** - used for more difficult terrain; and
  - **Chain Trencher**.

Figure 3: Example of machinery used to dig trenches -Tractor Loader Backhoe (TLB) (left) and Chain Trencher (right).

2.2.1.2 Trench backfilling and compacting

- After the trench is dug, it will be prepared by adding soft soil where sharp rocks may damage the fibre duct.
- The fibre duct with cabling is then laid in the trench.
- The trench is backfilled first with approximately 400 mm of soft soil over the ducting;
- A compacting machine (Figure 4) is used to compact the first 400 mm of the backfill;
- The remainder of the trench is then backfilled to a level slightly above ground surface and then compacted to the same level and density as the surrounding soil.
- Soil density / compaction is tested at intervals using a Dynamic Cone Penetrometer (DCP).
    - A penetration rate of 25 – 50 mm / blow will be compared with adjacent soil (values of 10 mm / blow on soil and 25 mm / blow on the backfilled trench section is sufficient).
- A maximum of 4 km of trench will be dug and be open until the cabling is laid.
- Once the trench is dug, the cabling will be laid within 5 – 7 days.
- Once the cabling is laid, the trench will be backfilled within 1 – 2 days.
- Where the cabling needs to be installed across adjoining roads and property entrances, the trench will be dug and backfilled on the same day.

Figure 4: Example of trench backfilling and compaction.

2.2.1.3 Horizontal Directional Drilling (HDD)

- Where the cabling needs to traverse sensitive environments, such as rivers, HDD techniques will be employed.
- Drilling will start 32 m away from the bank of the river, and will continue 2 m below the river bottom.
- The direction of the drill bit is guided by hydraulic fluid or wire line magnetics:
    - A transmitter or steering tool located near the drill head sends a signal to the location engineer giving the exact coordinates of the drill stem.
    - Readings are constantly taken which check the depth, alignment and percent slope of the drill head.
- The drill fluids / muds are not hazardous and do not pose a significant risk to the environment.

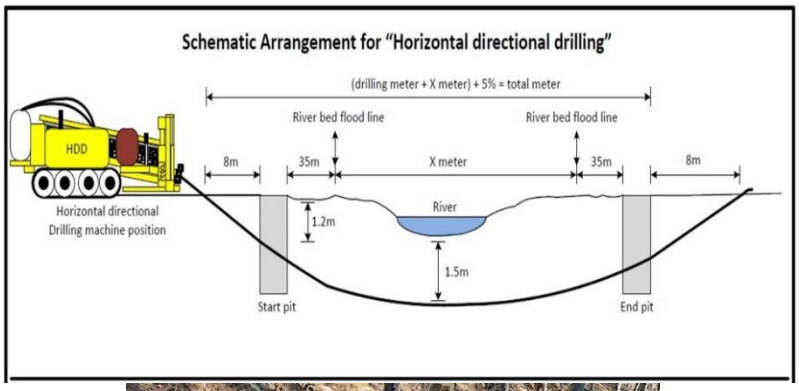


Figure 5: Schematic representation of a HDD operation (top) and example HDD machinery (bottom).

2.2.1.4 Manholes

Manholes (Figure 6) are required to access the cabling for maintenance, and are installed on all underground routes and spaced approximately 970 m apart or as the terrain dictates. Manholes in urban / town areas are all surface manholes, whilst in rural areas surface manholes will be installed approximately 3.9 km apart to facilitate maintenance and repair activities.

Figure 6: Example of a surface manhole to allow access to the underground fibre optic cable during operations and maintenance.

2.2.2 Overhead cabling

Overhead cable installation techniques will be used to traverse difficult terrain along the R381 at the sections indicated in Table 4 below.

Table 4: Location and property details of the proposed overhead sections of the Fibre Optic Project.

Section	Distance (km)	Geographic coordinates (degrees minutes second)	Properties / farm portions
Molteno Pass	15.14	32°17'03.0"S 22°33'55.1"E to 32°10'22.0"S 22°32'41.1"E	• Erf 3545 of the Beaufort West region [C00900010000354500000] (Karoo National Park); • Erf 1707 of the Beaufort West Region [C00900010000170700000] (Karoo National Park); • Portion 9 of the Farm Alwins Gate 186 [C00900000000018600009] (Karoo National Park); • Portion 1 of the farm Matjes Valie 103 [C00900000000010300001] (private property); and • Road reserve of the R381, as far as possible.
Blounek Pass	4.73	32°04'43.9"S 22°27'06.5"E to 32°02'37.1"S 22°27'06.1"E	• Remainder of the Farm Waterval 97 [C00900000000009700000] (private property). • Remainder of the Farm Middle Kraal 98 [C00900000000009800000] (private property); and • Road reserve of the R381, as far as possible.
Rosenberg Pass	0.75	31°53'24.4"S 22°23'54.2"E to 31°53'10.0"S 22°23'32.3"E	• Road reserve of the R381.

At these sections (Table 4) the cabling may be installed outside of the road reserve, following the shortest, most accessible, and technically feasible route. Poles will be spaced between 20 m and 80 m apart depending on the terrain.

Two types of poles will be used (Figure 7):

- Timber poles:
    - Total length of 9 m, buried 1.5 m deep, resulting in a total aboveground height of ~ 7.5 m;
    - The majority of the poles will consist of timber poles.

- Concrete poles:
    - Hollow concrete poles:
        - Total length of 11 m, buried 2 m deep, resulting in a total aboveground height of ~ 9 m;
        - Installed at end-points where fibre installation changes from underground to overhead and vice versa to let the cable run inside the pole for protection purposes.
    - Solid concrete poles:
        - Total length of 11 m, buried 2 m deep, resulting in a total aboveground height of ~ 9 m;
        - Concrete poles are generally preferred due to higher resistance to fire damage and theft. Also installed where the cabling needs to cross to the opposite side of the road.

Figure 7: Examples of fibre optic cables installed on timber (left) and concrete (right) poles.

A combination of two techniques are used to dig holes (Figure 8):

- Drill mounted on the back of a truck; and
- Hand-held drill (used in areas inaccessible to the abovementioned truck).

Dug holes may remain open for a maximum of 3 days before the poles are planted.

Figure 8: Holes for installing overhead cabling poles will be dug by truck-mounted (left) or hand-held (right) drills.

Poles are planted using a truck (Figure 9). Alternatively, where poles need to be planted in areas inaccessible by the pole-planting truck, manual labour will be used to plant the poles.

Figure 9: Example of a truck used to plant timber (top) and concrete (bottom) poles.

Once the poles are planted the soil around the pole will be compacted. A dry cement mixture may also be used to secure the pole in place.

2.2.3 Repeater station

A repeater station – a system used to regenerate and extend the data transfer reach of fibre optic cable, and correct any signal distortion – will be located in the town of Loxton. The repeater station consists of a 3 x 6 m container that hosts the repeater equipment, enclosed in a 10 x 12 m fenced area (Figure 10).

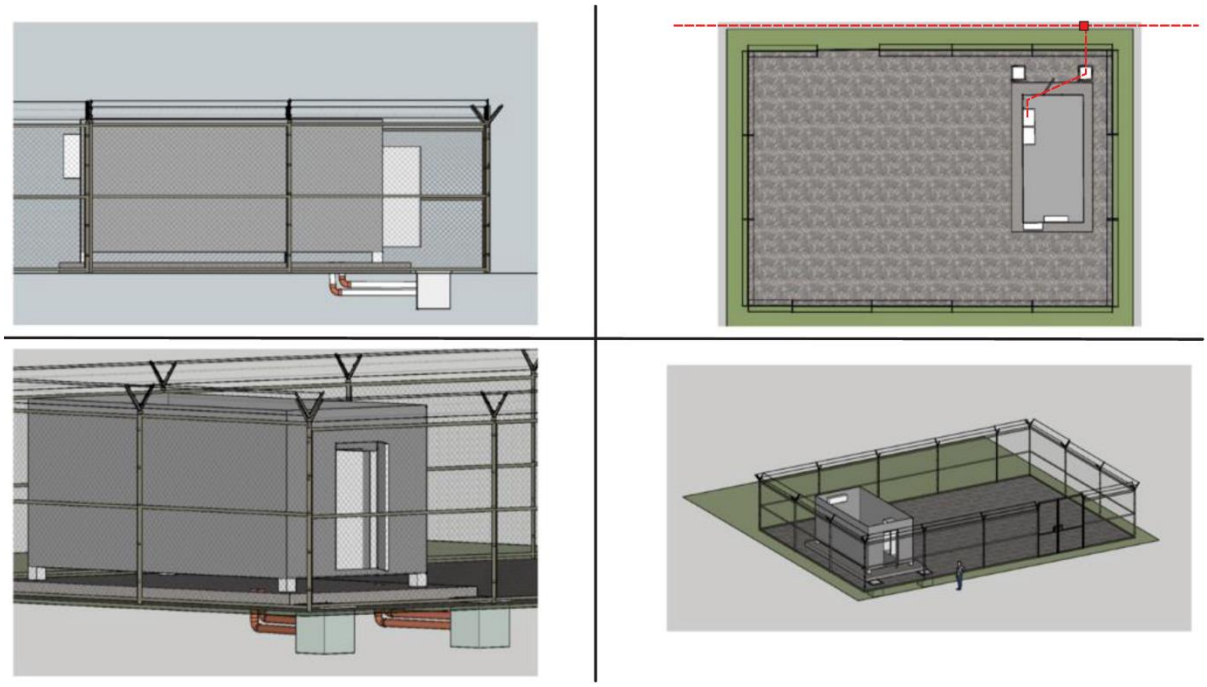


Figure 10: Typical layout of a repeater station used to regenerate the data signal, extend the data transfer reach of the fibre optic cable and correct any data signal distortion.

2.2.4 Laydown areas and construction camps

Two (02) site basecamps, on the outskirts of Beaufort West and Carnarvon, are proposed for storing vehicles and equipment. An air-conditioned container facility to hold meetings and with ablutions will be established. The basecamps will have a footprint of approximately 1 000 m^2 and will be fenced. The exact location of the basecamps along the proposed fibre optic route will be determined at the start of the construction phase. Basecamps may be placed within the 30 m wide corridor and avoid sensitive environments identified in this BA, or will be positioned such that it does not trigger any Listed Activities that require an EA.

Additionally, four (04) temporary laydown areas / material drop-off points are proposed along the route. The exact location of the laydown areas / drop-off points will be determined once at the start of the construction phase, have a footprint of approximately 150 m^2 and will be fenced. These areas may be spaced approximately 40 km apart along the proposed fibre optic route. Laydown areas may be placed within the 30 m wide corridor and avoid sensitive environments identified in this BA, or will be positioned such that it does not trigger any Listed Activities that require an EA.

No temporary accommodation is required. It is envisaged that 90 % of workers will be from the local population, and will be transported back to their homes in Beaufort West / Loxton / Carnarvon at the end of each day. The remaining 10 % of workers who do not reside in Beaufort West / Loxton / Carnarvon will be housed at guest houses within these towns as required.

2.2.5 Traffic

An estimated twenty-two (22) vehicles will be operating at any given time during the construction phase, each travelling a maximum of 205 – 230 km per day (especially towards the completion of construction at the middle section of the route) (Table 5).

Table 5: Estimated number of vehicles and daily travel distances during the construction phase.

Vehicle type	Distance per day to-and-from site (km)	Distance per day on site during construction (km)	Total distance per vehicle per day (km)	Number of vehicles
Eight ton truck	180	25	205	10
Bakkie	180	50	230	10
Car	180	50	230	2
Total	**540**	**125**	**665**	**22**

2.2.6 Services: waste, water, and fuel

All waste is classified as General waste; no hazardous waste will be generated. This includes that no maintenance of vehicles or machinery, e.g. resulting in used oil, will occur on site. In the event of a fuel / oil spill, used spill containment and clean-up kits (hazardous waste) will be disposed of appropriately.

The main waste stream from the proposed Fibre Optic Cable project is limited to the timber cable drums / reels on which the cabling is delivered to site and other recyclable packaging during construction. Any waste that is not accepted by local recycling facilities (Beaufort West), will be returned to the cabling supplier for reuse / proper disposal.

Where HDD will be used, the main waste that will be generated includes drill cuttings and excess drilling muds, which are largely inert and not harmful / hazardous. These will be removed from site and disposed of at a suitable landfill facility, with proof of disposal obtained and retained on file.

Excavated material will be reused on site as far as possible to backfill trenches. Excess spoil, if any, will be removed from site and disposed of at a suitable landfill facility, with proof of disposal obtained and retained on file.

Sewage from on-site portable sanitation facilities for use by the construction crews, will be managed and removed by a reputable sanitary services provider.

No water will be used for construction activities[4] due to water scarcity in the region. Backfilled trenches and soils around installed poles will be dry-compacted. Refer to Section 2.2.7 below for non-consumptive water uses associated with watercourse crossings and for which a water use General Authorisation (GA) is being applied for.

Fuel will be transported to site and kept in South African Bureau of Standards (SABS)-approved mobile 1 000 ℓ (1 m^3) fuel trailer (Figure 11) or in 25 ℓ jerry cans (no more than 16 cans (400 ℓ) at a time. No permanent fuel storage tanks will be erected. Drip trays or similar containment measures will be used to avoid contaminated soils from potential spills / leaks.

[4] In the event that excessive dust is generated, water may be sprayed onto the soil to control dust generation. However, due to prolonged drought and water scarcity in the region, this is the last resort option for dust suppression, and in which case water must be sourced from water-secure areas, with the necessary approvals in place.

Figure 11: Example of a mobile fuel trailer for fuel transport and storage.

2.2.7 Non-consumptive water uses (NWA Section 21(c) and (i) water uses)

The National Water Act (NWA) Act No. 36 1998 (South Africa, 1998b) defines non-consumptive water uses, which forms part of the construction phase of the proposed Fibre Optic Project. These include:

- Impeding the flow in a watercourse (NWA Section 21(c)); and
- Altering the bed, banks, course or characteristics of a watercourse (NWA Section 21(i)).

The dug trenches, in which the fibre optic cabling will be installed underground and backfilled, are temporary impediments and alteration to the watercourses that need to be traversed along the proposed fibre optic route. In total, fifty-two (52) watercourse crossings (Figure 12) have been identified based on watercourse delineation by the aquatic specialist. The watercourses are predominantly dry, ephemeral and / or alluvial systems.

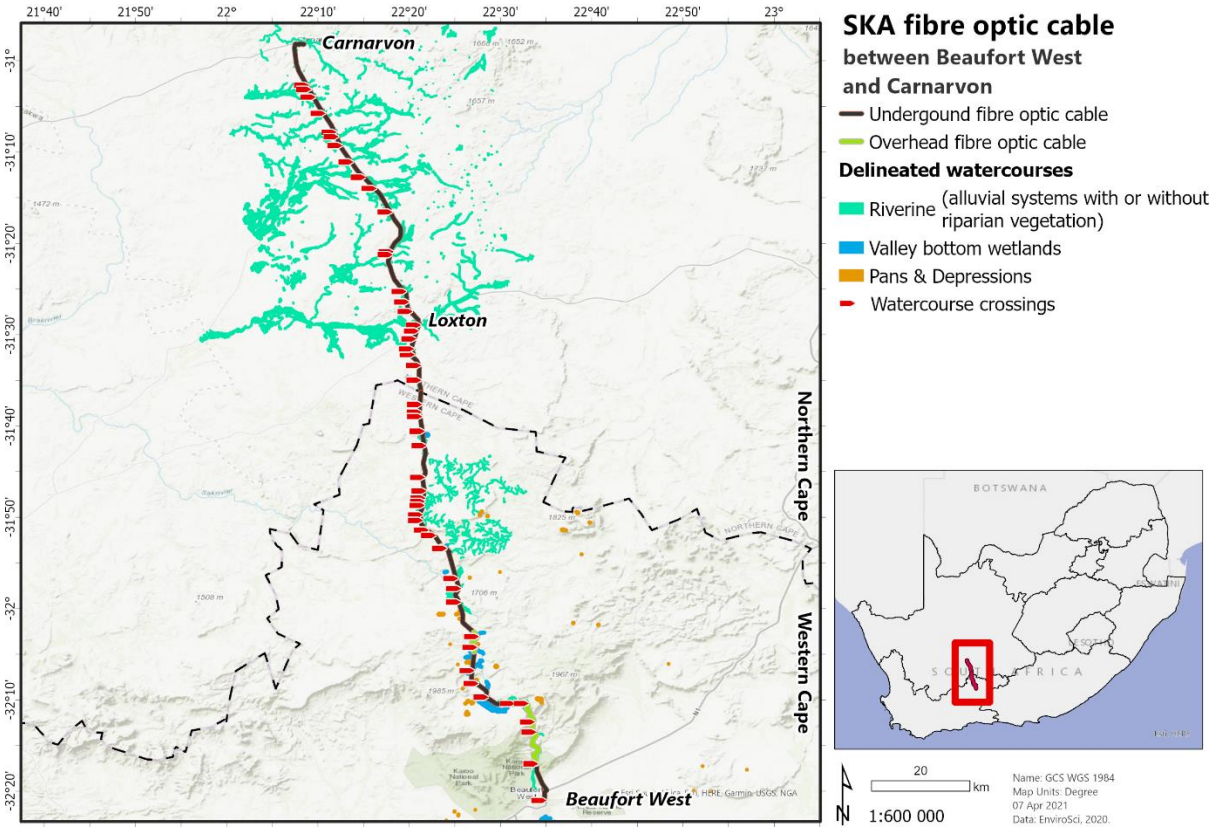


Figure 12: The proposed fibre optic cable will traverse watercourses on fifty-two instances, for which water use General Authorisation in terms of the National Water Act has been obtained.

2.2.8 Employment

It is envisaged that four (04) main contractor teams will be employed, creating approximately 180 construction phase job opportunities. It is estimated that 90 % of workers will be sourced from the local population of Beaufort West / Loxton / Carnarvon and surrounds. The two construction crews, starting at Beaufort West and Carnarvon, will consist of approximately 100 and 80 workers respectively.

2.3 Operations and Maintenance Phase

Activities during the operations and maintenance phase are minimal and limited to specialist technicians periodically driving the length of the fibre optic cable to check for and repair any fibre breaks.

In the event that the underground cabling breaks or is faulty, the location of the fault can be determined accurately. If there are no surface manholes within the vicinity of the break, the closest buried manhole will be excavated in a targeted manner, the cabling repaired, and the excavation backfilled.

If on-site portable sanitation facilities are required during maintenance / repairs activities, the resulting sewage will be managed and removed by a reputable sanitary services provider.

Operations and maintenance of the fibre optic cabling is a specialised service that will not create employment beyond that of the Operations and Maintenance (O&M) manager / technical specialist service provider.

2.3.1 Services: waste, water, fuel and electricity

During the operations phase, minimal waste will be generated. In the event that repairs are to be made to the cabling, waste will be general, non-hazardous, consisting mostly of recyclable packaging.

No water is required for operations and maintenance of the proposed Fibre Optic Project.

The repeater station at Loxton will require 2 kW/h of electricity during operations. Electricity will be sourced from the national grid via an existing transformer / Municipal Power Distribution cabinet. A backup generator will also form part of the regeneration station to supply electricity in the event of a power outage. Approximately 50 ℓ of diesel for the backup generator will be stored in SABS-approved containers at the repeater station.

2.4 Decommissioning Phase

The main aim of decommissioning is to return the land to its original, pre-construction condition. Should the unlikely need for decommissioning arise, underground infrastructure will be left abandoned in place and is not hazardous or harmful to the environment. Overhead fibre optic cable will be recovered. Timber and concrete poles will be removed and re-used for other developments, where possible, or disposed of appropriately. Decommissioning procedures will be undertaken in line with the EMPr and legislative requirements at the time, and the site will be rehabilitated and returned to the pre-construction state.

CHAPTER 3 SENSITIVITIES AND IMPACTS

3.1 Environmental sensitivities

Chapter 7 of the BAR (Part A) provides a description of the environmental features and sensitive areas that were identified by the specialists (Table 6). Based on the findings of the specialist studies, environmental sensitivity maps have been produced (Appendix 3). Importantly, it indicates the location of potential Riverine rabbit habitat where care must be taken during construction activities (e.g. see Section 4.5.3).

Table 6: Summary of the main sensitive environmental features within the SKA fibre optic study area.

Specialist assessment	Main environmental sensitivity
Terrestrial Ecology, Biodiversity and Species.	• Riverine rabbit (Critically Endangered (CR)) habitat; • Rocky areas and outcrops where Species of Conservation Concern (SCC) may occur.
Aquatic Ecology, Biodiversity and Species.	• Valley-bottom wetlands; • Riverine systems, with or without riparian vegetation or that formed part of an alluvial system.
Visual Impact Assessment.	• Topographic and geological features (ridges, peaks, scarps, rocky outcrops); • Scenic water features (rivers, large dams); • National Parks (Karoo National Park); • Scenic passes and poorts (along the R381 road).
Heritage, Archaeology and Palaeontology.	• None (All recorded heritage features (archaeology and palaeontology) non-graded, Not Conservation Worthy and grade IIIC).

3.2 Environmental impacts

Based on the specialist studies, the following main potential impacts, as indicated in have been identified (Table 7).

Table 7: Key potential impacts of the proposed Fibre Optic Project to ecosystems, heritage and scenic resources

Specialist assessment	Key impact
Terrestrial ecology, biodiversity and species	• Clearance of natural vegetation, and resultant loss of SCCs and faunal habitat. • Direct faunal mortalities. • Establishment and spread of alien vegetation.
Aquatic ecology, biodiversity and species	• Clearing of vegetation within delineated watercourse / wetland crossings, and riverine systems. • Creation of hard surfaces, resulting in runoff, erosion and sedimentation.
Visual, aesthetic and scenic resources	• Potential visual effect of abandoned poles and cables, if not removed after decommissioning. • Visual effect of spoil heaps from underground cable trenches in the R381 road reserve. Potential dust and noise caused by excavation works. • Visual intrusion of overhead cables in the landscape, particularly when visible on the skyline, and on the scenic Molteno Pass and other smaller passes and poorts. Visual clutter of poles where cable is routed close to the R381 road.
Heritage resources (archaeology and palaeontology)	• Damage to /destruction of significant heritage resources

Appropriate management and mitigation measures, as per the recommendations made in the specialist studies, are included within the EMPr to ensure the potential impacts are suitably addressed and managed during all phases of the development. Other potential impacts for which specialist studies were not undertaken but where mitigation or management actions may be required (e.g. socio-economic aspects relating to personnel), have also been included in the EMPr.

CHAPTER 4 EMPR

4.1 Structure and contents

This EMPr is divided into the following four phases of the project cycle:

- Design phase;
- Construction phase;
- Operations and maintenance phase; and
- Decommissioning phase.

The design and construction phases must be undertaken iteratively as needed per section of construction work and as unforeseen underground engineering difficulties arise (Figure 13).

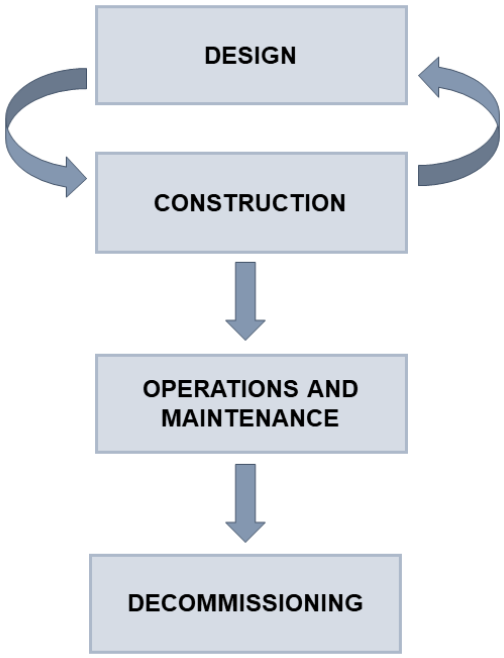


Figure 13: This EMPr addresses four phases of the proposed Fibre Optic Project cycle. The design and construction phases must be undertaken iteratively as required per section of construction work and as unforeseen underground engineering difficulties arise.

Furthermore, the following specific mitigation and management plans are included:

- Alien invasive plant management plan (Section 4.8); and
- Erosion management plan (Section 4.9).

The EMPr includes the findings and recommendations of the BA Process and specialist studies, which are included in each of the above phases. However, the EMPr is considered a "living" document and must be updated with additional information or actions during the design, construction, operational and decommissioning phases, as applicable and necessary.

The EMPr follows an approach of identifying an over-arching goal and objectives, accompanied by management actions that are aimed at achieving these objectives (the outcomes). The management actions are presented in a table format in order to show the links between the goal and associated objectives, actions, responsibilities, and monitoring requirements and targets.

The management plans for the design, construction, operational and decommissioning phases consist of the following components:

- **Activity / aspect**: The potential positive or negative impact of the development that needs to be enhanced, mitigated or eliminated.
- **Objectives**: The objectives for mitigating / managing environmental impacts associated with the activity / aspect.
- **Mitigation / Management Actions**: The actions needed to achieve the objectives of enhancing positive benefits and mitigating or eliminating negative impacts; taking into consideration factors such as responsibility, methods, frequency, resources required and prioritisation.
- **Monitoring**: The key monitoring actions required to check whether the objectives are being achieved, taking into consideration methodology, frequency and responsibility.

4.2 Environmental management goals and mitigation hierarchy

The overall goal for environmental management for the proposed Fibre Optic Project is to plan, design, construct and operate the project in a manner that implements the mitigation hierarchy (Figure 14) and:

- Complies with the applicable environmental legislation, standards and practices;
- Avoids unacceptable environmental impacts.
- Minimises the ecological footprint of the project on the local environment;
- Minimises impacts on fauna, flora and freshwater ecosystems;
- Facilitates harmonious co-existence between the project and other land uses in the area;
- Enhances the socio-economic benefits in the local area; and
- Contributes to the environmental baseline and understanding of environmental impacts of fibre optic cable development in a South African context.

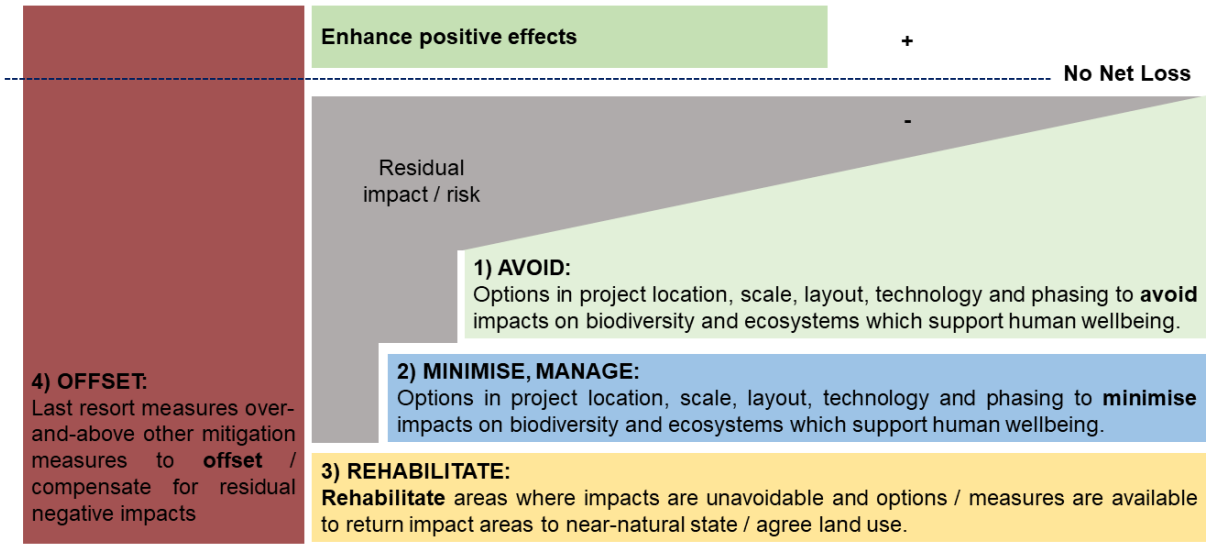


Figure 14: The mitigation hierarchy (after Rio Tinto, 2008[5])

[5] Rio Tinto. 2008. Rio Tinto and biodiversity: Achieving results on the ground. London, Melbourne. https://bobbloomfield.files.wordpress.com/2013/03/2008riotintobidoversitystrategy.pdf

4.3 Roles and responsibilities

For the purposes of the EMPr, the generic roles that need to be defined are those of the:

- Project developer;
- Environmental Control Officer (ECO);
- Appointed ecology specialist/s;
- Lead contractor; and
- O&M manager.

These roles form the core of the project implementation team. It is acknowledged that the specific titles for these functions will vary from project to project. The intent of this section is to give a generic outline of what these roles typically require. It is expected that this will be appropriately defined at a later stage as needed.

4.3.1 Project Developer

The Project Developer (i.e. the holder of the EA) is the 'owner' of the project and, as such, is responsible for ensuring that the conditions of the EA issued in terms of NEMA are fully adhered to, as well as ensuring that any other necessary permits or licenses are obtained and complied with (Box 1). It is expected that the Project Developer will appoint the ECO and the Lead Contractor, and possibly an Environmental Manager (or Health, Safety and Environmental Manager).

Box 1: Responsibilities of the Holder of Environmental Authorisation in terms of Section 24N: Environmental Management Programme of the National Environmental Management Act

(7) *The holder and any person issued with an environmental authorisation—*
- (a) *must at all times give effect to the general objectives of integrated environmental management , laid down in section 23 [of the Act];*
- (c) *must manage all environmental impacts—*
  - (i) *in accordance with his or her approved environmental management programme, where appropriate; and*
- (d) *must monitor and audit compliance with the requirements of the environmental management programme;*
- (e) *must, as far as is reasonably practicable, rehabilitate the environment affected by the prospecting or mining operations to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and*
- (f) *is responsible for any environmental damage, pollution, pumping and treatment of polluted or extraneous water or ecological degradation as a result of his or her operations to which such right, permit or environmental authorisation relates.*

(8) *Notwithstanding the Companies Act, 2008 (Act No. 71 of 2008), or the Close Corporations Act, 1984 (Act No. 69 of 1984), the directors of a company or members of a close corporation are jointly and severally liable for any negative impact on the environment, whether advertently or inadvertently caused by the* company or close corporation which they represent, including damage, degradation or pollution.

The holder of the EA is also responsible for safeguarding the BA outputs (BAR, EMPr and associated spatial data (KMZs and shapefiles)) and must provide these to the ECO, Contractor, Infrastructure O&M Manager and any other relevant project implementation team members.

4.3.2 Environmental Control Officer

An independent ECO must be appointed to monitor the compliance of the proposed project with the conditions of EA (should such authorisation be granted by the DFFE) during the construction, operations and maintenance phases, and decommissioning phases, as required. The ECO must also monitor compliance of the proposed project with environmental legislation and recommendations of the EMPr, as well as oversee the implementation of the EMPr throughout the development cycle, monitor environmental impacts, and undertake record-keeping.

The ECO will be responsible for updating the EMPr as and when necessary, and compiling a monitoring checklist based on the EMPr. The roles and responsibilities of the ECO should include the following:

- The ECO must undertake periodic environmental audits during the relevant phases of the proposed project in order to monitor and record environmental impacts and non-conformances, and to monitor site activities to ensure adherence to the specifications contained in the EMPr, using a monitoring checklist. The timeframes for environmental audits will be indicated in the EA.
- Environmental compliance/audit reports must be compiled and submitted by the ECO to the Competent Authority (i.e. DFFE and / or the relevant Provincial departments[6]) on a regular basis (i.e. at intervals as indicated in the EA).
- The ECO must maintain a diary of site visits and audits, a non-conformance register, a public complaint register, and a copy of previous environmental audits undertaken. The diary must also include a copy of the EA and relevant permits for reference purposes.
- The ECO should liaise with the appointed ecological specialist/s (see Section 4.3.3) and maintain a record of micro-siting and other recommendations provided by the ecological specialists for implementation during construction.
- Prior to the commencement of construction, the ECO must meet on site with the Contractor to confirm the construction procedure and designated construction areas and work activity zones.
- Reporting of any non-conformances within 48 hours of identification of such non-conformance to the relevant agents.
- Conducting an environmental inspection on completion of the construction period and 'signing off' the construction process with the Contractor.
- Ensure that records are kept of all monitoring activities and results.
- Conducting an environmental inspection on completion of decommissioning and 'signing off' the site rehabilitation process.

The Lead Contractor and sub-contractors may have their own Environmental Officers, or designate Environmental Officer functions to certain personnel.

4.3.3 Appointed ecological specialist/s

Independent and suitably qualified terrestrial and aquatic ecology specialist/s must be appointed to advise on micro-siting of the cabling in identified sensitive areas within the approved SKA Fibre Optic Project corridor (see Section 2.1) during the construction phase. The ecological specialist/s

[6] Western Cape Department of Environmental Affairs and Development Planning (DEA&DP); Northern Cape Department of Environment and Nature Conservation (DENC).

may provide this guidance in a once-off or phased manner, on-site, before construction on relevant cabling sections commences, in combination with remote advice as the need arises.

4.3.4 Lead contractor

The Lead contractor will be responsible for the following:

- Ensure that all appointed contractors and sub-contractors are aware of the EMPr and their respective responsibilities;
- Prior to the commencement of construction, the Lead Contractor must meet on site with the ECO in order to confirm the construction procedure and designated construction areas and work activity zones;
- Ensure that each sub-contractor employs an Environmental Officer (or employs a designated suitably qualified individual to fulfil the role of an Environmental Officer) to monitor and report on the daily activities on-site during the construction period;
- Implementation of the overall construction programme, project delivery and quality control for the construction for the Fibre Optic Project;
- Overseeing compliance with the Health, Safety and Environmental Responsibilities specific to the project management related to project construction;
- Promoting total job safety and environmental awareness by employees, contractors and sub-contractors and stress to all employees and contractors and sub-contractors the importance that the project proponent attaches to safety and the environment;
- Ensuring that safe, environmentally acceptable working methods and practices are implemented and that sufficient plant and equipment is made available properly operated and maintained, to facilitate proper access and enable any operational to be carried out safely; and
- Ensuring that all appointed contractors and sub-contractors repair, at their own cost, any environmental damage as a result of a contravention of the specifications contained in the EMPr, to the satisfaction of the Project Developer's ECO.

During the operations and maintenance phase, the O&M Manager (see Section 4.3.5) may also appoint a Contractor to assist with significant repairs and maintenance activities.

A contractor may also be appointed by the O&M Manager / holder of EA for decommissioning activities (removal over overhead infrastructure).

4.3.5 Infrastructure Operations and Maintenance Manager

The Infrastructure O&M Manager will be responsible for the following:

- Operation of the fibre optic cable;
- Required maintenance and repair of the infrastructure (assisted by a Contractor, where required) and
- Overall compliance with the EMPr and EA during the O&M phase.

4.4 Planning and design phase[7]

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
4.4.1 Human resources					
1. Personnel	Effective implementation and monitoring of the EMPr.	(a) Appoint an independent and suitably qualified Environmental Control Officer (ECO).	▪ Letter of employment kept on file.	▪ Planning and design phase. ▪ Before construction commences.	▪ Project Developer.
		(b) Appoint suitably qualified wildlife management security / field rangers to protect staff from animals (specifically lions) whilst working in the Karoo National Park.	▪ Letter of appointment kept on file and verified by the ECO.	▪ Planning and design phase. ▪ Before construction commences in the Karoo National Park section.	▪ Project Developer and ECO.
		(c) Appoint an independent and suitable qualified terrestrial ecologist to advise on micro-siting of underground cable routing and overhead pole placement in identified sensitive areas within the approved SKA Fibre Optic Project corridor (see Section 2.1) during the construction phase. The ecological specialist/s may provide this guidance in a once-off or phased manner, on-site, before construction on relevant cabling sections commences, in combination with remote advice as the need arises.	▪ Letter of appointment kept on file and verified by the ECO.	▪ Planning and design phase. ▪ Before construction commences.	▪ Project Developer and ECO.
		(d) Appoint an independent and suitable qualified aquatic ecologist to advise on micro-siting of underground cable routing and overhead pole placement in identified sensitive areas within the approved SKA Fibre Optic Project corridor (see Section 2.1) during the construction phase. The ecological specialist/s may provide this guidance in a once-off or phased manner, on-site, before construction on relevant cabling sections commences, in combination with remote advice as the	▪ Letter of appointment kept on file and verified by the ECO.	▪ Planning and design phase. ▪ Before construction commences.	▪ Project Developer and ECO.

[7] Note: The design and construction phases must be undertaken iteratively as required per section of construction work and as unforeseen underground engineering difficulties arise.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
		need arises. (note: where a single specialist is suitably qualified in both terrestrial and aquatic ecology, only one specialist may be appointed)			
2. Employment	Fair and transparent local employment opportunities.	(a) Maximise potential positive socio-economic impacts through fair tendering, procurement and employment policies. (b) Use local labour and maximise opportunities for the training of unskilled and skilled workers. (c) Use local sub-contractors where possible.	▪ Tender and procurement processes followed. ▪ Number of local opportunities created. ▪ Number of local sub-contractors used.	▪ Planning and design phase. ▪ Before construction commences (and during construction as required).	▪ Project Developer. ▪ Contractor.
4.4.2 Authorisations, approvals and permits					
3. Environmental Authorisation (EA)	Legislative compliance.	(a) Obtain valid EA. (b) All conditions in the EA must be included in the ECO's checklist.	▪ Copies of the issued EA and EMPr must be kept on file and verified by the ECO.	▪ Before construction commences.	▪ Project Developer and ECO.
4. SANParks approval	Legislative compliance.	(a) SANParks approval to construct in the Karoo National Park, must be in place. (b) This is required in terms of Section 50(5) of the National Environmental Management: Protected Areas Act (NEM:PAA). (c) Establish construction phase access options and schedule with Karoo National Park Management.	▪ Copy of the SANParks approval (Appendix 4) must be kept on file and verified by the ECO. ▪ Construction phase access options and schedule agreed with Karoo National Park Management.	▪ Before construction commences in the Karoo National Park (Molteno Pass) section.	▪ Project Developer and ECO.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
5. Protected flora removal permits	Legislative compliance.	(a) Obtain permits for the removal of provincially protected plant species (Appendix 5). (b) This is required in terms of: (i) Sections 49 to 51 of the Northern Cape Nature Conservation Act (NCNCA) (ii) Section 63 of the Western Cape Nature and Environmental Conservation Ordinance, 19 of 1974 (as amended) (WCNECO).	▪ Copies of Provincial protected flora permits must be kept on file and verified by the ECO.	▪ Before construction commences.	▪ Project Developer and ECO.
6. Water use General Authorisation	Legislative compliance.	(a) Obtain water use General Authorisation (GA). (b) This is required in terms of the National Water Act (NWA) for non-consumptive water uses, Section 21 (c): impeding or diverting the flow of water in a watercourse; and Section 21 (i): altering the bed, banks, course or characteristics of a watercourse.	▪ Copy of water use GA (Appendix 6) must be kept on file and verified by the ECO.	▪ Before construction commences.	▪ Project Developer and ECO.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
4.4.3 Environmental induction and awareness					
7. General conduct by construction team	Effective housekeeping. Good environmental conduct.	(a) All personnel must be made aware of the environmental requirements and restrictions outlined in this EMPr, including any additional aspects that may arise during the design, construction and operations and maintenance phases. (b) Construction crew, in particular the drivers and operators of heavy machinery, should undergo environmental training to increase their awareness of environmental concerns, including, but not limited to: (i) Reduce driving speeds and adhere to speed limits; (ii) Remain within site boundaries at all time; (iii) Protect animals – do not touch, capture or attempt to remove animals. Inform the ECO if animals are encountered; (iv) Do not backfill the trench or holes if an animal is stuck inside. Inform the ECO if animals are encountered; (v) Protect plants – do not cut down trees or plants, other than within the approved trenching area; and (vi) Do not litter. (c) Use provided portable sanitation facilities, and report any full / leaking toilets.	▪ Environmental induction / awareness training carried out. Attendance registers must be kept on file.	▪ Before construction commences. ▪ During construction as the need arises and / or new personnel are onboarded.	▪ ECO. ▪ Contractor.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
4.4.4 Infrastructure placement and cable routing					
8. Micro-siting	Avoid highly sensitive **terrestrial and aquatic** ecology, biodiversity and species and **heritage** features. Define and minimise disturbance footprint to **terrestrial and aquatic ecology**, biodiversity, and species. Use appropriate construction methods for more sensitive areas.	(a) The proposed fibre optic cable route may be micro-sited within the approved corridor (see Appendix 2): (i) Underground sections: a 30 m wide corridor around the centre line of the roads (i.e. the road reserve) where the cabling will be installed underground. (ii) Overhead sections, outside of the road reserve: a 30 m wide corridor around the engineering Low Level Design (LLD) (latest technically feasible engineering design at the time of writing this report). (b) Walkdowns (including search and rescue, where necessary) by terrestrial and aquatic specialists to ensure that: (i) Any of the proposed structures are placed within previously disturbed areas – i.e. within the existing road reserve / servitude (i.e. approved corridor) as far as possible; (ii) Sensitive areas are avoided; (iii) Important species / Species of Conservation Concern (SCC) are avoided; (iv) Fauna, and plant species that are not covered under the Provincial protected flora permits (see no. 5 above), are avoided; and (v) Appropriate construction methods (e.g. hand digging and Horizontal Directional Drilling (HDD)) are employed as necessary. (c) Before trenches are dug in areas that have been indicated as prime habitat for the riverine rabbit (see Appendix 3), the route should be walked on foot to ensure that no burrows are present in the path of the trench. (i) If any riverine rabbit burrows are found, the routing must be adapted (micro-sited) so as to avoid the	▪ Micro-sited routing and construction method agreed.	▪ Before construction commences on relevant sections. ▪ As the need arises due to unforeseen technical or environmental difficulties.	▪ Contractor. ▪ ECO. ▪ Appointed Ecology Specialist/s.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	**Time period / timing / frequency**	**Responsibility**
		burrows. (d) A 10 m buffer must be applied to the Anniversary Monument (Location: Lat -32.25241; Long 22.56853 on Molteno Pass). No permanent or temporary infrastructure or activities may be established within 10 m of this heritage features.			
9. Construction camps, laydown areas and stockpiles	Avoid (as far as possible) and minimise damage to **terrestrial and aquatic ecology, biodiversity and species.**	(a) Locate temporary construction camps, stockpiles and laydown areas outside of: (i) Any sensitive areas identified by ecological specialists during the BA phase, and / or identified during micro-siting (see no. 8 above); and (ii) Any delineated aquatic systems and within any existing disturbed areas as far as possible (see Appendix 7Appendix 6). (b) Target previously disturbed areas (e.g. within the road reserve) within the approved corridor.	▪ Temporary construction camps, laydown areas and stockpiles must be sited in agreed locations informed by terrestrial and aquatic ecologists. ▪ Location to be recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ Before construction commences.	▪ Contractor. ▪ ECO. ▪ Appointed Ecology Specialist/s.
	Minimise the **visual intrusion** of temporary construction camps, laydown areas and stockpiles.	(c) Locate any construction camps and material stockpiles in the least visually obtrusive positions in the landscape, away from public roads, where possible.			
10. Underground cabling	Avoid (as far as possible) and minimise damage to **terrestrial and aquatic ecology**, **biodiversity and species.**	(a) Locate trenches so as to ensure that: (i) Any of the proposed structures are placed within previously disturbed areas – i.e. existing road reserve / servitudes within the approved corridor as far as possible; (ii) Sensitive areas are avoided; and / or (iii) Appropriate construction methods (e.g. hand digging and HDD) are employed as necessary. (iv) Where the road is cut into a hillside, the trench follows the bottom of the cutting, at the edge of the	▪ Micro-sited routing and construction method, in are line with agreed recommendations (see no. 8).	▪ Before construction commences on relevant sections.	▪ Contractor. ▪ ECO. ▪ Appointed Ecology Specialist/s.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
		road, and not go over the top of the cutting.			
		(b) Construction of the trench in favoured riverine rabbit habitat (see Appendix 3) should preferably not be conducted during the breeding season (August to May).	▪ Construction planned in appropriate seasons.	▪ At construction planning stage.	▪ Project developer. ▪ Contractor. ▪ ECO.
11. Overhead cabling	Minimise the **visual** intrusion of permanent overhead infrastructure.	(a) Where technically feasible, install the fibre optic cabling underground. (b) Reduce potential visual impacts by locating poles for overhead cabling so as to: (i) Minimise criss-crossing the road as far as possible; and (ii) Follow existing disturbance corridors (e.g. existing power- and telephone lines) as far as possible.	▪ Final routing follows existing disturbance corridors as far as possible.	▪ Before construction commences on relevant sections.	▪ Contractor. ▪ ECO. ▪ In consultation with SANParks for the Molteno Pass section.
	Avoid (as far as possible) and minimise damage to **terrestrial and aquatic ecology**, biodiversity and species.	(c) Locate poles for overhead cabling so as to ensure that: (i) Sensitive areas (fine-scale / at ground-level) are avoided; (ii) Existing disturbance corridors (e.g. existing power- and telephone lines) are followed as far as possible; and / or (iii) Appropriate construction methods (e.g. hand digging and pole planting by hand) are employed as necessary. (d) Where overhead infrastructure is proposed within the Karoo National Park, the micro-sited route and construction phase access must be established in consultation with Park Management.	▪ Micro-sited routing and construction method to be agreed (see no. 8).	▪ Before construction commences on relevant sections.	▪ Contractor. ▪ ECO. ▪ Appointed ecology specialist/s. ▪ In consultation with SANParks for the Molteno Pass section.

4.5 Construction phase[8]

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
4.5.1 Environmental induction and awareness					
12. General conduct by construction crew	Effective housekeeping. Good environmental conduct.	(a) All personnel must be made aware of the environmental requirements and restrictions outlined in this EMPr, including any additional aspects that may arise during the design, construction and operations and maintenance phases. (b) Construction crews, in particular the drivers and operators of heavy machinery, should undergo environmental training to increase their awareness of environmental concerns, including, but not limited to: (i) Reduce driving speed and adhere to speed limits; (ii) Remain within site boundaries at all time; (iii) Protect animals – do not touch, capture or attempt to remove animals. Inform the ECO if animals are encountered; (iv) Do not backfill the trench or holes if an animal is stuck inside. Inform the ECO if animals are encountered; (v) Protect plants – do not cut down trees or plants, other than within the approved trenching area; and (vi) Do not litter. (vii) Use provided portable sanitation facilities, and report any full / leaking toilets.	▪ Environmental induction / awareness training to be carried out. Attendance registers must be kept on file.	▪ Before construction commences ▪ During construction as the need arises and / or new personnel are onboarded.	▪ ECO. ▪ Contractor.

[8] Note: The design and construction phases must be undertaken iteratively as required per section of construction work and as unforeseen underground engineering difficulties arise.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
4.5.2 Waste management					
13. Solid and liquid non-hazardous waste	Avoid contamination of **terrestrial and aquatic environments** by solid and liquid waste. Minimise risk of **animals being ensnared in or ingesting waste**. Minimise **visual** impacts from spoil heaps and other waste.	(a) All waste must be removed from installed / completed cabling sections: (i) Recyclable waste (e.g. cable packaging and timber drums) must be disposed of at local recycling facilities (e.g. Beaufort West), or must be returned to the cabling supplier for reuse / proper disposal. (ii) Where HDD techniques will be employed drill cuttings and excess drilling muds removed from site and disposed of at a suitable and licensed landfill facility. (iii) Excavated material must be re-used for trench backfilling. Trenches must be backfilled as soon as possible. Excess spoil, if any, must be removed from site and disposed of at a suitable and licensed landfill facility, with proof of disposal obtained and retained on file. (iv) Sewage from on-site portable sanitation facilities for use by the construction crews, must be managed and removed by a reputable sanitary services provider.	▪ Site confirmed as clear from packaging waste and other litter / general waste at the end of each day.	▪ Daily, as cabling sections are completed.	▪ Contractor. ▪ ECO.
			▪ Proof of disposal for all types of waste must be retained on file.	▪ With each waste disposal event.	▪ Contractor.
			▪ Cables laid (5 – 7 days) and trenches backfilled (1 – 2 days) as quickly as possible.	▪ Daily and as trenched sections are backfilled.	▪ Contractor. ▪ ECO.
14. Hazardous waste	Avoid contamination of **terrestrial and aquatic environments** by hazardous waste (used fuel / oil spill kits)	(a) In the event of fuel / oil spills (see Section. 4.5.4), used spill kit materials (hazardous waste) must be disposed of at a suitable and licensed facility, with proof of disposal obtained and retained on file.	▪ Proof of disposal retained on file.	▪ As required in the event of a fuel / oil spill.	▪ Contractor. ▪ ECO.
4.5.3 Infrastructure placement and cable routing					
15. Site establishment	Define and minimise disturbance footprint to **terrestrial and aquatic ecology**, biodiversity and	(a) Demarcate all infrastructure sites and delineate the routing clearly to avoid unnecessary clearance of vegetation.	▪ Areas and conditions (e.g. avoid specific construction method)	▪ At construction commencement per section.	▪ Contractor. ▪ ECO. ▪ Appointed

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
	species. Avoid identified **sensitive ecological areas** and **heritage features**.	(b) Demarcate areas, identified by the Appointed Ecological Specialist/s during pre-construction walkdowns (refer to no.8), that: (i) Need to be avoided; and (ii) Need specific and appropriate construction methods (e.g. hand digging and HDD) employed. (c) Where the road is cut into a hillside, the trench must follow the bottom of the cutting, at the edge of the road, and not go over the top of the cutting. (d) Before trenches are dug in areas that have been indicated as prime habitat for the riverine rabbit (see Appendix 3), the route should be walked on foot to ensure that no burrows are present in the path of the trench. (i) If any riverine rabbit burrows are found, the routing must be adapted (micro-sited) so as to avoid the burrows. (e) A 10 m buffer must be applied to the Anniversary Monument (Location: Lat -32.25241; Long 22.56853 on Molteno Pass). No permanent or temporary infrastructure or activities may be established within 10 m of this heritage feature.	must be clearly demarcated.		Ecological Specialist/s.
16. Underground cabling	Minimise **vegetation clearance** impacts on **SCCs** and **protected and endemic plants and animals.** Minimise vegetation clearance impacts in **delineated watercourses / wetlands**. Minimise the	(a) Vegetation clearance should be confined to the minimum footprint required for construction and unnecessary clearance should be avoided. (b) Avoid cliffs and rocky sheets, as far as possible. (c) Where the road is cut into a hillside, the trench must follow the bottom of the cutting, at the edge of the road, and not go over the top of the cutting. (d) SCC Search and Rescue should be initiated by appointed aquatic ecological specialist prior to construction.	▪ Construction activities (including trench and adjacent spoil heaps) kept to minimum demarcated areas.	▪ At construction commencement per section.	▪ Contractor. ▪ ECO. ▪ Appointed Ecological Specialist/s.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
	establishment and spread of **alien invasive plants**. Minimise **water runoff and erosion**	(e) Implement alien invasive plant management plan.	▪ See Section 4.8		
		(f) Implement erosion management plan.	▪ See Section 4.9		
	Avoid or minimise impacts that could potentially affect **animal behaviour** or result in **animal mortalities** (especially **Riverine rabbit**).	(g) Before trenches are dug in those areas that have been indicated as prime habitat for the riverine rabbit (Appendix 3), the route should be walked on foot by the Environmental Control Officer (ECO) to ensure that no riverine rabbit burrows are present in the path of the trench. (i) If any riverine rabbit burrows are found, the routing must be adapted (micro-sited) so as to avoid the burrows.	▪ Demarcated trenching area must be confirmed as clear from Riverine rabbit burrows before trenching commences. ▪ Routing adjusted to avoid burrows (where identified).	▪ Just before construction commencement per section in identified high sensitivity Riverine rabbit areas.	▪ ECO.
		(h) Inspect trenches for the presence of trapped animals to be rescued before backfilling trenches. (i) Trenches should not be left open for long periods of time, and must be backfilled within 1 – 2 days.	▪ Cables laid (5 – 7 days) and trenches backfilled (1 – 2 days) as quickly as possible. ▪ Trenches confirmed as clear (i.e. no animals trapped inside) before cable installation and backfilling.	▪ Daily and as trenched sections are backfilled.	▪ Contractor. ▪ ECO.
		(j) No construction is allowed during night-time (between sunset and sunrise).	▪ Daily work schedules ends before sunset and are strictly followed.	▪ Daily.	▪ Contractor. ▪ ECO.
	Minimise vegetation clearance in **delineated wetlands / watercourses** and **riverine (riparian / alluvial) systems**	(k) Delineated wetlands / watercourses and riverine areas must be crossed using HDD where possible (i.e. crossing distance makes HDD feasible). (l) Where HDD is not feasible, delineated wetlands / watercourses and riverine areas must be hand-trenched (i.e. no mechanical trenching) (see Appendix 7).	▪ Appropriate construction methods implemented.	▪ Just before construction commencement per section in delineated watercourse / wetland areas.	▪ Contractor. ▪ ECO.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	**Time period / timing / frequency**	**Responsibility**
	Avoid or minimise damage to or destruction of significant **heritage resources.**	(m) Excavations should be monitored for fossil remains, archaeological resources and burial sites / graves	▪ Chance Fossil Finds protocol implemented (Appendix 8).	▪ Daily.	▪ ECO.
		(n) In the event that substantial heritage resources are exposed during construction, these should be safeguarded, preferably in situ. (i) The relevant heritage authority (South African Heritage Resources Agency (SAHRA) in the Northern Cape; Heritage Western Cape (HWC) in the Western Cape) must be notified immediately so that appropriate action can be taken by a professional palaeontologist or archaeologist. ➢ Northern Cape: SAHRA Archaeology, Palaeontology and Meteorites Unit, Natasha Higgitt / Phillip Hine +27 21 462 5402). ➢ Western Cape: HWC, Colette Scheermeyer, +27 21 483 5959. (ii) For unmarked human graves / burials: ➢ Northern Cape: SAHRA Burial Grounds and Graves Unit, Mimi Seetelo, +27 12 320 8490) ➢ Western Cape: HWC, Colette Scheermeyer, +27 21 483 5959.	▪ (Further) damage to exposed heritage resources avoided. ▪ Relevant Heritage Resources Authority contacted. ▪ Location recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ As required.	▪ ECO.
17. Overhead cabling	Minimise **vegetation clearance** impacts on **SCCs** and **protected and endemic plants and animals.** Minimise vegetation clearance impacts in **delineated watercourses /**	(a) Vegetation clearance should be confined to the minimum footprint required for construction and unnecessary clearance should be avoided. (b) Avoid cliffs and rocky sheets, as far as possible.	▪ Construction activities (including trench and adjacent spoil heaps) kept to minimum demarcated areas.	▪ At construction commencement per section.	▪ Contractor. ▪ ECO. ▪ Appointed Ecological Specialist/s.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
	wetlands. Minimise **water runoff and erosion**				
	Minimise vegetation clearance in **delineated wetlands / watercourses** and **riverine (riparian / alluvial) systems**	(c) Avoid placing poles for overhead cables in delineated wetlands / watercourses and riverine areas (see Appendix 7).	▪ Appropriate construction methods implemented.	▪ Just before construction commencement per section in delineated watercourse / wetland areas and riverine systems.	
	Avoid or minimise impacts that could potentially affect **animal behaviour** or result in **animal mortalities.**	(d) Inspect dug holes for the presence of trapped animals to be rescued before planting poles. (e) Holes should not be left open for long periods of time, and must be backfilled within 3 days.	▪ Poles planted in dug holes as quickly as possible (3 days). ▪ Holes confirmed as clear (i.e. no animals trapped inside) before pole is planted.	▪ Daily and as trenched sections are backfilled.	▪ Contractor. ECO.
	Avoid or minimise damage to or destruction of significant **heritage resources.**	(f) Dug holes should be monitored for fossil remains, archaeological resources and burial sites / graves	▪ Chance Fossil Finds protocol implemented (Appendix 8).	▪ Daily.	ECO.
		(g) In the event that substantial heritage resources are exposed during construction, these should be safeguarded, preferably in situ. (iii) The relevant heritage authority (SAHRA in the Northern Cape; HWC in the Western Cape) must be notified immediately so that appropriate action can be taken by a professional palaeontologist or archaeologist. ➢ Northern Cape: SAHRA Archaeology, Palaeontology and Meteorites Unit, Natasha Higgitt / Phillip Hine +27 21 462 5402). ➢ Western Cape: HWC, Colette Scheermeyer, +27 21 483 5959.	▪ (Further) damage to exposed heritage resources avoided. ▪ Relevant Heritage Resources Authority contacted. ▪ Location recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ As required.	ECO.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
		(iv) For unmarked human graves / burials: ➢ Northern Cape: SAHRA Burial Grounds and Graves Unit, Mimi Seetelo, +27 12 320 8490) ➢ Western Cape: Western Cape: HWC, Colette Scheermeyer, +27 21 483 5959.			
4.5.4 Vehicles, equipment and machinery					
18. Vehicles, equipment and machinery	Avoid or minimise **roadkill** incidents.	(a) All vehicles must reduce driving speeds and adhere to speed limits. (b) Avoid, as far as possible, driving at night (between sunset and sunrise).	▪ All drivers made aware of speed limits (also refer to Section 4.5.1).	▪ All trips.	▪ Contractor.
	Reduce **dust** generation, which could result in: - Reduced physiological and photosynthetic functioning of **plants**; - Deterrence of **herbivores**; - **Visual** impacts.	(c) All vehicles must reduce driving speeds and adhere to speed limits to reduce dust generation.			
		(d) In the event that excessive dust is generated, water may be sprayed onto the soil to control dust generation. However, due to the prolonged drought and water scarcity in the region, this is a last resort option, and in which case water must be sourced from water-secure areas, with the necessary approvals in place.	▪ Water for dust control (if required) sourced from water-secure areas. Approvals in place.	▪ In the event that water for dust suppression is found to be necessary, before being implemented.	▪ ECO. ▪ Contractor.
	Reduce **noise** generation	(e) All vehicles must be in good, working condition, and be maintained regularly.	▪ Random visual inspections of construction vehicles for roadworthiness.	▪ Weekly.	▪ Contractor.
		(f) All operators of construction equipment must be properly trained in the use of the equipment.	▪ Operators trained in use of equipment.	▪ Before construction commences.	▪ Contractor.
		(g) All equipment must be in good, working condition, and be maintained regularly.	▪ Random visual inspections of construction equipment for working conditions.	▪ Weekly.	▪ Contractor.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	**Time period / timing / frequency**	**Responsibility**
	Avoid **fuel spills and leaks** that may contaminate soils.	(h) No vehicles or machinery may be parked, refuelled or maintained in delineated watercourses / wetlands (Appendix 7).	▪ Clear demarcation of areas where vehicles and machinery may not be parked.	▪ Daily.	▪ Contractor. ▪ ECO.
		(i) Use drip trays or similar containment measures to avoid contaminated soils when refuelling and when leaks are evident.	▪ Monitor the placement of fuel storage tanks and use of drip trays at the site camp via visual inspections. Monitor the usage of spill containment measures and record and report non-compliance.	▪ As required during refuelling. ▪ In the event of a fuel or oil spill / leak.	▪ Contractor. ▪ ECO.
		(j) Fuel / oil spill kits must be kept on site and used to contain and clean any spills / leaks. (i) Used spill kit materials (hazardous waste) must be disposed of at a suitable and licensed facility, with proof of disposal obtained and retained on file (see Section 4.5.2).	▪ Verified presence of fuel / oil spill kits on site.	▪ Daily.	▪ Contractor. ▪ ECO.
			▪ Monitor the implementation of emergency spill containment. Record and report non-compliance.	▪ As required in the event of a fuel / oil leak or spill.	▪ Contractor. ▪ ECO.

4.6 Operations and maintenance phase

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Timing	Responsibility
4.6.1 Environmental induction and awareness					
19. General conduct by maintenance crew	Effective housekeeping. Good environmental conduct.	(a) Maintenance crew must be made aware of the environmental requirements and restrictions outlined in this EMPr, including any additional aspects that may arise / did arise during the design, construction and operations and maintenance phases. (b) Maintenance crew, in particular the drivers and operators of heavy machinery, should undergo environmental training to increase their awareness of environmental concerns, including, but not limited to: (i) Reduce driving speed and adhere to speed limits; (ii) Protect animals – do not touch, capture or attempt to remove animals. Inform the ECO if animals are encountered. (iii) Protect plants – do not cut down trees or plants, other than within the approved trenching area. (iv) Do not litter.	▪ Environmental induction / awareness training carried out. Attendance registers kept on file.	▪ Before operations and maintenance commences. ▪ During operations and maintenance as the need arises and / or new personnel are onboarded.	▪ O&M Manager. ▪ Contractor.
4.6.2 Waste management					
20. Solid and liquid non-hazardous waste	Avoid contamination of **terrestrial and aquatic environments** by solid and liquid waste. Minimise risk of **animals being ensnared in or ingesting waste**. Minimise **visual** impacts from spoil heaps and other waste.	(a) When repairs to the fibre optic cable needs to be carried out, all waste must be removed from installed / completed cabling sections: (i) Recyclable waste (e.g. cable packaging and timber drums) must be disposed of at local licensed recycling facilities (e.g. Beaufort West), or must be returned to the cabling supplier for reuse / proper disposal. (ii) Where cabling needs to be excavated (i.e. repair cannot be executed via surface manholes), the excavated material must be re-used for trench backfilling. Excess spoil, if any, must be removed from site and disposed of at a suitable and licensed landfill facility, with proof of disposal obtained and	▪ Site confirmed as clear from packaging waste and other litter / general waste at the end of each day.	▪ Daily, as cabling section repairs are completed.	▪ O&M Manager. ▪ Contractor. ▪ ECO.
			▪ Proof of disposal for all types of waste retained on file.	▪ With each waste disposal event.	▪ O&M Manager. ▪ Contractor.
			▪ Cables repaired as quickly as possible. ▪ Where excavation was required to reach and repair the cable, the	▪ Daily and as trenched sections are backfilled.	▪ O&M Manager. ▪ Contractor. ▪ ECO.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Timing	Responsibility
		retained on file. (iii) Sewage from on-site portable sanitation facilities for use by the construction crews, will be managed and removed by a reputable sanitary services provider.	repair must be executed and the excavation backfilled as quickly as possible.		
21. Hazardous waste	Avoid contamination of **terrestrial and aquatic environments** by hazardous waste (used fuel / oil spill kits)	(a) In the event of fuel / oil spills (see Section. 4.6.4), used spill kit materials (hazardous waste) must be disposed of at a suitable and licensed facility, with proof of disposal obtained and retained on file.	▪ Proof of disposal retained on file.	▪ As required in the event of a fuel / oil spill.	▪ O&M Manager. ▪ Contractor. ▪ ECO.
4.6.3 Environmental monitoring					
22. Underground cabling	Minimise the establishment and spread of **alien invasive plants**. Minimise **water runoff and erosion**	(a) Implement alien invasive plant management plan.	▪ See Section 4.8		
		(b) Implement erosion management plan.	▪ See Section 4.9		
23. Overhead cabling	Monitor and minimise potential **avifauna collisions**.	(a) A monitoring programme by an avifaunal specialist should be initiated to determine the extent of bird collisions with the overhead cable.	▪ Overhead route monitored for avifauna collisions. ▪ Photographic evidence and location of bird / bat mortalities recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ One week monitoring, every six months, for two years after construction was completed (i.e. twice a year), or as advised by a suitably qualified avifauna specialist.	▪ Contractor. ▪ ECO, in consultation with a suitably qualified Avifauna Specialist. ▪ O&M Manager.
		(b) If recorded annual collision rates of Red Data species exceed the mortality threshold of the directly affected populations of those species (thresholds and species as determined by an avifaunal specialist after consultation with other avifaunal specialists and BirdLife South	▪ Bird Flight Diverters or similar deterring structures installed.	▪ As required.	▪ Appointed suitably qualified Avifauna Specialist.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Timing	Responsibility
		Africa), bird flight diverters should be attached to the sections demarcated by the avifaunal specialist Note: The monitoring programme / study does not need to be done in accordance to Appendix 6 of the NEMA EIA Regulations, but is only required to determine areas of known flight paths and collisions so that bird flappers can be installed on identified sections.			▪ ECO. ▪ O&M Manager. ▪ Contractor.
4.6.4 Equipment and vehicles					
24. Vehicles, equipment and machinery	Avoid or minimise **roadkill** incidents.	(a) All vehicles must reduce driving speeds and adhere to speed limits. (b) Avoid, as far as possible, driving at night (between sunset and sunrise).	▪ All drivers made aware of speed limits (also refer to Section 4.5.1).	▪ All trips.	▪ O&M Manager. ▪ Contractor.
	Reduce **dust** generation, which could result in: - Reduced physiological and photosynthetic functioning of **plants**; - Deterrence of **herbivores**; - **Visual** impacts.	(c) All vehicles must reduce driving speeds and adhere to speed limits to reduce dust generation.			
		(d) In the event that excessive dust is generated, water may be sprayed onto the soil to control dust generation. However, due to prolonged drought and water scarcity in the region, this is a last resort option, and in which case water must be sourced from water-secure areas, with the necessary approvals in place.	▪ Water for dust control (if required) sourced from water-secure areas. Approvals in place.	▪ In the event that water for dust suppression is found to be necessary, before being implemented.	▪ O&M Manager. ▪ ECO. ▪ Contractor.
	Reduce **noise** generation	(e) All vehicles must be in good, working condition, and be maintained regularly.	▪ Random visual inspections of construction vehicles for roadworthiness are to be undertaken.	▪ Weekly.	▪ O&M Manager. ▪ Contractor.
		(f) All operators of O&M equipment must be properly trained in the use of the equipment.	▪ Operators must be trained in use of equipment.	▪ Before construction commences.	▪ O&M Manager. ▪ Contractor.
		(g) All equipment must be in good, working condition, and be maintained regularly.	▪ Random visual inspections of construction equipment must be	▪ Weekly.	▪ O&M Manager. ▪ Contractor.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	**Timing**	**Responsibility**
			undertaken for working conditions.		
	Avoid **fuel spills and leaks** that may contaminate soils.	(h) No vehicles or machinery may be parked, refuelled or maintained in delineated watercourses / wetlands (Appendix 7).	▪ Clear demarcation of areas where vehicles and machinery may not be parked.	▪ Daily.	▪ O&M Manager. ▪ Contractor. ▪ ECO.
		(i) Use drip trays or similar containment measures to avoid contaminated soils when refuelling and when leaks are evident.	▪ Monitor the placement of fuel storage tanks and use of drip trays at the site camp via visual inspections. Monitor the usage of spill containment measures and record and report non-compliance.	▪ As required during refuelling. ▪ In the event of a fuel or oil spill / leak.	▪ O&M Manager. ▪ Contractor. ▪ ECO.
		(j) Fuel / oil spill kits must be kept on site and used to contain and clean any spills / leaks. (i) Used spill kit materials (hazardous waste) must be disposed of at a suitable and licensed facility, with proof of disposal obtained and retained on file (see Section 4.5.2).	▪ Verify the presence of fuel / oil spill kits on site.	▪ Daily.	▪ O&M Manager. ▪ Contractor. ▪ ECO.

4.7 Decommissioning Phase

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Timing	Responsibility
4.7.1 Environmental induction and awareness					
25. General conduct by decommissioning crew	Effective housekeeping. Good environmental conduct.	(a) All personnel must be made aware of the environmental requirements and restrictions outlined in this EMPr, incl. any additional aspects that may arise / did arise during the design, construction, and operations and maintenance phases. (b) Decommissioning crew, in particular the drivers and operators of heavy machinery, should undergo environmental training to increase their awareness of environmental concerns, including, but not limited to: (i) Reduce driving speed and adhere to speed limits; (ii) Remain within site boundaries at all time; (iii) Protect animals – do not touch, capture or attempt to remove animals. Inform the ECO if animals are encountered; (iv) Do not backfill the trench or holes if an animal is stuck inside. Inform the ECO if animals are encountered; (v) Protect plants – do not cut down trees or plants, other than within the approved trenching area; and (vi) Do not litter. (vii) Use provided portable sanitation facilities, and report any full / leaking toilets.	▪ Environmental induction / awareness training carried out. Attendance registers kept on file.	▪ Before decommissioning commences ▪ During decommissioning as the need arises and / or new personnel are onboarded.	▪ ECO. ▪ Contractor.
4.7.2 Waste management					
26. Solid and liquid non-hazardous waste	Avoid contamination of **terrestrial and aquatic environments** by solid and liquid waste. Minimise risk of **animals**	(a) All waste must be removed from the decommissioning footprint: (i) Recyclable waste (e.g. cable packaging and timber drums) must be disposed of at local recycling facilities (e.g. Beaufort West), or must	▪ Site confirmed as clear from packaging waste and other litter / general waste at the end of each day.	▪ Daily, as cabling sections are completed.	▪ Contractor. ▪ ECO.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	**Timing**	**Responsibility**
	being ensnared in or ingesting waste. Minimise **visual** impacts from spoil heaps and other waste.	be returned to the cabling supplier for reuse / proper disposal. (ii) If any excavation is required for decommissioning activities, excavated material must be re-used for trench backfilling. Excess spoil, if any, must be removed from site and disposed of at a suitable and licensed landfill facility, with proof of disposal obtained and retained on file. (iii) Sewage from on-site portable sanitation facilities for use by the decommissioning crews, must be managed and removed by a reputable sanitary services provider.	▪ Proof of disposal for all types of waste must be retained on file. ▪ Excavated areas (if any) must be backfilled as quickly as possible after infrastructure removal.	▪ With each waste disposal event. ▪ Daily and as excavated areas are backfilled.	▪ Contractor. ▪ Contractor. ▪ ECO.
27. Hazardous waste	Avoid contamination of **terrestrial and aquatic environments** by hazardous waste (used fuel / oil spill kits)	(a) In the event of fuel / oil spills (see Section. 4.7.4), used spill kit materials (hazardous waste) must be disposed of at a suitable and licensed facility, with proof of disposal obtained and retained on file.	▪ Proof of disposal must be retained on file.	▪ As required in the event of a fuel / oil spill.	▪ Contractor. ▪ ECO.
4.7.3 Infrastructure removal					
28. Underground cabling	Minimise **vegetation clearance** impacts on **SCCs** and **protected and endemic plants and animals.** Minimise vegetation clearance impacts in **delineated watercourses / wetlands**. Minimise the establishment and spread of **alien invasive plants**. Minimise **water runoff and erosion**	(a) Avoid unnecessary vegetation clearance for decommissioning activities.	▪ Decommissioning activities footprint kept to a minimum.	▪ At decommissioning commencement per section.	▪ Contractor. ▪ ECO.
		(b) Implement alien invasive plant management plan.	▪ See Section 4.8		
		(c) Implement erosion management plan.	▪ See Section 4.9		

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Timing	Responsibility
29. Overhead cabling	Minimise lasting **visual impacts**.	(a) Overhead cabling and poles must be removed and disposed of appropriately.	▪ Proof of disposal retained on file.	▪ At the end of the decommissioning phase.	▪ Contractor. ▪ ECO.
	Avoid or minimise impacts that could potentially affect **animal behaviour** or result in **animal mortalities.**	(b) After poles have been decommissioned and removed, the holes must be backfilled with surrounding soil.	▪ Holes confirmed as clear (i.e. no animals trapped inside) before being backfilled.	▪ Daily and as holes are backfilled.	▪ ECO. ▪ Contractor.
4.7.4 Vehicles, equipment and machinery					
30. Vehicles, equipment and machinery	Avoid or minimise **roadkill** incidents.	(a) All vehicles must reduce driving speeds and adhere to speed limits. (b) Avoid, as far as possible, driving at night (between sunset and sunrise).	▪ All drivers made aware of speed limits (also refer to Section 4.5.1).	▪ All trips.	▪ Contractor.
	Reduce **dust** generation, which could result in: - Reduced physiological and photosynthetic functioning of **plants**; - Deterrence of **herbivores**; - **Visual** impacts.	(c) All vehicles must reduce driving speeds and adhere to speed limits to reduce dust generation.			
		(d) In the event that excessive dust is generated, water may be sprayed onto the soil to control dust generation. However, due to prolonged drought and water scarcity in the region, this is a last resort option, and in which case water must be sourced from water-secure areas, with the necessary approvals in place.	▪ Water for dust control (if required) sourced from water-secure areas. Approvals in place.	▪ In the event that water for dust suppression is found to be necessary, before being implemented.	▪ ECO. ▪ Contractor.
	Reduce **noise** generation	(e) All vehicles must be in good, working condition, and be maintained regularly.	▪ Random visual inspections of construction vehicles for roadworthiness.	▪ Weekly.	▪ Contractor.
		(f) All operators of decommissioning equipment must be properly trained in the use of the equipment.	▪ Operators trained in use of equipment.	▪ Before construction commences.	▪ Contractor.
		(g) All equipment must be in good, working condition, and be maintained regularly.	▪ Random visual inspections of construction	▪ Weekly.	▪ Contractor.

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	**Timing**	**Responsibility**
			equipment for working conditions.		
	Avoid **fuel spills and leaks** that may contaminate soils.	(h) No vehicles or machinery may be parked, refuelled or maintained in delineated watercourses / wetlands (Appendix 7).	▪ Clear demarcation of areas where vehicles and machinery may not be parked.	▪ Daily.	▪ Contractor. ▪ ECO.
		(h) Use drip trays or similar containment measures to avoid contaminated soils when refuelling and when leaks are evident.	▪ Monitor the placement of fuel storage tanks and use of drip trays at the site camp via visual inspections. Monitor the usage of spill containment measures and record and report non-compliance.	▪ As required during refuelling. ▪ In the event of a fuel or oil spill / leak.	▪ Contractor. ▪ ECO.
		(i) Fuel / oil spill kits must be kept on site and used to contain and clean any spills / leaks. (i) Used spill kit materials (hazardous waste) must be disposed of at a suitable and licensed facility, with proof of disposal obtained and retained on file (see Section 4.5.2).	▪ Verified presence of fuel / oil spill kits on site.	▪ Daily.	▪ Contractor. ▪ ECO.

4.8 Alien invasive plant management plan

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
31. Alien invasive plant management	Avoid the **establishment and spread of alien invasive plant species** within the disturbance footprint Early detection of alien invasive plant species.	(a) Monitor the disturbance footprint (i.e. where soils were physically disturbed during Construction, Operations and Maintenance, and Decommissioning) for early detection of alien invasive plant establishment. (ii) Most recent NEM:BA alien species lists must be consulted at each monitoring trip	▪ Alien invasive plant monitoring checks carried out. ▪ Location recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ Construction, Operations and Maintenance, and Decommissioning project phases. ▪ Every three months during all project phases. ▪ Every three months, for a total of six months after decommissioning (i.e. four times a year during all project phases, and two instances after decommissioning).	▪ ECO.
		(b) If alien invasive plants are found to have established, a control and combat plan must be developed and implemented.	▪ Alien plant control and combat plan developed. ▪ Alien plant control and combat implemented in accordance with plan.	▪ As required.	▪ ECO. ▪ Qualified terrestrial ecologists / ecological rehabilitation specialists, as required.

Alien invasive species known to occur in the region:
*** recorded during field survey, October 2020**

Species		**NEM:BA Alien and Invasive Species List Category**
Atriplex lindleyi subsp*. inflata**	Sponge-fruit saltbush	1b
*Atriplex nummularia**	Old man saltbush	2
*Salsola kali**	Tumbleweed	1b
*Cirsium vulgare**	Spear thistle, Scotch thistle	1b
Cylindropuntia fulgida	Chain-fruit cholla (previously known as rosea cactus)	1b
Cylindropuntia imbricata	Imbricate cactus, Imbricate prickly pear	1b
*Opuntia ficus-indica**	Mission prickly pear, Sweet prickly pear	1b
Opuntia microdasys	Yellow bunny-ears, Teddy- bear cactus	1b
Tephrocactus articulatus	Pine cone cactus, Paper- spine cholla	1a
Cuscuta campestris	Common dodder	1b
*Prosopis glandulosa**	Honey mesquite	1b WC; 3 NC
Prosopis velutina	Velvet mesquite	1b WC; 3 NC
*Argemone ochroleuca**	Yellow-flowered Mexican poppy	1b
Pinus sp.*	Pine	1b, 2 or 3
*Pennisetum setaceum**	Fountain grass	1b
*Populus alba**	White poplar	2
NEM:BA: National Environmental Management Biodiversity Act; WC: Western Cape; NC: Northern Cape		

Most recent NEM:BA alien species lists must be consulted at each monitoring trip.

4.9 Erosion management plan

Activity / aspect	Mitigation / management objectives	Mitigation / management actions	Monitoring		
			Methodology / indicator	Time period / timing / frequency	Responsibility
32. Erosion management plan	Minimise **runoff, soil erosion** and **sedimentation of watercourses.**	(a) Stabilise any identified points of erosion immediately using sand bags (in the short term), gabions, reno mattress, or similar appropriate erosion control measures, as required.	▪ Erosion points stabilised. ▪ Location recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ Daily during construction, as cabling sections are completed.	▪ ECO. ▪ Contractor.
		(b) Monitor the route / disturbance footprint for early detection of soil erosion. (c) Areas around surface manholes should especially be monitored for potential erosion.	▪ Erosion management plan monitoring checks carried out. ▪ Location recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ Monthly, for the first three months of the operations and maintenance phase.	▪ ECO. ▪ O&M Manager. ▪ Qualified terrestrial ecologists / ecological rehabilitation specialists, as required.
		(d) In areas that have been identified after construction as requiring permanent erosion protection, active revegetation is encouraged – i.e. once construction has been completed, the disturbed areas are demarcated as exclusion areas from additional disturbance, thus preventing compaction / disturbance of area.	▪ Potential erosion hotspots identified and delineated. ▪ Erosion control measures implemented and monitored. ▪ Location recorded (geographic coordinates in Degrees, Minutes, Seconds / Decimal Degrees).	▪ As required, during the operations and maintenance phase. ▪ Every three months, for a total of six months after decommissioning (i.e. four times a year during all project phases, and two instances after decommissioning).	▪ ECO. ▪ O&M Manager. ▪ Contractor. ▪ Qualified terrestrial ecologists / ecological rehabilitation specialists, as required.

APPENDICES

Appendix 1 EAP curricula vitae

Luanita Snyman-van der Walt (EAP)

LUANITA SNYMAN-VAN DER WALT
MSc Environmental Science (NWU)
PgD Geographic Information Science (VU)
Pr. Sci. Nat. Environmental Science

Tel : +27 21 888 2490
Email: LvdWalt1@csir.co.za

Full Name:	Snyman-Van der Walt, Luanita
Professional Registration:	Pr.Sci.Nat Environmental Science – Reg No: 400128/16
Nationality:	South Africa
Marital Status:	Married
Current employer:	CSIR Environmental Management Services
Position in Firm:	Senior Environmental Scientist and Assessment Practitioner
Specialisation and Research interest:	Environmental Assessment and Management; Strategic Environmental Assessment; Geographic Information Systems; Geodesign; Science-society-policy interface; Systems-thinking; Terrestrial, landscape & Urban Ecology.

BIOSKETCH

Luanita holds an MSc in Environmental Science and PgD in Geographic Information Science. She is an environmental scientist and assessment practitioner registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (Reg. no. 400128/16). She has 7 years' experience in strategic environmental assessment, management, and planning, with a focus on Geographic Information System (GIS) analyses for environmental assessment and decision-making on sustainable development.

She is trained and has technical expertise in environmental science (terrestrial- and urban ecology) and geographic information science, and has managed, coordinated, designed and provided technical input to multiple Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs) and Risk and Resilience Assessments, and Environmental Screening Studies (ESSs) in South Africa, as well as Environmental and Social Impact Assessments (ESIAs) in Namibia and Cameroon.

PROJECT TRACK RECORD

Completion	Description	Role	Client
In progress	Basic Assessment for the Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon,	Environmental Assessment Practitioner; Project manager; Technical GIS analysis and mapping; Report writing	South African National Research Network
February 2021	Four Basic Assessment Processes for the Proposed Development of nine 175 MW Solar Photovoltaic Facilities, associated Infrastructure, and Electrical Grid Infrastructure (i.e. Witte Wall PV 1, Witte Wall PV 2, Grootfontein PV 1, Grootfontein PV 2, Grootfontein PV 3, Hoek Doornen PV 1, Hoek Doornen PV 2, Hoek	Project member – Technical GIS and mapping	Veroniva (PTY) Ltd

Completion	Description	Role	Client
	Doornen PV 3, and Hoek Doornen PV 4), near Touws River, Western Cape		
March 2021	Environmental and Social Impact Assessment for exploration/appraisal drilling, Matanda Block, Onshore Douala Basin, Cameroon	Project manager; Technical GIS analysis and mapping; Report review	Gaz du Cameroun
March 2021	Environmental and social screening: Feasibility study for a desalination plant and water carriage system to secure water supply to central coast, Windhoek and en-route users.	Project manager; Technical GIS analysis and mapping; Environmental Sensitivity Analysis	Namwater
May 2020	Environmental Screening Study for the Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon,	Project manager; Technical GIS analysis and mapping; Report writing	South African National Research Network
November 2019	Strategic Environmental Assessment for the Saldanha Bay Municipality (Phase 1)	Technical GIS analysis and mapping, Biodiversity and Ecology assessment	Western Cape Department of Environmental Affairs and Development Planning.
September 2019	Environmental Screening Study for a proposed 100 – 150 megalitre/day desalination plant for the City of Cape Town: Pre-feasibility study for terrestrial project components	Technical GIS and mapping, Environmental Sensitivity Analysis	City of Cape Town
October 2019	Strategic Environmental Assessment for Gas Pipeline Corridors and Electricity Grid Expansion.	Integrating Author and Editor: Biodiversity and Ecology	Department of Environmental Affairs
October 2019	Strategic Environmental Assessment Aquaculture Development in South Africa	Project member – Technical GIS and mapping	Department of Environmental Affairs
August 2019	Sustainable Development Goal Lab on "Africa's first Decision-Theatres".	Project manager	Future Earth
December 2018	Substantive amendment to the Environmental Authorisation of the Edison PV solar development.	Project manager and Environmental Assessment Practitioner.	29 Solar
October 2018	Environmental Screening Study: Stand Number 159. Diepkloof, Gauteng, Proposed for a Comprehensive Integrated Transport Customer Service Centre.	Project manager, author, Technical GIS and mapping	CSIR Built Environment
March 2018	Scoping and Environmental Impact Assessment for the proposed development of the Kap Vley Wind Energy Facility near Kleinzee in the Northern Cape	Specialist study: Aquatic Ecology	juwi Renewable Energies
March 2018	Scoping and Environmental Impact Assessment for the proposed development of a 100 MW Solar Photovoltaic Facility near Kenhardt in the Northern Cape Province	Specialist study: Visual Impact Assessment	juwi Renewable Energies
September 2017	Sustainable Development Goal Lab on "Mainstreaming resilience into climate change adaptation and disaster risk planning."	Project leader	Future Earth; Stockholm Resilience Centre; University of Tokyo (funders)
June 2017	Strategic Environmental Assessment for the development of Shale Gas in South Africa	Project officer	Department of Environmental Affairs
December 2017	Guidance for Resilience in the Anthropocene: Investments for development (GRAID) – African Cities.	Project member: Sustainability assessment guideline	Stockholm Resilience Centre (funder)
January 2017	Environmental and Social Impact Assessment for the Floating Liquid Natural Gas project near Kribi, Cameroon.	Project member – Technical GIS and mapping, ecology inputs	Golar

Completion	Description	Role	Client
October 2016	Environmental Screening Study for the Giyani Waste Oil Boiler, Limpopo: Environmental management plan for the Hi-Hanyile essential oil distillery	Project manager	CSIR Enterprise Creation for Development
September 2016	Scoping and Environmental Impact Assessment for 5 x 100 MW Solar PV facilities near Dealesville, Free State.	Project manager and Environmental Assessment Practitioner	29 Solar
June 2016	Environmental and Social Impact Assessment for the Bomono Early Field Development Project, Cameroon.	Project member - Technical GIS and mapping, ecology inputs	EurOil
May 2016	Scoping and Environmental Impact Assessment for the proposed Development of a 7 x 75 MW Solar Photovoltaic Facilities near Kenhardt, Northern Cape	Project member - Technical GIS and mapping	Mulilo
April 2016	Scoping and Environmental Impact Assessment for the Proposed Development 3 x 75 MW Solar Photovoltaic Facilities near Kenhardt, Northern Cape	Project member - Technical GIS and mapping	Scatec
April 2016	Strategic Environmental Assessment for identification of electricity grid infrastructure development corridors in South Africa	Project member - Technical GIS and mapping	Department of Environmental Affairs
February 2016	Environmental Impact Assessment for the development of 12 Solar PV projects near Dealesville, Free State.	Project member - Technical GIS and mapping, ecology inputs, stakeholder engagement	Mainstream Renewable Energy
September 2015	Environmental Screening Study for the Proposed Vaayu Energy SA Wind Energy Facility near Wesley, Eastern Cape	Project leader	Vaayu Energy
February 2015	Environmental Screening Study for Biochar- and Composting facilities in the Umzimvubu Catchment	Project member - Technical GIS and mapping & ecology inputs	Department of Environmental Affairs
March 2015	Strategic Environmental Assessment for identification of renewable energy zones for wind and solar PV projects in South Africa	Project member - Technical GIS and mapping	Department of Environmental Affairs
November 2014	Rapid environmental screening study for WASA wind monitoring masts (11-15) in the eastern cape, Kwazulu-Natal and Free State provinces, South Africa	Project member - Technical GIS and mapping	CSIR Built Environment
August 2014	Environmental Screening Study for the importation of Liquid Natural Gas into the Western Cape	Project member - Technical GIS and mapping, ecology inputs	Western Cape Government
March 2014	Environmental Screening Study for a Proposed LNG Terminal at Saldanha and associated pipeline infrastructures to Atlantis and Mossel Bay, Western Cape	Project member - Technical GIS and mapping, ecology inputs	PetroSA

PAST EMPLOYMENT RECORD

2015 – 2018 Junior Environmental Scientist and Assessment Practitioner, Council for Scientific and Industrial Research – Environmental Management Services (EMS), Implementation Unit (IU) - Stellenbosch.

2014 - 2015 Environmental Scientist and Assessment Practitioner (Intern). Council for Scientific and Industrial Research – Environmental Management Services (EMS), Implementation Unit (IU) - Stellenbosch.

QUALIFICATIONS

2017 - current MSc. Geographic Information Science Vrije Universiteit, Amsterdam, Netherlands (UNIGIS)

2019	PgD. GISc *(Cum Laude)*	Vrije Universiteit, Amsterdam, Netherlands (UNIGIS)
2018	PgC. GISc *(Cum Laude)*	Vrije Universiteit, Amsterdam, Netherlands (UNIGIS)
2013	MSc. Environmental Science *(Cum Laude)*	North West University, Potchefstroom, South Africa
2010	BSc. Hons. Environmental Science	North West University, Potchefstroom, South Africa
2009	BSc. Botany- Zoology-Tourism	North West University, Potchefstroom, South Africa

SOFTWARE SKILLS

- Esri Arcmap
- Microsoft Office (Word, Excel, Powerpoint, Visio, Project)
- Google Earth
- Vensim PLE
- QGIS

PEER REVIEWED PUBLICATIONS

Snyman-van der Walt, L., Schreiner, G., Laurie, S., Audouin, M., Lochner, P., Marivate, R., Pasquini, L., Davison, A., Hadingham, T. and Cameron, R., 2020. Pathways for Mainstreaming Resilience-Thinking into Climate Change Adaptation and Planning in the City of Cape Town. *In:* The Palgrave Handbook of Climate Resilient Societies, pp.1-22.

Schreiner, G.O., De Jager, M.J., Snyman-Van der Walt, L., Dludla, A., Lochner, P.A., Wright, J. G., Scholes, R.J., Atkinson, D., Hardcastle, P., Kotze, H., Esterhuyse, S. 2018. 'Evidence-based and participatory processes in support of shale gas policy development in South Africa'. *In:* Whitton, J., Cotton, M., Charnley-Parry, I.M. & Brasier, K. (*Eds*.) Governing Shale Gas: Development, Citizen Participation and Decision Making in the US, Canada, Australia and Europe. London, UK: Routledge.

Schreiner, G.O. & Snyman-van der Walt, L. 2018. Risk modelling of shale gas development scenarios in the central Karoo. *International Journal of Sustainable Development and Planning*, 13(2): 294-306.

Scholes, R.J., Schreiner, G.O. & Snyman-Van der Walt, L., 2017, 'Scientific assessments: Matching the process to the problem', *Bothalia,* 47(2), a2144. https://doi.org/10.4102/abc. v47i2.2144.

Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7

Burns, M., Atkinson, D., Barker, O., Davis, C., Day, L., Dunlop, A., Esterhuyse, S., Hobbs, P., McLachlan, I., Neethling, H., Rossouw, N., Todd, S., Snyman-Van der Walt, L., Van Huyssteen, E., Adams, S., de Jager, M., Mowzer, Z. and Scholes, B. 2016. Scenarios and Activities. In Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M.(*Eds*.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR.

Van Wilgen, B.W., Boshoff, N., Smit, I.P., Solano-Fernandez, S. & Van der Walt, L. 2016. A bibliometric analysis to illustrate the role of an embedded research capability in South African National Parks. *Scientometrics,* 107:185-212.

Van der Walt, L., Cilliers, S. S., Kellner, K., Du Toit, M.J., Tongway, D. 2014. To what extent does urbanisation affect fragmented grassland functioning? *Journal of Environmental Management*, 151, 517-530.

Van der Walt, L., Cilliers, S. S., Du Toit, M. J., & Kellner, K. 2014. Urban Ecosystems Conservation of fragmented grasslands as part of the urban green infrastructure : How important are species diversity, functional diversity and landscape functionality? *Urban Ecosystems*, 18(1): 87-113. DOI 10.1007/s11252–014–0393–9.

Van der Walt, L., Cilliers, S. S., Kellner, K., Tongway, D., & van Rensburg, L. 2012. Landscape functionality of plant communities in the Impala Platinum mining area, Rustenburg. *Journal of Environmental Management*, 113, 103–116. doi:10.1016/j.jenvman.2012.08.024. DOI: http://dx.doi.org/10.1016/j.jenvman.2014.11.034.

Breedt, J.A.D., Brewer, I., Coetzer, A., Van der Walt, L. & Cilliers, S.S., 2012. "Landskapsfunksionaliteit en plantdiversiteit in stedelike en landelike gefragmenteerde grasvelde in die Potchefstroom omgewing", *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 31(1), Art. #279, 1 page. http://dx.doi. org/10.4102/satnt.v31i1.279.

Van der Walt, L., Cilliers, S.S., Kellner, K. 2011. Landscape function of plant communities in the Impala Platinum mining area, Rustenburg, South Africa. *South African Journal of Botany*. 77(2): 563.

CONFERENCES

Snyman-van der Walt, L. & Laurie, S. 2017. Sustainable Development Goals Lab: Mainstreaming resilience into climate change adaptation and disaster risk planning. 7th International Conference on Sustainability Science, Stockholm Sweden. 24 – 26 August 2017. TOdB: CSIR/IU/021MH/EXP/2017/0015/A

Snyman-van der Walt, L. 2017. Conference Presentation. GIS analysis and stakeholder input to identify strategic areas for aquaculture development: National Strategic Environmental Assessment for Aquaculture Development in South Africa; International Association for Impact Assessment - South Africa Conference, Worcester, 15 – 18 August 2017. TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0010/A

Snyman-van der Walt, L. 2017. Key results of the South African shale gas scientific assessment: science for policy and responsible decision-making. Conference Presentation at 2017 2017 Southern African Systems Analysis Centre Capacity Development Programme. Stellenbosch, 12 July 2017. TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0008/A.

Snyman-van der Walt, L. 2017. National Strategic Environmental Assessment for aquaculture development in South Africa: GIS analysis for identifying optimal areas for marine and freshwater aquaculture development presentation at World Aquaculture Conference, Cape Town, 26-30 June 201, TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0006/A.

Schreiner, G.O. & Snyman-van der Walt, L. 2017. Modelling social-ecological risks of shale gas development in the Central Karoo: key results of the South African shale gas scientific assessment. CSIR document number: CSIR/IU/021MH/EXP/2017/0005/A. Oral presentation at the American Association of Petroleum Geologists workshop on exploration and development of unconventional hydrocarbons: understanding and mitigating geotechnical challenges through conventional wisdom, Cape Town, South Africa, 20 June 2017.

Schreiner, G.O, Snyman-Van der Walt, L., Fischer, D. & Cape, L. 2017. Scenarios-based risk model for shale gas scientific assessment. Conference proceedings from the International Association of Impact Assessment International Conference 2017, Montreal, Canada. 4-7 April 2017.

Van der Walt, L., Cilliers, S.S., Du Toit, M.J. & Kellner, K. 2013. Conservation of fragmented grasslands as part of the green infrastructure: how important are species diversity, functional diversity, and landscape functionality? Oral presentation at the First Congress of SURE (Society of Urban Ecology), Berlin, Germany, 25-27 July 2013.

Van der Walt, L., Cilliers, S.S., Kellner, K. & Du Toit, M.J. 2012. Landscape functionality and plant diversity in urban and rural grassland fragments in the Tlokwe Municipal area, North-West, South Africa. Poster presentation at the 38th Annual South African Association of Botanists (SAAB) Conference, Pretoria, South Africa, 15-18 January 2012.

Van der Walt, L., Cilliers, S.S. & Kellner, K. 2011. Landscape function of plant communities in the Impala Platinum mining area, Rustenburg, South Africa. Oral presentation at the 37th Annunal South African Association of Botanists (SAAB) Conference, Grahamstown, South Africa, 17-19 January 2011.

RELEVANT COURSES

2018
- GeoServices-4-Sustainability Summer School. Module: *Geo-Application Development* and Module: *Advanced Remote Sensing*, Eberswalde University for Sustainable Development, Germany.

2015
- Effective skills for dealing with challenging meetings, Conflict Dynamics (cc), CSIR Stellenbosch.
- Foundation Level Course in Science Communication and Working with the Media, CSIR, Stellenbosch.

2014
- CiLLA Project Management 1 Course, CSIR Stellenbosch.

2012 • Transboundary Protection of Biodiversity, North West University Law Faculty (South Africa) and Justig Liebig University (Germany), NWU Potchefstroom.

2010 • Control of alien invasive species, Centre for Wildlife Management, University of Pretoria.

PROFESSIONAL AFFILIATIONS/REGISTRATIONS

2015-current • South African Council for Natural Scientific Professions (SACNASP), Professional Natural Scientist (Reg. no. 400128/16).

2014-current • International Association for Impact Assessment (IAIA) South Africa (Membership Number: 3584)

2014-2015 • South African Council for Natural Scientific Professions (SACNASP), Candidate Professional Natural Scientist (Reg. no. 100276/14).

2011-2012 • South African Association of Botanists (SAAB)

HONOURS AND AWARDS

2017 • CSIR Implementation Unit Excellence Awards: Collaboration Award – Team Shale Gas Strategic Environmental Assessment.

2016 • CSIR Excellence Awards: Collaboration Award finalist – Team Shale Gas Strategic Environmental Assessment.

2015 • CSIR Implementation Unit Excellence Awards: Human Capital Development Award – Team Special Needs & Skills Development.
• Award: Best MSc Student in the Faculty of Natural Science, Potchefstroom Campus, North West University

2014 • Award: Best Masters Degree Student (S2A3 Bronze Medal) for Environmental Science and Technology, Potchefstroom Campus, North West University

2013 • Award: Mildred vd Merwe-Radloff Award for Best MSc Thesis – Botany, Potchefstroom Campus, North West University

2007-2013 • Golden Key International Academic Honours Association

LANGUAGE CAPABILITY

	Speaking	Reading	Writing
Afrikaans	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent

Edward Perry (peer review EAP)

CURRICULUM VITAE

ED PERRY

OPERATIONS MANAGER

Environmental Management Planning & Approvals, South Africa

QUALIFICATIONS

Postgrad Cert.	2016	Postgraduate Certificate in Occupational Health and Safety, University of Cape Town
Postgrad Cert.	2012	Postgraduate Certificate in Envionmental Law, Centre for Environmental Management, Potchefstrom
Postgrad Cert.	2008	Postgrduate Certificate in Environmental Assessment, Oxford Brookes University
MSc	1994	MSc Applied Hydrobiology, Cardiff University
BSc (Hons)	1990	BSc (Hons) Environmental Science, Plymouth University

EXPERTISE

- Environmental and Social Impact Assessments
- EHSS Auditing
- Environmental Compliance
- Management Systems
- Due Diligence

Ed Perry joined SLR as the Operations Manager for the Environmental Management Planning and Approvals (EMPA) team in Africa (offices in South Africa, Namibia, and Ghana) in August 2019. He has worked in environmental consultancy for over twenty years for a wide range of public and private sector clients.

Ed is a registered Environmental Auditor with the Institute for Environmental Management and Assessment and a Lead Auditor with the International Cyanide Management Institute. Prior to moving to South Africa in 2011 Ed worked in the UK on a wide range of projects including EIAs and Integrated Pollution and Prevention Permits. This included permitting the first hazardous waste landfill in the UK under the new integrated permitting mechanism and undertaking a study for the European Commission on the implementation of the Landfill Directive in 15 European countries.

Since moving to South Africa, Ed has been involved with ESIAs and environmental authorisations throughout Africa. Ed has been Project Director / Partner in Charge of EIAs for a wide range of facilities including: New Mines and Extensions to Mines, Renewable Energy Facilities; Metal Extractive Industries; and Large Water Storage Schemes;.

Ed has also undertaken a wide range of environmental audits including; due diligence audits, EMPR audits, and over 20 international cyanide code audits of mines throughout Africa. These audits include assessing ESHIAs, RAPs and associated documentation against the requirements of the IFC Performance Standards. Ed is a registered Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPASA).

PROJECTS

A sample of Ed's project experience, summarised by sector, is provided below.

Mining

Lucara Diamonds – Karowe Diamond Mine, Botswana

Ed is part of the SLR team acting as the Independent Technical Expert (ITE) on behalf od the lender to assess a project to expand the mine. Ed undertook the environmental and social assessment against the requirements of the Equator Principles and the IFC Performance Standards.

CURRICULUM VITAE — ED PERRY

Kefi Minerals – Tulu Kapi Gold Mine, Ethiopia	Ed is the Technical Reviewer for an Enviornmental and Social Due Diligence review of the ESHIA and associated documents against the requirements of the IFC Performance Standards, local legisation, and best practice. This includes liaison with the Environmental Assessment Practitioners producing the ESHIA and the Lender's representatives.
Swakop Uranium – Heap Leach Project, Namibia	Ed is the Technical Reviewer and Project Director for the heap leach project, undertaking screening and subsequent ESIA for the location of a new heap leach.
Nampower – Biomass Power Plant, Namibia	Ed is the Project Director for an ESIA as part of a financing arrangement with the European Development Bank for Nampower to construct a new Power Plant using biomass from encroaching b
West Wits Gold Mine – South Africa	Ed is the Technical Reviewer and Project Director for an ESIA for a new gold mine in South Africa including open cast and underground mining. The application for a mining right was successful with an Environmental Authorisation being issued. A Water Use Licence is currently being applied for.
Maamba Collieries Limited – Maamba Coal Mine, Zambia	Ed was the lead auditor leading the creation and implementation of an integrated management system in accordance with the requirements of the IFC performance standards, ISO 14001, ISO 9001, and OHSAS 18001.
Eramet - Senegal	Lead Auditor for a due diligence audit of a mineral sands mining operation. The operation was the subject of a possible joint venture. The environmental audit, which included 3 days on site, was to establish if what environmental risks were involved with the project, which was just about to enter the construction phase.
Continental Coal Limited – Penumbra, South Africa	Ed was the Lead Auditor undertaking review of EIA, EMP and site procedures against the requirements of the IFC Procedures.
Eurasian Natural Resources Corporation – Kakanda Mine, DRC	Ed was the Project Manager for the review of a Safety, Health, Environment and Community Management System for Kakanda Mine in the DRC.
Anglo-American – Polokwane Smelter, Polokwane	Ed was the Project Manager responsible for undertaking an external compliance audit for the Anglo-American Polokwane Smelter as stipulated in the slag stockpile permit for the Polokwane Metallurgical Complex. This included a review of the permit for the temporary stockpile of ash as part of the expansion of the Complex.
Ruighoek Mine, South Africa	Ed was the Project Manager for an ESIA associated with the expansion of this chromium mine in South Africa.
AngloGold Ashanti – Yatela, Sadiola, Siguri Gold Mines, Mali and Guinea	Ed was the Lead Auditor and Project Manager undertaking a re-certification audit against the requirements of the International Cyanide Code for three gold mines.
Freda Rebecca Gold Mine - Zimbabwe	Ed was the Lead Auditor and Project Manager for a gap audit to ascertain the status of the gold mine with regards to its ability to comply with the International Cyanide Code
Gold Fields Ghana – Tarkwa and Damang Gold Mines	Ed was the Lead Auditor and Project Manager undertaking a re-certification audit against the requirements of the International Cyanide Code for the two gold mines.

CURRICULUM VITAE ED PERRY

Goldfields, Harmony, AngloGold Ashanti – South Africa	Ed was the Lead Auditor and Project Manager undertaking a re-certification audit against the requirements of the International Cyanide Code for 5 gold mines for AngloGold Ashanti, 4 gold mines for Harmony, and a gold mine for Gold Fields.
Riversdale Capital – Zambeze Coal Mine, Zambia	Ed was the Technical Reviewer for an ESHIA for the development of the Zambeze Coal Mine on behalf of Riversdale Capital.
Confidential – proposed mine, South Africa	Ed was the Project Manager for an ESIA for a new proposed iron ore mine in South Africa. This application was withdrawn following baseline studies by specialist showing the existence of fatal flaws with regards to water use and location of the TSF.
	Industry
Dundee Precious Metals – Tsumeb Smelter, Namibia	Ed is the Project Director of an Agricultural Assessment to provide a consolidated management plan for improved agricultural land management, long term monitoring and mitigation of potential impacts.
Distell – South Africa	Ed was Project Manager for a number of projects for Distell in order to obtain various environmental authorisations for their brewing facilities including the one for the siting of a new waste water treatment works.
SPAR – South Africa	Ed was Project Manager for a number of energy projects undertaken for SPAR in South Africa including looking at Science Based Targets, Internal Carbon Pricing, and an ISO 50001 Energy Management System.
SCAW – South Africa.	Ed was the Project Manager for a range of Environmental Authorisations, including ESIAs, Air Emssions Licences, Water Use Licences and contaminated land assessments. These studies were undertaken for SCAW ata number of their smelter sites in Gauteng over a 5 year period.
Confidential – South Africa	Ed lead an EHS audit of a cable tie manufacturer using plastic extrusion as part of a due diligence project.
Pfizer – South Africa	Ed was the Project Manager and Lead Auditor for an EHS audit of the head offices of Pfizer in South Africa.
Sasol - Sasolburg	Ed was the Project Manager and Lead Auditor for International Cyanide Code recertification audit for the Sasol cyanide production facility at Sasolburg.
Sohar Aluminium - Oman	Ed was the Lead Auditor of Sohar Aluminium's environmental management system auditing the system against the requirements of ISO 14001 and benchmarking this facility against international requirements.
Confidential – KZN, South Africa	Lead Auditor for a due diligence audit of a white goods manufacturing company in Kwa-Zulu Natal.
Sasol – Secunda	Ed was the Lead Auditor for a third party audit of waste contractors operating on behalf of Sasol. The audit investigated compliance with South African environmental legislation and environmental best practice.
Confidential – South Africa, Kenya, UAE	Ed was the project manager for a due diligence audit of a packaging company's facilities in South Africa, Kenya and UAE.

CURRICULUM VITAE ED PERRY

	Infrastructure
Lesotho Highlands Development Agency - Lesotho	Ed took over as Project Manager undertaking an ESIA for the Polihali Reservoir and Western Access Road in Lesotho on behalf of the Lesotho Highlands Development Agency.
Freight Forwarders Group – Kenya and Tanzania	Ed was the Lead Auditor undertaking a re-certification audit against the requirements of the International Cyanide Code for the Freight Forwarders transportation group of companies.
Transnet Pipelines – South Africa	Ed was the Project Manager responsible for the creation and implementation of an Energy Management System for all of the pumps stations, workshops and offices for Transnet Pipelines, who pump crude oil and petroleum products from Durban to Johannesburg.
Interwaste – South Africa	Ed was the Technical Reviewer for the EIA for a new integrated waste management facility including a new landfill in South Africa against the requirments of NEMA and NEM:WA.
	Oil and Gas
Shell – South Africa	Ed was the Project Manager for various environmental authorisations in South Africa associated with the Shell GUESS program. This program related to the closure and clean up of Shell service stations.
Vopak – Richards Bay, South Africa	Ed was the Project Manager for an ESIA for a new terminal operated by Vopak at Richards Bay for the handling and storage of Liquid Petroleum Gas and Clean Petroleum Products.
Vopak – Durban, South Africa	Ed was the Project Manager for an ESIA for the expansion of the Vopak terminal at Durban Docks for the handling and storage of Liquid Petroleum Gas and Clean Petroleum Products.
Bidvest – Durban South Africa	Ed was the Project Manager for an ESIA for the expansion of the Bidvest terminal at Durban Docks for the handling and storage of Liquid Petroleum Gas and Clean Petroleum Products.
	Power
Nampower - Namibia	Ed is the Technical Reviewer for an ESIA for a biomass power plant that will use wood from encroacher bush in Namibia. This project is being funded by the European Investment Bank and it is therefore required to comply with the IFC Performance Standards.
Department for International Development – UK Government	The UK Department for International Development is providing support to medium sized renewable energy facilities (mainly hydroelectric power plants) in Uganda through the Global Energy Transfer Feed in Tariff programme (GET FiT). The project was to assess how local communities in the vicinity of these facilities could obtain power and how environmental and social safeguards for these types of facilities could be improved in the future. Ed was the lead environmental and social advisor undertaking a review of the environmental and social safeguards.
Confidential - Angola	Ed was Project Manager for a project undertaking a Strategic Environmental Assessment of locations for renewable energy facilities in Angola.
Confidential - Mozambique	Ed was the Project Manager for an ESIA to be submitted to the Mozambican authorities for the development of a unique renewable energy pilot facility.
MEMBERSHIPS	

4

SLR

CURRICULUM VITAE — ED PERRY

IEMA	Practitioner for the Institute of Environmental Management and Assessment
IEMA	Registered Environmental Auditor
EAPSA	Registered Environmental Assessment Practitioner

PUBLICATIONS

- The Role of Socio-Economic Factors, Seasonality and Geographic Differences on Household Waste Generation and Composition in the City of Tshwane. 2016 (Wastcon).
- EMS as a Tool for Integrated Business Risk Management. 2005 (various journals).
- Golder Associates EMS Roadmap. 2004 (CD ROM).
- Incentives to Encourage Recycling. 2002. Materials Recycling Week
- Recycle of Life. 2002. Government Business
- New Approaches to Management of Waste. 2002 (various journals)
- Minimise the Waste – Maximise the Message. 2001
- Guide to Waste Reduction on Construction Sites. 1999. Construction Confederation

Appendix 2 Detailed fibre optic route coordinates

The spatial extent of the proposed Fibre Optic Project, for which EA is being sought, is defined as follows:

- Underground sections (total of approximately 162 km): within a 30 m wide corridor around the centre line of the roads (i.e. the road reserve) where the cabling will be installed underground.
- Overhead sections, outside of the road reserve (total of approximately 21 km): a 30 m wide corridor around the engineering Low Level Design (LLD) route (latest technically feasible engineering design at the time of writing this report).

Thus, 30 m around the coordinates provided below:

(KMZ and shapefiles also provided – the holder of the EA is responsible for safeguarding outputs from the BA process and must provide this to the project implementation team).

Table 8: Location details of the Fibre Optic Project.

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
UNDERGROUND IN ROAD RESERVE OF THE R381, FROM START IN BEAUFORT WEST TO MOLTENO PASS SECTION.				
1-UDG-BW start	-32.3504	22.57657	32° 21' 01.45296160" S	022° 34' 35.66783960" E
2-UDG	-32.3506	22.58036	32° 21' 02.00291034" S	022° 34' 49.30938015" E
3-UDG	-32.3463	22.58088	32° 20' 46.75101817" S	022° 34' 51.16497783" E
4-UDG	-32.3423	22.58164	32° 20' 32.20080011" S	022° 34' 53.89356026" E
5-UDG	-32.3411	22.58146	32° 20' 27.82345066" S	022° 34' 53.27059703" E
6-UDG	-32.3358	22.5812	32° 20' 09.02991886" S	022° 34' 52.30598450" E
7-UDG	-32.3323	22.5849	32° 19' 56.37408241" S	022° 35' 05.63729855" E
8-UDG	-32.3282	22.58261	32° 19' 41.59805606" S	022° 34' 57.38818967" E
9-UDG	-32.3239	22.5796	32° 19' 25.97040761" S	022° 34' 46.55034939" E
10-UDG	-32.3195	22.57661	32° 19' 10.28562641" S	022° 34' 35.80027383" E
11-UDG	-32.3147	22.57442	32° 18' 53.00473608" S	022° 34' 27.90072979" E
12-UDG	-32.3099	22.57231	32° 18' 35.55831511" S	022° 34' 20.33035145" E
13-UDG	-32.305	22.57023	32° 18' 18.08243493" S	022° 34' 12.82925048" E
14-UDG	-32.3002	22.56813	32° 18' 00.63823782" S	022° 34' 05.25374631" E
15-UDG	-32.2952	22.56669	32° 17' 42.56787540" S	022° 34' 00.07618073" E
16-UDG	-32.2899	22.56664	32° 17' 23.58132606" S	022° 33' 59.91103601" E
17-UDG	-32.2847	22.56559	32° 17' 04.95096006" S	022° 33' 56.12302521" E
OVERHEAD – MOLTENO PASS, WITHIN THE ROAD RESERVE OF THE R381 (WHERE POSSIBLE) AND OUTSIDE ROAD RESERVE ON THE FOLLOWING PROPERTIES: • **Erf 3545 of the Beaufort West region [C00900010000354500000] (Karoo National Park).** • **Erf 1707 of the Beaufort West Region [C00900010000170700000] (Karoo National Park).** • **Portion 9 of the Farm Alwins Gate 186 [C00900000000018600009] (Karoo National Park).** • **Portion 1 of the farm Matjes Valie 103 [C00900000000010300001].**				
18-OVH-Molteno	-32.2842	22.5653	32° 17' 03.02461154" S	022° 33' 55.06331864" E
19-OVH-Molteno	-32.2842	22.56547	32° 17' 02.94091091" S	022° 33' 55.69023963" E
20-OVH-Molteno	-32.2791	22.56458	32° 16' 44.86673690" S	022° 33' 52.47386231" E
21-OVH-Molteno	-32.2739	22.56434	32° 16' 25.86727471" S	022° 33' 51.63368839" E
22-OVH-Molteno	-32.2693	22.56212	32° 16' 09.60720586" S	022° 33' 43.62430146" E
23-OVH-Molteno	-32.2658	22.56241	32° 15' 56.91674841" S	022° 33' 44.68485862" E
24-OVH-Molteno	-32.2628	22.5664	32° 15' 46.12713425" S	022° 33' 59.03698334" E
25-OVH-Molteno	-32.2589	22.56979	32° 15' 32.12045798" S	022° 34' 11.25605872" E
26-OVH-Molteno	-32.2544	22.5684	32° 15' 15.88049089" S	022° 34' 06.24983823" E
27-OVH-Molteno	-32.2518	22.56396	32° 15' 06.53495032" S	022° 33' 50.26720424" E
28-OVH-Molteno	-32.2498	22.55908	32° 14' 59.29453256" S	022° 33' 32.68276468" E
29-OVH-Molteno	-32.2485	22.55767	32° 14' 54.75479842" S	022° 33' 27.61200097" E
30-OVH-Molteno	-32.2457	22.55926	32° 14' 44.63517952" S	022° 33' 33.32014439" E
31-OVH-Molteno	-32.2439	22.55843	32° 14' 37.86907444" S	022° 33' 30.35991510" E
32-OVH-Molteno	-32.2409	22.55947	32° 14' 27.37904234" S	022° 33' 34.10617670" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
33-OVH-Molteno	-32.2364	22.56172	32° 14' 10.91420258" S	022° 33' 42.18368623" E
34-OVH-Molteno	-32.2321	22.56486	32° 13' 55.62767268" S	022° 33' 53.49730025" E
35-OVH-Molteno	-32.2308	22.56556	32° 13' 50.76480016" S	022° 33' 56.00879929" E
36-OVH-Molteno	-32.2276	22.56362	32° 13' 39.44424042" S	022° 33' 49.04269495" E
37-OVH-Molteno	-32.2271	22.56402	32° 13' 37.54869755" S	022° 33' 50.48492730" E
38-OVH-Molteno	-32.225	22.56008	32° 13' 29.93194058" S	022° 33' 36.27590531" E
39-OVH-Molteno	-32.2245	22.55898	32° 13' 28.11873609" S	022° 33' 32.31102377" E
40-OVH-Molteno	-32.2205	22.55841	32° 13' 13.63151249" S	022° 33' 30.26510066" E
41-OVH-Molteno	-32.2153	22.55892	32° 12' 55.06325500" S	022° 33' 32.10214917" E
42-OVH-Molteno	-32.2125	22.55944	32° 12' 44.99693502" S	022° 33' 33.97245183" E
43-OVH-Molteno	-32.2102	22.55864	32° 12' 36.69345999" S	022° 33' 31.12071380" E
44-OVH-Molteno	-32.2076	22.55855	32° 12' 27.37344249" S	022° 33' 30.76582087" E
45-OVH-Molteno	-32.2057	22.55995	32° 12' 20.69664442" S	022° 33' 35.82888543" E
46-OVH-Molteno	-32.204	22.56098	32° 12' 14.34451938" S	022° 33' 39.51655209" E
47-OVH-Molteno	-32.2014	22.55943	32° 12' 04.97355553" S	022° 33' 33.94223362" E
48-OVH-Molteno	-32.1975	22.55586	32° 11' 50.96367062" S	022° 33' 21.08404688" E
49-OVH-Molteno	-32.1927	22.55417	32° 11' 33.72825731" S	022° 33' 15.01530504" E
50-OVH-Molteno	-32.1878	22.55289	32° 11' 15.97959434" S	022° 33' 10.39982093" E
51-OVH-Molteno	-32.185	22.54837	32° 11' 06.14186426" S	022° 32' 54.14588165" E
52-OVH-Molteno	-32.1805	22.55045	32° 10' 49.76619757" S	022° 33' 01.60524662" E
53-OVH-Molteno	-32.176	22.54848	32° 10' 33.50493050" S	022° 32' 54.53489054" E
54-OVH-Molteno	-32.1742	22.54889	32° 10' 27.21284468" S	022° 32' 56.01735196" E
55-OVH-Molteno	-32.1729	22.54465	32° 10' 22.28736431" S	022° 32' 40.74561608" E
56-OVH-Molteno	-32.1728	22.54605	32° 10' 22.10238336" S	022° 32' 45.76840434" E
57-OVH-Molteno	-32.1728	22.54465	32° 10' 22.03944820" S	022° 32' 40.73755132" E
UNDERGROUND IN ROAD RESERVE OF THE R381, BETWEEN MOLTENO PASS AND BLOUNEK PASS.				
58-UDG	-32.174	22.49533	32° 10' 26.50896770" S	022° 29' 43.18997724" E
59-UDG	-32.174	22.50059	32° 10' 26.36480976" S	022° 30' 02.12227075" E
60-UDG	-32.1739	22.50587	32° 10' 25.98436834" S	022° 30' 21.13613473" E
61-UDG	-32.1738	22.51115	32° 10' 25.63830791" S	022° 30' 40.15110880" E
62-UDG	-32.1737	22.51644	32° 10' 25.29224749" S	022° 30' 59.16608287" E
63-UDG	-32.1735	22.52172	32° 10' 24.75217055" S	022° 31' 18.17639578" E
64-UDG	-32.1734	22.527	32° 10' 24.18470587" S	022° 31' 37.18605072" E
65-UDG	-32.1732	22.53228	32° 10' 23.61724119" S	022° 31' 56.19570565" E
66-UDG	-32.1731	22.53756	32° 10' 23.04977651" S	022° 32' 15.20536058" E
67-UDG	-32.1729	22.54284	32° 10' 22.48231183" S	022° 32' 34.21501551" E
68-UDG	-32.1722	22.4904	32° 10' 20.01252918" S	022° 29' 25.42527857" E
69-UDG	-32.1695	22.48588	32° 10' 10.12559911" S	022° 29' 09.18227708" E
70-UDG	-32.1667	22.48142	32° 09' 59.96307621" S	022° 28' 53.10707490" E
71-UDG	-32.1638	22.47697	32° 09' 49.69433102" S	022° 28' 37.10253807" E
72-UDG	-32.1597	22.47408	32° 09' 34.79032501" S	022° 28' 26.69724524" E
73-UDG	-32.1545	22.47486	32° 09' 16.09874887" S	022° 28' 29.50125539" E
74-UDG	-32.1496	22.4743	32° 08' 58.46074171" S	022° 28' 27.46810353" E
75-UDG	-32.1464	22.47005	32° 08' 47.16121122" S	022° 28' 12.18808510" E
76-UDG	-32.1434	22.46575	32° 08' 36.14379040" S	022° 27' 56.68641177" E
77-UDG	-32.1403	22.46145	32° 08' 25.08199260" S	022° 27' 41.21625901" E
78-UDG	-32.1372	22.45715	32° 08' 14.02019480" S	022° 27' 25.74610626" E
79-UDG	-32.1341	22.45286	32° 08' 02.90856513" S	022° 27' 10.31351223" E
80-UDG	-32.1305	22.44907	32° 07' 49.93381940" S	022° 26' 56.65746504" E
81-UDG	-32.1255	22.44771	32° 07' 31.97351659" S	022° 26' 51.74989800" E
82-UDG	-32.1203	22.44817	32° 07' 13.07161652" S	022° 26' 53.40093283" E
83-UDG	-32.1151	22.4489	32° 06' 54.23958726" S	022° 26' 56.03148128" E
84-UDG	-32.1098	22.44952	32° 06' 35.35442613" S	022° 26' 58.26243802" E
85-UDG	-32.1046	22.44992	32° 06' 16.39242052" S	022° 26' 59.72234901" E
86-UDG	-32.0993	22.45033	32° 05' 57.43041491" S	022° 27' 01.18226000" E
87-UDG	-32.0941	22.45109	32° 05' 38.63470458" S	022° 27' 03.91464293" E
88-UDG	-32.0888	22.45188	32° 05' 19.84473475" S	022° 27' 06.75862951" E
89-UDG	-32.0836	22.45243	32° 05' 00.93120476" S	022° 27' 08.75045788" E
OVERHEAD – BLOUNEK PASS, WITHIN THE ROAD RESERVE OF THE R381 (WHERE POSSIBLE) AND OUTSIDE ROAD RESERVE ON THE FOLLOWING PROPERTIES: • **Remainder of the Farm Waterval 97 [C00900000000009700000].** • **Remainder of the Farm Middle Kraal 98 [C00900000000009800000].**				

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
90-OVH-Blounek	-32.0789	22.45238	32° 04' 44.06088094" S	022° 27' 08.55324082" E
91-OVH-Blounek	-32.0788	22.45181	32° 04' 43.83273014" S	022° 27' 06.51615552" E
92-OVH-Blounek	-32.0756	22.45177	32° 04' 32.32599452" S	022° 27' 06.36196394" E
93-OVH-Blounek	-32.0715	22.45446	32° 04' 17.31505951" S	022° 27' 16.05668125" E
94-OVH-Blounek	-32.0675	22.45167	32° 04' 03.05074598" S	022° 27' 06.00487021" E
95-OVH-Blounek	-32.0634	22.44853	32° 03' 48.18441178" S	022° 26' 54.71565692" E
96-OVH-Blounek	-32.059	22.45117	32° 03' 32.32431337" S	022° 27' 04.20324135" E
97-OVH-Blounek	-32.0565	22.45407	32° 03' 23.39639974" S	022° 27' 14.65199975" E
98-OVH-Blounek	-32.0552	22.45448	32° 03' 18.79242715" S	022° 27' 16.11355818" E
99-OVH-Blounek	-32.0514	22.45729	32° 03' 05.06415169" S	022° 27' 26.23028290" E
100-OVH-Blounek	-32.0506	22.45719	32° 03' 02.21457694" S	022° 27' 25.88224819" E
101-OVH-Blounek	-32.0472	22.45486	32° 02' 50.02197874" S	022° 27' 17.50749483" E
102-OVH-Blounek	-32.0436	22.4517	32° 02' 37.07520690" S	022° 27' 06.12362411" E
103-OVH-Blounek	-32.0435	22.45183	32° 02' 36.60534962" S	022° 27' 06.58795163" E
UNDERGROUND IN ROAD RESERVE THE R381, BETWEEN BLOUNEK PASS AND ROSEBERG PASS				
104-UDG	-32.043	22.45132	32° 02' 34.97866581" S	022° 27' 04.73919067" E
105-UDG	-32.0396	22.44735	32° 02' 22.41573224" S	022° 26' 50.46117621" E
106-UDG	-32.0361	22.44338	32° 02' 09.85279868" S	022° 26' 36.18316174" E
107-UDG	-32.0326	22.43942	32° 01' 57.26659454" S	022° 26' 21.92565808" E
108-UDG	-32.0292	22.43536	32° 01' 45.11242245" S	022° 26' 07.30385317" E
109-UDG	-32.0254	22.43177	32° 01' 31.41730185" S	022° 25' 54.37672358" E
110-UDG	-32.0204	22.43154	32° 01' 13.26544486" S	022° 25' 53.55522311" E
111-UDG	-32.0151	22.43183	32° 00' 54.27640897" S	022° 25' 54.60164743" E
112-UDG	-32.0099	22.43128	32° 00' 35.48044532" S	022° 25' 52.61930854" E
113-UDG	-32.0047	22.42998	32° 00' 17.05148990" S	022° 25' 47.93803996" E
114-UDG	-31.9998	22.42815	31° 59' 59.21047247" S	022° 25' 41.35245871" E
115-UDG	-31.9948	22.42644	31° 59' 41.24443165" S	022° 25' 35.16738856" E
116-UDG	-31.9897	22.42486	31° 59' 23.09605831" S	022° 25' 29.48208124" E
117-UDG	-31.9848	22.42311	31° 59' 05.16703554" S	022° 25' 23.20389022" E
118-UDG	-31.9801	22.42067	31° 58' 48.48433594" S	022° 25' 14.41515621" E
119-UDG	-31.9756	22.41801	31° 58' 32.09040449" S	022° 25' 04.81927657" E
120-UDG	-31.9708	22.42016	31° 58' 15.03547600" S	022° 25' 12.56504881" E
121-UDG	-31.9665	22.42314	31° 57' 59.33194808" S	022° 25' 23.29296603" E
122-UDG	-31.9616	22.42405	31° 57' 41.60421224" S	022° 25' 26.56892881" E
123-UDG	-31.9564	22.42278	31° 57' 23.13706351" S	022° 25' 22.02432603" E
124-UDG	-31.9513	22.42136	31° 57' 04.82381716" S	022° 25' 16.90269267" E
125-UDG	-31.9463	22.4199	31° 56' 46.54633389" S	022° 25' 11.64697179" E
126-UDG	-31.9412	22.41844	31° 56' 28.26885061" S	022° 25' 06.39125090" E
127-UDG	-31.9361	22.41697	31° 56' 09.99902496" S	022° 25' 01.10911151" E
128-UDG	-31.931	22.41549	31° 55' 51.74408523" S	022° 24' 55.77561617" E
129-UDG	-31.926	22.41401	31° 55' 33.48914551" S	022° 24' 50.44212083" E
130-UDG	-31.9209	22.41253	31° 55' 15.23420579" S	022° 24' 45.10862549" E
131-UDG	-31.9158	22.41105	31° 54' 56.97821857" S	022° 24' 39.77873219" E
132-UDG	-31.9108	22.40958	31° 54' 38.70996392" S	022° 24' 34.49102297" E
133-UDG	-31.9057	22.40813	31° 54' 20.42109010" S	022° 24' 29.27622082" E
134-UDG	-31.9006	22.40673	31° 54' 02.08936609" S	022° 24' 24.21293220" E
135-UDG	-31.8957	22.40486	31° 53' 44.37634641" S	022° 24' 17.48318820" E
136-UDG	-31.8917	22.4015	31° 53' 30.14325760" S	022° 24' 05.38204191" E
OVERHEAD – ROSEBERG PASS, IN THE ROAD RESERVE OF THE R381				
137-OVH-Roseberg	-31.8901	22.3984	31° 53' 24.44750265" S	022° 23' 54.25716000" E
138-OVH-Roseberg	-31.89	22.39847	31° 53' 24.08273979" S	022° 23' 54.50761436" E
139-OVH-Roseberg	-31.8889	22.39583	31° 53' 20.08487329" S	022° 23' 44.98787511" E
140-OVH-Roseberg	-31.8876	22.39299	31° 53' 15.23988381" S	022° 23' 34.75990085" E
141-OVH-Roseberg	-31.8861	22.39228	31° 53' 10.02207126" S	022° 23' 32.21035846" E
UNDERGROUND IN ROAD RESERVE OF THE R381 and R63 FROM BLOUNEK PASS TO END AT SKA INTERNET POINT-OF-PRESENCE IN CARNARVON				

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
142-UDG	-31.8824	22.38974	31° 52' 56.47092650" S	022° 23' 23.07543987" E
143-UDG	-31.8776	22.38765	31° 52' 39.36168175" S	022° 23' 15.53916225" E
144-UDG	-31.8733	22.38464	31° 52' 23.72626681" S	022° 23' 04.71246541" E
145-UDG	-31.8689	22.38162	31° 52' 08.12657691" S	022° 22' 53.83468684" E
146-UDG	-31.8653	22.3778	31° 51' 55.06211346" S	022° 22' 40.09236068" E
147-UDG	-31.8621	22.37358	31° 51' 43.65962182" S	022° 22' 24.89893883" E
148-UDG	-31.8592	22.36916	31° 51' 33.27861459" S	022° 22' 08.96395575" E
149-UDG	-31.8564	22.36473	31° 51' 22.90238152" S	022° 21' 53.02587665" E
150-UDG	-31.8533	22.3605	31° 51' 11.83120626" S	022° 21' 37.79789674" E
151-UDG	-31.8487	22.35804	31° 50' 55.22266161" S	022° 21' 28.95116482" E
152-UDG	-31.8443	22.35564	31° 50' 39.30615743" S	022° 21' 20.29065076" E
153-UDG	-31.839	22.35505	31° 50' 20.44978204" S	022° 21' 18.18512200" E
154-UDG	-31.8337	22.35478	31° 50' 01.45778628" S	022° 21' 17.21288749" E
155-UDG	-31.8285	22.35461	31° 49' 42.44963690" S	022° 21' 16.59705150" E
156-UDG	-31.8232	22.35482	31° 49' 23.48476861" S	022° 21' 17.36134272" E
157-UDG	-31.8183	22.35679	31° 49' 05.94876004" S	022° 21' 24.42975756" E
158-UDG	-31.8131	22.35772	31° 48' 47.27463854" S	022° 21' 27.79415783" E
159-UDG	-31.8079	22.35838	31° 48' 28.40327958" S	022° 21' 30.15229430" E
160-UDG	-31.8026	22.35903	31° 48' 09.53192061" S	022° 21' 32.51043077" E
161-UDG	-31.7974	22.35985	31° 47' 50.74964447" S	022° 21' 35.45130321" E
162-UDG	-31.7922	22.36065	31° 47' 31.96526923" S	022° 21' 38.33356872" E
163-UDG	-31.787	22.36114	31° 47' 13.03423569" S	022° 21' 40.11444009" E
164-UDG	-31.7817	22.36112	31° 46' 54.02513858" S	022° 21' 40.02377089" E
165-UDG	-31.7765	22.36008	31° 46' 35.38023221" S	022° 21' 36.27457585" E
166-UDG	-31.7713	22.35924	31° 46' 16.62159008" S	022° 21' 33.26549717" E
167-UDG	-31.766	22.35878	31° 45' 57.68696372" S	022° 21' 31.59851823" E
168-UDG	-31.7608	22.35898	31° 45' 38.86282655" S	022° 21' 32.32359699" E
169-UDG	-31.7562	22.36161	31° 45' 22.49469150" S	022° 21' 41.78469490" E
170-UDG	-31.7514	22.36326	31° 45' 04.90971205" S	022° 21' 47.75184246" E
171-UDG	-31.7462	22.36246	31° 44' 46.17133419" S	022° 21' 44.84925990" E
172-UDG	-31.741	22.36114	31° 44' 27.75277006" S	022° 21' 40.11159250" E
173-UDG	-31.7359	22.36022	31° 44' 09.09905041" S	022° 21' 36.79356325" E
174-UDG	-31.7306	22.36058	31° 43' 50.23784118" S	022° 21' 38.07514621" E
175-UDG	-31.7255	22.36176	31° 43' 31.70426005" S	022° 21' 42.34074901" E
176-UDG	-31.7203	22.36295	31° 43' 13.17067892" S	022° 21' 46.60635181" E
177-UDG	-31.7151	22.36374	31° 42' 54.39251445" S	022° 21' 49.46905747" E
178-UDG	-31.7099	22.36309	31° 42' 35.58033011" S	022° 21' 47.11813821" E
179-UDG	-31.7047	22.36193	31° 42' 17.03045024" S	022° 21' 42.93411862" E
180-UDG	-31.6996	22.36068	31° 41' 58.54957462" S	022° 21' 38.44643681" E
181-UDG	-31.6944	22.35968	31° 41' 39.89801838" S	022° 21' 34.84496393" E
182-UDG	-31.6892	22.35892	31° 41' 21.07502822" S	022° 21' 32.12760524" E
183-UDG	-31.684	22.3582	31° 41' 02.23795995" S	022° 21' 29.52741793" E
184-UDG	-31.679	22.35954	31° 40' 44.27403580" S	022° 21' 34.34174495" E
185-UDG	-31.6743	22.35748	31° 40' 27.31693392" S	022° 21' 26.94314803" E
186-UDG	-31.669	22.3566	31° 40' 08.56883461" S	022° 21' 23.77171162" E
187-UDG	-31.6638	22.35577	31° 39' 49.78835712" S	022° 21' 20.77460270" E
188-UDG	-31.6586	22.35494	31° 39' 31.00787962" S	022° 21' 17.77749378" E
189-UDG	-31.6534	22.35406	31° 39' 12.25306772" S	022° 21' 14.62590920" E
190-UDG	-31.6482	22.35316	31° 38' 53.51242963" S	022° 21' 11.38901554" E
191-UDG	-31.6429	22.35272	31° 38' 34.60009087" S	022° 21' 09.78246861" E
192-UDG	-31.6377	22.35276	31° 38' 15.58345796" S	022° 21' 09.92077456" E
193-UDG	-31.6324	22.35289	31° 37' 56.57836550" S	022° 21' 10.39938069" E
194-UDG	-31.6271	22.35331	31° 37' 37.62065343" S	022° 21' 11.91402586" E
195-UDG	-31.6219	22.35374	31° 37' 18.66648679" S	022° 21' 13.47109363" E
196-UDG	-31.6166	22.3542	31° 36' 59.72035408" S	022° 21' 15.12428801" E
197-UDG	-31.6113	22.35466	31° 36' 40.77422092" S	022° 21' 16.77747728" E
198-UDG	-31.6061	22.35507	31° 36' 21.81380650" S	022° 21' 18.25258918" E
199-UDG	-31.6008	22.35482	31° 36' 02.85840454" S	022° 21' 17.33697163" E
200-UDG	-31.5956	22.35399	31° 35' 44.11403017" S	022° 21' 14.38010108" E
201-UDG	-31.5905	22.35268	31° 35' 25.69475395" S	022° 21' 09.64566046" E
202-UDG	-31.5853	22.35186	31° 35' 06.98076670" S	022° 21' 06.70139124" E
203-UDG	-31.58	22.35185	31° 34' 47.96266218" S	022° 21' 06.67497875" E
204-UDG	-31.5747	22.35188	31° 34' 28.94512558" S	022° 21' 06.75348989" E
205-UDG	-31.5694	22.35194	31° 34' 09.92842125" S	022° 21' 06.98576827" E
206-UDG	-31.5641	22.35201	31° 33' 50.91171692" S	022° 21' 07.21804666" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
207-UDG	-31.5589	22.35198	31° 33' 31.89598223" S	022° 21' 07.13922242" E
208-UDG	-31.5539	22.3502	31° 33' 14.09022134" S	022° 21' 00.70967943" E
209-UDG	-31.5491	22.34813	31° 32' 56.59324890" S	022° 20' 53.25912233" E
210-UDG	-31.5451	22.34482	31° 32' 42.18408900" S	022° 20' 41.36771932" E
211-UDG	-31.5416	22.34079	31° 32' 29.90677809" S	022° 20' 26.84390374" E
212-UDG	-31.5376	22.33855	31° 32' 15.18599810" S	022° 20' 18.76270703" E
213-UDG	-31.5336	22.34095	31° 32' 01.02636733" S	022° 20' 27.40409588" E
214-UDG	-31.5288	22.3389	31° 31' 43.64139366" S	022° 20' 20.03314672" E
215-UDG	-31.5236	22.33826	31° 31' 24.82669074" S	022° 20' 17.74644258" E
216-UDG	-31.5184	22.33937	31° 31' 06.33442511" S	022° 20' 21.74894321" E
217-UDG	-31.5134	22.34095	31° 30' 48.18459677" S	022° 20' 27.42901239" E
218-UDG	-31.5083	22.34255	31° 30' 30.05708445" S	022° 20' 33.18073334" E
219-UDG	-31.5033	22.34414	31° 30' 11.91670591" S	022° 20' 38.89173451" E
220-UDG	-31.4983	22.34572	31° 29' 53.77710823" S	022° 20' 44.60520781" E
221-UDG	-31.4932	22.34732	31° 29' 35.64908394" S	022° 20' 50.35531495" E
222-UDG	-31.4882	22.3489	31° 29' 17.50311548" S	022° 20' 56.04764737" E
223-UDG	-31.4833	22.35086	31° 28' 59.88035701" S	022° 21' 03.10532933" E
224-UDG	-31.4795	22.35082	31° 28' 46.16558783" S	022° 21' 02.93429580" E
225-UDG	-31.4766	22.34843	31° 28' 35.87547501" S	022° 20' 54.33788947" E
226-UDG	-31.4721	22.34945	31° 28' 19.61496839" S	022° 20' 58.01198897" E
227-UDG	-31.4683	22.34582	31° 28' 05.81138237" S	022° 20' 44.93619143" E
228-UDG	-31.4644	22.34225	31° 27' 51.77131300" S	022° 20' 32.10789888" E
229-UDG	-31.4605	22.33868	31° 27' 37.75139661" S	022° 20' 19.25757043" E
230-UDG	-31.4566	22.33511	31° 27' 23.73148022" S	022° 20' 06.40724198" E
231-UDG	-31.4527	22.33154	31° 27' 09.71156384" S	022° 19' 53.55691353" E
232-UDG	-31.4475	22.3307	31° 26' 51.07845246" S	022° 19' 50.52956042" E
233-UDG	-31.4423	22.32999	31° 26' 32.23651219" S	022° 19' 47.94687114" E
234-UDG	-31.4371	22.32927	31° 26' 13.39457193" S	022° 19' 45.36418187" E
235-UDG	-31.4318	22.32855	31° 25' 54.55263166" S	022° 19' 42.78149259" E
236-UDG	-31.4266	22.32783	31° 25' 35.71069140" S	022° 19' 40.19880332" E
237-UDG	-31.4222	22.32528	31° 25' 19.76846764" S	022° 19' 31.01295163" E
238-UDG	-31.4181	22.32191	31° 25' 05.11718243" S	022° 19' 18.88740676" E
239-UDG	-31.414	22.31854	31° 24' 50.46589721" S	022° 19' 06.76186190" E
240-UDG	-31.4099	22.31518	31° 24' 35.81461199" S	022° 18' 54.63631704" E
241-UDG	-31.4059	22.31181	31° 24' 21.16332677" S	022° 18' 42.51077217" E
242-UDG	-31.4018	22.30844	31° 24' 06.51204155" S	022° 18' 30.38522731" E
243-UDG	-31.3973	22.30574	31° 23' 50.33446327" S	022° 18' 20.65166623" E
244-UDG	-31.3924	22.30388	31° 23' 32.52641946" S	022° 18' 13.97649254" E
245-UDG	-31.3874	22.30202	31° 23' 14.72570777" S	022° 18' 07.28155342" E
246-UDG	-31.3824	22.30051	31° 22' 56.53588028" S	022° 18' 01.82859339" E
247-UDG	-31.3773	22.29907	31° 22' 38.27437136" S	022° 17' 56.64534735" E
248-UDG	-31.3725	22.29691	31° 22' 20.92100764" S	022° 17' 48.86475601" E
249-UDG	-31.3676	22.29509	31° 22' 03.19087596" S	022° 17' 42.33046289" E
250-UDG	-31.3625	22.2965	31° 21' 44.96956797" S	022° 17' 47.39172909" E
251-UDG	-31.3575	22.29822	31° 21' 26.98670265" S	022° 17' 53.57985420" E
252-UDG	-31.3525	22.29994	31° 21' 09.01226491" S	022° 17' 59.79293801" E
253-UDG	-31.3474	22.30095	31° 20' 50.64468240" S	022° 18' 03.42578465" E
254-UDG	-31.3423	22.30142	31° 20' 32.42208792" S	022° 18' 05.12826680" E
255-UDG	-31.3378	22.30415	31° 20' 16.13787014" S	022° 18' 14.95207992" E
256-UDG	-31.3333	22.30689	31° 19' 59.87395133" S	022° 18' 24.80917920" E
257-UDG	-31.3295	22.31051	31° 19' 46.08634001" S	022° 18' 37.82686868" E
258-UDG	-31.3258	22.31432	31° 19' 32.93362419" S	022° 18' 51.56096198" E
259-UDG	-31.3214	22.31712	31° 19' 16.96398680" S	022° 19' 01.63356500" E
260-UDG	-31.3162	22.31791	31° 18' 58.25605219" S	022° 19' 04.48910506" E
261-UDG	-31.3109	22.3182	31° 18' 39.26678624" S	022° 19' 05.53555478" E
262-UDG	-31.3057	22.31764	31° 18' 20.50216715" S	022° 19' 03.50789071" E
263-UDG	-31.3011	22.31502	31° 18' 04.13998958" S	022° 18' 54.07568467" E
264-UDG	-31.297	22.31178	31° 17' 49.12961408" S	022° 18' 42.39765576" E
265-UDG	-31.2928	22.30853	31° 17' 34.13948908" S	022° 18' 30.69360239" E
266-UDG	-31.2884	22.30562	31° 17' 18.30259507" S	022° 18' 20.22955184" E
267-UDG	-31.2838	22.30302	31° 17' 01.74917817" S	022° 18' 10.86614739" E
268-UDG	-31.2792	22.30042	31° 16' 45.19068172" S	022° 18' 01.51172802" E
269-UDG	-31.2746	22.29783	31° 16' 28.62085277" S	022° 17' 52.17739541" E
270-UDG	-31.27	22.29524	31° 16' 12.04627661" S	022° 17' 42.85149559" E
271-UDG	-31.2654	22.29264	31° 15' 55.48804027" S	022° 17' 33.49683579" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
272-UDG	-31.2608	22.29005	31° 15' 38.91744442" S	022° 17' 24.16387195" E
273-UDG	-31.2562	22.28745	31° 15' 22.34619417" S	022° 17' 14.83211297" E
274-UDG	-31.2516	22.28486	31° 15' 05.77779625" S	022° 17' 05.49528827" E
275-UDG	-31.247	22.28227	31° 14' 49.20519634" S	022° 16' 56.16593172" E
276-UDG	-31.2427	22.27925	31° 14' 33.64010945" S	022° 16' 45.29360935" E
277-UDG	-31.2388	22.27562	31° 14' 19.80931253" S	022° 16' 32.24551680" E
278-UDG	-31.235	22.27195	31° 14' 06.15927012" S	022° 16' 19.00304615" E
279-UDG	-31.2312	22.26828	31° 13' 52.46603314" S	022° 16' 05.80515969" E
280-UDG	-31.2274	22.26461	31° 13' 38.77224854" S	022° 15' 52.60783950" E
281-UDG	-31.2236	22.26095	31° 13' 25.07846394" S	022° 15' 39.41051931" E
282-UDG	-31.2198	22.25728	31° 13' 11.39451581" S	022° 15' 26.20302308" E
283-UDG	-31.216	22.2536	31° 12' 57.74020304" S	022° 15' 12.96486839" E
284-UDG	-31.2122	22.24993	31° 12' 44.07895470" S	022° 14' 59.73390359" E
285-UDG	-31.2084	22.24626	31° 12' 30.39807657" S	022° 14' 46.52342268" E
286-UDG	-31.2046	22.24267	31° 12' 16.43288977" S	022° 14' 33.62550063" E
287-UDG	-31.2006	22.23921	31° 12' 02.07062093" S	022° 14' 21.15897624" E
288-UDG	-31.1965	22.2359	31° 11' 47.27717299" S	022° 14' 09.24355457" E
289-UDG	-31.1921	22.23286	31° 11' 31.72143909" S	022° 13' 58.30243307" E
290-UDG	-31.1878	22.22982	31° 11' 16.16570519" S	022° 13' 47.36131157" E
291-UDG	-31.1835	22.22678	31° 11' 00.60997129" S	022° 13' 36.42019008" E
292-UDG	-31.1792	22.22374	31° 10' 45.05423738" S	022° 13' 25.47906858" E
293-UDG	-31.1749	22.2207	31° 10' 29.49850348" S	022° 13' 14.53794709" E
294-UDG	-31.1705	22.21767	31° 10' 13.94276958" S	022° 13' 03.59682559" E
295-UDG	-31.1662	22.21463	31° 09' 58.38703568" S	022° 12' 52.65570409" E
296-UDG	-31.1619	22.21159	31° 09' 42.83130178" S	022° 12' 41.71458260" E
297-UDG	-31.1574	22.20879	31° 09' 26.77359888" S	022° 12' 31.63718498" E
298-UDG	-31.1526	22.2066	31° 09' 09.46659466" S	022° 12' 23.75850545" E
299-UDG	-31.1478	22.2045	31° 08' 52.01856199" S	022° 12' 16.19179198" E
300-UDG	-31.1429	22.2024	31° 08' 34.57052932" S	022° 12' 08.62507851" E
301-UDG	-31.1381	22.20029	31° 08' 17.12249665" S	022° 12' 01.05836504" E
302-UDG	-31.1332	22.19819	31° 07' 59.67437389" S	022° 11' 53.49185932" E
303-UDG	-31.1284	22.19609	31° 07' 42.23168764" S	022° 11' 45.91291243" E
304-UDG	-31.1236	22.19396	31° 07' 24.82395936" S	022° 11' 38.25393125" E
305-UDG	-31.1188	22.19177	31° 07' 07.53737976" S	022° 11' 30.37235710" E
306-UDG	-31.1143	22.18886	31° 06' 51.65413613" S	022° 11' 19.91235860" E
307-UDG	-31.1099	22.18596	31° 06' 35.77089250" S	022° 11' 09.45236010" E
308-UDG	-31.1055	22.18305	31° 06' 19.88764887" S	022° 10' 58.99236159" E
309-UDG	-31.1011	22.18015	31° 06' 04.00403803" S	022° 10' 48.53292074" E
310-UDG	-31.0967	22.17724	31° 05' 48.12024886" S	022° 10' 38.07375067" E
311-UDG	-31.0923	22.17433	31° 05' 32.26378918" S	022° 10' 27.57320497" E
312-UDG	-31.0879	22.17141	31° 05' 16.40980949" S	022° 10' 17.06890466" E
313-UDG	-31.0835	22.16849	31° 05' 00.55582980" S	022° 10' 06.56460436" E
314-UDG	-31.0789	22.16586	31° 04' 44.07578599" S	022° 09' 57.07858627" E
315-UDG	-31.0743	22.16324	31° 04' 27.54639955" S	022° 09' 47.67282312" E
316-UDG	-31.0697	22.16063	31° 04' 11.01701311" S	022° 09' 38.26705996" E
317-UDG	-31.0651	22.15802	31° 03' 54.48762666" S	022° 09' 28.86129680" E
318-UDG	-31.0605	22.15541	31° 03' 37.95580669" S	022° 09' 19.45981564" E
319-UDG	-31.0559	22.1528	31° 03' 21.41102977" S	022° 09' 10.08116503" E
320-UDG	-31.0513	22.1502	31° 03' 04.85915588" S	022° 09' 00.71503573" E
321-UDG	-31.0468	22.14759	31° 02' 48.31135775" S	022° 08' 51.34170262" E
322-UDG	-31.0422	22.14499	31° 02' 31.76355961" S	022° 08' 41.96836950" E
323-UDG	-31.0376	22.14239	31° 02' 15.21576148" S	022° 08' 32.59503639" E
324-UDG	-31.033	22.13978	31° 01' 58.66757029" S	022° 08' 23.22239723" E
325-UDG	-31.0284	22.13718	31° 01' 42.11906211" S	022° 08' 13.85031775" E
326-UDG	-31.0238	22.13458	31° 01' 25.57055393" S	022° 08' 04.47823827" E
327-UDG	-31.0191	22.13213	31° 01' 08.74839480" S	022° 07' 55.68185144" E
328-UDG	-31.0142	22.13024	31° 00' 51.00238652" S	022° 07' 48.85001507" E
329-UDG	-31.0091	22.12862	31° 00' 32.90035029" S	022° 07' 43.01861033" E
330-UDG	-31.004	22.12736	31° 00' 14.48443880" S	022° 07' 38.47815137" E
331-UDG	-30.9988	22.12666	30° 59' 55.63095041" S	022° 07' 35.98115869" E
332-UDG	-30.9935	22.12597	30° 59' 36.77746202" S	022° 07' 33.48416601" E
333-UDG	-30.9883	22.12531	30° 59' 17.90594799" S	022° 07' 31.12857231" E
334-UDG	-30.9831	22.12467	30° 58' 59.02899284" S	022° 07' 28.81566050" E
335-UDG	-30.9778	22.124	30° 58' 40.16796531" S	022° 07' 26.39980483" E
336-UDG	-30.9726	22.12462	30° 58' 21.31409517" S	022° 07' 28.64356368" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
337-UDG	-30.9711	22.13233	30° 58' 16.08057945" S	022° 07' 56.38180468" E
338-UDG	-30.9697	22.12509	30° 58' 10.89765852" S	022° 07' 30.30814425" E
339-UDG	-30.9696	22.13739	30° 58' 10.45448580" S	022° 08' 14.59243035" E
340-UDG	-30.9692	22.13267	30° 58' 09.24492008" S	022° 07' 57.60840063" E
341-UDG-CNV end	-30.9699	22.14119	30° 58' 11.78892624" S	022° 08' 28.29445774" E

Appendix 3 Environmental sensitivity maps

(KMZ and shapefiles also provided – the holder of the EA is responsible for safeguarding outputs from the BA process and must provide this to the project implementation team).

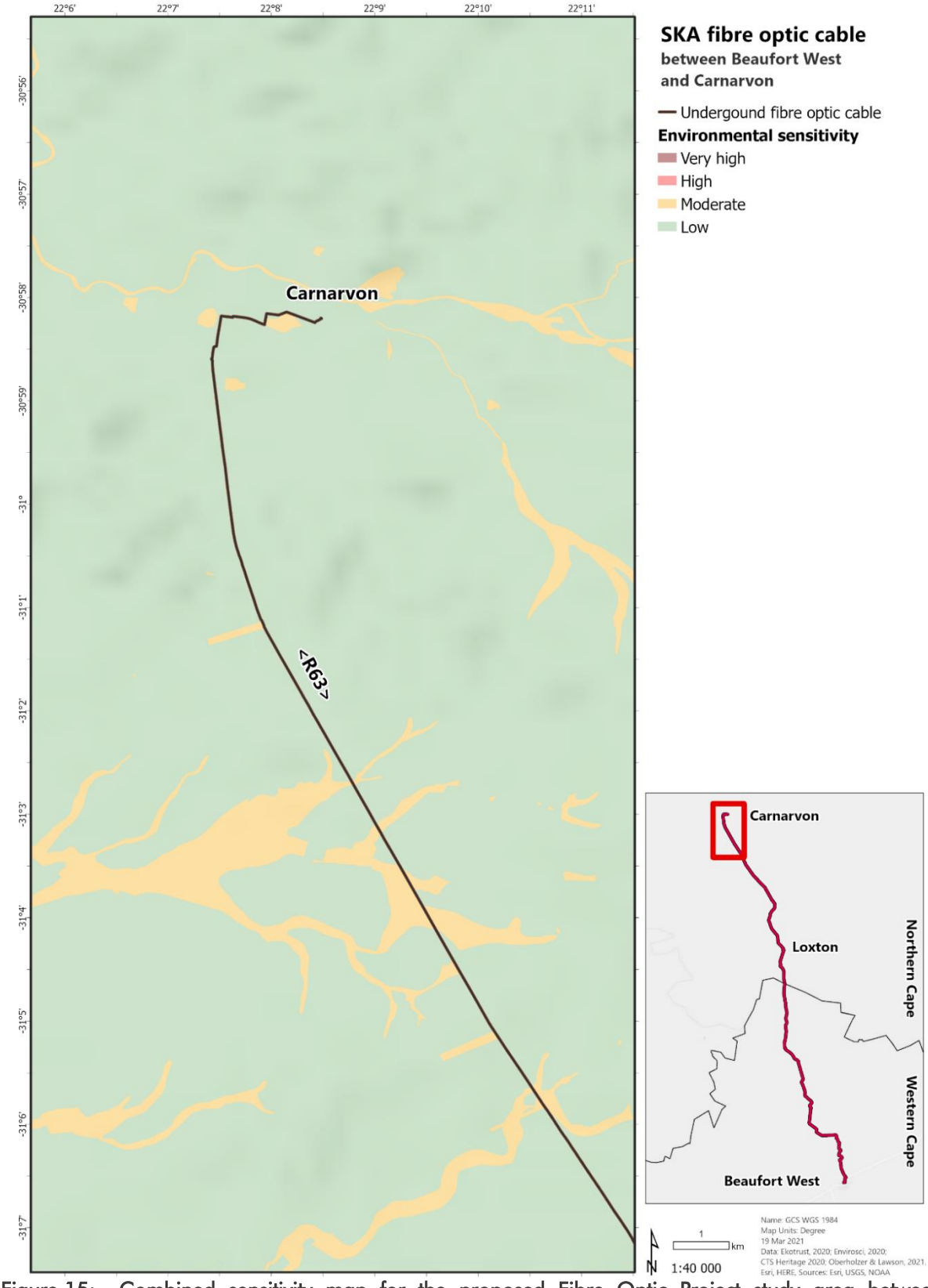


Figure 15: Combined sensitivity map for the proposed Fibre Optic Project study area between Carnarvon and 22.1725415°E, 31.0902216°S, following the R63 road.

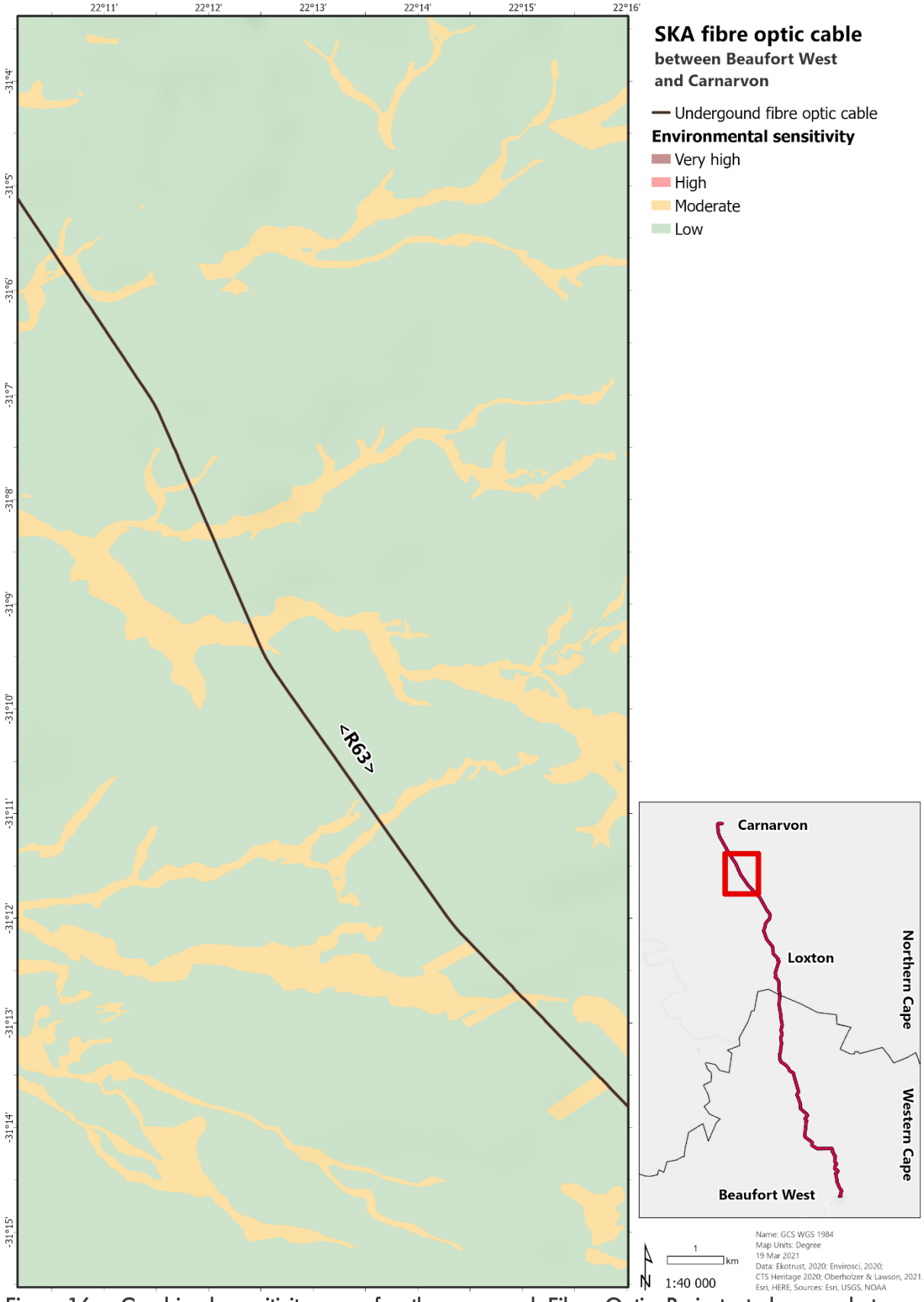


Figure 16: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.1725415°E, 31.0902216°S and 22.2595105°E, 31.2226844°S, following the R63 road.

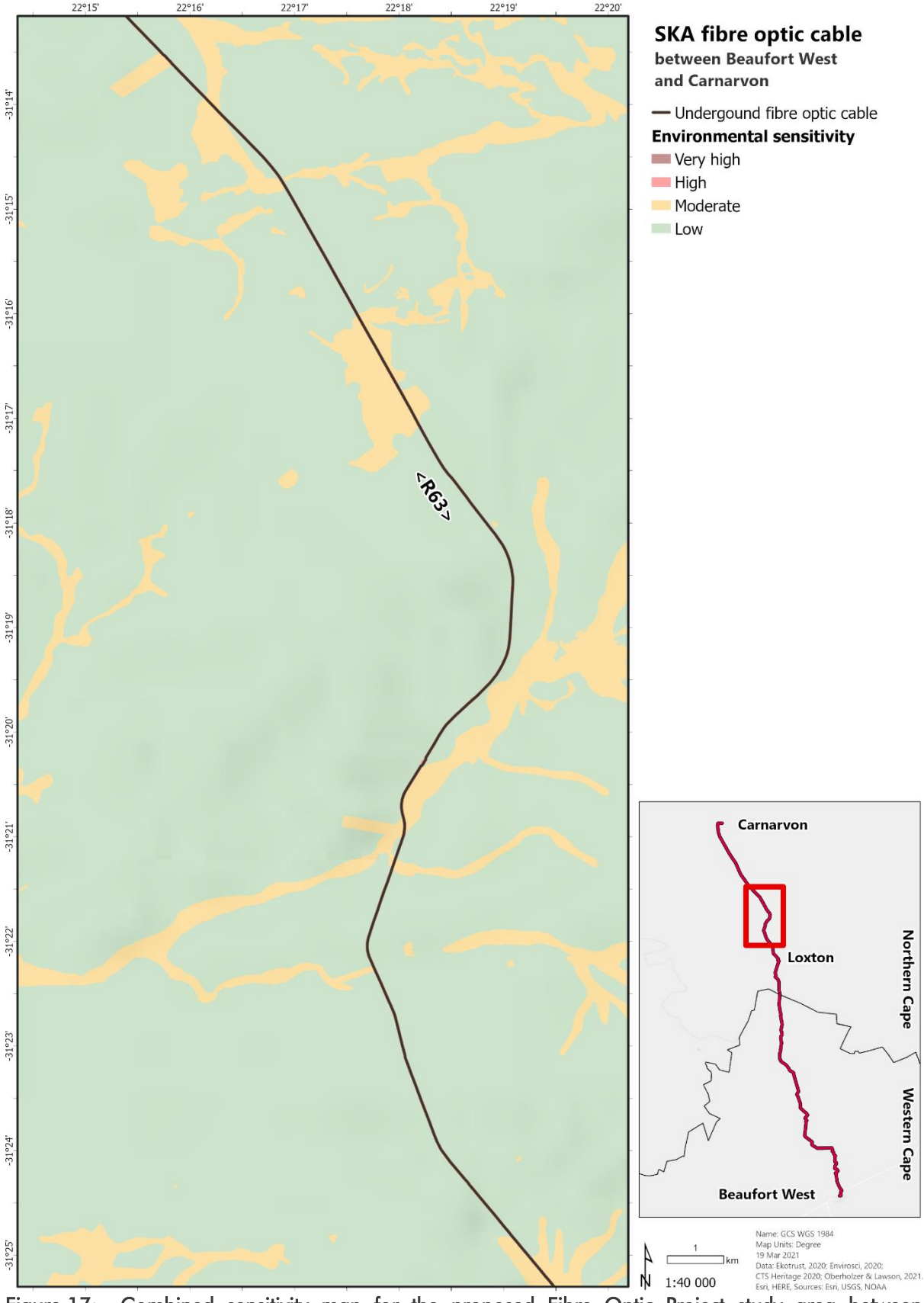


Figure 17: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.2595105°E, 31.2226844°S and 22.3189222°E, 31.4145349°S, following the R63 road.

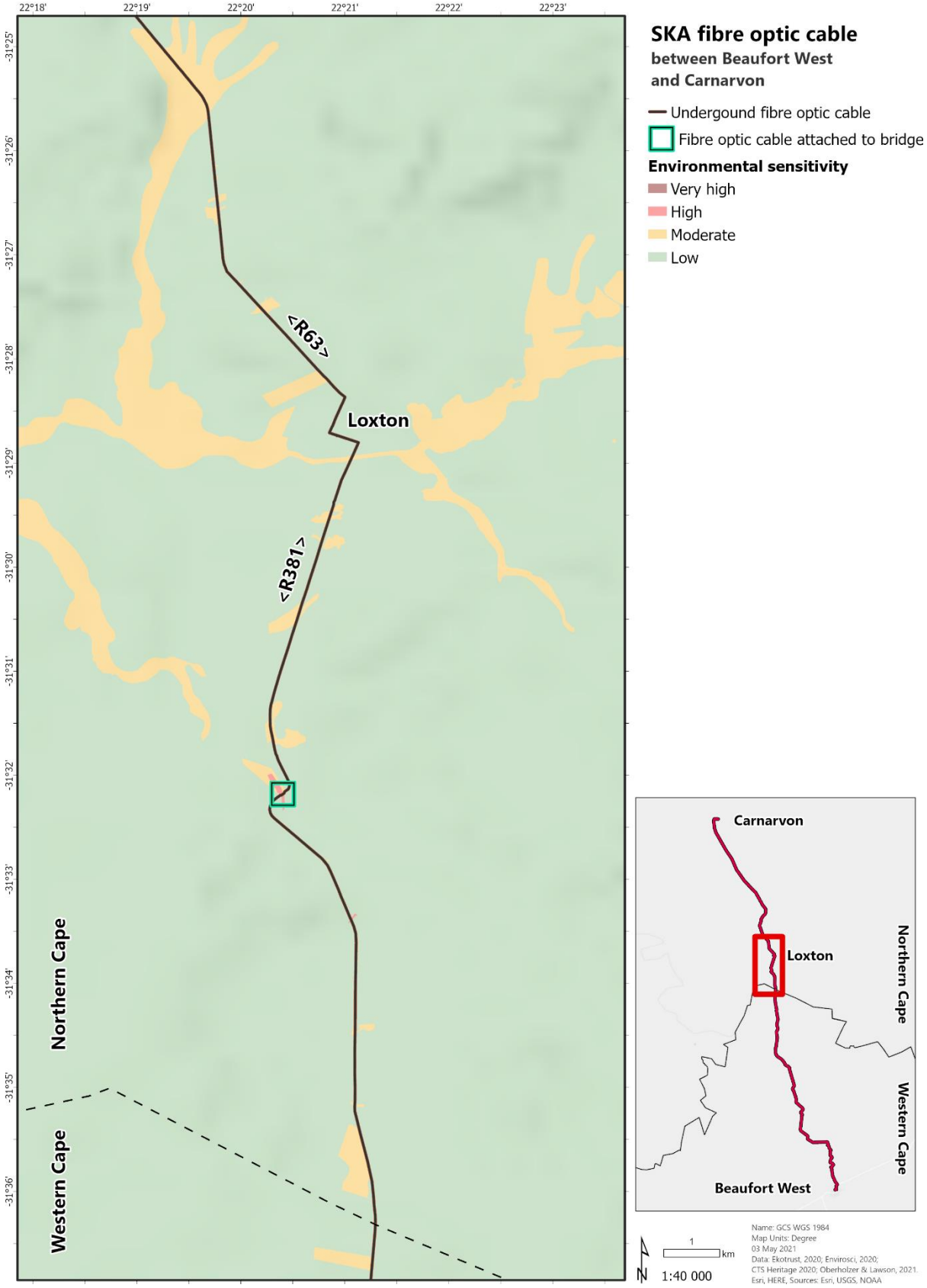


Figure 18: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.3189222°E, 31.4145349°S and 22.3529785°E, 31.6261245°S, following the R381 and R63 roads.

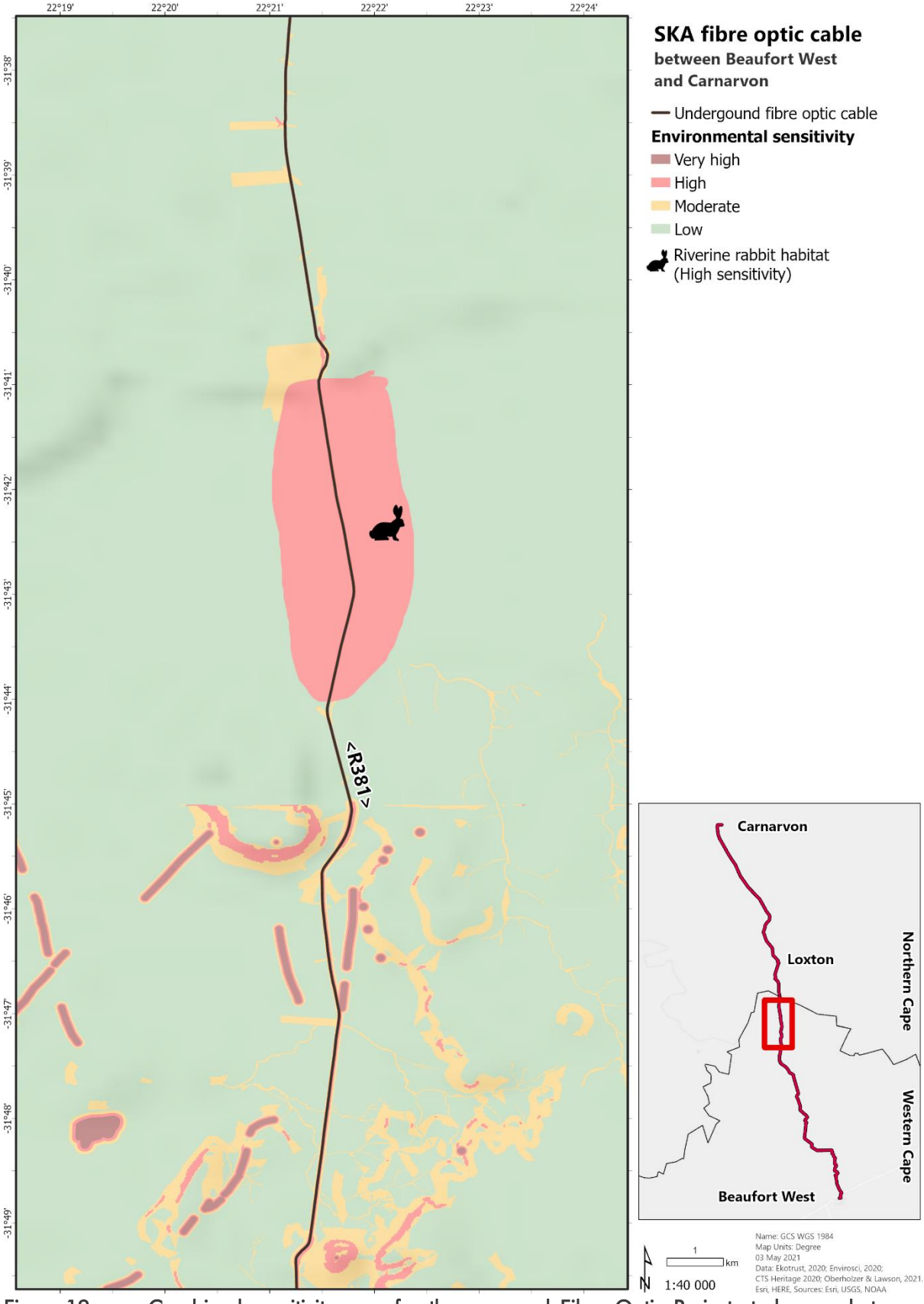


Figure 19: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.3529785°E, 31.6261245°S and 22.3575792°E, 31.8099024°S, following the R381 road.

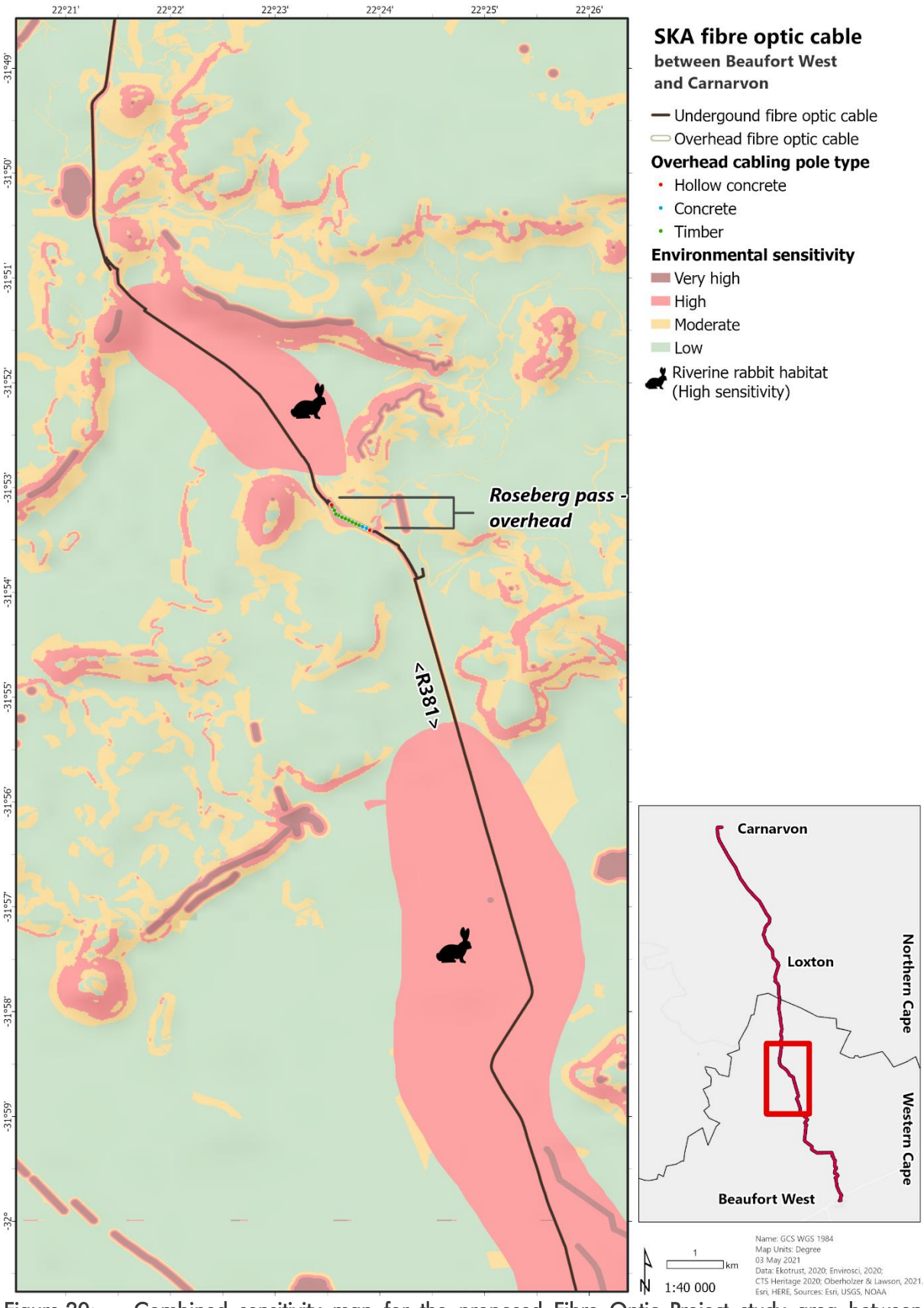


Figure 20: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.3575792°E, 31.8099024°S and 22.4265683°E, 31.9969218°S, following the R381 road.

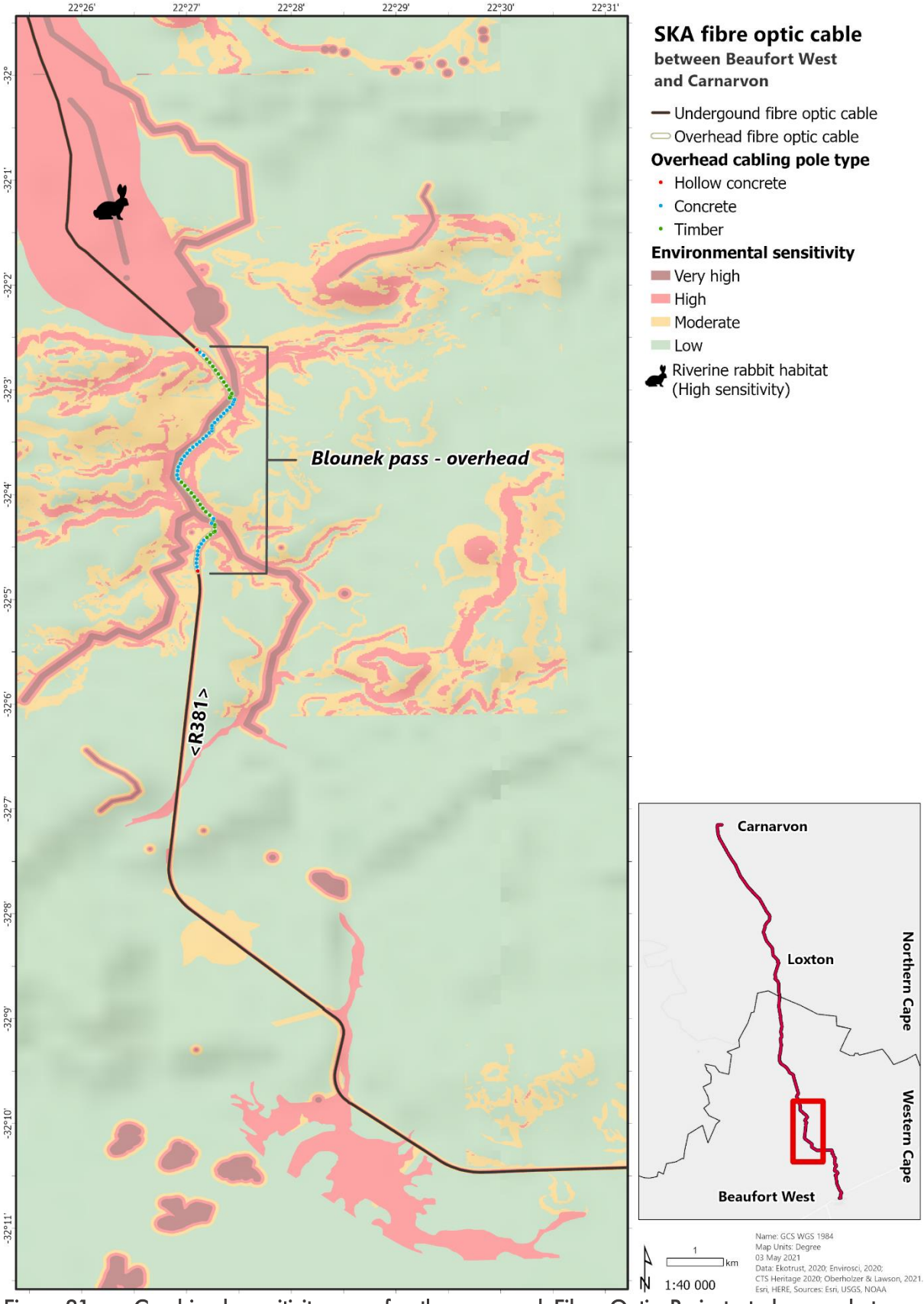


Figure 21: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.4265683°E, 31.9969218°S and 22.5173782°E, 32.1658240°S, following the R381 road.

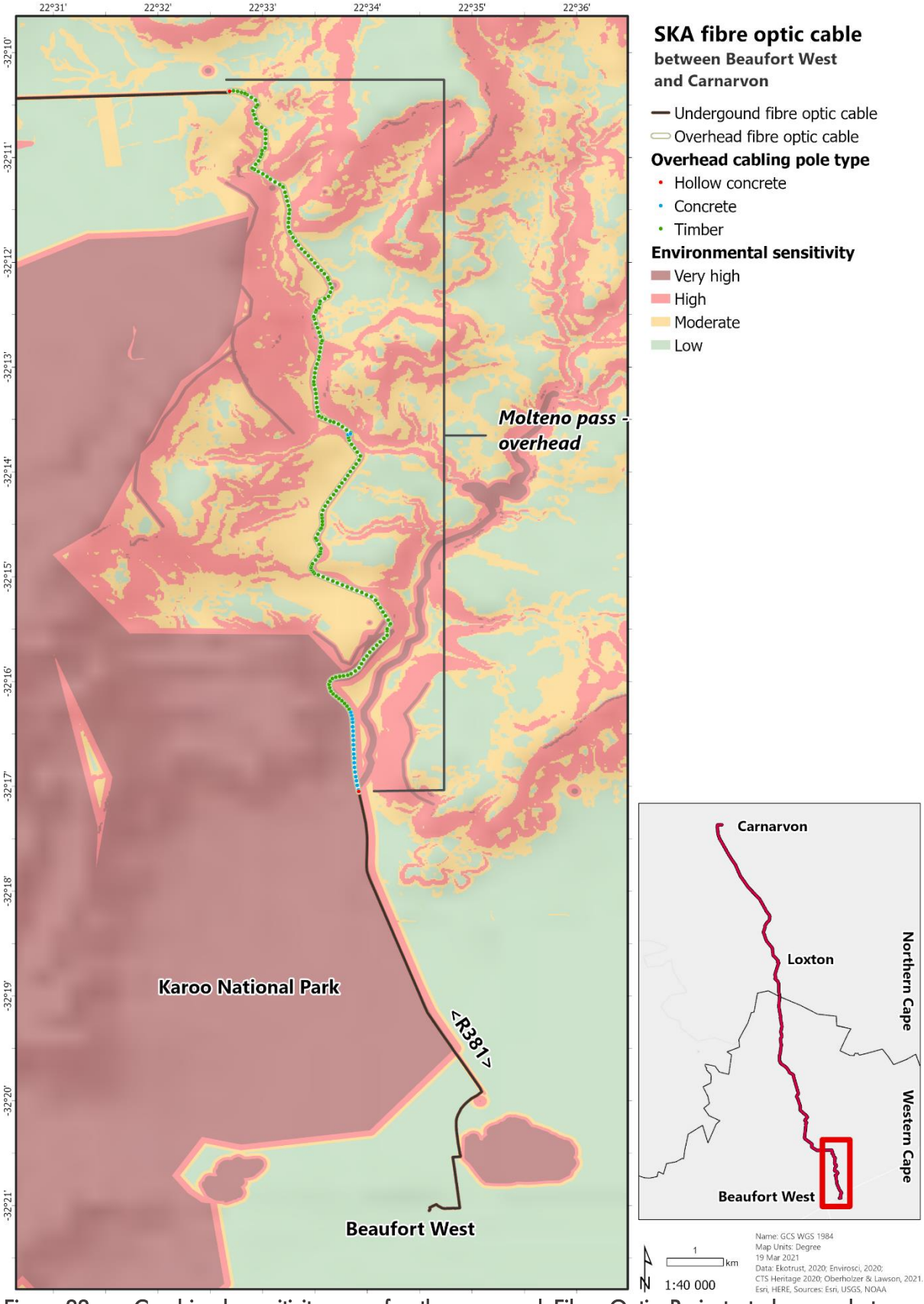


Figure 22: Combined sensitivity map for the proposed Fibre Optic Project study area between 22.5173782°E, 32.1658240°S and Beaufort West, following the R381 road.

Appendix 4 NEM:PAA Section 50 (5) approval for activities in the Karoo National Park

To develop and manage a system of national parks that represents the biodiversity, landscapes, and associated heritage assets of South Africa for the sustainable use and benefit of all.

South African NATIONAL PARKS

South African National Research Network (SANReN)
Council for Scientific and Industrial Research (CSIR)
NextGen Enterprises and Institutions Cluster
PO Box 395
Pretoria
0001
South Africa

Attention: Mr. Zuki Makalima
CC: Mr. Mlungisi Majola
Ms. Luanita Snyman-van der Walt

APPROVAL IN TERMS OF SECTION 50 (5) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: PROTECTED AREAS ACT (ACT NO. 57 OF 2003, AS AMENDED) FOR THE INSTALLATION OF OVERHEAD FIBRE OPTIC CABLES IN THE KAROO NATIONAL PARK, FOR THE PURPOSES OF THE SQUARE KILOMETRE ARRAY (SKA) RADIO-TELESCOPE

The South African National Research Network (SANReN), hosted and implemented by the Council for Scientific and Industrial Research (CSIR) is tasked with constructing fibre optic cable between Beaufort West and Carnarvon (via Loxton). The purpose of the fibre optic cable is to connect the South African Radio Astronomy Observatory (SARAO) core site hosting the Square Kilometre Array (SKA) and MeerKAT telescopes to transport radio astronomy measurements to the SARAO Science Data Processor (SDP) that will be located in Cape Town.

The fibre optic cable will follow the Ni, R381 and R63 roads between Beaufort West and Carnarvon. Where the cabling needs to traverse difficult terrain, for example the Molteno Pass on the eastern side of the Karoo National Park ("the Park"), it would need to be installed overhead within the Park on a combination of timber and concrete poles between 7.5 and 9 m high at intervals of 20 - 80m. SANParks acknowledges that the SANReN fibre route to be constructed for SARAO would encroach the identified properties, which have been declared as part of the Park, where it is not possible to remain within the road reserves:

- Erf 3545 of the Beaufort West region [C09000100000354500000];
- Erf 1707 of the Beaufort West Region [C09000100000170700000]; and
- Portion 9 of the Farm Alwins Gate 186 [C09000000000018600009].

Section 50 (5) of the National Environmental Management: Protected Areas Act (Act no. 57 of 2003, as amended) (NEM:PAA) stipulates:

addo elephant
agulhas
augrabies falls
bontebok
golden gate highlands
karoo
kgalagadi transfrontier
knysna lake area
kruger
mapungubwe
marakele
mountain zebra
namaqua
table mountain
tankwa-karoo
tsitsikamma
|ai-|ais/richtersveld
vaalbos
west coast
wilderness

643 Leyds Street
MUCKLENEUK
0002

P.O. Box 787
PRETORIA
0001

Tel: 012 426-5000

central reservations: 012 428 9111
reservations@sanparks.org
www.sanparks.org

No development, construction or farming may be permitted in a national park, nature reserve or world heritage site without the prior written approval of the management authority.

Furthermore, Section 19 of the NEM:PAA regulations for the proper administration of special nature reserves, national parks and world heritage sites (Government Notice R1061 in Government Gazette 28181, dated 28 October 2005) stipulates:

(1) No development contemplated in section 50 (5) of the Act shall be implemented—

(a) in any area other than an area specifically designated for such development in a management plan; and

(b) before a management authority has indicated in writing the nature and extent of the strategic or environmental impact assessment required for the development.

(2) No commercial activity or activity contemplated in section 50 of the Act, which requires an environmental impact assessment to be undertaken, either in terms of subregulation (1)(b) or under any other law, may be implemented before a management authority has approved, with or without conditions, the environmental impact assessment before it is submitted to the relevant authority for approval.

SANParks confirms that it is the management authority of the Karoo National Park. Approximately 4.7 km of the overhead cabling is proposed within the Park in order to traverse the difficult terrain in the Molteno Pass section. The proposed fibre optic cabling will follow the same corridor as the abandoned Telkom telephone line (adjacent to the Eskom power line). The proposed SKA fibre optic cable is a remote zone, in an existing footprint used for linear infrastructure. SANParks has no objection to the proposed fibre optic cable footprint in the Park.

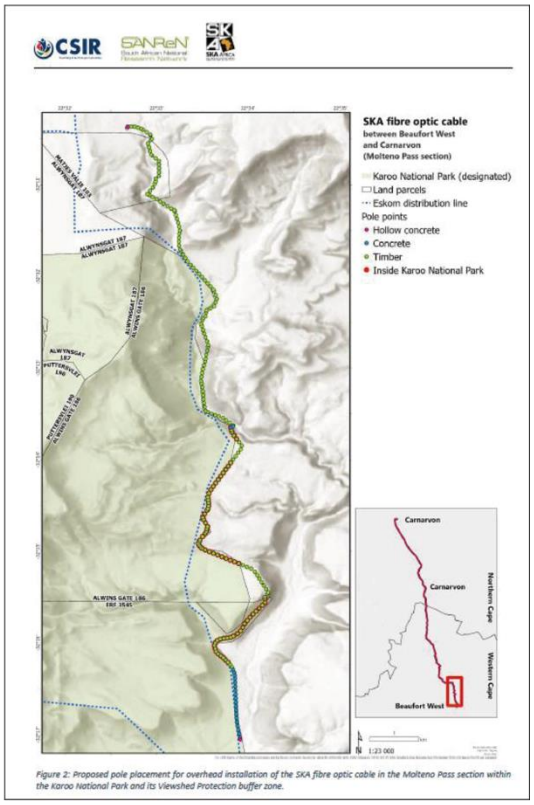


Figure 2: Proposed pole placement for overhead installation of the SKA fibre optic cable in the Molteno Pass section within the Karoo National Park and its Viewshed Protection buffer zone.

SANParks understands that Environmental Authorisation (EA) is also required for the proposed fibre optic cable development. The Environmental Impact Assessment (EIA) process (Basic Assessment (BA)) be conducted in accordance the requirements of the National Environmental Management Act (NEMA) EIA Regulations in this regard, and Park Management must be included in the Public Participation Process going forward. A Water Use License (WUL) is also required for the proposed fibre optic cable project.

We hereby grant approval in terms of Section 50 (5) of the NEM:PAA and wayleave for CSIR to proceed with the fibre installation within the Karoo National Park (after EA has been obtained).

We further recognize that SANReN is a non-profit initiative for the benefit of South African research, education and innovation communities, and thus waive any payment for the granting of the wayleave.

We trust that the CSIR and all construction, operations and maintenance contractors will:

- To the best of its abilities, endeavour to avoid any possible damage to Park property or services through the installation of the fibre optic cable. CSIR will minimize any inconvenience and also repair any damage that may be caused during the installation.
- Endeavor to arrange for access to the property at mutually agreeable times and to minimize any disruption.
- Ensure that all construction, operations and maintenance activities will be carried out in accordance to the EA (if granted) and associated Environmental Management Programme for the proposed fibre optic cable development.

Yours sincerely

Mr Property Mokoena
Managing Executive - Parks Division
South African National Parks

Date: 2 August 2021

CC: Andre Riley
Nico van der Walt
Kristal Maze
Marinda van Graan
Maretha Alant

Appendix 5 Plant species list for protected flora permits

[1]International Union for Conservation of Nature (IUCN) category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)
[4] Newposa list (SANBI)
[5] Plants observed during September/October 2020 site visit
cf: uncertain; sp: species; subsp: subspecies; LC: Least Concern;
ToPS: Threatened or Protected Species.

Family	Species	IUCN[1]	WCNECO[2] SCH 4	NCNCA[3] SCH 1	NCNCA[3] SCH 2	CITES	ToPS	ENDEMIC	Invasive	Alien/ naturalised	NEWPOSA[4]	CURRENT[5]	Permit required	Western Cape	Northern Cape
Aizoaceae	*Aizoon rigidum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Cephalophyllum* sp.		x		x							x	x	x	x
Aizoaceae	*Delosperma* sp.		x		x							x	x	x	x
Aizoaceae	*Drosanthemum hispidum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Drosanthemum karrooense*	LC	x		x							x	x	x	x
Aizoaceae	*Drosanthemum lique*	LC	x		x						x	x	x	x	x
Aizoaceae	*Galenia* cf. *papulosa*	-	x		x							x	x	x	x
Aizoaceae	*Galenia meziana*	LC	x		x							x	x	x	x
Aizoaceae	*Galenia namaensis*	LC	x		x						x	x	x	x	x
Aizoaceae	*Hereroa concava*	LC	x		x						x	cf	x	x	x
Aizoaceae	*Mesembryanthemaceae* sp. 1		x		x							x	x	x	x
Aizoaceae	*Mesembryanthemum articulatum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum coriarium*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum crystallinum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum emarcidum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum geniculiflorum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum granulicaule*	LC	x		x						x	cf	x	x	x
Aizoaceae	*Mesembryanthemum grossum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum noctiflorum* subsp. *stramineum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Mesembryanthemum tetragonum*	LC	x		x						x	x	x	x	x
Aizoaceae	*Ruschia cradockensis subsp. triticiformis*	LC	x		x						x	x	x	x	x
Aizoaceae	*Ruschia intricata*	LC	x		x						x	x	x	x	x
Aizoaceae	*Ruschia* sp. 1		x		x							x	x	x	x
Aizoaceae	*Ruschia* sp. 2		x		x							x	x	x	x
Aizoaceae	*Ruschia spinosa*	LC	x		x						x	x	x	x	x
Aizoaceae	*Schlechteranthus spinescens*	LC	x		x						x	cf	x	x	x
Aizoaceae	*Stomatium difforme*	LC	x		x						x	x	x	x	x
Aizoaceae	*Stomatium suaveolens*	LC	x		x			x			x	x	x	x	x
Aizoaceae	*Stomatium villetii*	LC	x		x			x			x	x	x	x	x
Aizoaceae	*Tetragonia acanthocarpa*	LC	x		x							x	x	x	x
Aizoaceae	*Tetragonia* sp. 1	-	x		x							x	x	x	x
Aizoaceae	*Tetragonia* sp. 2	-	x		x							x	x	x	x
Aizoaceae	*Tetragonia spicata*	LC	x		x						x	x	x	x	x
Aizoaceae	*Trichodiadema setuliferum*	LC	x		x							x	x	x	x
Amaryllidaceae	*Ammocharis coranica*	LC	x		x							x	x	x	x
Amaryllidaceae	*Boophone disticha*	LC	x		x							x	x	x	x
Amaryllidaceae	*Gethyllis transkarooica*	LC	x		x						x	cf	x	x	x
Anacampserotaceae	*Anacampseros albidiflora*	LC	x		x	x						x	x	x	x
Anacampserotaceae	*Anacampseros lanceolata* subsp. *lanceolata*	LC	x		x	x					x	cf	x	x	x
Anacampserotaceae	*Anacampseros ustulata*	LC	x		x	x					x	x	x	x	x
Apiaceae	*Deverra denudata* subsp. *aphylla*	LC			x						x	x	x		x
Apiaceae	*Heteromorpha arborescens*	LC			x						x	x	x		x
Apocynaceae	*Carissa bispinosa*	LC	x		x						x	x	x	x	x
Apocynaceae	*Carissa haematocarpa*	LC	x		x							x	x	x	x
Apocynaceae	*Gomphocarpus fruticosus* subsp. *fruticosus*	LC	x		x						x	x	x	x	x
Apocynaceae	*Gomphocarpus tomentosus* subsp. *tomentosus*	LC	x		x						x	x	x	x	x
Apocynaceae	*Huernia barbata* subsp. *barbata*	LC	x		x						x	x	x	x	x
Apocynaceae	*Pachypodium succulentum*	LC	x		x	x					x	x	x	x	x
Apocynaceae	*Stapelia grandiflora*	LC	x		x						x	x	x	x	x
Araliaceae	*Cussonia paniculata*	LC			x						x	x	x		x

[1]International Union for Conservation of Nature (IUCN) category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)
[4] Newposa list (SANBI)
[5] Plants observed during September/October 2020 site visit
cf: uncertain; sp: species; subsp: subspecies; LC: Least Concern; ToPS: Threatened or Protected Species.

Family	Species	IUCN[1]	WCNECO[2] SCH 4	NCNCA[3] SCH 1	NCNCA[3] SCH 2	CITES	ToPS	ENDEMIC	Invasive	Alien/ naturalised	NEWPOSA[4]	CURRENT[5]	Permit required	Western Cape	Northern Cape
Asphodelaceae	*Aloe broomii*	LC	x		x	x						x	x	x	x
Asphodelaceae	*Aloe claviflora*	LC	x		x	x					x	x	x	x	x
Asphodelaceae	*Aristaloe aristata*	LC	x		x	x					x	x	x	x	x
Asphodelaceae	*Astroloba foliolosa*	LC			x						x	x	x		x
Asphodelaceae	*Bulbine abyssinica*	LC			x						x	x	x		x
Asphodelaceae	*Gonialoe variegata*	LC	x		x	x					x	x	x	x	x
Caryophyllaceae	*Dianthus micropetalus*	LC			x						x	x	x		x
Celastraceae	*Gymnosporia szyszylowiczii*	-			x						x	x	x		x
Crassulaceae	*Adromischus* sp.	-			x							x	x		x
Crassulaceae	*Cotyledon orbiculata*	LC			x						x	x	x		x
Crassulaceae	*Cotyledon* sp.	-			x							x	x		x
Crassulaceae	*Crassula corallina* subsp. *corallina*	LC			x						x	x	x		x
Crassulaceae	*Crassula cotyledonis*	LC			x						x	cf	x		x
Crassulaceae	*Crassula deltoidea*	LC			x							x	x		x
Crassulaceae	*Crassula ericoides*	LC			x							x	x		x
Crassulaceae	*Crassula muscosa* var. *muscosa*	LC			x						x	x	x		x
Crassulaceae	*Crassula rupestris*	LC			x						x	x	x		x
Crassulaceae	*Crassula subaphylla*	LC			x							cf	x		x
Crassulaceae	*Crassula tetragona* subsp. *tetragona*	LC			x						x	x	x		x
Crassulaceae	*Crassula vaillantii*	LC			x					x	x	x	x		x
Euphorbiaceae	*Euphorbia* cf. *caterviflora*	-			x	x						x	x		x
Euphorbiaceae	*Euphorbia* cf. *decepta*	-			x	x					x	x	x		x
Euphorbiaceae	*Euphorbia clavarioides*	LC			x	x					x	x	x		x
Euphorbiaceae	*Euphorbia inaequilatera*	LC			x						x	x	x		x
Euphorbiaceae	*Euphorbia mauritanica*	LC			x	x					x	x	x		x
Fabaceae	*Lessertia frutescens* subsp. *frutescens*	LC		x							x	x	x		x
Fabaceae	*Lessertia inflata*	LC		x							x	x	x		x
Geraniaceae	*Pelargonium abrotanifolium*	LC		x							x	cf	x		x
Geraniaceae	*Pelargonium aridum*	LC		x							x	x	x		x
Geraniaceae	*Pelargonium minimum*	LC		x								x	x		x
Hyacinthaceae	*Lachenalia campanulata*	LC	x		x						x	cf	x	x	x
Hyacinthaceae	*Ornithogalum* sp.	-			x							x	x		x
Iridaceae	*Babiana hypogaea*	LC	x		x							x	x	x	x
Iridaceae	*Babiana* sp.	-	x		x							x	x	x	x
Iridaceae	*Gladiolus permeabilis*	LC	x		x						x	x	x	x	x
Iridaceae	*Gladiolus* sp.	-	x		x							x	x	x	x
Iridaceae	*Hesperantha cucullata*	LC	x		x							cf	x	x	x
Iridaceae	*Moraea miniata*	LC	x		x						x	x	x	x	x
Iridaceae	*Moraea* sp.	-	x		x							x	x	x	x
Scrophulariaceae	*Jamesbrittenia tysonii*	LC			x						x	x	x		x
Scrophulariaceae	*Nemesia cynanchifolia*	LC			x						x	cf	x		x

Appendix 6 Water use General Authorisation in terms of the National Water Act 36 of 1998

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Northern Cape Region, Private Bag X6101, Kimberley, 8301, 28 Central Road, Beaconsfield, Kimberley, 8301
Tel.: 053-836 7600, Fax: 053-842 3258

F	053 842 3258		KK Sekwaila
E	SekwailaK@dws.gov.za	☎	053 836 7600
			27/2/2/D155/2/1

South African National Research Network
Council for Scientific and Industrial Research
Meiring Naude Road
Scientia
Pretoria
0002

Dear Mr. M Majola

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Your request dated 15 June 2021 to be registered to use water in terms of General Authorisation Government Notice. 509 dated 26 August 2016 refers.

The Department is pleased to confirm that the intended water use falls within the ambit of the General Authorisations. Therefore, you may continue with the water uses as permissible in terms of Section 22 (1) (a) (iii) of the NWA. You are therefore requested to adhere to the conditions stipulated in the said General Authorisations.

Water use(s) registered:

Sub Sec	Description as per the Act	Existing Authorizations	Applied for	Authorisation Recommended or Not Recommended
(c)	Impeding or diverting the flow of water in a watercourse		X	Recommended
(i)	Altering the bed, banks, course or characteristics of a watercourse		X	Recommended

2030 NDP NATIONAL DEVELOPMENT PLAN
Our Future - make it work

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Table 1: Details of the registered water use(s)

Purpose	Property description	Coordinates	
		Lat.	Long
Section 21 (c) and (i):			
SKA fibre optic cable across Gamka River	Land Parcel 36 of the Minor Region BEAUFORT WEST	-32,35041315	22,58019825
SKA fibre optic cable across Gamka River	Land Parcel 3545 of the Minor Region BEAUFORT WEST	-32,28344373	22,56514822
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 430 of the Major Region BEAUFORT WEST	-32,22574793	22,56210118
		-32,20711646	22,55919889
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 103 of the Major Region BEAUFORT WEST	-32,1734204	22,54788862
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 187 of the Major Region BEAUFORT WEST	-32,1734118	22,52275107
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 193 of the Major Region BEAUFORT WEST	-32,16192412	22,47441069
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 96 of the Major Region BEAUFORT WEST	-32,13688753	22,45631798
		-32,11348836	22,44889388
SKA fibre optic cable across delineated riverine system (Sak river)	Land Parcel 97 of the Major Region BEAUFORT WEST	-32,07089224	22,45410336
SKA fibre optic cable across delineated valley bottom wetland (Sak river)	Land Parcel 98 of the Major Region BEAUFORT WEST	-32,0513348	22,45709816
SKA fibre optic cable across delineated riverine system (Sak river)	Land Parcel 82 of the Major Region BEAUFORT WEST	-31,9884844	22,42401966
		-31,96357548	22,42424135
		-31,9452307	22,41916752
SKA fibre optic cable across delineated valley bottom wetland (unnamed watercourse)	Land Parcel 43 of the Major Region BEAUFORT WEST	-31,89012904	22,39846813
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 21 of the Major Region BEAUFORT WEST	-31,86649984	22,37892309
		-31,85685799	22,36536345
		-31,83922639	22,35443607
		-31,82899462	22,35460003
		-31,8117013	22,35778219
		-31,80487857	22,35823485
SKA fibre optic cable across	Portion 1 of Land Parcel 21 of the	-31,79865348	22,35943061

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Purpose	Property description	Coordinates	
		Lat.	Long
delineated riverine system (unnamed watercourse)	Major Region BEAUFORT WEST	-31,78537607	22,36086399
		-31,76068953	22,35839774
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 7 of the Major Region BEAUFORT WEST	-31,70284271	22,36098254
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 6 of the Major Region BEAUFORT WEST	-31,67647805	22,3579492
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 5 of the Major Region BEAUFORT WEST	-31,64969956	22,3531577
SKA fibre optic cable across delineated valley bottom wetland (Slanfontein se river)		-31,64182563	22,35244112
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 5 of the Major Region BEAUFORT WEST	-31,62745547	22,35309316
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 144 of the Major Region VICTORIA WEST	-31,58337816	22,35163392
SKA fibre optic cable across Slangfontein se river	Land Parcel 143 of the Major Region VICTORIA WEST	-31,5564022	22,35094749
SKA fibre optic cable across Brak river	Land Parcel 143 of the Major Region VICTORIA WEST	-31,53659374	22,3395647
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 143 of the Major Region VICTORIA WEST	-31,52625351	22,33816434
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 359 of the Minor Region VICTORIA WEST-LOXTON	-31,50782658	22,34244906
		-31,49356796	22,34707419
		-31,4827042	22,35099943
		-31,4578298	22,33589914
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 142 of the Major Region VICTORIA WEST	-31,44049889	22,32952228
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 142 of the Major Region VICTORIA WEST	-31,42147397	22,32455294
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 2 of Land Parcel 570 of the Major Region CARNARVON	-31,35421768	22,2991751
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 571 of the Major Region CARNARVON	-31,34875837	22,30086385
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 540 of the Major Region CARNARVON	-31,27640358	22,29874785
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 6 of Land Parcel 539 of the Major Region CARNARVON	-31,2332426	22,27003958

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Purpose	Property description	Coordinates	
		Lat.	Long
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 539 of the Major Region CARNARVON	-31,21281004	22,25022928
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 4 of Land Parcel 485 of the Major Region CARNARVON	-31,184839	22,227482
SKA fibre optic cable across delineated riverine system (Brak river)	Portion 3 of Land Parcel 485 of the Major Region CARNARVON	-31,15500975	22,20749182
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 3 of Land Parcel 485 of the Major Region CARNARVON	-31,1388829	22,20044458
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 16 of Land Parcel 485 of the Major Region CARNARVON	-31,13064756	22,19689841
SKA fibre optic cable across delineated riverine system (Alarmleegte river)	Land Parcel 533 of the Major Region CARNARVON	-31,09619129	22,17673568
SKA fibre optic cable across delineated riverine system (Reitzvilleleegte river)	Portion 13 of Land Parcel 485 of the Major Region CARNARVON	-31,06661389	22,158721
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 13 of Land Parcel 485 of the Major Region CARNARVON	-31,0524351	22,15065329
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 33 of Land Parcel 485 of the Major Region CARNARVON	-31,0449275	22,14640449

Attached herewith are the Registration Certificate and a copy of the general authorisation for ease of reference.

You are required to comply with the conditions of the General Authorisation.

Yours faithfully,

Tekalake?.
PROVINCIAL HEAD: NORTHERN CAPE
DATE: 26/07/2021

Page 4 of 4

Appendix 7 Delineated aquatic systems

(KMZ and shapefiles also provided – the holder of the EA is responsible for safeguarding outputs from the BA process and must provide this to the project implementation team).

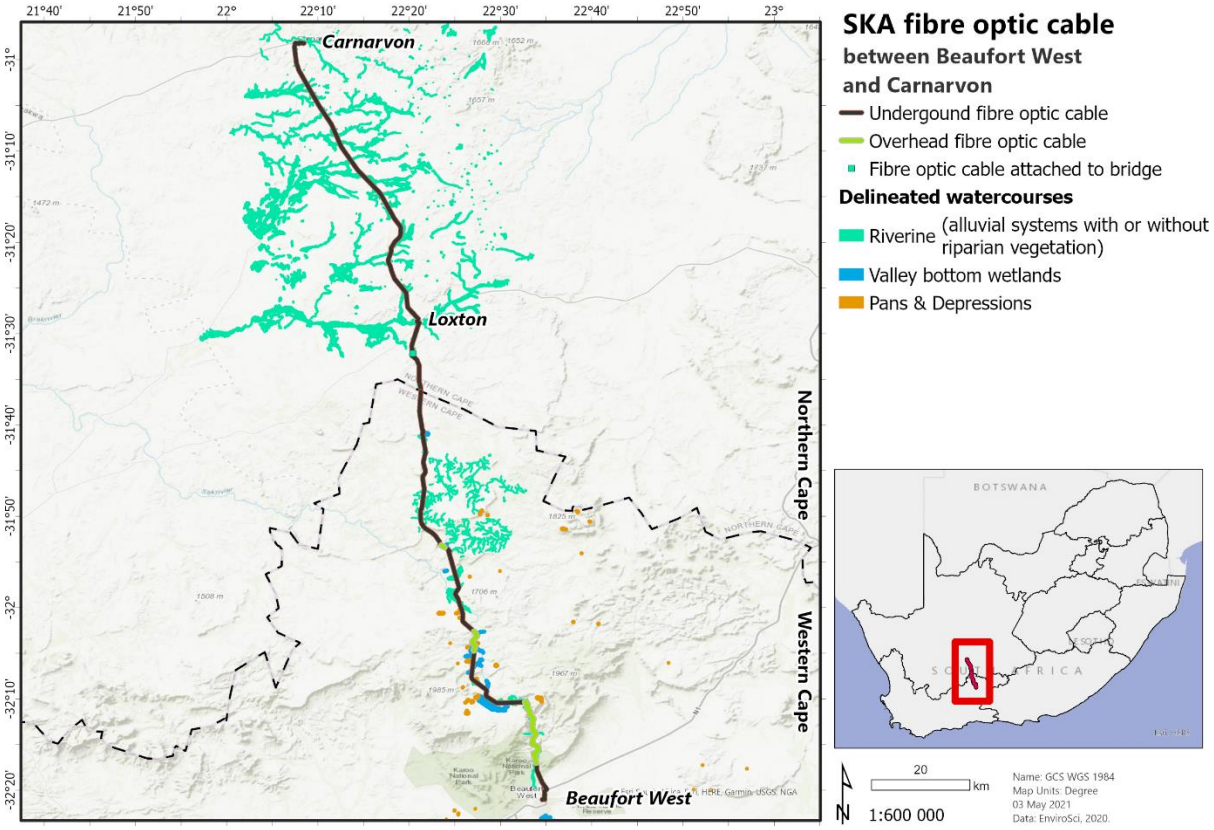


Figure 23: Delineated natural watercourses along the fibre optic route.

Table 9: Location of delineated watercourse crossings.

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
2	-32.28344373	22.56514822	32° 17' 00.39743881" S	022° 33' 54.53358901" E
3	-32.22574793	22.56210118	32° 13' 32.69254800" S	022° 33' 43.56425880" E
4	-32.20711646	22.55919889	32° 12' 25.61925749" S	022° 33' 33.11598955" E
5	-32.1734204	22.54788862	32° 10' 24.31343641" S	022° 32' 52.39901716" E
6	-32.1734118	22.52275107	32° 10' 24.28247498" S	022° 31' 21.90385784" E
7	-32.16192412	22.47441069	32° 09' 42.92681666" S	022° 28' 27.87849853" E
8	-32.13688753	22.45631798	32° 08' 12.79510080" S	022° 27' 22.74473160" E
9	-32.11348836	22.44889388	32° 06' 48.55810834" S	022° 26' 56.01797280" E
10	-32.07089224	22.45410336	32° 04' 15.21204946" S	022° 27' 14.77211362" E
11	-32.0513348	22.45709816	32° 03' 04.80527749" S	022° 27' 25.55338983" E
12	-31.9884844	22.42401966	31° 59' 18.54385080" S	022° 25' 26.47076880" E
13	-31.96357548	22.42424135	31° 57' 48.87174240" S	022° 25' 27.26886000" E
14	-31.9452307	22.41916752	31° 56' 42.83051280" S	022° 25' 09.00305400" E
15	-31.89012904	22.39846813	31° 53' 24.46453296" S	022° 23' 54.48526316" E
16	-31.86649984	22.37892309	31° 51' 59.39943120" S	022° 22' 44.12310600" E
17	-31.85685799	22.36536345	31° 51' 24.68875597" S	022° 21' 55.30843100" E
18	-31.83922639	22.35443607	31° 50' 21.21499025" S	022° 21' 15.96983933" E
19	-31.82899462	22.35460003	31° 49' 44.38062261" S	022° 21' 16.56010125" E
20	-31.8117013	22.35778219	31° 48' 42.12467394" S	022° 21' 28.01587511" E
21	-31.80487857	22.35823485	31° 48' 17.56285534" S	022° 21' 29.64547041" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
22	-31.79865348	22.35943061	31° 47' 55.15253242" S	022° 21' 33.95018447" E
23	-31.78537607	22.36086399	31° 47' 07.35385411" S	022° 21' 39.11037079" E
24	-31.76068953	22.35839774	31° 45' 38.48232240" S	022° 21' 30.23187120" E
25	-31.70284271	22.36098254	31° 42' 10.23375762" S	022° 21' 39.53713361" E
26	-31.67647805	22.3579492	31° 40' 35.32097747" S	022° 21' 28.61713068" E
27	-31.64969956	22.3531577	31° 38' 58.91839820" S	022° 21' 11.36770598" E
28	-31.64182563	22.35244112	31° 38' 30.57227083" S	022° 21' 08.78804036" E
29	-31.62745547	22.35309316	31° 37' 38.83968957" S	022° 21' 11.13537010" E
30	-31.58337816	22.35163392	31° 35' 00.16138320" S	022° 21' 05.88210120" E
31	-31.5564022	22.35094749	31° 33' 23.04791187" S	022° 21' 03.41098169" E
32	-31.53659374	22.3395647	31° 32' 11.73744898" S	022° 20' 22.43291966" E
33	-31.52625351	22.33816434	31° 31' 34.51263960" S	022° 20' 17.39163840" E
34	-31.50782658	22.34244906	31° 30' 28.17567820" S	022° 20' 32.81661118" E
35	-31.49356796	22.34707419	31° 29' 36.84465967" S	022° 20' 49.46707351" E
36	-31.4827042	22.35099943	31° 28' 57.73513215" S	022° 21' 03.59794517" E
37	-31.4578298	22.33589914	31° 27' 28.18727640" S	022° 20' 09.23691840" E
38	-31.44049889	22.32952228	31° 26' 25.79600242" S	022° 19' 46.28021982" E
39	-31.42147397	22.32455294	31° 25' 17.30629560" S	022° 19' 28.39058400" E
40	-31.35421768	22.2991751	31° 21' 15.18365750" S	022° 17' 57.03034773" E
41	-31.34875837	22.30086385	31° 20' 55.53012039" S	022° 18' 03.10985125" E
42	-31.27640358	22.29874785	31° 16' 35.05289880" S	022° 17' 55.49226720" E
43	-31.2332426	22.27003958	31° 13' 59.67336877" S	022° 16' 12.14250427" E
44	-31.21281004	22.25022928	31° 12' 46.11613998" S	022° 15' 00.82539917" E
45	-31.184839	22.227482	31° 11' 05.42040000" S	022° 13' 38.93520000" E
46	-31.15500975	22.20749182	31° 09' 18.03508560" S	022° 12' 26.97055560" E
47	-31.1388829	22.20044458	31° 08' 19.97844728" S	022° 12' 01.60047347" E
48	-31.13064756	22.19689841	31° 07' 50.33121240" S	022° 11' 48.83425800" E
49	-31.09619129	22.17673568	31° 05' 46.28864534" S	022° 10' 36.24843636" E
50	-31.06661389	22.158721	31° 03' 59.81000130" S	022° 09' 31.39560110" E
51	-31.0524351	22.15065329	31° 03' 08.76634498" S	022° 09' 02.35182606" E
52	-31.0449275	22.14640449	31° 02' 41.73901440" S	022° 08' 47.05615680" E

Appendix 8 Chance Fossil Finds Procedure

(Adopted from the HWC Chance Fossils Finds Procedure: June 2016)

Introduction

This document is aimed to inform workmen and foremen working on a construction and/or mining site. It describes the procedure to follow in instances of accidental discovery of palaeontological material (please see attached poster with descriptions of palaeontological material) during construction/mining activities. This protocol does not apply to resources already identified under an assessment undertaken under Section 38 of the National Heritage Resources Act (Act 25 of 1999).

Fossils are rare and irreplaceable. Fossils tell us about the environmental conditions that existed in a specific geographical area millions of years ago. As heritage resources that inform us of the history of a place, fossils are public property that the State is required to manage and conserve on behalf of all the citizens of South Africa. Fossils are therefore protected by the National Heritage Resources Act. Ideally, a qualified person should be responsible for the recovery of fossils noticed during construction/mining to ensure that all relevant contextual information is recorded.

Heritage Authorities often rely on workmen and foremen to report finds, and thereby contribute to our knowledge of South Africa's past and contribute to its conservation for future generations.

Training

Workmen and foremen need to be trained in the procedure to follow in instances of accidental discovery of fossil material, in a similar way to the Health and Safety protocol. A brief introduction to the process to follow in the event of possible accidental discovery of fossils should be conducted by the designated Environmental Control Officer (ECO) for the project, or the foreman or site agent in the absence of the ECO. It is recommended that copies of the attached poster and procedure are printed out and displayed at the site office so that workmen may familiarise themselves with them and are thereby prepared in the event that accidental discovery of fossil material takes place.

Actions to be taken

One person in the staff must be identified and appointed as responsible for the implementation of this protocol in instances of accidental fossil discovery and must report to the ECO or site agent. If the ECO or site agent is not present on site, then the responsible person on site should follow the protocol correctly in order to not jeopardize the conservation and well-being of the fossil material. Once a workman notices possible fossil material, he/she should report this to the ECO or site agent.

Procedure to follow if it is likely that the material identified is a fossil:

- The ECO or site agent must ensure that all work ceases immediately in the vicinity of the area where the fossil or fossils have been found;
- The ECO or site agent must inform SAHRA or HWC of the find immediately. This information must include photographs of the findings and GPS co-ordinates;
- The ECO or site agent must compile a Preliminary Report and fill in the attached Fossil Discoveries: Preliminary Record Form within 24 hours without removing the fossil from its original position. The Preliminary Report records basic information about the find including:

- The date
- A description of the discovery
- A description of the fossil and its context (e.g. position and depth of find)
- Where and how the find has been stored
- Photographs to accompany the preliminary report (the more the better):
- A scale must be used
- Photos of location from several angles
- Photos of vertical section should be provided
- Digital images of hole showing vertical section (side);
- Digital images of fossil or fossils.

Upon receipt of this Preliminary Report, SAHRA will inform the ECO or site agent whether or not a rescue excavation or rescue collection by a palaeontologist is necessary.

- Exposed finds must be stabilised where they are unstable and the site capped, e.g. with a plastic sheet or sandbags. This protection should allow for the later excavation of the finds with due scientific care and diligence. SAHRA can advise on the most appropriate method for stabilisation.
- If the find cannot be stabilised, the fossil may be collected with extreme care by the ECO or the site agent and put aside and protected until SAHRA advises on further action. Finds collected in this way must be safely and securely stored in tissue paper and an appropriate box. Care must be taken to remove all the fossil material and any breakage of fossil material must be avoided at all costs.

No work may continue in the vicinity of the find until SAHRA has indicated, in writing, that it is appropriate to proceed.

Heritage Authority contact details

The relevant heritage authority (SAHRA in the Northern Cape; HWC in the Western Cape) must be notified immediately so that appropriate action can be taken by a professional palaeontologist or archaeologist.

- **Northern Cape**: SAHRA Archaeology, Palaeontology and Meteorites Unit, Natasha Higgitt / Phillip Hine +27 021 462 5402).
- **Western Cape**: HWC, Colette Scheermeyer, +27 021 483 5959.

For unmarked human graves / burials:

- **Northern Cape**: SAHRA Burial Grounds and Graves Unit, Mimi Seetelo, +27 012 320 8490)
- **Western Cape**: HWC, Colette Scheermeyer, +27 021 483 5959.

Fossil recording form

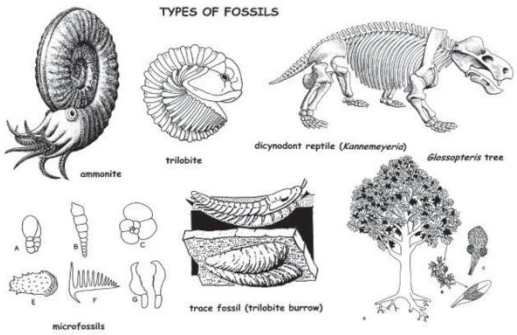
FOSSIL DISCOVERIES: PRELIMINARY RECORDING FORM		
Name of project:		
Name of fossil location:		
Date of discovery:		
Description of situation in which the fossil was found:		
Description of context in which the fossil was found:		
Description and condition of fossil identified:		
GPS coordinates:	Lat:	Long:
If no co-ordinates available then please describe the location:		
Time of discovery:		
Depth of find in hole		
Photographs (tick as appropriate and indicate number of the photograph)	Digital image of vertical section (side)	
	Fossil from different angles	
	Wider context of the find	
Wider context of the find. Temporary storage (where it is located and how it is conserved)		
Person identifying the fossil Name:		
Contact:		
Recorder Name:		
Contact:		
Photographer Name:		
Contact:		

Fossil finds poster

Palaeontology: what is a fossil?

Fossils are the traces of ancient life (animal, plant or microbial) preserved within rocks and come in two forms:

- Body fossils preserve parts, casts or impressions of the original tissues of an organism (e.g. bones, teeth, wood, pollen grains); and
- Trace fossils such as trackways and burrows record ancient animal behaviour.



How to report chance fossil finds:
What should I do if I find a fossil during construction/mining?

If you think you have identified a fossil:

Immediately inform the ECO or Site Agent.
He/she will then contact HWC and write a report and if necessary operations will stop in that specific area until the fossil is recovered

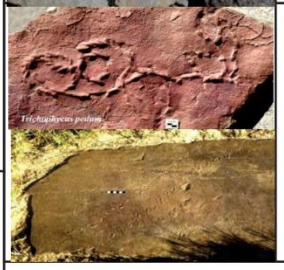
Heritage Western Cape
ceoheritage@westerncape.gov.za
021 483 5959
www.hwc.org.za

iLifa leMveli Isiphuma Esisi
Erfenis Wes-Kaap
Heritage Western Cape

Types of palaeontological finding - What does a fossil look like?

Fossils vary in size, from fossilised tree trunks and dinosaur bones down to very small animals or plants. Finds can be **individual fossils** (one isolated wood log or bone) or **clusters and beds** (several bones, teeth, animal or plant remains, trace fossils in close proximity or bones resembling part of a skeleton). A bed of fossils is a layer with many fossil remains.

Below there is a list of few examples of fossils which may be identified during excavations in the Western Cape.

Image	Description	Image	Description
	Leaves		Snail shells and other shells
	Fossil wood		Bones of larger animals
	The remains of fish and marine life (e.g. teeth, scales, starfish)		Large burrows made by moles and other animals
	Stromatolites		Traces made by burrowing insects (ants, wasps, dung-beetles etc.).
	Animal footprints		

Images provided by Dr John Almond

Text by HWC's Archaeology, Palaeontology & Meteorites Committee June 2016